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

Blood, Sweat, and Tears on the Distributed Computing Trail

Internet Tools Access Administrative Data at the University of Delaware

Strategies for Restructuring IT Organizations

Understanding Software Interoperability in a Technology-Supported System of Education

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Campus Profile: Penn State
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While CAUSE, like thousands of other organizations, has been very busy setting up a World Wide Web server, to date we have received few article submissions for CAUSE/EFFECT related to the management and use of the Web to deliver campus services. Perhaps the rapid proliferation of this technology has taken even information resources professionals by storm, and you have been so busy “just doing it” that you haven’t yet had a chance to reflect on and share your Web experiences through formal publication.

While there are hundreds of resources about the Web on the Web, it is nonetheless important for practitioners’ journals such as CAUSE/EFFECT to publish articles about networked information issues and experiences, from the familiar management perspectives that have been our hallmark for more than fifteen years.

Thus we are pleased to feature Carl Jacobson’s article about the use of Internet tools to access administrative data at the University of Delaware—an innovative approach to providing “open, public, and wide-reaching” campus services, recently spotlighted in the Chronicle of Higher Education. What is especially appropriate about this article is the simultaneous publication on the CAUSE Web server of an HTML version of the story provided by the author, complete with links to demonstrations and other relevant resources that could not be included in the print version. Similarly, Christine Quinn’s viewpoint article offering some do’s and don’ts for building a World Wide Web site can also be explored as an HTML Web presentation.

In addition to summarizing three major themes that emerged from CAUSE’s Northeast Regional Conference on OSF’s DCE—one of which is that DCE can be used to enhance the Web—the article by Shull, Arzt, and Updegrove refers to some selected resources about DCE in higher education, which have been synthesized and presented through a page on the CAUSE Web server.

Uniform resource locator (URL) addresses are provided in each of these articles, but you can also easily find these “linked” resources in CAUSE/EFFECT Online, a service we began offering with the Fall 1994 issue. This is found under Publications on the CAUSE Web server (http://cause-www.colorado.edu/).

In the past twelve months, we have experimented with a number of ways of presenting our contents in digital form. As an association with a great deal of diversity in our membership, we face the challenge of providing network services to member representatives whose desktop computing configurations and capabilities run the gamut, from character-based terminal emulation access to high-powered workstations, running different software and with varying levels of technical support available. We’ve tried to provide not only ASCII text files, but choices of word-processed files including graphics, and, more recently, versions in portable document format (PDF).

Having been impressed with the capabilities of software that produces PDF files—such as Adobe’s Acrobat™—we began offering the entire magazine in this format with the Spring 1995 issue, including Hypertext linkages within the full-page layout presentation. For those who do not have this software, the “reader” is free and can be downloaded to your desktop. While you may need some technical assistance to be sure you configure this correctly for your system, the time it takes to mount this software is well worth it—there is an increasing amount of information being made available on the Internet in this attractive and convenient format.

One final logistical note for this issue of CAUSE/EFFECT: we asked authors who did not write HTML versions of their articles to provide us with URLs for links to supplementary material. So the online Acrobat version of this issue offers HTML-like connectivity to supporting documents for readers who want to pursue these experiences in more depth.

While we explore ways to leverage network capabilities to deliver CAUSE publications and other services more effectively, we want to remain sensitive to the needs of our members who may not be able to (or perhaps prefer not to) access such information online. At the recent CAUSE Board meeting, both the Publications Committee and the Information Resources Committee recommended that as our association moves aggressively toward the digital information future, we be mindful of the needs of less technologically advanced members.

As we continue to deliver your print subscription to CAUSE/EFFECT as well as experiment with and plan for new, Web-based publications, we will appreciate your feedback on these efforts. You can use our interactive online forms, send e-mail to jrudy@cause.colorado.edu, or send a fax to 303-440-0461. But please let us hear from you!

Julia A. Rudy, Editor
The Internet: Next Steps in the Evolution
by Richard P. West

The "network" was a given when the Coalition for Networked Information was formed over five years ago. The Internet, used primarily by the higher education community and to a lesser extent the federal government, had matured to the point that "content" deserved attention separate and distinct from the network per se. Discussions prior to that time had focused on the network as a way of exchanging messages or tapping into large mainframe or supercomputing resources at remote sites. While these uses of the Internet are information uses, CNI's founders envisioned "content" available on the Net that previously had been available only via print forms.

The underlying infrastructure that the CNI program relies upon continues to get a lot of attention in the national media and in Congress. CNI has a keen interest in the spirit and results of these discussions, not only because they are important in their own right, but because deciding what's good for promoting the development of network conduit versus what's good for network content is not a simple matter. Let's review the current status of the network.

Reforming the telecom industry

Most Congressional policy discussions don't start with the idea of legislating Internet-related activities. Rather, the government is trying to enact a legislative reform of the telecommunications industry in response to the revolutionary technological and marketplace changes that started in the early 1980s with the break-up of AT&T. This break-up is often remembered as the "deregulation" of the telephone industry in the U.S., but it was actually a mandated "divestiture" by AT&T of its regional and local operating companies to create a more competitive marketplace for long-distance services and to allow AT&T to enter the market for computer systems and services. Although often used synonymously, "deregulation" and "divestiture" actually describe quite different processes and outcomes. Much of the current debate seems at cross-purposes because different parties place different priorities on "market structure" (i.e., who participates in what sectors of the market under what rules) versus "market functions" (i.e., the national as well as individual purposes to be served by the market and by what means). The Internet has been swept into this debate, and decisions arising from it will influence how the Internet will grow and be managed for years to come.

The long-distance phone service market has been a competitive one for a number of years now, although only three or four firms dominate that market and one of those, AT&T, is very much larger than the others. This is definitely a situation in which divestiture has led to competition, but how much competition makes for a "competitive market" worthy of the name? Certainly some of the expected benefits of a competitive environment (e.g., lower prices and constantly improving technology and quality) are now present in the long-distance voice and data services marketplace. However, a market with only a few large providers cannot be considered a highly competitive one, and the market for local phone service is not competitive at all. So, two of the major targets of the current legislative reform effort are how to generate still more competition in the long-distance sector, and how to generate competition for the first time (since the very earliest days of telephony, that is) in the local one.

Changing technology and, more precisely, the integrating effect of digital technologies is the second, profoundly confusing, target of current federal and state telecommunications legislative reform efforts. Many, perhaps even most, services and functions that can now be provided over an integrated digital network have traditionally required their own delivery networks, often provided by entirely different firms. Voice, data, and video delivery systems have generally been built and regulated separately, and have also been subject to different industry practices and customer and government expectations. Parts of some of the resulting distribution systems are regulated, while others are not.

A "uniform code" (also known as the "level playing field") for all telecommunications services, functions, and delivery systems is the ultimate goal of legislative and regulatory reform efforts, but it has proven to be very difficult to describe, let alone achieve. This is particularly so in light of the companion goal of wanting to increase competition, as the various "do's and don'ts" of the uniform code are often viewed and
portrayed as pro- or anti- the competitive interests of individual players and sectors, and there is no commonly accepted definition of what measures will produce "more competition" in the market as a whole.

Rapid and significant technological change is no stranger to the Internet; indeed, some of us think it defines the Internet, especially relative to other telecommunication delivery systems. Further, competition has become a central feature of the Internet community’s life, as we have learned to operate in a world with many long-distance providers rather than the single one that NSFNet represented until earlier this year.

\*CNI advocates the view that technical rather than legal measures are the way to address objectionable materials and behaviors in networked environments... \*

Legislatining the Internet

Unfortunately, throughout most of 1995 the only aspect of the Internet that has drawn the attention of the popular media and members of Congress is the existence of pornography, among other objectionable materials and behaviors. This attention is unfortunate not only because it eclipses the real lessons that the Internet experience can bring to the broader telecommunications reform debate, but because proposals arising from this attention seek to prohibit the “availability” rather than to manage the “accessibility” of certain networked resources and services. In so doing, they represent over-reactions that would not only constrain expression within consenting Internet-user communities, but would preempt, rather than assist, traditional roles and responsibilities of parents and teachers in favor of government-imposed, national standards.

CNI advocates the view that technical rather than legal measures are the way to address objectionable materials and behaviors in networked environments, and that the nation will be much better served by a vibrant, competitive, customer-oriented market for such technical measures than by the years of litigation and adjudication, regarding what materials and behaviors are and are not objectionable before the law, that will most certainly result from the legal measures some have proposed.

However this issue is finally addressed, there remains an important question regarding the regulation of local telephone service which will determine how many providers there may be in local markets and what prices will be charged for voice, data, and video services. The potential integration of video, voice, and data communication via digital distribution systems means that regulation, if any, in the new digital world will be different from what was true in the single, functionally differentiated distribution system environment. Changes here will affect higher education’s traditional special treatment in some areas, such as the reserving of video broadcast spectrum for higher education’s exclusive use. Although broadcast video will continue to exist, using integrated digital networks will be much more in higher education’s overall interest given the expanded range of resources and services enabled by integrated networks. The nature of higher education’s access to these systems will most likely be very different from what has been the case for access to broadcast systems. For instance, special reservations of capacity will be technically impractical at best, and such reservations may even be technically impossible.

Encouraging the evolution of the NII

What should be higher education’s position regarding telecommunications reform? I argue that the presence of the new, ubiquitous, integrated digital delivery system is essential, and that all efforts should be focused on means that assure proper management and coordination of the dispersed Internet. Reserving capacity on this new delivery system should not be a higher education priority; encouraging the rapid evolution of a national information infrastructure (NII) on the model of the Internet should be higher education’s overwhelming priority. I believe that this objective is best achieved by encouraging competition in all network environments and by the reduced costs and improved technologies that will occur as the result of this competition. However, I also believe that the deregulation of the local phone service is not the same as creating competition in those markets. If there are only one or two providers of network services in many or most local markets, then competition is not likely to be sustained.

We should concentrate our efforts on assuring a competitive Internet marketplace on the way to a competitive NII marketplace. Let’s find the will to avoid the temptation to seek the sorts of special treatment that higher education has traditionally enjoyed, and not to over-react to tangential issues such as pornography on the Internet. If we are not attentive to how telecommunications reform occurs in this Congress, and in our statehouses, we could end up without a competitive market, which will disenfranchise those of us who are counting on a low-cost, higher-value Internet and NII.

Unless we are very careful and diligent, CNI’s assumption that the network will take care of itself will be proven wrong, and the sorts of content-rich resources and services that have been CNI’s primary focus will prove to be impossible or too expensive for higher education.
Blood, Sweat, and Tears on the Distributed Computing Trail

by Chris Shull, Noam Arzt, and Dan Updegrove

CAUSE’s Northeast Regional Conference netted some insights and advice, as well as some new resources, to help you learn more about the Open Software Foundation’s Distributed Computing Environment in higher education.

At their meeting last December, the CAUSE Board of Directors passed a motion to strongly encourage CAUSE member institutions to investigate adopting the Open Software Foundation’s Distributed Computing Environment (DCE) as a campus standard, to promote interoperability across heterogeneous systems within and between institutions, to aid in the transition to client/server computing, and to facilitate sharing and leveraging our campus technology investments.1 But questions remain:

- What is DCE?
- Is DCE mature enough to consider for “real” applications?
- What are technically aggressive universities doing with DCE?
- Is DCE appropriate for other types of institutions?
- What is required to deploy DCE successfully?
- What does DCE cost?

To help answer these questions, CAUSE’s Northeast Regional Conference this year was devoted to “OSF DCE: Implementing a Distributed, Networked Computing Environment.” Held in June on the campus of the University of Pennsylvania, the conference drew more than 100 attendees, primarily from Pennsylvania, New Jersey, and Delaware, but also from as far away as Texas, California, and Ontario, Canada. It succeeded in spotlighting DCE by first providing a day-and-a-half workshop entitled, “Getting Started With DCE: Implications for Technology Managers,” presented by the University of Michigan’s Center for Information Technology Integration (CITI). For the remainder of the attendees, the conference began the next day with a two-hour “DCE Overview and Tutorial.” The balance of the conference was devoted to plenary and concurrent sessions describing DCE and DCE-related work in progress at Boston College, Harvard University, NASA’s Langley Research Center, Ohio State University, OSF and the OSF Research Institute, Penn State University, Transarc, the University of Michigan, and the University of Pennsylvania. A Demonstration Showcase presented work by CITI, Ohio State, and the “Big Ten,” as well as products from Open Horizon, Inc. and Open Environment Corporation.

From the conference presentations, three major themes emerged.

**DCE enables client/server computing**

The true focus of client/server computing is on collaboration: servers collaborating with desktops, various vendors’ software cooperating to deliver a service to the end user, and people exploiting the power of their desktops and network connections to find and process information. DCE offers a standard, secure set of services in a world replete with heterogeneous platforms, increasing requirements for distributed computing and communications, and a diverse legacy of methodologies and products. DCE is the ultimate middleware.

For example, Ken Blythe shared the vision and experiences of the Big Ten Universities who see DCE as the only way to allow them to put their past independent directions aside and move forward to share their efforts towards common goals, even though they are dispersed among multiple campuses of multiple institutions.

**DCE technologies require real work**

David Bianco of Computer Sciences Corporation (under contract to NASA’s Langley Research Center) said, “DCE is like sushi—some of it you will like, some you will not, but either way, you can be sure it is raw.” This word of caution resonated throughout the conference, suggesting that colleges and universities looking to use DCE should be prepared to do some cooking, i.e., development and programming. There is more to this distributed computing than DCE. Whether it is Transarc’s Encina, DCE’s application program
interfaces (APIs) for Perl, or underlying data and databases, DCE is a foundation to build on, not a building unto itself.

The advice from the presenters almost across the board was that IT managers must lay the foundation for one to two years forward and position their organizations for DCE in the future, if not now. Specifically, managers should:

- train someone to follow OSF DCE technologies and products;
- work to create and manage a consolidated, campuswide username space in anticipation of its requirement for DCE deployment; and
- pilot and implement DCE to the limits of their ability, muddling through if necessary until they can develop clear objectives.

DCE is simply too important to ignore, even though some key vendors continue to move very slowly toward adopting it or adapting it into their products.

DCE can be used to enhance the Web

The third major theme of the conference struck at the very heart of what makes the Internet such a runaway success—the World Wide Web. WWW has become more than just an information browser—it is potentially the "universal client" for a wide variety of information transactions both within and beyond the organization. Yet several presenters challenged us to be more critical of this emerging standard and raise our level of expectation about its behavior and robustness. Consider the following:

- Would you tolerate a "404 Not Found" error when you try to access a file on your Novell file server? Yet people will increasingly use WWW for file distribution and basic file services based upon a fragile foundation.

- Do you apply the same standards of information access and security within your organization as you do for external use? Yet we apply WWW technology uniformly to solve communications issues within and outside our organizations.

Steve Lewontin of the OSF Research Institute commented that in his mind the World Wide Web was a legacy application! While he quickly qualified that comment, both his "DCE Web Project" and Mic Bowman’s "File System Enhanced World Wide Web Access" presentations challenged us to think critically about WWW and how we would like it to evolve. The OSF Research Institute’s DCE Web project has developed a much richer concept of controlling access to Web resources within an enterprise or community. This notion is distinctly different from the model of “spontaneous commercial transactions with unknown parties” that is driving the development of the SSL and SHTTP protocols and products like Netscape’s Commerce Server. The “community Web” concept seems to be a good fit for university information services such as libraries.

Mic Bowman challenged us to raise our standards for the way the WWW works, pointing out that WWW and clients like Mosaic and Netscape are fantastic compared to the distinct Internet programs that preceded them, but that we routinely accept error conditions while surfing the Web that we find completely unacceptable from our file systems. Research at Transarc has demonstrated a number of ways advanced file systems can be used to improve the Web.

During the conference, participants agreed that CAUSE should maintain a Web page on DCE in higher education. That page, which among other items points to the proceedings of the presentations described in this article, can be found at http://cause-www.colorado.edu/issues/dce.html. In addition, a CAUSE DCE Constituent Group has been established which will meet at CAUSE95 in November in New Orleans; the group is also in the process of establishing an electronic discussion list to share challenges and solutions. To subscribe, send e-mail to mailserv@cause.colorado.edu including the message: subscribe dce. Be sure to send that message from the e-mail account to which you wish messages from the list to be sent.
Internet Tools Access
Administrative Data at the University of Delaware

by Carl Jacobson

The introduction of NCSA’s Mosaic browser ignited a fire of interest that is changing the face of the Internet and the way we deal with networked information. The scramble for commercial success on the Internet has brought many technology vendors into the Web trade, resulting in the development of new tools and methods. As these advances define the role of commerce on the Internet, they will also change the way we conduct routine business on our networked campuses.

The World Wide Web offers a new model for application development in colleges and universities. At the University of Delaware, for example, Web tools are effectively being employed to produce multi-platform administrative applications. Web applications are quickly and easily crafted to interact with administrative databases, providing powerful, new functionality. Web applications cross most client platforms and can be simultaneously GUI- and character-based, reaching users of both old and new desktop hardware. Web tools are particularly suited to customer outreach efforts, delivering direct service to students, faculty, and staff. The capabilities of the Web’s HyperText Markup Language (HTML) facilitate new classes of applications, including hyper-reporting, mixed media, electronic forms, and kiosk services.

Administrative systems and customer service

The University of Delaware provides widespread access to its administrative systems, delivering improved customer service to students, faculty, and staff. The Internet’s free, public, outreach tools (World Wide Web, Gopher, and e-mail) have been merged with the institution’s closed, proprietary administrative systems (student records, human resources, and financial management).

Private, personal information, including student and employee records, is integrated with the public, general information of the campuswide information system. Freely distributed clients for DOS, Windows, Mac, UNIX, and timeshare users allow access to official, production data on both MVS and UNIX platforms. The methods employed to achieve this success are simple, inexpensive, and easily adapted.

While the administrative systems of the University can be characterized as closed, proprietary, controlled, and secure, the student view of computing is open, pedestrian, public, and wide-reaching. In keeping pace with trends toward a more student-centered campus, Delaware’s administrative systems have been reworked to place an emphasis on self-service. Self-service technologies have been applied to deliver timely information directly to the customer. These technologies empower the customer and provide cost-effective, automated services that know no geographic boundaries. Self-service technolo-

Carl Jacobson is Director of Management Information Services at the University of Delaware, where he has worked for the past eighteen years. Management Information Services has responsibility for acquisition, development, and maintenance of administrative and library systems. Mr. Jacobson’s emphasis is on expanding the boundaries of the University’s administrative systems beyond the realm of administrators to students, faculty, researchers, high school students, and parents.
Technologies merge

With a healthy portfolio of mainframe-based administrative systems, Delaware chose to adapt existing information resources to open, network technologies, in order to meet the goals of improved customer service.

It is impossible to grant the large, expanding customer base direct access to mainframe-based information systems. Faculty and research users of “academic” machines have little desire to log on to “administrative” machines and navigate through unfamiliar territory in search of needed information. Nor is it feasible to allow 22,000 students to log on to the administrative mainframe to review grades on the day they are posted. These closed, proprietary systems must be opened to allow such “pedestrian” use. Administrative information services must be adapted to behave more along the lines of a publicly available campuswide information system (CWIS).

To meet these goals, Delaware chose to leverage existing resources by merging

- the established, closed, proprietary mainframe-based administrative systems with
- the emerging, open, public, client/server-based campuswide information systems

in order to

- deliver customer service in the environment of the customer,
- do “administrative things” in “the student way,”
- allow the free, public access tools of the Internet to be used to do official university business.

The key to successfully merging these technologies is compromise. It is necessary to bring the security of the administrative environment to Internet tools, while opening the administrative systems to Internet protocols.

As Delaware first turned to the Web for administrative support, official institutional data were maintained using Software AG’s ADABAS database system and processed by programs written in COBOL and NATURAL. At the same time, CWIS information was collected, maintained, and delivered on the World Wide Web. The use of Web browsers was widespread among campus customers, while existing Natural/ADABAS systems were robust and useful. These disparate resources were combined in a unique but simple way to deliver improved information service to students, staff, and faculty.

This combination requires the transformation of the “host” of a host-terminal system into the “server” of a client/server system. The host and its associated applications become part of a client/server network enabling outreach and supporting diverse data types.

Opening closed systems

The opening of such closed systems focuses on the need for secure servers to translate Internet protocols into the languages of the administrative systems. Web HTTP (HyperText Transport Protocol) servers meet this need, functioning as effective gateways between the Web browsers and administrative programs and databases.

Such Web gateway servers may be built or bought. Several HTTP servers are available commercially at surprisingly low cost. Apple’s Internet Server and Netscape’s Commerce Server are examples of general-purpose HTTP servers that provide packaged sets of tools needed to develop Web applications. They are popular, inexpensive, vendor supported, and utilize economical hardware.

While commercial gateway servers provide the convenience of packaged toolsets, they may require additional hardware, new communications protocols, and unfamiliar programming languages. As an alternative, special-purpose HTTP servers can be developed in-house to perform these translations directly on existing hosts. Interpretive servers may be written on any networked platform, using any language supporting Internet communications interfaces.

This approach would, for example, allow COBOL programmers to open legacy systems to the Web using the tools, techniques, and training of the legacy environment. While Web browsers expect information to be packaged using HTTP, they are not concerned with how that packaging is performed.

Whether built or bought, gateway servers use standard HTTP to communicate with Web browsers on the user side. On the application side, these servers employ common gateway interfaces (CGIs) to communicate with external programs and databases. CGIs are programs or scripts, and may be written in many languages, including C, Perl, and AppleScript. CGIs allow Web servers to communicate with other servers, DBMSs, external programs, screen scrapers, and a variety of network program interfaces.

CGIs may be used in conjunction with DBMSs and programming languages to build complete, new administrative applications, or CGIs may play the role of transforming closed,
proprietary administrative systems into compelling Web applications.

With many Delaware administrative systems residing on an MVS mainframe, interpretive servers were developed to run in this environment. The servers accept Internet packets, recognize Web HTTP protocol, and call administrative application programs based on the content of these packets.

With interpretive servers speaking to administrative programs, existing tasks such as transcript production can be reused rather than redeveloped. Upon request from a student client, the server simply invokes the existing COBOL transcript program. However, instead of printing or displaying the results, they are packaged in a Web packet and sent out onto the network.

**Authentication, authorization, and encryption**

In order to provide the levels of security needed in conducting personal business, authentication, authorization, and encryption routines must be employed.

With an overall design goal of “using existing resources whenever possible,” security schemes used for touch-tone registration were enlisted at Delaware to provide similar protection to the Internet clients. Student-ID and PIN (Personal Identification Number) authentication was already known and in use by students and staff. PIN-based authorization tables were already in place in existing administrative systems. (Exhibit I illustrates the Web SID/PIN authentication and access to records.)

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

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

SSL is not the only security alternative available to those wanting to do business on the Web. Secure HTTP, Digest Access Authentication, and DCE-Web security are several examples of current Web security efforts.

**Stateless client/server relationships**

A significant advantage to adopting the Web-server model to provide student services lies in the “statelessness” of these servers. The transactions may be viewed as “stateless” in that a server has no lasting connection with each requesting client. The server “comes alive” upon receiving a request message, interprets and fulfills the request by passing a message back across the network, and returns to a “wait state” until the next user request comes along.

Since students do not log on to the administrative system, there is no data communications overhead. A single task monitors an Internet port and responds to customer requests. This “stateless” client/server relationship allows many customers to effectively use administrative resources without becoming members of that environment.

Without the overhead of CICS or TSO sessions, a mainframe server performs its simple tasks with little impact on the overall system. Response is immediate, even for longer packages such as student transcripts. In addition, due to the nature of the Web itself, the response time expectations of Web users are lower than those of interactive, transaction-based systems, so that if a delay is encountered, it is unremarkable.

Such interpretive servers have the advantage of accessing production data directly. They need not rely on data extracts, but instead return timely and accurate information from official production records. As students perform touch-tone drop-add, they can immediately confirm schedule changes. As students pay bills, they can quickly print summaries of charges and payments. With many business transactions reaching databases in real time, it has become necessary to report these changes in real time. “Just-in-time” production of course schedules and transcripts calls for this level of timeliness. The stateless Web server allows this to be accomplished easily and inexpensively.

At Delaware, servers have been deployed to run on MVS, UNIX, and MacOS platforms to allow information to be gleaned from various databases across campus and to take advantage of the relative merits of each operating system.

**Training and support**

With Web browsers already in the hands of students, faculty, and staff, the issues of training, support, and software distribution are minimized. Student grades and transcripts may be accessed in a manner familiar to all existing Web users, allowing students to use these tools to conduct institutional business (see Exhibit I), as well as to explore academic frontiers.
Client-side development costs are usually a large portion of a client/server budget. However, Web applications differ from the popular client/server model in that all Web development effort is on the server side. Since Web client tools are free and widespread, client-side costs have been kept to a minimum.

Server-side development may be as simple as re-routing the formatted-text output of a COBOL report program to a routine to place the output in an HTTP packet. In many cases, there is no need to add HTML codes to a formatted text document and no need for application programmers to learn the details of HTML.

However, HTML syntax is easy to learn and enables application developers to transform simple, pre-formatted text reports into powerful hypertext documents supporting multimedia and user input.

Software distribution

One strength of the client/server model of computing is the increased functionality provided at the desktop. Not only can Internet browsers access grades and course schedules, but they can also retrieve and display images, sounds, and even brief video clips. Any “digital object” of reasonable size can be delivered to any client workstation. This includes the delivery of client software itself.

In keeping with the goal of “self-service,” Delaware’s Internet client software is stored on a Web server and made available to anyone in the campus community across the network. A simple point-and-click causes the newest version of a program to be loaded across the network to the user’s hard drive.

For Web applications themselves, the bulk of processing code remains on the “server side.”
and version-control is centralized. HTTP mark-ups are, in effect, software code that is delivered and interpreted in real time, ensuring that the most recent code changes are invoked by every user.

The Web's hypertext capabilities provide for easy access to associated documentation for all network-delivered software.

**Classes of application**

The powerful capabilities of the Web enable the rapid development of new classes of administrative applications. While formatted text reports such as course schedules and transcripts can easily be delivered to Web browsers, the hypertexting and multimedia features of the Web offer exciting new potential. The Web's hypermedia model expands the potential of administrative computing.

**Hyper-reporting**

An HTML document may be linked to any other document on the Web, creating a powerful hypertext application that can be used to produce hyper-reports. Hyper-reporting can be used to link existing summary reports and detail screens to produce effective executive information systems. Institutional executives may receive regularly generated summary reports with built-in “drill-down” capability, with links to official, detailed, production data from administrative databases.

**Mixed media**

Web hyperlinking also supports diverse data types, such as photographic or document images. Student demographic data may be gleaned from a legacy student information system, while student photographs are retrieved from a UNIX-based image server. Both could be merged seamlessly by the desktop Web browser.

**Electronic forms**

Web browsers support fill-in-the-blank forms with ease-of-use features such as scroll boxes and radio buttons. Paper forms used for routine campus business may be effectively replaced by electronic documents, available to users on all platforms and routed and processed on the campus network. (See Exhibit II, an illustration of the University’s forms home page.)

**Touch-screen, multimedia kiosks**

PODIUM,¹ a multimedia authoring tool developed at the University of Delaware, has been made “Internet aware,” allowing it to “speak” Gopher and Web protocols. This tool, originally designed as a classroom technology, is now used by several institutions to develop compelling multimedia, touch-screen kiosks—merging image, sound, and video with administrative information. PODIUM is an early example of an emerging class of tool, facilitating the construction of special-purpose browsers for custom Web applications.

**Evolving Web capabilities**

One of the primary strengths of the Web is the ability to deal with diverse data types—the ability to support multimedia objects. Complex data objects may be sent across the network and “unwrapped” and “displayed” at desktop browsers. In the future, these objects will become even more complex. For example, an electronic form and its associated processing rules might be delivered directly to, and processed locally on, the client workstation.

Vendor efforts, such as Sun Microsystems’ Hot Java, demonstrate the ability to deliver secure program code as an integral part of a Web transaction. This capability will redefine distributed computing, allowing host servers to deliver machine-independent code to desktop clients for just-in-time processing.

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¹ PODIUM is an object-oriented multimedia application generator developed by Professor Fred Hofstetter. For more information, see http://www.udel.edu/lynam/fth/podium.html.
Conclusion
Rapid advances in the development of tools for the Internet will impact the processes of teaching, learning, and research at our institutions. Many of these same advances will contribute to the way we conduct business and affect daily campus life for students, employees, and visitors.

The World Wide Web is emerging as a new model for administrative service on our campuses. With the application of emerging tools and technologies, existing resources can be reused effectively to return immediate benefits for small investments. Each early adopter of these technologies will gain valuable experience and insight into the issues of delivering networked services and will establish a foundation for controlled growth and change.

Development Checklist
As the Web capabilities listed below demonstrate, Web development offers many advantages over traditional application development methods.

✔ Multi-platform
Web clients exist for DOS, Windows, Mac, UNIX, and other popular operating systems.

✔ Low cost
Commercial Web browsers are available to educational institutions at no cost.

✔ GUI
Web applications may be simultaneously GUI- and character-based, delivering functionality to users of older desktop hardware.

✔ Mixed media
Web protocols support images, sounds, and video clips as well as text, allowing character-based administrative data to be merged with these rich data types.

✔ Common user interface
Although Web browsers run on disparate platforms, a certain look and feel is maintained across platforms, providing an easy-to-support common user interface.

✔ Software distribution
Web browsers themselves may be easily and inexpensively distributed across the network, using the Web itself.

✔ Self-documenting
Hypertext capabilities allow application help and tutorial routines to become an integral part of any Web application.

✔ Distributed servers
Web browsers merge information from several servers onto a single screen, without specific user knowledge of these servers.

✔ Network security
Socket-level encryption provides a secure network communications channel that can be employed to protect any existing or emerging campus authentication scheme in addition to all user data.

✔ Local processing
As Web browsers employ “helper applications” to display and process information, Web applications can therefore make use of local processes, such as spreadsheet or word processing programs.

Additional Resources
Visit Delaware’s administrative Web site (http://www.mis.udel.edu/admin.html) for live demonstrations of secure business transactions. A Web version of this paper with hyperlinks to demonstrations and other relevant resources can be found at the URL http://cause-www.colorado.edu/cause-effect/cem95/cem9533.html

“The Web: A New Model for Application Development,” a CAUSE95 pre-conference seminar to be held November 28 in New Orleans, will provide an opportunity to explore, in depth, the use of the Web for application development. Seminar leader Carl Jacobson will target a general audience, addressing technical issues of interest to programmers and DBAs in the non-technical language of managers and directors. For more information about CAUSE95 activities, visit the CAUSE Web server (http://cause-www.colorado.edu/), or Gopher server (gopher://cause-gopher.colorado.edu/) or call 303-939-0315.
Strategies for Restructuring IT Organizations

by Susy S. Chan

In July 1993, DePaul University integrated its information technology and service functions under a new division of University Planning and Information Technology. This restructuring consolidated formerly fragmented services to achieve a unified direction for information technology closely aligned with University goals. This case study discusses the framework, process, and strategies for the restructuring and experiences during the first eighteen months.

DePaul University serves 16,700 students at five campuses in the metropolitan Chicago area. For the past ninety-eight years, its eight colleges and schools have emphasized excellence in instruction and responsiveness in meeting the educational needs of a diverse student body. In recent years, the University has enjoyed strategic growth in academic reputation, increased its market share of students, and expanded its physical plant. In order to maintain this competitiveness, the University recognized the importance of a coherent strategy in information technology support. In 1991, a University planning task force on information technology was formed and recommended general directions, but could not overcome the fragmented structure of IT at DePaul.

In July of 1993, the University’s new president, recognizing the urgent need for change, created a CIO position to restructure the information technology functions. A new division of University Planning and Information Technology (UPIT) was established, with clear expectations. This new division was to play a central role in enabling and facilitating the University’s own transformation into a more responsive institution in the market place. The University expected to achieve significant improvement in University services, particularly in student support, through the innovative use of technology, process reengineering, and rapid redeployment of information technology resources. Furthermore, there was a clear mandate from the president to move the University toward a workgroup computing environment. These broad University goals directed the strategic restructuring effort.

Framework and principles

The goal to move toward a workgroup computing environment necessitated several significant transformations.

• The technology architecture had to move from an obsolescent mainframe architecture to a networked client/server environment.
• UPIT as a division and its members had to embrace a user-oriented culture and acquire new skills in technology and consultation.
• Users needed to go through extensive training.
• The University’s core processes had to be redesigned.
• People who would perform new tasks had to be retrained.

As UPIT was expected to affect a wide range of changes in University services and information delivery, the division itself needed to undergo an immediate transformation.

In view of the urgency and the magnitude of

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change, our framework for restructuring was drawn primarily from process reengineering models (e.g., Thomas Davenport’s). This framework emphasizes a holistic approach to change in four dimensions—vision and directions, work process and organization, people, and technology. Vision and directions set the focus for improvement. Organizational structure defines the horizontal work processes and vertical functional roles. Managed cultural change and redefinition of incentives and opportunities are crucial to individuals who are affected by the transformation. And technology solutions become enabling strategies, a vehicle for implementing desired change. These four transformation strategies should be implemented in tandem to achieve successful transformation.

We also established five design principles to guide the restructuring effort:

**Strategic focus**
- Align with University’s strategic priorities.
- Concentrate UPIT resources and energy on its core services.
- Outsource, eliminate, or transfer non-essential services.
- Move from production service to consulting support.

**Organizational responsiveness**
- Cultivate a service-oriented culture.
- Reduce organizational hierarchy.
- Emphasize project management and customer service.
- Bridge the communication gap between users and the division.

**Integrated solutions**
- Adopt a cross-functional team approach to problem solving.
- Expand skill sets from a specialist to a generalist model.
- Implement horizontal cross-functional processes in targeted areas.

**Learning organization**
- Foster a culture of change and openness.
- Create clear incentives and opportunities for learning.
- Articulate expectation for new skill sets.
- Use role models in leadership development.

**Flexibility in resource management**
- Centralize headcount management and salary budgets.
- Anticipate job rotation and lateral career moves.
- Anticipate evolving realignment and restructuring.
- Realign resources based on changing functions and needs.

**The new division**

Our restructuring efforts brought into one division four separate units of vastly different culture, skill sets, and reporting lines. The Information Systems department, reporting to the vice president for business and finance, was a mainframe-oriented administrative computing group. Academic Computing Service, reporting to the academic provost, managed clusters and wide-area networks. Telecommunications, reporting to the associate vice president for administration, owned the communication fibers and voice services. Institutional Planning and Research, reporting to the vice president for university planning, provided decision support to the deans and executive offices.

Following the design framework and principles, these four units were restructured into seven functional groups as depicted in Table 1. This organization emphasizes UPIT’s goals to facilitate University transformation, including strategy formulation, process innovation, and technology and service delivery. Out of these seven groups, six were functional departments, each led by a director. Broad three-year goals and targeted skill sets were identified for each group, and each group was kept flat, with little redundancy in functions or services. Consolidation occurred in networking, help desk, user training, and systems and operation. Communication, marketing service, planning, and resource management were coordinated at the divisional level. The “process innovation support” function was treated initially as a virtual group because of the controversial nature of this new quality improvement approach and because of our intent to develop process innovation talents across the University. This area was later staffed by a consultant.

We emphasized a team approach, within and across work groups, throughout the division. A management team, consisting of the vice president and directors of the six functional groups, was formed to lead the division. The management team now meets weekly to review project status and policy issues. We also established two divisional cross-functional teams in software training and help-desk support. The help-desk function is managed by the Network and Telecommunication group, but staffed by designated technicians and consultants from several functional areas. The training workshops are coordinated by the Academic Technology Develop-
ment group, but each workgroup is responsible for training in one or two software packages.

Several secondary functions were discontinued to allow for the reallocation of resources to support an expanded client base in core functional areas. A centralized word processing function was eliminated. The program to assist employee and student purchase of home computers was terminated. A service to produce slides and overhead transparencies was transferred to the library’s AV service, and users were also directed to outside vendors for film production. These services supported only a few users but consumed considerable divisional resources, which were then redirected to fund two faculty technology labs to support self-production of instructional materials.

We streamlined the titles and ranks within the division to encourage lateral moves and obtain flexibility for further restructuring. There is no associate or assistant vice president on the management team. Other hierarchical ranks and titles, such as associate and assistant director, were replaced by generic titles of senior consultant and manager. Within each group two titles are used, one for position (e.g., senior application developer) and one for assignment (e.g., project leader).

Process

Most of the restructuring plan was completed in four months, from July through October of 1993. (See Table 2 for a chronology.) The steps we took to implement the restructuring included the following.

Step 1. Communicate directions and rationale for change.

The vice president met with the entire technology staff in June 1993 to discuss the goals of the new division and the framework, process, timetable, opportunities, and anticipated outcomes of this restructuring.

Step 2. Select directors and form UPIT management team.

A new job description was prepared for each director’s position. Former directors and senior staff members were invited to apply for the new positions. This process resulted in two reassignments, three promotions, and one continuation.

Step 3. Conduct job analysis of all UPIT members.

Every UPIT member prepared a one-page functional resume about their educational background, skills sets, and project experience. Each individual also participated in a 45-minute interview with an organizational psychologist to voice his/her preference for group assignment, career aspiration, fear, and concerns about restructuring. These two sources of information

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descriptions of job categories (but not individual job descriptions) for his/her functional group. All job descriptions specified the “desired” skill sets at different proficiency levels and expectations for learning and teamwork.

**Step 6. Regrade salaries to reflect market rates**

Once the job categories were complete, the human resources department reviewed them against comparative market salary data to regrade each group of positions. The regraded positions and salary structure reflected expanded responsibilities and higher performance expectations. This process resulted in salary increases for most staff members. Consolidation of positions in several areas allowed us to reinvest salary dollars in those people who were motivated to grow with the new division.

**Step 7. Implement a new performance appraisal system**

The UPIT management team, in collaboration with the human resources department, designed a new performance appraisal system. Twice a year the new appraisal system evaluates each individual’s performance toward divisional objectives and fulfillment of divisional attributes. The new system was introduced to the UPIT staff in October 1993 and implemented two months later.

**Key strategies**

Beyond the first four months of intensive restructuring efforts, we also implemented three interrelated strategies: high performance management to manage the change in culture, training and development to manage the change in human resources, and partnerships to manage the change in relationship with users.

**High performance management**

We designed and implemented a performance management program (see Figure 1) to enable the division to achieve high productivity and develop talents. This program has three components—performance goal setting, performance appraisal, and skills development. The program links divisional goals with individual performance objectives and skills development. The divisional goals are translated into performance objectives for the vice president and then for directors or cross-functional projects. Individual performance has two components: one set of objectives is closely linked to divisional priorities and projects, while the other pertains to the division’s core values.

To cultivate a culture of service orientation, openness to change, collaborative teamwork,
and continual learning, we introduced ten core values.

**Core Values of UPIT**

- Commitment to the mission
- Continuous quality improvement
- Creativity and innovation
- Customer focus
- Leadership
- Openness to change
- Results oriented
- Self-directed learning
- Self-empowerment
- Teamwork and collaboration

These values signify the expectation for every member in the division. We incorporated the behavioral attributes of these values into the performance appraisal system. The twice-a-year appraisal (June and December) encourages a timely review of progress and adjustment. Performance in all areas is measured on a seven-point scale, where 3, 4, and 5 indicate performance meeting expectations. This measurement scale also encourages us to raise expectations or set new expectations for an individual, to continue to improve productivity and continue challenging him or her.

The diagnostic value of performance appraisal would be limited without an opportunity for skill development. Given DePaul’s mandate to move rapidly to a new technology environment, there needs to be constant upgrade of technical skills and non-technical skills. The job analysis process revealed serious gaps in the division’s skill profiles; namely, analysis, consultation, and project management. The training and development strategies are discussed in details below.

**Training and development**

We adopted multiple approaches to skills development, emphasizing both soft and technical skills. The central theme was to create an organizational culture of learning with an openness to change and innovation. Each individual is expected to initiate self-directed learning through formal course work, workshops, vendor-sponsored seminars, and cross-training through teamwork or participation in new projects. In addition, we sponsored selected individuals to participate in several programs.

- **Leadership Learning Forum.** Meeting at DePaul, this program emphasized creativity, problem solving, teamwork, and change management, through guest speakers, readings, and team problem solving. Under the sponsorship of the management team, one-third of the division participated in this program, meeting one day every six weeks.
- **New skills development.** The vice president also sponsored selected individuals for four-month intensive certificate programs offered by DePaul’s School of Computer Science, Information Systems, and Telecommunication. We had individuals complete programs (on their own time) in Windows applications, telecommunications, local area networks (LAN), client/server strategies, database, and desktop applications.
- **Friday Forum.** Held every other week by project team leaders, the sessions showcased major projects and helped to sharpen staff presentation skills.

**External Leadership Learning Forum.** Several directors and senior staff members also participated in the leadership development programs sponsored by CAUSE and the Society for Information Management (SIM).

**Partnership with users**

Restructuring disrupted our established relationships with the user community. We had to redirect users’ expectations and build new relationships with various groups. Two formal advisory bodies were created to solicit user feedback. An academic advisory group, primarily consisting of faculty and student representatives, reviews policies and initiatives affecting teaching, research, and student computing. A customer service panel, consisting of representatives from all college and divisional offices, provides feedback on services and new needs. Both groups now meet monthly with the vice president and UPIT directors.

We also created new publications and re-
Through restructuring we were able to deliver these results and serve a greatly expanded client base with the same operating budget and a smaller staff. The DePaul administration in turn was willing to provide support for capital projects. This restructuring resulted in a clear strategic vision for information technology, heightened productivity and expectations, and an accelerated momentum for actions. Fundamentally, it ignited new dynamics for organizational and self renewal. Strategic restructuring is an exhilarating yet daunting experience. The impact and implications are far-reaching. The following reflect our experience and concerns.

Cascading sponsorship for change

Support from DePaul executives was critical to the success of restructuring. In addition, strong cascading sponsorship from the vice president through directors also contributed to the result. This cascading sponsorship is manifested in training, priority setting, and human resource management.

A map to guide restructuring

Our framework helped to keep the process on course and on schedule. Restructuring generates anxiety and resistance. A clear plan and a timetable allowed us to communicate with users and those who were affected. A short timetable made the change seem more dramatic but alleviated prolonged anxiety. The fast pace helped to direct everyone’s energy toward the new organization and the intended outcomes.

A faster planning cycle

Restructuring ignites evolving changes. We found that the change triggers self-renewal and further realignment of functions, groups, and individuals because nearly every piece of the organization puzzle was redefined or rearranged. A traditional long-term planning model was too time consuming and could not be effectively supported by an evolving organization. We had to adopt a much shorter cycle for planning and empowered implementation teams to work out details.

Open and informal communication

On one hand, our restructuring unleashed tremendous energy from those who embraced the change; on the other hand, it paralyzed the productivity of those who resisted it.
ings with staff to do handholding, answer questions, address their fears, and ensure opportunities for technology training. We found open and informal communication helped bring the impact of change to a personal level.

Making retraining a must
Our restructuring afforded many people opportunities for retraining and new responsibilities. Commitment to staff development is the most critical element in restructuring IT organizations. This requires both the resource commitment from the administration and the willingness of the IT staff. We defined the skills sets at the onset and set a two-year timeline to retrain everyone. Through targeted training and participation in projects, the majority of staff have developed new technical skills. It takes much longer to develop soft skills (project management, communication, customer orientation). Retraining has been emphasized as a career necessity, not an option. In many cases, we provided opportunities, but not necessarily the release time. It is our experience that those who are motivated will view retraining as an opportunity, not as an obligation.

Determination and clear goals
There are high costs, especially human costs, associated with restructuring. Almost everyone involved in our restructuring experienced tremendous anxiety, not only those who left the division but also those who embraced the change. Managers who carried out the change experienced burnout from dealing with adverse reactions to decisions. It demanded our determination to achieve the outcome. How fast an IT organization can launch such change depends largely on its willingness to endure pain and stress.

Support from human resource department
We worked very closely with the human resources department throughout the process, but they had limited experience in implementing organizational restructuring of this magnitude. This probably is the case at most universities. We had to draw support from outside consultants and our own divisional resources to initiate new performance appraisal and training programs.

Balancing rapid restructuring with process improvement
We achieved positive results from restructuring. However, we found it difficult to sustain the benefits of restructuring without a continuous process for improvement. Such a process allows people to replenish their energy, strengthen relationships with users, and refocus on quality of services. We are now implementing a process improvement effort after two years of fast-paced restructuring.

Staff retention
Retraining improves employability. Some of our newly trained staff, armed with knowledge in Oracle, UNIX, Novell, and Windows applications, were eagerly pursued by headhunters and corporations in the Chicago area. We had to constantly reexamine the salary structure, growth possibilities, and training opportunities. Our focus is on hiring and retaining individuals who demonstrate a capacity to grow. We expect them to achieve. Implicitly, we have adopted the philosophy of preparing staff for employability, either at DePaul or elsewhere, instead of guaranteeing lifetime employment. This philosophy has both short-term and long-term implications. In the short run, this direction improves productivity. In the long-run, the cost of managing a very mobile workforce is high. Our experience suggests that a holistic approach to performance management—from recruiting to selection, evaluation, reward, training, and retention—has to be mapped out before restructuring takes place to ensure productivity.

Communication and relationship with users
Our restructuring disrupted users’ established relationships with former organizations. The pace of technology change that we implemented during the first eighteen months heightened users’ anxiety about their own work life. Although we had made an extended effort to communicate the change throughout the process, it never seemed to be adequate. Job rotation, high staff turnover, rising expectations, and new service offerings all made it difficult for us to cement a relationship with user groups. We are now exploring new models to better serve users.

Conclusions
DePaul’s effort for restructuring the IT organization has achieved remarkable results, but not without some pain and agony. Within eighteen months, the division built the University’s network infrastructure, brought 1,700 users into a highly advanced network environment, reengineered major work processes, and started implementing client/server solutions. Five critical success factors contributed to this result: (1) cascading sponsorship from executive to UPIT directors, (2) a framework and process for restructuring; (3) a holistic approach to high performance management; (4) a clear strategic focus; and (5) a timetable for outcome measures.
Understanding Software Interoperability in a Technology-Supported System of Education

by Kurt Rowley

As technical compatibility standards have become critical in business and industrial computing, educational software interoperability is rapidly becoming an issue for users and developers of educational information systems. New software interoperability initiatives are under way in several domains of educational computing, including library automation, higher education information services, and K-12 performance support systems. A number of important issues face educational computing and information technology managers, developers, and researchers with regard to new educational software interoperability efforts.

Rapid changes in computer-related technologies have had a profound effect on the organizational structure and operation of business, industry, government, and education. In each of these domains, the development of multiple new technologies, which support complex interactions with each other and with their constituent organizations, has been associated with human-factor and technological compatibility problems. One compatibility issue that has recently been discussed in the educational computing literature is the inability of most educational software applications to share standardized data with software from multiple suppliers, to work together to accomplish joint objectives. In the computer industry, this type of multi-supplier compatibility is often referred to as “interoperability,” and is considered a key enabler of networked, large-scale clusters of compatible hardware and software systems.

Why care about interoperability?

There are several factors that impede the interoperability of educational software: the wide diversity in software product objectives, approaches, and performance; the expense of developing integrated systems; continuous obsolescence and new computer technologies in the field; and competitive pressures in the marketplace that compel software suppliers to be innovative, and to distinguish themselves from each other. Another impediment to the development of interoperability standards for educational software is the complexity of educational software environments.

Educational software systems are diverse, including administrative (such as financial, scheduling, and student information systems), productivity (such as word processing, communications, and presentation systems), and instructional (such as decision support, computer-based instruction, and information-retrieval systems).

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New technologies and interoperability

To address the role of interoperability, one should consider first the difficulty of integrating new educational technologies into practice. Consider instructional software, for example. In most schools today, instructional software is used as a reward or a diversion, with little integration into the curriculum, although the use of productivity tools such as word processors has been widely accepted in schools at all levels. The integration of more powerful instructional tools—such as computer-based instruction and micro-world simulations—into the average classroom has been slow and difficult.

One reason often given for the lack of integration of computers into the mainstream of education is resistance to the use of technology by instructors. Business and industry also experienced front-line resistance to the use of new technologies in the early years of automation, but through a continual dialogue between users and developers, the new technologies were successfully integrated with the front lines. One of the major accomplishments of this dialogue, and a key factor in the acceptance and integration of computer technologies in business, was their hardware compatibility between competing commercial suppliers, a combined hardware and software interoperability. As interoperability becomes a broader issue in educational computing at all levels, it is useful to consider examples of how interoperability has succeeded.

The Internet example

A successful example of interoperability is evidenced in the workings of the components of the Internet. In this case, software from multiple suppliers cooperates to manage a multitude of electronic networks, each connected to a common electronic backbone. While each of the software systems involved in a single Internet transaction may be supported by different hardware platforms and telecommunication software suppliers, by following standardized protocols, each transaction proceeds in a reliable fashion, handed-off across the various networks. The benefits of interoperability to the Internet are significant. The interoperability among the components of the Internet enable the creation of an enormous telecommunications infrastructure, facilitating the proliferation of global-area applications such as ftp and the World Wide Web.

The MIDI example

Another example of deliberately developed standards of interoperability is the musical instrument digital interface (MIDI) standard. MIDI, an
electronic network standard common in home, school, and professional music studios, was developed by a consortium of electronic music equipment suppliers, and was designed to allow all brands of computerized electronic musical instruments to use a common network interface at both the hardware and software levels. The high level of interoperability among MIDI-compatible electronic music equipment has made it possible for musicians to use an electronic music keyboard from any manufacturer that supports MIDI to control any other music keyboard, or electronic musical instrument with a MIDI interface.

The most obvious benefit of MIDI is that in most music studios today, one can find a mix of all kinds and brands of electronic studio equipment working together as components. With MIDI, musical equipment manufacturers and software suppliers specialize in their areas of expertise, yet their products work harmoniously with products from other suppliers to create a larger whole, an integrated, technology-supported music studio. With MIDI, electronic musical instrument manufacturers do not have to “re-invent the wheel” of the computer network interface between their devices.

MIDI has spawned a new genre of music technology firms that specialize in software that manages the composition and performance of music across MIDI networks. The quality and sophistication of products in the electronic instrument industry has leaped forward over the past decade, spurred on in part by user demand for the MIDI interface, as well as by the music and studio industry’s acceptance of, adherence to, and promotion of the MIDI standard.8

The challenge for education

The successful integration of computer automation into the front lines of education, including, for example, the use of the computer-based instructional and microworld capabilities of computers in classrooms, requires a level of technical collaboration among educational stakeholders and participants that parallels efforts in the prior examples. The complexity of the information requirements of education is probably greater than the complexity of either the communication standards of the Internet, or the network standards of MIDI. The development of standards of interoperability for educational software requires the involvement of a menagerie of knowledge and information stakeholders. Education is, after all, a prodigious information industry.

Defining the standards of interoperability

In contrast to the enabling information-sharing standards used by the Internet, and by MIDI-based equipment in music studios, most educational software applications have no ability to share data, or to contribute student performance information to common databases. Educational computing is an enterprise of many applications tied together in educational goals, but not always linked in a technical sense, such as with software interoperability.

The importance of formally designing standards of interoperability cannot be overstated. When de facto standards arise, they often take on attributes of the lowest common denominators of compatibility, not serving the future interests of the field.9 The development of a standard gauge for U.S. railroads is an interesting illustration of the resilience of de facto standards, and their resistance to improvement. If clear-thinking systems designers do not plan well for interoperability standards at all levels of educational computing, it is probable that the standards which do in time emerge (like the railroad gauges in the sidebar illustration) will be both inferior and difficult to displace.

Because commercial educational software manufacturers are subject to competitive forces, they cannot afford to develop standards without widespread agreement. For one or two firms alone, entry into interoperability agreements can become a liability, if other firms attempt to outcompete their standards, or create closed standards giving their existing products competitive advantage. It is important, therefore, in any standards effort involving commercial firms, to develop a consensus about long-term upward compatibility issues, and maintain a level playing field for all participants, including the newest players as well as the established ones. Developing an understanding of theoretical and applied issues can assist in reaching this consensus about long-term interoperability needs. Such is the role that some system users, developers, and researchers are now seeking to play, as issues and opportunities in interoperability are identified.

Current interoperability efforts in education

Electronic interoperability has recently been achieved in several domains of educational computing. For example, the SPEEDE (EDI) standard has been developed in higher education for the electronic exchange of transcripts through a universal transcript definition.10 Other examples within higher education are the communication protocol standards of MARC and Z39.50 used in library automation.11 These application-level technical standards were developed in conjunc-
tion with organizations such as the International Organization for Standardization (ISO, Geneva, Switzerland), the American National Standards Institute (ANSL, New York), and the National Information Standards Organization (NISO, New Brunswick, New Jersey). Another level of standard developed recently is the Open Software Foundation’s Distributed Computing Environment (OSF’s DCE). DCE technology will provide standards at the data access and network resource, or “middleware,” level. Further new technical standards, in early stages of development, will include a broader range of educational software.

The state of Florida, a pioneer in EDI in education through the Florida Information Resources Network (FIReN) system, a statewide network for the Florida education system, is seeking through the auspices of the Florida Schoolyear 2000 initiative to extend the definition and utilization of standardized electronic educational information. This is being done through the creation of data flow control (DFC) standards, which new electronic learning support systems for Florida K–12 schools must adhere to, several of which are under development as part of Schoolyear 2000’s Florida Learning Support System (FLSS) program. Data flow control is an open access method for data that is “owned” by multiple software systems. A data flow controller has the ability to manage the access to data from various software systems from a variety of suppliers. The Florida Learning Support System data flow controller (FLSS-DFC) will interact with interoperable applications to automatically maintain and grant access to public data element dictionaries containing information such as data ownership, characteristics, locations, access privileges, and update requirements.

The FLSS-DFC standard will initially allow electronic learning support systems of all varieties, and from multiple vendors, to interact and share data between all levels of educational systems, using standard protocols. Uniform data flow control will eventually extend to a host of other educational software systems, allowing for interoperability between and among various student information systems, instructional software systems, performance support systems, and administrative information systems at all levels of education in Florida.

There are a number of other recent and emerging standards that will facilitate the interoperability of educational software. These include data communication standards as well as various standards under development in the computer industry for multimedia interoperability. New multimedia standards efforts seek to make multimedia file streams interoperable by allowing standardized multimedia data to flow across open networks for use by all compliant software applications. Several interesting and important interoperability standards and potential standards across the scale of educational computing are depicted in Exhibit I.

The Leading Questions

A number of new standards of interoperability have been developed and implemented over the past few years, and more are on the horizon for education. A few questions related to

The Longevity of a De Facto Standard

The story of the U.S. standard railroad track gauge (the distance between the rails) is an interesting illustration of how de facto technical standards survive over long periods of time. The U.S. standard track gauge is 4' 8-1/2". The reason generally given for using this number is that the first U.S. railroads were built by English ex-patriots, and that was the gauge used in England at the time. Most railroad historians believe that the English gauge for railroads was used because early English tramways had used the same gauge. Further, historians believe that tramway rails were spaced at 4' 8-1/2" because the builders of early tramway cars used the most logical existing tools and axle widths available to them, namely, tools and jigs available for the construction of horse- and oxen-drawn wagons.

As the story goes, wheels on wagons were generally spaced to travel securely in the ruts of the roads in Great Britain, which had been unchanged since Roman times. Wheels spaced any wider or narrower than the rails in the road would never survive the shearing forces of the wagon, or chariot, traveling in and out of the ruts. Thus, the U.S. standard railroad track gauge may be attributable to the axle-width of the Roman war chariot, which was probably determined by the width of the typical Roman horse.

There were many attempts by innovative rail companies in the early years of railroading to widen the U.S. standard track gauge. The justification for the wider gauge usually given was that wider gauges lend more stability and allow higher carrying capacity. In the mid-1800s, cities and states often built rail routes with track gauges incompatible with their economically competing neighbor cities and states, running their own rail lines to important agricultural, shipping, and industry centers in an attempt to secure economic development. It was common for long-distance passengers and cargo to be unloaded and reloaded many times as they were transferred between railroad carriers on tracks of different gauges. Passengers and freight customers came to expect frequent “breaks in gauge,” using local services for the unloading, across-town transportation, and reloading of the trains.

 Debate about the inefficiencies of the well-established, incompatible railroad track gauges raged for over thirty years in the U.S. Even Abraham Lincoln got involved, attempting to institute a standardized, wide-track gauge. The idea of a single track gauge standard eventually won the day, but the momentum of the narrower English standard, which by the 1860s was used on slightly more than half of the railways, was too great to ignore. In the 1880s the railroads were forced by growing national market forces to adopt the English standard, still in use in the U.S."

*The debate surrounding the integration of diverse, 19th Century American railroads is strikingly similar to current standards discussions in computing. For a fascinating treatment of this integration, see George Taylor and Irene Neu, The American Railroad Network 1861-1890 (Cambridge, Mass.: Harvard University Press, 1956).

11 For a discussion of these library automation standards, see the articles by Lynch and by Mccallum, op cit.

(footnotes continued)
ongoing development of standards of interoperability, and evaluation of new systems for interoperability capability, that should be considered by educational computing practitioners, developers, and researchers, are:

- What are desirable characteristics and models of computer integration for all aspects of education?
- What is the theory base for building and testing interoperability in educational software? In other words, what are we trying to accomplish?
- To what degree is the involvement of stakeholders at multiple educational levels, including K-12, vocational training, higher education, corporate training, and even independent schools, important for defining and developing various applications of interoperability, and for the ultimate pursuit of a computer-integrated system of education?

Other important questions are related to defining the missions of a technology-supported system of education. For example:

- What are the implications of interoperability in the practice of educational computing?
- What are the likely effects of educational software interoperability on the design of educational computer technology, its acceptance in the marketplaces of education, and ultimately on educational administration and learner performance?
- What is the role of interoperable instructional and educational software in a computer-integrated model of education?

As more and more electronic interoperability appears across the spectrum of education, students and educators should insist on answers to these questions, to assure that increased interoperability leads to more customer-centered, performance-oriented systems of education.

The future of educational software interoperability

For one illustration of how interoperability could provide useful and novel benefits to students, instructors, and administrators in the future, consider the situation in which an instructor would like students to experiment with off-the-shelf instructional software, perhaps even "edutainment" software such as "Where in the World is Carmen Sandiego™," "SimEarth™," or similar popular software titles. Perhaps through an interoperable instructional data interface, the instructor could some day receive information from these types of software that could help him or her understand the student's individual performance, information that could be used by the instructor to pinpoint future learning objectives for the student, or identify other instructional software that might be useful. Overall student performance information could then be forwarded electronically to administrators, providing continuous indicators of educational mission accomplishment.

By sharing information about what was learned, or how well a student performed, a student’s individual educational objectives could be partly met through interoperable integration of student information systems with off-the-shelf instructional software systems. More to the point, the computer-based aspects of education would become an enormous open system, facilitating the work of educators in meeting the needs of individual students through the use of interoperable software, including these types of popular software packages.

The management of software from a variety of suppliers via interoperable capabilities could increase educators' abilities to address individual needs. This would require industry-standard application program interfaces (APIs), and common approaches to data access. It would also involve evaluating the effects of integrating educational software, and learning how information from diverse genres of educational software can interact productively, coming from a field of diverse software suppliers. Such future applications could, as with the examples given earlier, create from the interoperable components a larger whole, an integrated, technology-supported system of education.

Meaningful interoperability

Perhaps the greatest challenge in managing and studying the development and implementation of standards of interoperability for educational software is to address the complexity of performance data in a manner meaningful to students, teachers, and administrators. This includes inquiry into the long-term costs and benefits in both time and money, of standardizing data among all educational software, from stand-alone software packages to global networks of educational databases. This also requires a perspective of the future, a view of an educational enterprise where educational technologies across all geographical boundaries could conceivably interoperable at a functional level. Such integrated systems could combine across distance learning networks to meet both the unique needs of each individual learner and the needs of society, a noble mission for educational systems.

A fundamental and ongoing discussion of interoperable instructional software in the field of educational computing and technology should identify which data elements are most important to be shared among systems of educational software. To reap the potential benefits of inter-

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12 A good discussion of DCE can be found in “Why Your Campus Should Consider Adopting OSF’s DCE Standards,” by Samuel Plice, CAUSE/EFFECT, Spring 1995, pp. 5-7. According to Plice, DCE supports interoperability by defining standards for file services and network security across multi-vendor platforms; it has the potential to create an important foundation for all interoperability.

13 The Schoolyear 2000 Initiative is a large-scale, systemic, and comprehensive effort to increase the intellectual productivity of public school students in Florida through developing, testing, and implementing a process of schooling supported by technology. The Florida Schoolyear 2000 Initiative is (continued)
Exhibit I: Interoperability standards and potential standards across the scale of educational computing

The following table illustrates software interoperability standards in educational computing using the metaphor of a railroad to illustrate the hierarchy of standards. Some of these interoperability standards have been won after great market battles in the business world, while others have emerged quietly and comparatively quickly, after careful planning by standards and professional organizations. As educational software standards are beginning to diffuse across the scale of education, a technology-supported system facilitated by the full-scale interoperability of educational software is becoming a more real possibility.

<table>
<thead>
<tr>
<th>Level/Scale</th>
<th>Railroad Metaphor</th>
<th>Example Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications Networks</td>
<td>Railroad track</td>
<td>Ethernet, ISDN, TCP/IP</td>
</tr>
<tr>
<td>Operating System Access</td>
<td>Standardized rail cars that carry standardized containers</td>
<td>DOS, Windows, System 7, UNIX, POSIX-0SE, OSF’s DCE</td>
</tr>
<tr>
<td>General Information and Resource Sharing</td>
<td>Standardized cargo containers and passenger cars for various functions (dining, touring, sleeping)</td>
<td>Data Sharing: EDIFACT, SGML, SPDL, IRDS, SQL, new multimedia standards Communication: UUCP, ftp, HTTP/HTML</td>
</tr>
<tr>
<td>Application Information and Resource Sharing</td>
<td>Accommodations for typical railroad cargo in the standardized containers, and various types of passengers</td>
<td>Administrative: SPEEDE (ANSI X12), FLSS-DFC Library: MARC, Z39.50 Instructional: FLSS-DFC, many others needed in specialized discipline areas (such as MIDI in music education) Productivity: De facto file standards in word processing, spreadsheets, graphic images, CAD, etc.</td>
</tr>
<tr>
<td>Human to Computer Interface</td>
<td>Consistent and comfortable accommodations for passengers, and adequate tie-downs in the cargo containers</td>
<td>ISO 9241 (task, visual, form standards), various keyboard and icon layout standards, APIs for operating system access, GUI standards such as X Windows</td>
</tr>
</tbody>
</table>


operability, managers of educational computing and technology, as well as system-user organizations, developers, and researchers, must get involved in designing and managing systems in which multiple software modules utilize compatible user interfaces, data standards, application data interfaces, and most importantly, compatible indicators of student performance results. This will also include identifying evaluation criteria for interoperable systems based on current and potential user needs in a complex environment, an environment where suites of educational software from a variety of sources and suppliers can interact using common data sets, producing composite effects to help all educational organizations accomplish their missions.

Getting involved

Some of the issues surrounding standards of software interoperability in education have been recently addressed by various organizations involved in educational computing. Managers, developers, and researchers of educational computing, with regard to interoperable educational software, now have the opportunity to become involved in expanding the functional boundaries of interoperable systems, studying the usefulness of interoperability in multiple disciplines of education, and developing evaluation criteria for interoperable systems. This could include, for example, studying relationships between electronic student performance histories and other information-related aspects of the educational system available in an increasingly online educational world.

Some major tasks for researching, developing, implementing, and managing interoperable systems, as suggested and implied by this article, are outlined in the sidebar on the next page, including identification of some areas in which practitioners, developers, and researchers might be involved to help facilitate useful educational

jointly sponsored by the Florida Legislature, the Florida Department of Education, Florida school districts, and the Center for Educational Technology at Florida State University, Tallahassee.


15 Schoolyear 2000’s Florida Learning Support System standards effort is being pursued through a multi-year co-development agreement between the Florida Department of Education (Tallahassee), and Encyclopaedia Britannica Education Corporation (Chicago). The co-developers are also working with a consortium of educational software suppliers to develop and further implement this data flow control standard. The data flow controller is being designed and developed by Information Systems of Florida.

Tasks for designing, developing, and implementing interoperable systems

Design/Research
• Developing design requirements for educational software interoperability, including the identification of user needs, technology potential, desired outcomes for interoperable educational software designs, acceptable APIs, common approaches to data access, and universal formats for indicators of student performance results.
• Fostering the involvement of appropriate knowledge and information stakeholders in areas of education that could benefit from the increased information available in an interoperable, technology-supported system of education.
• Identifying or developing research tools capable of studying complex linkages between the elements of diverse educational software, and composite effects in the environment of a computer-integrated educational system.
• Developing core models for interoperable technologies, taxonomies for technology-supported systems of education that would integrate all educational software: instructional software, productivity software, administrative educational computing, automated quality systems, accountability and records systems, decision support systems, and others.

Development
• Identifying development issues through reviews of new standards of interoperability, and case studies of the design and implementation of new standards.
• Asking the right questions to assure that newly developed products will have the capability to become interoperable, and the interoperability will be designed to lead to a more customer-centered, student-performance-oriented system of education at all levels.
• Determining how diverse applications, including legacy systems, should coexist in an interoperable educational software environment.
• To fully exploit interoperability, identifying new educational software applications and opportunities made possible by common user interfaces and compatible data sources.

Implementation/Management
• Analyzing organizational and social issues related to the integration of interoperability and increased data availability into practice. This will include learning how to address the complexity of data from integrated systems in a manner meaningful to students, teachers, and administrators.
• Measuring the effects of various implementations of interoperability on: system performance, software features, product acceptance, and most importantly, user learning and performance.
• Defining evaluation standards and benchmarks for components of interoperable educational software systems.
• Determining soundness of implementations. Interoperability standards should be developed with input from those involved in the real-world implementation problems of the related hardware and software technologies.
• Analyzing the short- and long-term costs and benefits of educational software interoperability.

Software interoperability. For example, an information manager might identify data elements of a student information system that are, or are not, legally available to interoperable software applications. By identifying data that could be shared among applications, new concepts can emerge, and systemic benefits could be far-reaching.

Pursuing a broader, more systemwide scope for technology management than is typical in education is critical if widespread interoperability is to make a useful contribution to the field of educational computing and technology. The computer-integrated educational system of the future will depend on complex webs of networks and linkages between systems. In the delicate human systems of education, where each component of the system has an effect on other elements in the system, deliberate inquiry into the designs of components of interoperable computer-integrated educational software will become increasingly important. Understanding issues of interoperability at all levels should prove an important new direction for educational computing and technology practitioners, developers, and researchers.
PRO*CAS T: Providing Timely Information to Monitor Progress Toward University Goals

by Tad Jackson, Gary Hammon, and Martin Smith

Integral to the strategic planning process of any college or university is the ability to access timely, accurate information to support decision-making and monitor progress toward established goals. At the University of Massachusetts System, an integrated suite of technologies—an information warehouse with executive information, decision support, and data analysis—called PRO*CAST provides this capability to administrators, planners, and policy setters.

The University of Massachusetts System comprises five campuses—three residential, one urban commuter, and one medical center/medical school. The campuses are overseen by a systemwide Board of Trustees and President's Office. The five-year goal for the University is to develop the five-campus system as one that will be known by the year 2000 as an institution of academic excellence and one of the best in the nation in terms of responsiveness to state educational and economic needs.

To accomplish this, attention has been focused on four strategic priorities: (1) reaffirming teaching and learning, (2) embracing diversity and pluralism, (3) promoting economic development, and (4) advancing the distinctive goals of each campus. Measurable goals have been set by each campus for the four strategic priorities in order to clearly demonstrate to the citizens and officials of the Commonwealth that the University is making progress in achieving its stated goals.

(continued on page 32)
Initially a college of agricultural science, The Pennsylvania State University broadened its mission after Congress passed the Morrill Land Grant Act in 1862, when it became the sole land-grant institution of the Commonwealth of Pennsylvania. Today, approximately 4,300 full-time faculty serve 68,826 full- and part-time students throughout the University.

The University Park Campus, located adjacent to State College, is the administrative hub of the institution, enrolls more than half of all undergraduates, and is the primary site for graduate study. But the University affords diverse educational opportunities throughout the state (see map, page 31) through campuses in Harrisburg and Erie (The Behrend College) and the College of Medicine in Hershey at The Milton S. Hershey Medical Center. In addition, seventeen “Commonwealth Campuses” offer the first two years of study in most of the University’s baccalaureate curricula. Nine of every ten Pennsylvanians live within thirty miles of a Penn State campus.

Effective planning strategies

Penn State has been fortunate in having executive leaders over the past decade who recognized the importance of strategic planning and adopted the administrative philosophy that “budgets follow plans.” Every department that reports to the provost annually develops a plan, which is presented at a budget hearing after which budget allocations are made.

One of these departments, Computer & Information Systems, is one of several overarching areas that must plan across the University. Over the years, C&IS has developed an outstanding set of planning documents. For example, Penn State was one of the first universities in the nation to publish a formal, written telecommunications plan in 1984 that helped to articulate the vision and importance of an information infrastructure to the future excellence of the University. Throughout the decade, academic, administrative, and library computing have also developed and published plans. In recent years, however, these individual plans have given way to single annual C&IS plans that provide overall strategies, directions, and budget proposals for central information technology investment.

Three years ago, C&IS, along with twenty-three other academic and support units, was asked by the University Future Committee (UFC) to develop a three-year strategic plan, based on its current budget, that included a 10 percent overall budget reduction. Funds generated from this reduction would then be reallocated to support the University’s most critical needs. In their final report in the spring of 1993, the UFC recommended that, within available resources, high priority be given to the development of the University’s information technology initiatives; that this development be coordinated through the C&IS, academic colleges, the campuses, and other support units; that priorities be established among the various funding requirements; and that the highest priority be assigned to expansion of the telecommunications infrastructure. As a result, most of C&IS’s 10 percent budget reduction was restored.

At about this same time, a study group made up of academic leaders was formed by the president’s office to develop a plan for an information infrastructure to serve Penn State’s future needs. This was prompted in part by a progress report on telecommunications initiatives, produced by Steve Updegrove, director of the Office of Telecommunications. The study group’s report pointed out that, while much progress had been made toward the goals identified in the telecommunications plans of the 1980s, lack of funding had precluded full implementation of the plans. What was significant about this study
group was its examination of information infrastructure (including human resources) and access from an institutional view. The group’s report established an institutional vision, specified essential strategic investments, and identified costs and three funding strategies: support from the Commonwealth of Pennsylvania, strategic alliances with technology companies, and internal reallocation.

This work at the campus level, along with executive leadership in understanding the importance of telecommunications and getting it onto the agenda of the state legislature, led to the approval of $15.8 million in funding for capital expenditures from the Commonwealth, which will enable completion of most of the University’s network initiatives. A ten-year, $15-million alliance with AT&T negotiated two years ago has supported the purchase of interactive video equipment and plans to upgrade campus networks; other partnerships with IBM, Bell Atlantic, Kodak, Apple, and Digital Equipment Corporation have also helped to support IT investment.

According to C&IS Executive Director Gary Augustson, “We’ve done a good job of creating an environment attractive to corporations for partnering. Nonetheless, there is still the challenge of allocating ongoing dollars to support such one-time investments. Providing life-cycle funding for information technology—including permanent funding for staff positions—remains a significant, serious problem.”

Senior leadership at Penn State has also been aggressive in implementing and ensuring support for continuous quality improvement programs. Successful CQI teams have improved processes at the distributed level, but the next challenge is to reengineer processes at the institutional level. It is in this area that Augustson believes will come the most significant leveraging of IT for cost savings in the University.

Information resources management

Penn State University Libraries and Computer & Information Systems enjoy a close and cooperative relationship, both reporting to the University’s executive vice president and provost. In particular, the partnership between the two organizations has enabled access to and delivery of extensive and high-quality electronic information resources, as well as the training needed to take full advantage of such resources in the developing networked information environment.

Dean of University Libraries Nancy Cline says, “We’re really fortunate in the relationship we have with IT here. There is a solid history of cooperation for many years, which has been very good for the University community. The freedom that individuals are coming to expect in accessing information is a challenge to both the library and the IT organization. The fact that we can work on this together is a real strength.”

A major benchmarking study in which C&IS participated with peer institutions has shown that the organization is effectively leveraging IT investments to support teaching and learning, research, and administration of the University.2

Augustson believes the C&IS organizational structure that early on brought central administrative and academic computing, telecommunications, and library computing under one umbrella has greatly facilitated planning for and managing information technology at Penn State. Cline and Augustson both praise the decision to move library computing systems into the C&IS line organization in 1988 as forward-looking, recognizing the powerful role information technology would play in the future of the library. Cline adds that the key to its success has been that while the reporting line changed, the Library Computing Services (LCS) staff continued to be physically housed in the main library building. Under the direction of Eric Ferrin (who meets regularly with the University Libraries Council of Deans), LCS is responsible for computing solutions to support the libraries’ programs and services, as well as for providing technical leadership in the development of and access to electronic information resources.

Another innovative organizational move that occurred two years ago was the creation of a top-level position within C&IS to oversee network and information security and education of users in the responsibilities associated with a network environment. After a nationwide search, Kathy Kimball joined the staff in 1993 as University Network and Information Security Officer. A committee is working with Kimball to reevaluate existing policies and practices in light of different emerging needs.

Successful organizations continue to evolve, and C&IS is no exception. Within the next year, says Augustson, a new unit called Client Services will be created “to emphasize the importance of the service aspect of C&IS. At the same time, we’ll be doing some flattening within the organization. We’ve intended this for some time, but severe fiscal constraints have put this on hold.”

The University Libraries and C&IS have found participation in the Committee on Institutional Cooperation (CIC)—the academic counterpart of the “Big Ten” athletic conference, including all past and current members—an excellent venue for partnership and collaboration, and consequently for leveraging resources. Through a host of subcommittees and special projects, several efforts are under way, among them CICnet, a new project on instructional technolo-

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1Penn State was featured in a book on model networking strategies published by Educom in the mid-80s; was among the institutions recognized by CAUSE in 1993 and 1994 for excellence in campus networking; and recently received an award for the best kiosk in higher education.  
2The study results are reported in “Observations on Benchmarking Information Technology Support,” CAUSE/EFFECT, Spring 1995, pp. 20-28.
gies, and the “Virtual Electronic Library.” The goal of the latter project is to make the collections of all CIC members accessible via Z39.50 standards (an area in which LCS head Ferrin is recognized nationally for his expertise).

Electronic information resources

The University Libraries constitute a major resource for students and researchers in all fields of study. Access to bibliographical information about most of the Libraries’ resources and other databases on various subjects is available through LIAS, the computerized Library Information Access System. A LIAS vision statement, written on the tenth anniversary of the introduction of the online public access catalog at Penn State, recognized the need to focus more on access to information and less on materials acquisition, with increasing attention paid to providing access to materials that the library does not possess, order, or control.

To that end, LIAS has become much more than an online catalog; it is a true information system, providing access to databases, gateways to the Internet, access to special collections, and other information. LIAS continues to evolve to meet needs in the networked environment that now includes Gopher and Web servers and systems. In cooperation with the Center for Academic Computing (CAC) and LCS, the Libraries will play an important role in supplying coherent access to “raw data.” The future also is one which will provide more access to images on the network; tying that into the logical architecture that libraries have always represented so that people can find what they want is a challenge for librarians’ information organizational skills.

Support for research, teaching, and learning

The Center for Academic Computing, under the direction of Russ Vaught, is the principal provider of central academic computing services at Penn State. It features a distributed computing environment consisting of an IBM ES/9000 740 computer with two vector facilities and an IBM Parallel Processor with 61 nodes that provide numerically intensive computing capability. In addition, laboratories and classrooms with high-function workstations and desktop computers that can be used for both research and instruction provide access for faculty, students, researchers, and staff at all University locations.

Over the past decade, Penn State has won more than a dozen and a half awards for innovative use of technology to enhance teaching and learning; the University was also the first to use two-way interactive video to deliver classes. Having had an early start in this area, it is not surprising that current faculty technology projects can be described as “leading edge” (see sidebar above).

Teaching, Learning, and Technology Initiatives

Penn State faculty are engaged in several major initiatives to incorporate technology into the curriculum.

Project Vision

This project, under the auspices of Penn State’s Commonwealth Educational System (CES), has provided selected faculty release time to develop programs to be directly introduced into the curriculum. Jack Royer, senior associate dean for CES, says the project has provided the impetus for faculty to work collaboratively toward the common goal of a learner-centered environment, a value articulated in CES’s recent strategic plan.

Project Vision grew out of complementary efforts of the Center for Academic Computing’s Education Technology Services (ETS) and CES’s Center for Learning and Academic Technologies (C-LAT). Focusing on selected courses, nine faculty in these disciplines who were deemed to be outstanding teachers (not necessarily technology advocates) were asked to participate on teams to develop a new curriculum for a contemporary learning environment, one that does not employ lectures but is active, collaborative, and asynchronous.

Supported by a $150,000 grant from Bell Atlantic and IBM equipment contributions, this fall Project Vision will arm sixty students (twenty each at three sites) with laptop computers to participate in four “new” courses—Science, Technology and Society, American Studies, Health Education, and a freshman seminar focused on how to learn with laptops in an asynchronous fashion. Resources will be placed on each course’s Web home page (reached via C-LAT’s home page) that would have been delivered through a lecture, and instead will be discussed using conferencing software throughout the course.

Business Curriculum

A similarly dramatic curriculum makeover is occurring in the College of Business, under the leadership of Peter Bennett, senior associate dean and professor of marketing. Having received assurance from the college’s accrediting agency that a proposed revamping of the curriculum would not threaten accreditation, six of the college’s eight core disciplines are in the process of being redesigned to take advantage of multimedia and interactive, collaborative learning. Bennett describes the capability of HyperText linkages to content that cuts across the curriculum as offering an opportunity to teach these key courses in a much more integrated and effective manner. As in Project Vision, faculty participating in this endeavor have been given release time.

NLII Participation

Penn State is also an active participant in Educom’s National Learning Infrastructure Initiative, and is planning to partner with Rensselaer Polytechnic Institute in a “studio learning project.”
in instructional systems are able to provide expertise in learning theory and design derived from the principles of cognitive psychology, a unique contribution to the challenge of creating innovative learning tools.

ETS also offers seminars in the development of instructional resources, consulting in the use of existing resources, an annual symposium on teaching and learning with technology, a summer institute that provides faculty more time to work on projects, a Faculty Integrated Media Center, the Wagner Training Center (a state-of-the art facility for teaching software applications), and Human Resource Development Center courses. A Classroom Improvement Committee has been a powerful resource in helping to define appropriate incorporation of technology into classrooms throughout the University.

Support for administration

The Office of Administrative Systems is the central University resource responsible for providing data processing and information systems support for University administration through the design, development, maintenance, and operation of all centralized administrative databases. A Classroom Improvement Committee has been a powerful resource in helping to define appropriate incorporation of technology into classrooms throughout the University.

By 1997, the University will have completed its Administrative Information Systems project—the development over the past decade of a set of integrated information systems that fully automates all of the University's student- and business-related processes. OAS staff have done most of this development in-house, using entity modeling, joint application development techniques, and an advisory structure to significantly engage users in the development process and achieve their buy-in for these systems.

An integral part of this project was the development of EASY, an electronic approval system that allows documents to be electronically generated, approved, and updated in the University's central database—a cheaper, faster, more accurate, more secure mechanism than paper approval. The system, which won top honors in the NACUBO/USX Cost Reduction Incentive Awards program for saving the University $746,000, recently processed its one-millionth electronic form.

OAS Director Ken Blythe says that while the University is aggressively working toward a distributed computing environment, this does not mean the demise of their legacy systems: “Our goal is to bootstrap off the development systems, to bring them forward as the basis on which client/server solutions are accomplished.” To that end, OAS has implemented Mandarin technology and tools (which have enabled the mainframe databases to be accessible to users), a data warehouse, and object-oriented development tools to create more robust client/server system solutions.

Last year a Future Computing Environment Committee made up of representatives of key central administrative offices was established to discuss moving toward an open, standards-based environment. The Committee’s draft report names three standards as being of fundamental importance to distributed computing at Penn State: the Open Software Foundation’s Distributed Computing Environment (DCE), the Open Data Base Connectivity (ODBC) standard for access to relational databases, and the World Wide Web.

The report also discusses the need to eliminate the out-of-date SNA protocol and move toward delivering administrative services through the campus backbone network, and the likelihood that World Wide Web technology will provide a front-end for such services. Blythe envisions a “Community Web”—an internal campuswide information system that uses Web-based— to fulfill this need. HTML, he says, is the most attractive aspect of this new environment: “We spent many years struggling with how to do cross-platform systems, provide standards for graphic objects, print ubiquitously—and now we have it all on the Web.”

Penn State’s adoption of DCE as a standard, along with most of the other CIC institutions, will enable significant sharing and leveraging of resources.

Many factors contribute to good information resources management at Penn State, but when all is said and done, Augustson believes “individuals are really the key to our success. We are fortunate to have people who brought different perspectives to the University when they came, and who have stayed on. But while we enjoy continuity, we are also all open to change, and open to each other’s ideas—an important ingredient in our business. Clearly it’s not our level of funding that makes it work; it’s our people who really make a difference.”

Most of the campus documents referenced in this article are available from the CAUSE Library. For details, send e-mail to orders@cause.colorado.edu
**PRO *CAST...**

(continued from page 27)

The mission of the President’s Office is to carry out the policy of the Board of Trustees in attaining these goals. To that end, the President’s Office has developed its own set of goals, called “strategic imperatives,” which focus on providing leadership during the restructuring process, acquiring the necessary external support, establishing new sources of funding, and ensuring the overall accountability of the University.

University Information Systems (UIS) is a systemwide service arm that supports the information technology needs of the President’s Office, provides wide-area infrastructure support for the five-campus system, and develops and maintains centralized administrative information systems.

**Rationale for implementation of PRO *CAST**

When the Board of Trustees, president, and campus chancellors began to set goals for the University System and individual campuses, they acknowledged the importance of having timely, accurate information to monitor progress toward the goals. They also realized that there were a number of problems that currently prevented obtaining the necessary information promptly.

Sometimes the data were not available, and this would result in the inability to monitor some goals or respond to external requests for information. When the data were available, it was difficult for the President’s Office staff to locate and collect them from the five campuses. Once the data were obtained, they had to be manually entered into the computer from hardcopy reports. Because the time frame for the information requests was usually very short, this left little time for those preparing the report to add value such as interpretation of the results. It was also a labor-intensive project to look at trends, since the data were usually stored in a number of point-in-time files. In short, the information was not readily available or useful for management purposes.

To address these issues, University Information Systems proposed that a source of well-defined, high quality data be created, along with the appropriate tools to extract the data and present them in a wide variety of formats for the many different constituencies that needed information. Executive information capabilities were required to summarize the vast amounts of information into an easy-to-digest format with eye-catching graphics. Information access by executives must be effortless, so preset capabilities were necessary, along with an option to change any of the settings (e.g., data range, employee type, funding source). Decision support capabilities were also required to allow manipulation of data with “what if” calculations. These features would allow decision-makers and policy setters to model various courses of action. Finally, online analytical processing capabilities were needed to enable institutional researchers to provide combinations of data that were not readily available in the past, and to improve access to trend data. Using a new form of information warehouse, a solution to these needs, called PRO *CAST*, was developed.

**Overview and architecture**

PRO *CAST* provides an integrated suite of technologies—an information warehouse with executive information, decision support, and data analysis capabilities—for the President’s Office and campuses of the University of Massachusetts System, and indirectly for the Board of Trustees and the Commonwealth of Massachusetts. The application helps administrators, planners, and policy setters to examine past trends for the University, determine where the University is currently positioned relative to its peers, plan for the future, and measure progress toward the goals that have been set for the University System and individual campuses. Components of PRO *CAST* are incorporated into various business processes for nearly eighty managers and staff at the campuses and the President’s Office.

PRO *CAST* comprises six components, as shown in Figure 1: information warehouse, easy data collection, encyclopedia, built-in business rules, data transformations, and data delivery tools. These pieces are purposely designed in a modular fashion, using open-architecture client/server, relational database, and networking technologies so that the system is upgradable as technology advances and scalable as University needs dictate.

The information warehouse is housed on a Digital VAX system using both relational data-
base technology (Rdb) and multi-dimensional analytical data structures containing summary and detailed information.

The data in the information warehouse come from various sources, and more information is being added as new business problems are identified that cannot be addressed with existing information. A substantial part of the data currently is obtained from the legacy operational systems—financial records, human resource, and in the future, student systems. Data are extracted from legacy databases through SAS programs and loaded directly to the information warehouse. Other data, such as capital campaign information, are prepared by individual campus users in spreadsheets and also loaded to the information warehouse.

The encyclopedia component contains data definitions, along with notes about the quality of the data and any anomalies the user might find in the data. The extract programs from the legacy systems also provide measures of the quality of the data, and this information is available through the encyclopedia. Historical context is incorporated to assist in interpreting data as they change over time.

Information about business rules (relationships between sets of data elements) is documented in the encyclopedia, as well as built into the graphs and reports in the executive information system.

To facilitate reporting, some data are transformed when they are brought into the information warehouse. For example, detailed data are rolled up into useful summaries. Also, data from the campus systems have inconsistent coding structures, and are transformed to reflect a single, common coding structure. To assist in standardizing business rules, new data elements are created so that business rules do not have to be coded into each program. This ensures consistent reporting and ease of maintenance, as there is only one source to update when changes are required.

Data can be accessed and presented in a number of different ways. An executive information system/decision support tool, HOLOS, is used to display standard charts and graphs over selectable periods of time. What-if calculations can also be performed with HOLOS. Microsoft Excel (or another SQL-compliant tool that is supported within the UIS architecture) may be used by the data analyst to extract data from the information warehouse for local data analysis and reporting.

The client/server architecture, along with specific software packages, are illustrated in Figure 2. Both Macintosh computers and IBM PC and compatibles running Windows serve as client machines.

An innovative approach

Our implementation of PRO*CAST has significantly differed from the way other institutions have implemented data warehouses. The project was undertaken as a systemwide effort to maximize the use of University resources, taking a low-budget, high-impact approach with minimal up-front investment. As success was demonstrated, we have added some additional resources. However, the initial investment was low and has continued to remain small.

Development of PRO*CAST was not technology driven, though it easily could have been. The University did not take the approach of designing and populating an entire enterprise-wide database—an activity which would take a prohibitive amount of time, personnel, and machine resources before it was useful. Instead, the project focused first on understanding the pressing business problem and process ...

"... the project focused first on understanding the pressing business problem and process ...”
“The approach of populating the information warehouse as business needs are identified has proven highly effective for the user community ...”

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provided by the University Controller's Office using the same labor-intensive manual process needed to produce the annual financial report. This reporting is now accomplished through PRO*CAST.

• Human resource management reporting was transformed from a ten-page, difficult-to-digest, single-point-in-time report to several easy-to-read graphs that provide key information about staffing trends.

The approach of populating the information warehouse as business needs are identified has proven highly effective for the user community, and has not adversely affected the integrity of the database design or increased UIS maintenance efforts. For example, summary tables were created before the detailed tables to meet the business needs stated above and initially populated directly from legacy data sources. When detailed data tables were later added to the information warehouse, no redesign of the summary tables was needed.

The design approach also incorporated data administration modeling work where this was already available. Otherwise, the insights of the data administrator and application development groups were sought as a way to validate table design.

The PRO*CAST architecture includes provisions for distributed information warehouses that store campus-specific data of interest only to local, campus personnel. Planning is under way on some campuses to take advantage of this feature. For example, the Boston campus has initiated an Automated Management Reporting project with a key goal of enabling campus customers to take full advantage of data stored both locally and in the central information warehouse. PRO*CAST is currently delivering the core of this requirement—supplying data via the information warehouse, providing access through sophisticated reporting tools, and allowing data sharing through a wide area network with access to common file servers. The project team has identified opportunities for distributed data sources and is planning to avoid duplication by making the information systems complementary while still meeting local requirements. The next step is to develop a design for the data already stored locally.

Changes in operational procedures

In the past, data collection was cumbersome. Sometimes, several weeks of effort were required to collect the data to produce a single report. Each campus sent data by hard copy (often a computer printout) which was keyed by hand into a spreadsheet by the receiving department. Data from centralized legacy systems were obtained through antiquated batch report writing tools.
With PRO*CAST, the data collection process is more efficient. The method of obtaining data from the centralized legacy systems has been automated, and no human intervention is required to put the regular updates of information into the information warehouse. Data provided by the campuses now come in a machine-readable spreadsheet format, transmitted over the wide area network using work-group computing techniques. The spreadsheets are easily loaded into the information warehouse, saving countless hours of data entry time and making the data available for other uses beyond the original intent.

Reporting procedures have also been made more efficient. In the past, complex, linked spreadsheets were required to summarize data from the five campuses. Trend reporting required data from many point-in-time spreadsheet files. PRO*CAST eliminates the complicated reporting process by providing automatic summarization, drill-down capabilities for more detail, and drill-across for historical data.

Other benefits
Besides streamlining operational procedures, PRO*CAST has improved the quality and timeliness of information, has provided new capabilities such as access to new information or combinations of existing information previously unavailable, and has addressed data issues and specific technology goals of UIS. Many of these benefits are available not only to the University System but to each of the five campuses.

Timely reporting and productivity
- provides more timely information for review by management since information is available as soon as it is loaded
- improves data quality through direct feeds of data to the warehouse, eliminating errors produced by manual data entry, the cost of locating those errors (laborious quality control processes), and the consequences of making decisions based on erroneous information
- frees up many hours of staff time by replacing the manual data collection, allowing staff more time to add value to reports by providing interpretation or background information
- tailors the presentation of data to the needs of differing audiences, while also standardizing routine, periodic reporting

New capabilities
- provides new information, such as gift reporting, previously not collected in any form
- replaces the manual effort involved in gathering and graphing trend information
- makes it easier to compare the University to its peers by providing ready access to University statistics and incorporating national comparative data such as IPEDS
- provides online analytical processing capabilities, which result in new information and knowledge from existing data, including the ability to combine data from different operational areas such as finance, budget, human resources, and fund-raising

Data issues
- provides a single source of data, which eliminates the effort required to reconcile conflicting sets of data
- makes the reams of available data more usable by structuring the data and providing a cohesive set of tools for access and reporting
- raises management's awareness of data issues, including data quality
- accounts for changes in data definition over time (e.g., in some years, tuition and fees were lumped together as a single revenue item; in other years, they were reported separately)

Technology goals
- provided a first step into "new" (client/server and relational database) technology for UIS
- provided the impetus for establishing workgroup computing so campuses could share data and work collaboratively
- encourages campuses in the system to deal with intra-campus and wide-area technology connectivity issues

Other, more general benefits have also been realized. For example, as University administrators began to use PRO*CAST, it raised their awareness of the value of management reporting, and of information technology in general.
The cost of the project, as mentioned earlier, was small—especially in relationship to the benefits. The costs came in two main areas, technology and personnel. Where possible, we also tried to build upon existing work and be creative in overcoming the obstacles that presented themselves.

Building on existing work

The ability to implement systems such as PRO*CAST requires teamwork from many areas in the information technology organization, as well as close partnerships with customers and their local information technology assistants. In UIS, this meant assistance from network services, desktop support, technical services, data administration, and application area specialists. It was useful and productive to build on the work already completed by these areas, such as data quality initiatives, key management reports and wide-area-network capabilities. For example, existing management reports were essential to establishing the executive information system (EIS) components. The human resources EIS used a widely accepted hardcopy management report as its framework. PRO*CAST added extensive trend reporting to the basic report framework, while ensuring that existing report information was readily available through point-and-click. As newer tools, such as the EIS, became available, the developers found that there was increasing interest in direct access, rather than simply remaining in the point-and-click mode. This did not mean that the EIS component wasn’t required, but rather that customers felt that the EIS must be complemented by analytical access to the data used to derive EIS graphs and reports. This need has given UIS the opportunity to provide new tools in support of data analysis and to implement summary analytical data stores prior to EIS implementation.

Support for meeting University goals

Perhaps the most important benefit of PRO*CAST is that it is helping the University to achieve its strategic goals, in a number of ways. First, it allows University management to easily monitor progress towards those goals. Based on the measures set for the goals, management can determine where corrective action is necessary. For example, the Board of Trustees has identified a number of financial indicators to measure the financial health of the University, and they consider these indicators when formulating their strategy. PRO*CAST also allows management to model a variety of options, or analyze combinations of data not possible in the past, before planning a course of action or setting a policy. Finally, by producing measurable statistics, it increases the confidence level of external funding sources, such as the governor and legislature, by demonstrating that the University is making progress towards its redefined mission and is using its resources effectively.

Investment in technology

To minimize project costs, the University took advantage of technology resources that were already in place or under development: the wide area network, existing local area networks, VAX, Rdb (for the information warehouse), Excel (to provide reporting capabilities for the information warehouse), and SAS (for data extraction from the legacy systems). The only significant technology investment was purchase of an executive information/decision support software tool (HOLOS). A few small (~$500) purchases were made in order to assess client-based reporting tools.
Investment in personnel

UIS worked closely with our user community, particularly the University budget director, chief financial officer of the University Foundation, University controller, and University payroll coordinator, to identify important business problems and to understand where the data could be found and how the information should be stored and presented. Despite the close working relationship, the vast majority of project effort was expended by UIS staff.

University Information Systems reallocated staff positions for this project. The initial development team comprised 3.3 FTE including the manager, with vital assistance provided by network and desktop support personnel. In addition to development of PRO*CAST, this same group was responsible for the University-wide data administration function. As success has been demonstrated and as UIS has reorganized to meet new needs, additional staff and responsibilities have been added to expand the role of the group.

Obstacles

There were obstacles that had to be overcome in implementing PRO*CAST. The use of new technologies presented a significant challenge to the development team and the infrastructure partners. These staff had no prior experience on the VAX, Rdb, the middleware, Excel-Rdb connectivity—yet these technologies were the core of the initial implementation! Although there were limited training funds available, the development team accepted the challenge with a positive attitude and used innovative approaches to the training. The single most important factor in acquiring the technical knowledge was the team’s commitment to the success of the project. Everyone recognized that the business needs were critical, and that there simply was not sufficient time or money to engage in a lengthy traditional training approach.

The budget did support a one-day Rdb overview by DEC, and purchase of one programmed instruction course in VAX utilities. A UMASS graduate education major was recruited to present the programmed instruction modules in a classroom setting. This enabled the entire team to share the learning process and delivered training for a fraction of the cost of sending the team for outside training. This approach also enabled the team to focus the training on only the most relevant topics. Several other training items were provided in brief demonstrations by key staff such as the VAX systems administrator.

Bringing connectivity to the desktop and providing desktop installations of the necessary middleware were key to the success of the project. UIS enlisted the assistance of the technical support staff on each of the campuses to help provide the necessary connections and support for the project.

Vendor partnership

To expedite the project, UIS partnered with Digital Equipment Corporation for consulting assistance in loading and tuning the first two tables of the information warehouse relational database. The following graph illustrates the donation summary by campus.
“The need for rapid collaboration dictates that groupware capabilities will be one of the next technologies to be implemented.”

PRO *CAST Assists in Monitoring Progress Toward the University’s Goals

PRO *CAST currently provides some of the financial and financial-aid indicators used to measure progress toward University and campus goals. Work is under way to supply the remainder of this information. Discussions have begun concerning inclusion of academic and student-related data—the most complex of the subject areas.

Example: Selected Campus Measurable Goals for the “Reaffirming Teaching and Learning” Strategic Priority

**Goal:** Increase access to and affordability of a UMASS education.
**Measures:** rate of growth in tuition and fees; unmet financial need as a percent of total need; loans as a percent of total need; state share of unrestricted E&G expenditures

**Goal:** Provide high quality undergraduate instruction in a broad range of disciplines.
**Measures:** unrestricted E&G spending per FTE student; percentage of core faculty teaching undergraduates; percentage of undergraduate courses taught by core faculty

**Goal:** Promote student success in earning a baccalaureate degree and preparing for advanced study.
**Measures:** one-year retention rates for full-time freshmen; graduation rates for full-time freshmen; performance on specialized exams

As PRO *CAST grows to encompass data from multiple business operations, it is becoming increasingly easier to perform management analyses that require data from multiple activities. Comparisons to information reported in publications such as the *Chronicle of Higher Education* are improved in both timeliness and efficiency through facilities PRO *CAST provides. Information warehouse sources that conform to national standards further facilitate comparison. The University’s gift-reporting data conform to the Council for Aid to Education standards, and plans are under way to offer additional comparative capabilities by deriving standard measures from existing data. This will include applying transformations to derive national classifications such as those used by the American Association of University Professors (AAUP).

Conclusion

PRO *CAST has served its purpose well and continues to be a key element in the President’s Action Plan for the Year 2000. It is expanding to include new users, as networking capabilities are brought to more desktops. Additional business problems are also being defined as word spreads about the value of PRO *CAST. As we look to the future, our biggest challenges will be keeping up with the training demands for more ad hoc data manipulation from the desktop, responding to the increasing requests for new types of information, and bringing in external data for institutional benchmarks and comparisons.
Transitioning Technology—Changing the Culture at Syracuse University

by Sue Borel and Natalie Vincent

Syracuse University has embarked on a project to move all of its administrative computing applications from a mainframe to a client/server environment. Many of the challenges have come not from the technological transition, but from the changes required in the way both the Information Systems organization and its clients work. This article examines and evaluates the cultural initiatives that became necessary in the technology transition, such as restructuring the IS organization, retraining existing technical staff, training clients, and finding new ways to do business with IS clients.

Syracuse University is a private research institution located in central New York state. It has twelve schools and colleges with an enrollment of around 15,000 graduate and undergraduate students. In March 1993, the vice president for research and computing published a document that was a vision of computing at the University in the next five years. The following is an excerpt from that document:

Information technology will have an increasing influence on University life in the future. Communication, even more than computation, will be the essence of the revolution. The volume of available information will continue to increase at a staggering rate (currently doubling every four years), with effects that are both daunting and tantalizing. The challenge will be to access selectively the information we need and to use that information to develop knowledge, understanding, wisdom. A key objective will be to empower each member of our community with the appropriate technology and facilitated access to all of the information to which he/she is reasonably entitled.

The effect of this document on our computing organization and our clients was dramatic. It led us to look for organization models, training methods, and support models that would move our staff and our clients into the future.

The Computing and Media Services organization has a staff of around 130 in four units: Information Systems, Client Services, Network Systems, and Faculty Computing and Media Services. Information Systems (IS) is a mainframe

Sue Borel has twenty-eight years of experience in information technology and has been a member of the computing staff at Syracuse University for fifteen years. For the past three years, she has been part of the team responsible for the transition of administrative applications to a new platform. Her primary area of interest is database design, and she is currently an officer in the Upstate New York chapter of the Data Administration Management Association.

Natalie Vincent has worked with Information Systems at Syracuse University for the past fifteen years in a variety of administrative support and client services roles. She is currently working with application project groups which are responsible for moving University information into the data warehouse. She is also part of the team which is training University staff in how to use the warehouse.

1 Benjamin R. Ware, 93 Forward! Directions for Computing at Syracuse University, March 1993, p. 1.
shop with a programming and technical staff of thirty-five FTEs to support administrative applications. Our client base is approximately 2,600; we have a portfolio of sixty application systems and a well-satisfied customer base, and have done a good job at providing applications needed to support the administrative operations of the University. We have not been equally successful in distributing information to our schools and colleges for management and decision-making.

A client/server project team was formed to develop a detailed plan to meet the objectives stated in the computing plan:

• To migrate from primarily mainframe platforms to a primarily client/server, distributed environment.
• To make information about students, courses, and financial accounts easily accessible to stakeholders.
• To provide our users with an easy to access reporting environment with appropriate software.

One of the assumptions of our plan was that we would retrain existing staff rather than outsource the majority of the work. We have a very stable, experienced staff who know and understand our business. As we evaluated new technologies, we realized that perhaps the most difficult transition would be changing the way the programming staff and our clients work. This change would be effected at the same time the University was undergoing restructuring and budget cuts. We looked first at our own organization and staff.

Reorganizing

Our own structure hindered the way we needed to work. The programming staff reported to three application managers who were each responsible for a specific suite of applications and clients. Resources were managed within each group with occasional transfers from one group to another. An advantage of this model was that our clients had a stable point of contact with programmers who were very familiar with their systems. Requests for system enhancements went to the appropriate application manager, who set schedules and priorities using the resources in their own group. Clearly this kind of model would not serve us well in our transition. We felt we needed to do three things:

• Establish an internal organizational structure that would be flexible and responsive to ever-changing resource needs for both the mainframe and client/server environments.
• Ensure that our legacy systems were maintained, but enhanced only when absolutely necessary.
• Change the way our clients communicated with our office to allow our staff time to retrain and move ahead with new technologies.

First, we changed the organization of the office. For maximum flexibility, all incoming work and programming resource are now managed from one point. The three groups of application programmers were consolidated to report to two application managers. Although each manager has a group of clients for whom he or she is the primary contact and coordinator, they jointly oversee project schedules and manage programming resources. Programmers refer calls from clients to one of these application managers. This moved our clients’ point of contact to the managers, creating fewer interruptions for the programming staff and allowing the managers to be the overall schedulers. The change provides our clients with their first visible effect of the technology transition. For our staff, this model emphasizes teams that are organized for the life of a project.

"Our own structure hindered the way we needed to work."
We have three technical support groups in Computing and Media Services. Last year, we evaluated combining these groups. Although it makes sense that they should be combined at some point in the future, there is not yet enough commonality to make the change feasible.

**Relationships with clients**

Having settled our internal organization, we studied how we would interact with our clients during the transition. The administrative vice presidents were notified that the majority of our programming resources would be directed to client/server projects. With the exception of some systems that will not be replaced until after 1997, mainframe applications would be enhanced only to meet changing legal requirements.

We waited for the roof to cave in. At first, it didn’t! Reality set in two months later, and we did receive some letters of protest. Clients who were displeased with our decisions have been encouraged to talk to our vice president. He plays a vital role in facilitating the politics and funding for this project. In addition, our project managers have been diplomatic and sympathetic but firm with our clients. We made a smooth organizational transition with the aid of their facilitation, listening, and negotiating skills. The change in the distribution of work effort is reflected in Figure 1.

A program was developed to enable University offices to have some computing expertise in their departments by subsidizing the hiring of staff with computing experience. We call these “distributed” positions. The department funds two-thirds of the person’s salary and our computing organization funds one-third. Some smaller offices, where budget and workload would not necessarily support a full-time computing person, are sharing a “distributed” person. The distributed staff members work in the client office, but are also part of an informal organization coordinated by Computing & Media Services. They have monthly meetings and are included in all of our departmental mailings and events. The distributed staff coordinator sits in on annual performance reviews. In addition, Computing & Media Services will pay for half their technical training expenses.

The first wave of distributed positions was in college offices; we are now beginning to see a move into administrative offices. These people are extremely effective because they are in the client offices every day, serving as liaisons between their “home” department and Computing & Media Services. Everyone gains with this program. Our client offices have a technology person available to them all the time who can answer many of the questions that would come to our department. This program has been very popular, as indicated by Figure 2.

### Issues still to be addressed

Within our organization there are still major issues we need to address.

- **Changing job descriptions.** Although we have changed the organization of our office and changed the way we work, our job descriptions and titles remain the same as they were in the 1970s. We realize they do not fit the way we work today and how we need to work in the future. We don’t yet know exactly what our office will look like in four years, but we believe we need to evolve to another model and have the flexibility to move people where they are most effective. We continually look at organizational models and job titles at other companies and institutions.
- **Employee recognition.** This has been an issue for some time; now it has become a larger one. The University has no employee recognition program and neither does our department. At a time when we are asking more of people and are unable to reward them monetarily, it becomes critical to have ways to let people know they are doing a good job.
- **Performance reviews.** In the past, performance reviews have been done by the managers of each area. With our current work model, we...
need to look at a different way of approaching reviews, so that work done in the various project teams is taken into account and recognized.

We’re making our first attempts at defining our environment at the end of this transition and looking at how our organization will need to change. The methodology we’re using involves defining our goal environment, then defining milestones that will lead us to that goal. For each milestone, we are looking at the stakeholders, what technology and organizational changes will be required, and what risks are involved.

Rethinking application development/acquisition

As a result of our experience with client/server pilot projects, we realized we needed to change the way we developed systems. Members of the client/server project team made several recommendations for application development.

• Use object-oriented analysis techniques. All of the application development tools that we evaluated use some object-oriented principles. While we did not expect that we would necessarily use true object orientation for our first endeavors, it appeared that there were aspects of the methodology we should adopt. The transition would require our staff to understand these techniques; the application of the techniques would require changes in the way we approach systems development.

• Use a three-tiered architecture for building our applications. One of the productivity gains we wanted was from reusable code. From reading, and conversations with consultants and others experienced in client/server architecture, the three-tiered approach to programming makes the most sense. This architecture divides an application program into three parts: presentation, process logic, and database services. This approach allows optimal code reuse and insulates the business rules and logic from the desktop presentation.

• Define specialists for some areas. Given the long list of new technologies, we need to designate specialty areas where we train a small number of people to be available as a support resource to project teams. We refer to these people as mentors, to reflect their role as educators and guides.

• Foster success. With so many things going on in parallel we need to look for combinations of software, human resource management techniques, and organizational structures to provide the best possible environment for success.

We looked first at the role that mentors would play. We would not be able to train everyone in all of the new technologies; it was too much change in a short period of time. The mentors would be trained and skilled in a particular area. They would join a project team as needed and work with them. We identified mentors for project management, object orientation, human interface design, data modeling, database design, networking, desktop hardware, server hardware, and printing. In most cases, the mentor role is part time, and we have at least two people who are knowledgeable in each area.

Led by the object-orientation mentors, who created a system development methodology outline, the mentor groups worked together to expand the outline into a detailed document. The methodology is packaged as a project notebook, which contains:

• A sample project management chart with each task being a methodology step
• An explanation of each step in the project management chart
• Samples of deliverables
• Guidelines from mentor areas
• Expectations and procedures for each mentor area
• A list of the mentors for each area

The team leader of each new project receives a notebook. Built into the methodology are “check-in” points where the project team meets with some or all of the mentors to review models and plans. These meetings ensure that communication is taking place between all of the mentors and the project teams. The methodology provides some structure to projects and gives us a common ground to discuss progress. It is not a finished product.

To encourage feedback on the methodology and project management in general, the application managers convene a weekly meeting of team leaders to talk about issues, problems, and even good things that are going on—a forum to find out what works and what doesn’t. This is a productive group and contributes to the evolution of the methodology. In our experience, the majority of the problems in implementing new applications have to do with the management of the project and not with the technology. In this environment, there are many more pieces to manage. The applications staff has to coordinate the installation of network connections, desktop equipment, and server hookups. We continue to look for ways to improve our skills in this area.

Parallel to the development of applications, we have several teams involved in searches for application packages—student systems, space and facilities management, classroom scheduling, and alumni development. When we were beginning to feel comfortable with the work done in systems development, we found chances were
good that we would be able to purchase software for our major application systems. We have backed off our plans to delve into three-tiered program architecture, because it is not clear that we will be developing any major applications ourselves. Does this mean that all of our systems development methodology work was in vain? We don’t think so. The principles we have learned helped our reeducation and reorientation process. We are now developing a package-search methodology and find we still need to interact with mentor groups to do technical evaluations of software. We’re still learning ways to work together effectively. We’re learning to be better communicators. The days when we could develop applications in our own cubicles are over. We asked for a lot of client interaction in the past, and now we are asking for even more. Everyone has a stake in the project and in improving the process.

Retraining IS
As far as technologies were concerned, it appeared that there was very little that would remain of our former lives once this transition was complete. The list of new things to learn was daunting: operating systems, networks, CASE software, object orientation, application development tools, end-user tools, networks, databases. In the first six months of the project we brought in a new database manager, a new CASE tool, several query products, two application development tools, new server hardware, and workstations for staff who were still using dumb terminals. We retrained ourselves in a variety of ways, including reading, free seminars, vendor demonstrations, conferences, consultants, professional training, internal workshops, departmental work groups, and other University resources.

While the client/server team was evaluating hardware and software, the rest of the staff spent a minimum of 20 percent of their time reading about client/server or enhancing their desktop computer skills. Our goal is to replace the majority of our applications by the end of 1997, so we looked for ways to come up to speed as soon as possible.

Many of the mentors attended professional training, but we also used conferences, user groups, and reading in the education process. We found a graduate student with experience in client/server technology at one of the Fortune 500 companies and hired him to consult with some of the mentors.

There were some skills needed by a larger audience; we have managed to provide them in a variety of ways. We felt everyone on our staff needed to understand object orientation. Our object-orientation mentors formed a work group of people who were interested in learning about object-oriented analysis—most of the office! Led by the mentors, the group selected a specific methodology, purchased books, and actually worked through the text, lesson by lesson, in weekly meetings. One of the things that made this work was the formation of small teams within the group. Each week one of the teams was responsible for leading the lesson discussion and exercises. This was a very successful model. It started our staff thinking differently, reinforced team concepts, and helped transition staff into the client/server project before there was actual work.

For our applications development tool, we brought an instructor to our site to provide a week of training. Some months later, when several projects were under way, we hired a consultant for a few hours a week to help refine the way we were using the tool. The programmers also formed an informal group of their own, with weekly meetings to share experiences, tips, and techniques using the new software.

Finally, we worked with the human resources staff development office to provide a special session of facilitation training for people in our office who were interested. These are skills that we feel will be vital to our staff in the future. It is clear that a large part of providing a solid computing environment is bringing together people, processes, software, and hardware. We are already putting these skills to good use.

We have learned that in our new environment we have to try things before we have all the answers. We have to be willing to implement short-term solutions with a vision of the long term. We have to be willing to try new things and look for creative solutions. We have to be willing to redo. These are concepts that are very different from the carefully studied, tried-and-true solutions we have implemented on the mainframe. It is an ongoing process, and we continue to evolve as professionals and as an organization.

Communicating effectively
As our client/server vision began to develop, we felt that one of the most important steps we could take was to let the University community know what we were trying to accomplish, how we planned to make this move, and how our time frame would affect various areas within the University. We developed The Roadshow, a presentation which gave a brief overview of the current mainframe environment, our vision of the client/server environment, the benefits to the University of this move, and a timeline projecting move-
Client/server computing will change both the need for and the source of the data available for reporting.

Client/server computing will change both the need for and the source of the data available for reporting.

One of the ideas of the plan that was met with interest and enthusiasm was the prospect of a data warehouse, an easily accessed repository of University information that could be used to meet the day-to-day reporting needs of a wide range of administrative and academic staff.

Before we began our move to client/server technology, we had been congratulating ourselves on the excellent job we had done providing data access and reporting avenues to our administrative clients. Now, looking at our expanded clientele, two things became clear:

1. There existed a group of over 145 staff members who were using our mainframe reporting processes as a vehicle to obtain information. Many of these individuals had been trained in the use of what were referred to as 4th-generation query tools (in reality about a 3.2 generation!) and had over the past few years built substantial self-generated reporting structures.

2. There was a considerably larger group of faculty and staff who were using many sources to gather information, often re-entering data on their desktop machines to create reports they were unable to generate from the mainframe administrative processes.

In addition, some individuals in each group had invested time and resources creating departmental systems—desktop database systems, usually populated and refreshed from mainframe extract files. Information that was not available on the mainframe was also stored in these databases. "Value added" is the term we use to describe data that are particular to the business or interests of a school, college, or department.

Each client group offered unique challenges, but they had one thing in common: they were faced with moving from their current technology, investing both time and dollars into a new way of retrieving and reporting on data. Prior to 1992, Information Systems had provided quick turnarounds for ad hoc reporting services for a nominal fee. In 1992 we moved to a process that incorporated the use of a query tool with a user-generated request to combine query results and standardized outputs such as reports, labels, or files available for download. This process worked well for our administrative clients who could access and understand the online systems that provided these services. However, few faculty or staff in academic offices needed or wanted access to these systems.

Client/server computing will change both
the need for and the source of the data available for reporting. Clients will be using PCs or Macintosh-based retrieval and reporting tools. Those already familiar with the world of DOS will find themselves moving into the world of Windows and probably to an upgraded, if not entirely new, set of software tools. The benefit to our clients is that these tools provide reporting and database services through a GUI, point-and-click, easy-to-use presentation, making desktop reporting and record keeping a viable alternative for our current and our new clients. The data warehouse will simplify access by presenting the data in categories, or subject areas, such as student information, human resources, or financials. Current detail, historical data, and summary data will be available for each of these areas. Human resources information was our first subject area and has been available since the spring of 1994. Information on currently registered students was made available during the fall of 1994, and admissions, financial aid, student housing, and historical student information will be available during the fall 1995 semester. We are also starting initiatives in our financial areas, with a December 1995 target for general ledger information.

The availability of this information in the warehouse has created a new audience for us—faculty and staff in academic offices. Our direction at Syracuse University is to encourage greater involvement of our schools and colleges in the recruitment, admission, and retention of students, making access to information essential. In selecting desktop query tools, we had to take into consideration the needs of this audience as well as those of our mainframe query audience. The tools had to provide push-button access as well as powerful selection and reporting capabilities. Other important requirements for a tool, based on our installed base of PCs and Macintosh hardware, was that the software run on both platforms and that it be similar enough in presentation and functionality to allow training and support to be addressed from a single viewpoint. After reviewing a wide range of products, we selected two we feel meet our needs.

We have recently completed “train the trainer” sessions that included Computing & Media Services staff members as well as key individuals from the registrar’s office, human resources, admissions, and financial aid. Our training coordinator is developing courseware at a variety of levels, from “fill in the blanks” to “so you really want to learn SQL!” Because understanding the software is only half of the learning experience and creating reports is only productive when you understand the data, we incorporated “understanding the data” into our training sessions. We have also created an online metadata database—information about data—of what these code values mean, what operational system supports this piece of data, and what are the special considerations related to this information.

Some of our clients are enthralled with technology and want to set up the office of the future immediately; others are overwhelmed by the complexity and costs of the new environment. The cost of standard desktop machines has moderated over the past few years; however, the level of equipment required to handle multiple software products accessing large reporting or operational databases has become an issue. We have changed our recommended level of equipment several times during the past two years and know that we will need to continue to issue new guidelines based on advances in technology. We work with each department or area to develop hardware, software, and training guidelines based on the information needs of individual clients and encourage everyone to start using the technology sooner rather than later. The operative word here is “start.”

Our evaluation may show that an office should start using the data warehouse. The best way to start using the data warehouse is to purchase one or two high-level machines and start learning Windows or the Macintosh environment. The staff members who will be accessing the data warehouse can then start to learn the software products that will allow them to turn data into information. Because we have a timeline for the movement of our major mainframe systems to the client/server environment, we are able to help offices plan for future purchases of equipment, software, and training. If the online computing services they are currently using are not scheduled for migration until 1996, then a workable computing environment can be phased in, giving a department more time to manage the impact of this change upon their resources—staff as well as financial.

Training and supporting clients

Very early in our client/server initiative we realized that while re-training our Information Systems staff was a major project, re-training our client community would be a huge project. It would involve educating large numbers of individuals about a new computing environment, new software, and the data itself. A decision was made to appoint a full-time training coordinator. We were fortunate to have an IS staff member with a strong background in analysis and design who also had experience preparing clients for
new system implementation. She was prepared to step up to the challenge of addressing training from a University-wide perspective, encompassing staff, faculty, and students.

By combining our network of volunteer staff with professional consulting and training organizations, we have put in place a wide range of training opportunities. We currently have two training facilities at different campus locations. The centers give our clients the opportunity to receive training in a classroom environment, away from phones and everyday interruptions. Where training in the mainframe environment consisted of "how to use the student records system," our sessions now cover a variety of topics such as Microsoft Word, Using the Internet, and Windows. We also provide training on the tools used to access the data warehouse: Brio Query from Brio Technologies, Inc., and VISION:Data from Sterling Software. Some courses are directed toward faculty and students, while others are designed to address the needs of the administrative or academic department staff. We believe in "just in time" training so the individual can begin putting new skills to use immediately.

Other initiatives are also helping our clients deal with change.

- **Network subscription service.** Areas that have hired a distributed staff member are usually supporting a LAN. Since many University departments do not want to absorb the financial or personnel resources required to maintain a network, Syracuse University has developed a model to make local area network technology available to these departments. Services offered through this model include file sharing, backup services, access to supported software products, printing services, and Internet access. A department can subscribe to one or more of the available services, and the monthly fee is determined by the level of subscription. This model supports the Macintosh and DOS/Windows environments and will be one of the vehicles used for deployment of client/server applications, including access to the data warehouse.

- **Help-desk software.** We have purchased and are installing help desk software, Apriori from Answer Systems. Our help line handles a wide variety of inquiries dealing with all aspects of computing services at the University, and we have seen increased demand as more applications become available in the client/server environment. While this new environment often raises more questions than it answers, we know that problems such as getting your password reset, accessing the server, or getting help with a software error message will probably be repeat inquiries. We know that we will be able to develop standard responses and resolutions for many of these problems. This type of software will help us manage the administrative overhead associated with providing support to our clients.

- **Office technology support group.** We have formed a group to provide both day-to-day support and long-range planning to our user community. Administrative and academic clients can call a single phone number, inquire about network or hardware problems, request an evaluation of their office needs, or find out when their network wiring request is scheduled. Some of the support problems this group is attempting to address require an on-site visit, not always an easy task, since some units within the University, including Information Systems, are located a mile or more away from the main campus. So while the core of the office technology organization is small, they operate as a virtual organization. They can bring together skilled staff from other units to address a request, or they can call on a staff member in a remote location to make that all-important personal contact with a client who needs support and assistance.

**Conclusion**

We know we do not have all the answers. We think we have put into place a framework that will help us identify the questions and develop solutions. We have come to understand that as we plan for the future we can no longer apply the words long-term to our computing solutions, that our plans must remain flexible.
OLAP: A Fast, Easy, Affordable Executive Information System—Finally!

by Henry M. Stewart

Online analytical processing (OLAP) has emerged as a “breakthrough” technology that can provide the foundation for EIS solutions. Using OLAP, senior managers are able to view hundreds of graphic and tabular displays that present a visualization of their institution’s business process.

If you have attended SIG meetings on executive information systems during the last four years, you know the story: with very few exceptions, developers have found that technology constraints have inhibited colleges and universities from meeting the ever-changing EIS needs of senior management. By the time EIS answers are created, the questions have changed! The few EIS systems that have survived are usually based on static data from fact books, data that are less interesting to management when they are pursuing answers to pressing, momentary business needs. Take heart, EIS visionaries—technology has finally caught up with your expectations.

The University of Rochester has been experimenting with online analytical processing (OLAP), and the results have been startling. During the spring of 1995 we began demonstrating the service to senior management and other IS staff members. Their reactions were all very similar—spontaneous, short bursts of uncontrolled laughter. They couldn’t believe what they were seeing! OLAP technologies have enabled us to develop special-interest EIS systems very quickly. These systems feature fast response, graphic, and tabular displays, drill-down/drill-up between levels of detail, and an easy screen interface featuring drag-and-drop and point-and-click technologies.¹

OLAP technology

How does it work? OLAP technology consists of two major components, the server and the client. Typically the server is a multi-user, LAN-based database that is loaded either from your legacy systems or from your data warehouse. You don’t need a data warehouse in order to implement OLAP, but if you have historical data, OLAP’s visualization will reveal patterns of your business process that are hidden in the data.

The server

Think of OLAP databases as multi-dimensional arrays or cubes of data—actually cubes of cubes—capable of holding hundreds of thousands of rows and columns of both text and numbers. The current terminology for these database servers is multi-dimensional databases (MDDs). The MDDs are loaded from your data source (legacy or warehouse) according to an aggregation model that you define. Fortunately, defining the model and loading the database can be very easy; for some OLAP products, no programming is required to build the model or to load the data.

The client

The client component for several OLAP products presents a spreadsheet-type interface

¹ We investigated several products, including those from Brio, Business Objects, Andyne, Trinzic, IMRS, and Cognos. Our investigation revealed the expected—varying levels of ease of use, performance, functionality, and cost. PowerPlay from Cognos best met our needs.
You may ask, “Doesn’t a data warehouse provide us with all we need for queries, reports, analysis, and answers to EIS queries?” The answer is, “yes and no.” A data warehouse is an excellent data structure for queries and reports, especially if those queries and/or reports request data for a specific point in time. But if your query needs to summarize, total, or aggregate data from a year or more (i.e., analysis), response time can change from seconds to hours! A well-designed data warehouse should provide good response to queries/reports. It probably will not provide good response for analysis.

The only way in which a warehouse will provide rapid response to analysis is if database administrators create summary tables within the warehouse. This approach may work for a few of the most common summaries, but it could easily consume your valuable DBA’s time. No matter how fast your DBAs work, they won’t be able to outguess the creative minds of senior management. The summary table they didn’t create will be the one that management needs. Our suggestion is to allow OLAP to create those summary tables, charts, and tabular reports. That’s what it is designed to do, and it does it fast and dynamically, according to the wishes of the manager who is controlling the mouse.

Summary

Although at the University of Rochester we were not seeking a solution to EIS specifically, we believe that OLAP technologies can serve as a foundation for the elusive EIS systems that CAUSE member schools have sought over the last few years. Best of all, these products can be very affordable. Prices will vary between vendors, but very good solutions are available for as little as $500 per workstation. When comparing OLAP functionality and cost to the EIS products of the 1980s, OLAP emerges as a “breakthrough” technology, capable of providing rich functionality and ease of use at a price that we can afford.

If your campus is ready to begin experimenting with information visualization, a good place to begin is by researching recent OLAP articles such as those listed below.

For further reading:

From Grass Roots to Corporate Image— the Maturation of the Web

by Christine A. Quinn

This viewpoint discusses the growth of the World Wide Web at Stanford University as well as efforts there to bring diverse groups together on Web presentation, and offers some advice about building a Web site.

Much like other innovative ways of handling information, the use of the World Wide Web has grown from the bottom up. Many research universities' Web servers were created within computer science departments by graduate students. Thus, the presentation of the university to the rest of the world was the concept of a single individual. As the popularity of the Web has increased, and the word gets out on how the Web works, others have become involved in what might be presented, how that might be presented, and what the links will look like. Questions arise as to who owns the information presented, who has responsibility for deciding what goes where, and who decides what the Web pages should look like.

Stanford, probably much like other universities struggling with these issues, started with such a Web site. As more and more individuals within the University (or affiliated sites) took to the Web, the organization, look, and responsibility of the pages became a more pressing issue.

How does a large, diversified, distributed organization such as a university begin to collect this information and provide a mechanism by which Web offerings could be presented in a similar way? Is it possible, for instance, for all Stanford pages to have a “Stanford” look? More importantly, is it desirable?

Something's missing

Something's missing from the Web; it's not a search mechanism, it's not a general index, and it's not higher bandwidth. What's missing is the corporate image. Some sites have tried for such an image and succeeded, some have tried and failed, but mostly Web sites are just not trying.

When a corporation hires an agency to create a million-dollar ad campaign, the CEO gets involved, vice presidents are consulted, marketing joins ranks with sales and provides focus groups, test beds, and so forth. When a company is about to bring a new piece of software into their product line, there are alpha sites, beta sites, and test groups, and developers meet and meet and meet.

When a brochure is being developed for an organization, artists are hired, graphic designers are contacted, art directors given direction, and printers told what quality of paper, type of ink, and printing style to use.

This is not commonly happening on the Web.

Joining the information superhighway has never been so easy

People are beginning to realize that the information superhighway is here, and the Webmasters are riding it like crazy. Crazy is the key word! Since the bulk of Web material today is created by computer scientists and/or technologists, the Web has the distinctive look and feel of a high-tech playground— toys, computers, video games— sprinkled here and there with little thought to order, discipline, or professionalism.

Now before you shout “Anarchy before order!” consider this:

• Even the simplest of TV ads require directors, camera people, production assistants, and so forth. And such a commercial may reach a million people— maybe a few times!

• When you put a Web site up and announce it at CERN or NCSA, you can reach 10 million people— many, more times than once, at sites that are far out of the reach of standard commercial TV.

Are you considering what your Web pages say about you?
Top Twenty Things Not to Do on a Web Page

1. Don’t release it until it’s tested, tested, tested.

2. Don’t forget to make the title very descriptive, so that when it’s saved to someone’s hotlist, she’ll know what it is.

3. Don’t let links be too non-descriptive—if someone prints your page out they won’t have the link to follow.

4. Don’t include references to “generic Web information”—there are plenty of those around; I came to your site for information about your organization.

5. Don’t do dangling links—avoid the word “here”—put the link on the item itself.

6. Don’t forget a Webmaster reference.

7. Don’t forget to tell people how big files are before they download them.

8. Don’t forget other platforms and browsers.

9. Don’t leave the important stuff for the bottom—someone may not make it down that far.

10. Don’t have dead-end links.

11. Don’t be sloppy with your HTML—know how the language works!

12. Don’t repeat the same link with different names.

13. Don’t steal someone else’s graphics.

14. Don’t make something look like a button and not work like a button.

15. Don’t violate white-space balance.

16. Don’t let links drop—check your hrefs.

17. Don’t forget a timestamp.

18. Don’t have too much information on a single page.

19. Don’t have a different style of icon for every bullet.

20. Don’t crowd images.

The last question asked is the first needed

Have you perused comp.infosystems.www.provider lately? Anyone there talking about aesthetics? I’ve seen “How do I set up an online database”; I’ve seen “Really COOL idea”; and I’ve seen “ANNOUNCE” far, far too many times. What I haven’t seen are questions like:

- How much graphics is too much?
- What should a button bar include?
- How much color should I use?
- Does anyone know a good artist?
- Just how much should go on a single Web page, anyway?

Stanford gets caught in the Web

Stanford caught onto the Web by virtue of the Computer Science department. A doctoral student learned about it, aliased his machine’s name to www.stanford.edu, and started organizing information. He scanned a number of images of Stanford, decided what topics would appear where, and offered it up to the world. The world!

Then he waited for people at Stanford to tell him they had a site and he added a link to their pages. It was hit-or-miss for many months and gradually the home page went from being a single document, where all was equal (the freshman dorm and the Medical School were on the same level), to a sorted list with general bullets that linked on to other sites as it is now.2

When attempts at discussing Web standards met mostly with apathy, a consultant, formerly in higher education and now in the corporate world, was invited to meet with the Stanford Web-footed. The consultant showed several sites (including his own, of course) that had attempted to bring a semblance of unity and art to their pages. He discussed use of color (fifty per image, 150 per page max3), button bars as navigational aids (Top, Find, Help, Comments), and icons for consistency. He also took time to show Webmasters what not to do. Based on his instruction (and my own experience), see the sidebar above for a list of the top twenty things not to do on a Web page.

More than gossamer—where there’s strength, there’s fire

A concerted effort requires organizations working together, but more importantly it requires a leader, someone who will set the stage and move forward in the design and implementation of a set of pages—pages that will reflect the quality of the institution they represent. This piece had been missing for Stanford, as it is from many Web sites.

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1 Visit the following site for more information about design issues on the World Wide Web: http://info.med.yale.edu/caim/StyleManual_Top.HTML


3 An illustration of this use of color is found at http://www.commerce.net/

4 This catalog can be found at http://www.scpd.stanford.edu/scpd.html
It was apparent that the standard paper documentation coming out of Stanford had a certain quality about it. The Stanford colors of deep red and sandstone are commonly used. The publication services group within Stanford had often used the distinctive architecture of the school and the richness of these colors to set their publications apart from those offered by other universities and organizations.

Where are these people now that the Web needs them?

The first time I had a chance to have the Web imitate art was when I became involved in the Stanford Center for Professional Development’s pages. My first suggestion was to use Stanford Publication Services to design a “look.” By employing both a graphic designer and an art director we found a concept that brought architecture and color to SCPD’s World Wide Web catalog.4

The ideas sound simple, but the implementation is not. It wasn’t simply a matter of creating a piece of art and turning it into a GIF file. The artist, unfamiliar with the new requirements of the medium, had no idea how to proceed. The art director, however, was able to instruct her on the need to keep the screen in mind and to apply such techniques as anti-aliasing to the text. With our combined efforts, the SCPD pages provided the image that was needed.

Beyond doing a set of pages for an individual group, the issue now is how to pursue this on a campuswide basis. As the primary promoter (or should I say, proselytizer) of a Well-Designed Web Architecture, my job at Stanford is to convince people of the beauty of the Web—the beauty not just in the gee-whiz nature of the user interface, but in the possibility of an overall design that embodies art as well as utility.

What does this say for you and your Web site?

It means you need to do some reflecting before reacting.

First, think about what you’re going to put on the Web before you put it on. It’s nice to get on the Web quickly, but only if your site reflects well on your campus once you’re on.

Second, consider what your pages say about your organization. Do they portray a professional quality that you would normally invoke with campus pamphlets or brochures? Or do they speak volumes about disorganization, disarray, and dissonance?

Third, think about what you want to say with your pages, how you want to organize them, and how people might look through them. Are you trying to tell the world who you are, what you do, what you can do for them? Are you selling something? If the answer to any of these is yes, consider how someone with a marketing background might get involved.

Finally, if you’re willing to spend $20,000 on a brochure that gets used for a year, why not invest at least that much with a graphic designer and an art director to do your Web site well? In years to come, this legacy of your venture onto the superhighway will pay back in plenty.

Note:

This viewpoint is adapted from a paper presented by the author at “The Second International World Wide Web Conference: Mosaic and the Web,” Chicago, October 1994. Paper proceedings of this conference are available (inquire to well@osf.org or phone 617-621-7339); online proceedings are available at http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings. The original HTML version of this viewpoint is available at http://www.ncsa.uiuc.edu/SDG/IT94/Proceedings/Campus.Infosys/quinn/quinn.html

OLAP...

(continued from page 48)


Teaching, Learning, and Technology at Research I Universities

by Robert S. Tannenbaum

I have just returned from an excellent conference, better than most that I have attended in a long time. Together with the incoming Chair of the University of Kentucky’s Instructional Computing Advisory Committee, I participated in the American Association for Higher Education’s “Teaching, Learning, and Technology Roundtable (TLTR) Summit Seminar.” Every one of the hundred or so attendees participated and contributed, sharing our experiences and efforts to introduce and expand the use of technology in the instructional process at our institutions. We wrestled with problems that we have in common, sought feasible solutions, and planned ongoing activities to continue and sustain our mutual objectives.

We came to the TLTR seminar as teams with from two to ten or more individuals from each of our respective institutions, bringing different perspectives on our mutual efforts, but reinforcing each other’s planning and designs for what to do upon our return to our home campuses. As teams, we could spread out, making more contacts with others from other institutions, gathering more and varied ideas, and then come back together to plan for the coming months. It was through these multifaceted contacts with a variety of other individuals, each of whom brought the perspectives of another institution, that we gained well beyond any planning that we could have done at home.

But the value of contacts with individuals from other institutions is limited by the degree of overlap and commonality of the institutions and their missions and difficulties. And at this seminar, I found very few of my colleagues from peer institutions. Are these issues of less concern to Research I institutions? I think not! I believe there are many issues that we need to address from our unique perspective:

- How do we promote and support the expensive and time-consuming efforts required to effectively integrate technology throughout the instructional process at an institution that is dedicated primarily to research?
- How do we educate, support, and reward our faculty members, who currently are oriented primarily toward performing research, to help them strengthen their teaching through the integration of technology into the instructional process?

- How do we deal with the political, social, and fiscal realities inherent in institutions that are as large as ours, have so many different subgroups (sectors, colleges, departments, divisions, institutes, etc.) with so many diverse agendas and missions, where one group may not even have heard of another, let alone know what the other is doing, and where we do not necessarily want to establish a single “institutional” approach to addressing issues?

And for those of us in state-supported institutions:

- How do we approach the mandate being pressed upon us by our legislatures and the public, and state government to focus on instruction and not “waste” resources on addressing obscure research questions?
- How do we continue to meet the obligations of a land grant institution and still devote the necessary resources to support instructional technology?
- How do we convince our legislators and governors that our efforts in behalf of instructional technology are sound pedagogically and fiscally even if they are expensive and time-consuming and do not necessarily result in increases in productivity that are measurable and quantifiable in a manner analogous to business productivity?

I submit that we all—both Research I and other institutions—will benefit enormously by engaging in such discussions; we all have a great deal to teach to and learn from each other. In an effort to interest other Research I institutions in the value of such discussions, and to introduce the concepts of the TLTR seminar program, I have arranged for a special interest group session at CAUSE95 in New Orleans this fall, to discuss teaching, learning, and technology at Research I institutions. For further information, please get in touch with me at rst@pop.uky.edu.

1. The conference, entitled “Teaching, Learning, and Technology Roundtable Program Start-up Workshop and Summit Seminar,” was conducted last July in Phoenix under the auspices of the American Association for Higher Education. For more information on this and upcoming events in the TLTR program, please contact Steven W. Gilbert at AAHE (202-293-6440 or gilbert@clark.net). See also S. W. Gilbert, “Teaching, Learning, & Technology—The Need for Campuswide Planning and Faculty Support Services,” Change, March/April 1995, pp. 47ff. That issue of Change offers many other articles related to the introduction and support of instructional technology.
The successful organizations of the 1990s will adopt new, flexible approaches to management methods, human resource policies and practices, and organizational structure and design. In fact, rapid technological advances, cross-functional work teams, and total quality programs are already transforming today’s workplace in ways that require extensive interactions among organizational members at all levels. As catalysts in the change process, information technology professionals must possess sound behavioral knowledge and communication skills—in addition to their technical expertise—to be effective in the new work settings.

Rick Maurer’s *Feedback Toolkit* is an excellent, straightforward resource of valuable guidelines that will improve your ability to communicate easily with others in the workplace. In the book, Maurer makes special mention that many people find face-to-face and interpersonal communication difficult, especially when it comes to giving and receiving feedback. This observation is supported all too well by a substantial body of human relations research. Effective communication requires skills that must be learned and practiced. Unfortunately, we are usually not taught or encouraged to listen, perceive, or respond to the verbal and nonverbal messages of others. Publications like the *Feedback Toolkit*, as well as Maurer’s previous book, *Caught in the Middle*, are vital to help raise people’s awareness about communication approaches that help us work together better. The importance of becoming comfortable with these approaches is heightened for members of the information technology field, since individuals entering technical areas are typically more comfortable working with data, ideas, and things (e.g., computers) than with people.

Drawing on his experience as an organizational consultant, Maurer provides us with a quick-to-read handbook containing simple, informal guidelines and tools condensed in an easy-to-grasp six-step framework for giving and receiving feedback in a variety of work settings. A primary goal of the material is to enable managers and employees alike “to speak the truth in an appropriate way” and thereby develop a two-way street that allows people to know whether they are “on- or off-track” on a regular basis. “Poor feedback,” says Maurer, “leads to performance problems, confusion, wasted effort, anxiety, and work of lower quality.”

The author astutely observes that trust is the key ingredient underlying effective communication in any form. Maurer applies a simple rule here: “The higher the trust level in the office, the easier it is for people to give and receive feedback.” By investing a short amount of time to learn Maurer’s creative but practical approaches to feedback, information technology managers can become more successful, significantly enhancing working relationships with staff and creating an environment of greater trust in which people find they can count on each other. Both of these outcomes will go a long way toward improving job performance, work quality, and the productivity of all involved.

Reviewed by Bruce A. Metz, Associate Vice President of Information Technology at Rider University in Lawrenceville, New Jersey. He has conducted a range of seminars in interpersonal communications for organizations including CAUSE and Educom.

**Distance Education: Strategies & Tools**

Edited by Barry Willis


Distance Education: Strategies & Tools is a very comprehensive book with contributions from nineteen different authors, which gives it balance as well as a wide range of topics flavored with much experience. I have had occasion to look over this book in the process of updating and adding to a paper I am writing on the topic. It is probably the best in its class. In fact, in the latter pages of my paper, I have several references for "best text," "best reference book," and "best how-to" book. This one replaces the earlier "best text" and is worth recommending to all CAUSE members.

Consider these chapter topics: historical roots of distance education around the world; research and evaluation; planning; processes and products of needs assessment; the critical role of print; the importance of audio; video, computer-based, future technologies; copyright regulation; telecommunications regulatory environment; regional planning and cooperatives; and faculty development.

Because of the importance of consistent and integrated efforts of students, faculty, facilitators, support staff, and administrators, the book makes frequent reference to their various roles. This
book can be considered a must for anyone considering the initiation of new distance education programs or the expansion of existing ones. Written at the professional level, it is appropriate for faculty and graduate-level students.

Reviewed by Gene Sherron, School of Library & Information Studies, Florida State University. As a professor of Information Studies, he teaches and does research in information systems, networking, management, information policy, and records management. gsherron@lis.fsu.edu

Are Your Lights On? How to Figure Out What the Problem Really Is

I’ve loved puzzles and problems for years—cryptic crosswords, math brainteasers, those twisted pieces of steel that are supposed to come apart if only you know the correct steps—the harder the better. I even envision myself as a problem solver at work. I ride the mighty steed of reason, armed with the keen sword of intellect and ready to do battle against whatever dragon-like problems arise around me.

Fortunately, I don’t share this vision of Myself As Hero very often, because, unfortunately and all too often, the steed stumbles, the sword needs sharpening, and the dragons organize themselves into committees and task forces. It’s a cruel world.

On the other hand, I do reread Are Your Lights On? every six months or so. Don and Jerry (the authors put themselves on a first-name basis with the reader) have done for problem solving what Ben and Jerry have done for ice cream.

Reviewed by Nick Backscheider, who is currently retained by Auburn University as a consultant to help them plan their use of information technology. Nick has worked in higher education management and planning for almost thirty years. backsni@mail.auburn.edu

Silicon Snake Oil: Second Thoughts on the Information Highway

As an astronomer, Cliff Stoll has been a longtime user of information resources and an early user of the precursors to the Internet. In The Cuckoo’s Egg, he told us about an abuse of the network for illegal purposes. In Silicon Snake Oil, he tells us that we need to differentiate between the quantity and the quality of information available to us.

We are all experiencing what is referred to as “information overload.” Stoll reminds us of the difference between information and data. He states that “information has utility, timeliness, accuracy, a pedigree.” He warns us of the dilemma we face in the wish to maintain open, free-flowing communication while lacking editorial filters. He is concerned that “the valuable gets lost in the dross.”

Stoll shares his concerns about today’s use of networking to produce a better society. While many of us in the information resource professions may not see the same outcomes as Stoll, we need to recognize that not everyone is buying into our views, and certainly not at the same rate. He is providing us with a sanity check as we help to build and apply the technologies we hope will improve our world of learning and access to information.

Today’s tools for information searching are still primitive. They have improved dramatically in the last few years, but they have a long way to
go. Stoll asks that we continue to be cognizant of the need to use technology wisely, and not to substitute it for real-life experiences. (He acknowledges that “the Internet is a great place to meet people,” but that such meetings are usually on a superficial level with a false sense of intimacy and a definite lack of etiquette.) He is also concerned about the lack of access to information, technology’s potential impact on libraries, and changes in copyright laws (perceived as impediments). He raises the question of whether the Internet should revert to a tool for researchers or become an archive of all facets of life.

Silicon Snake Oil is Stoll’s way of reminding us to proceed with caution while implementing access to an abundance of information. We must look for opportunities to improve the Internet’s organizational aspects and means for capturing and retrieving information, but not forget to communicate with each other without a keyboard and screen.

Reviewed by Leslie Maltz, Director of Computing and Communications Resources at Stevens Institute of Technology, and former Chair of the CAUSE Board of Directors [lmaltz@stevens-tech.edu]

Business Reengineering: The Survival Guide
by Dorine C. Andrews and Susan K. Stalnick

Ever since Hammer and Champy’s Reengineering the Corporation hit the top of the best seller list, the world has been abuzz about business processing reengineering, or BPR. Conferences are offering BPR tracks, seminar groups are adding classes, consultants are marketing the service, and new books and articles appear almost daily. While there is a plethora of books and other reading material on the market today, most focus on the definition and the reasons for pursuing BPR, but few provide concrete steps or methods for how to do it successfully. Business Reengineering: The Survival Guide, by Dorine C. Andrews and Susan K. Stalnick, is the exception. This is a complete guide in an easy-to-reference format for establishing and managing BPR projects.

As with Total Quality Management (TQM), BPR’s most obvious application is to the manufacturing industry, but as with TQM, BPR can also be applicable and beneficial to the service industry, including higher education. While we may be chastised on campus for using terms like “business” and “reengineering,” many of us are skirting the terminology issue by substituting phrases like “process innovation” or “process management,” and attempting to reap the same rewards for higher education.

Andrews and Stalnick’s book is a quick read and easy to understand for those who like to read cover-to-cover, but it also provides an easy-reference format for those who prefer the quick access or “emergency fix” style of reading. The book presents the BPR process in a clear, logical sequence, using the analogy of a traveler on a journey. The value of a well-planned itinerary reinforces the notion of methodology as an integral part of any successful BPR effort.

The authors encourage focusing on involving the right participants along the way and then on “moving with a purpose.” Of particular interest is a comprehensive explanation of the role of information technology and the information systems staff in the BPR effort. Another section concentrates on techniques to use for building a high performance team. Techniques and methods are detailed in appendices for easy access and use.

There are several practical suggestions for exercises and activities to identify and resolve difficulties and eliminate barriers, and charts to help guide decision-making during various stages. There are also specific preventative measures identified to monitor activities along the way and ensure success in the end. BPR can be a complicated activity; this logical, straightforward guide is immensely helpful. The authors’ professed “never-ending attempt to keep it simple” is successful.

Business Reengineering: the Survival Guide will not be particularly useful for the uninitiated or the simply curious. It is designed to be a reference guide for the involved. If you are considering whether BPR might be a viable option for your institution, the book provides a realistic view of what to expect, but it seems most valuable for those about to embark on or already involved in a BPR effort. It provides specific guidelines and techniques for planning, experiencing, and surviving the journey, wherever you are in the process.

Reviewed by Renée Woodten Frost, Director of Administrative Information Processes in the Information Technology Division of the University of Michigan. She is responsible for facilitating the innovation of University processes, determining what information technology products and services are needed to support these processes, and initiating the direction and development of these products and services. [rwfrost@um.cc.umich.edu]
**Question:**
What constraints, if any, is your institution placing on the use of institutionally owned computing and network resources, including conditions under which external access is allowed?

At **The University of the South**, the only restrictions on student access to institutionally owned computing and network resources are the conditions of responsible use, which are part of the University’s computing policies. All students have full access to the Internet in student labs, and those with computers have access in their residence hall rooms.

Laurence Alvarez  
Associate Provost  
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At **Dartmouth College**, we enter all faculty, staff, and students into a database that serves as a person’s “key” to network applications that request a name and password (e-mail, licensed databases, etc.) We also enter some names “by hand” to accommodate non-standard relationships with the institution. Of late, as the number of requests for entry has greatly increased, we’ve tightened our policy and, in fact, are about to “purge” many names. A locally based community network that offers very similar services has helped by picking up those who might in the past have been allowed “in.”

Dial-in, used extensively, until recently was not validated! We’re migrating to all-validated (via the above-mentioned database) dial-in in the next few months.

An interesting issue, not yet well dealt-with, are fixed IP address machines maintained in various labs, offices, etc., which themselves may then offer, on their own, accounts and dial-in access to those machines, which in turn are on the institution’s network. This doesn’t allow people into validated services, but may place all manner of people “on the Internet.”

Lawrence M. (Larry) Levine  
Director, Computing Services  
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The **University of Virginia**’s policies on access to institutionally owned computing and network resources are derived from its policy on the use of the University equipment. This policy, which is not specific to computing-related resources, clearly states who is able to use resources and for what purposes. Our biggest problems come in interpreting the policy with respect to persons who are contributing services of value to the University community, sometimes for no compensation, but who themselves are not defined by policy specifically as authorized users and who request access to make their contribution easier. In general, “external access” questions have been channeled into our work to develop broad-based, high-speed access to the Internet in our local community through a project known as the Monticello Area Virtual Village. That project is a partnership between the local governments, local telephone and cable businesses, other businesses, community service agencies, and the University.

We are constantly struggling to keep up with dial-up service demand, especially now that many users are establishing SLIP, PPP, or ARA connections, which generally average longer connect sessions than older style connections. In the past year, we have required users who dial in to authenticate their status by use of logins and passwords, and we have begun exploring other means of managing the resources, including limitations on connect times and “premium” connect options where users can guarantee access for a fee, but we have not yet adopted any of these as a standard practice. We are also examining outsourcing options.

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Allegheny College is a small, liberal arts college with about 1,700 students. All faculty members have a network-connected workstation on their desks and there are 200 machines in public labs that are network connected. We also have dial-in lines that are available to students, faculty, and staff. At the present time we have no restrictions on network access by students, faculty, or staff. We provide full Internet access, including access to all USENET groups. Spouses and dependents of faculty and staff can request a network account by completing a form. So far we have had only a handful request an account, so it does not pose a burden to our resources.

David Anderson  
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**Winter 1995 Readers Respond Question**

Has your library or IT organization reclassified jobs and/or redefined positions and, if so, why? Is this activity part of a broader organizational restructuring?

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

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

THE 24TH ANNUAL CAUSE CONFERENCE
November 28 — December 1, 1995 * New Orleans

Ann Rhoades, Senior Vice President of Human Resources (aka the “Dream Team”) for Doubletree Hotels and formerly Senior V.P., People Department, Southwest Airlines, will offer advice on how to build organization-wide teams and enhance an organization’s culture to make it more customer oriented—both externally and internally.

Clara Adams-Ender, formerly a Brigadier General in the U.S. Army, and now President/CEO of CAPE (Caring About People with Enthusiasm) Associates, Inc., will bring her message of caring and its impact on management, quality, and productivity.

James Johnson, Vice Provost for Information Technology at Emory University, will speak about the possibilities technology brings to higher education in his talk, “The Future is Now—What Do You Do When Dreams Come True?”

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