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ABSTRACT

This document presents the proceedings of a conference on new opportunities for partnerships within and among higher education institutions. Seven tracks, with seven to eight papers in each track, address the themes of: (1) partnering and partnerships in general; (2) customer-focused partnerships and collaboratives; (3) information as a strategic resource; (4) networking at the campus and state level; (5) new technology for multimedia, the Internet, document imaging, and the "virtual" university; (6) information technology architectures; and (7) professional development for information professionals and administrators. The document also contains the proceedings of a special session on the electronic exchange of student records and a summary of CAUSE94 conference evaluations. (MDM)

CAUSE

New Opportunities for Partnering

Proceedings of the 1994 CAUSE Annual Conference

November 29–December 2, 1994
Walt Disney World Dolphin
Orlando, Florida

ERRATUM:
The text of papers IV-4, "Multi-Network Collaborations: Extending the Internet to Rural and Difficult to Serve Communities," and IV-5, " ATM: Reality or Pipe Dream," have been reversed. Pages now numbered IV-5-2 through IV-5-8 should have been numbered IV-4-2 through IV-4-8, and pages now numbered IV-4-2 through IV-4-11 should have been numbered IV-5-2 through IV-5-11.

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Today, librarians, presidents, deans, registrars, business officers, and most others on campus use information resources—including technology, services, and information—and are concerned with using them more effectively and efficiently. And as the expectations for information resources grow, those who plan for, manage, and use such resources are challenged to fully leverage this significant investment—supporting the growing needs of staff, faculty, and students in the information age while positioning their institutions for the future.

CAUSE strives to promote more effective planning, management, and evaluation of technology and other information resources in colleges and universities, and to help individual member representatives develop as professionals in this field. And CAUSE believes that, while information technology is an enabling force, people are the key to accomplishing our mission.

CAUSE advocates the importance of information technology by keeping administrators, policy-makers, and users informed on the importance of information technology and its potential for enhancing the administration and delivery of higher education.

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INTRODUCTION

by Daniel A. Updegrove
CAUSE94 Chair

Dear Colleagues:

A hypermedia phenomenon is sweeping higher education and the Internet—the Mosaic/NetScape interface to the World Wide Web. From office, lab, home, or hotel you can peruse information resources in multiple formats, and any object you discover may also serve as a "hot link" to another resource.

Imagine spending three or four days in a multisensory, multimedia environment designed by Disney, where everyone you meet is both an information resource and a link to others, where the latest technology is available for demonstration, where an expert staff has taken care of all the logistical details, and where professionals from hundreds of campuses and companies have come to explore "New Opportunities for Partnering." This was CAUSE94 in Orlando!

Among the attractions presented at CAUSE94 were:

- Outstanding general session presentations by Jennifer James, Dennis Snow, and Glenn Ricart, who challenged our conceptions of societal change, the imperatives of high-quality service organizations, and the impact of technology on universities, respectively;
- A current issues forum where four leaders from higher education information technology responded to challenges posed by ACE President Robert Atwell, representing college and university presidents;
- Fifty-four track sessions, selected by the program committee from over 160 proposals (a record number), many of which showcased working partnerships within and among institutions and with IT vendors;
- Numerous informal poster sessions, where one-on-one discussions were encouraged;
- An expanded vendor exhibit area;
- Workstations connected to the conference network and to the Internet; and
- Disney World, with its stunningly successful synthesis of creative programming, innovative technology, service-minded staff (and good weather).

New opportunities for partnering abounded in Orlando this year. The conference attracted a record number of participants—over 2,100 attendees from higher education and industry in the U.S. and abroad, a 25 percent increase from CAUSE93. This printed Proceedings will serve as a resource and an in-depth reference for conference attendees and will give those professionals who were unable to come to Orlando a taste of the wealth of information that was available at CAUSE94.

(Please note that the papers contained in this printed Proceedings are also available online via the CAUSE Gopher and Web servers. See the copyright page for details.)

CAUSE gratefully acknowledges the enthusiasm, time, and efforts of the CAUSE94 Program Committee, and the generous support of their institutions: Daniel A. Updegrove (chair), University of Pennsylvania; Jacqueline Brown (vice chair), Princeton University; Dennis R. Aebersold, Gettysburg College; John D. Busby, Houston Community College System; Douglas S. Gale, University of Nebraska at Lincoln; Jacobus T. Meij, University of Stellenbosch; Daniel J. Oberst, Princeton University; Howard J. Ramagli, Lake Forest College; Martin Ringle, Reed College; Sheri Stahler, Temple University; Terri-Lynn B. Thayer, Brown University; and Sue Ellen Anderson, Educom liaison.

CAUSE 94

Track I
Partnering

Coordinator: Dennis R. Aebersold

HAVING YOUR CAKE AND EATING IT TOO: A RECIPE FOR A COLLABORATIVE CWIS IN A DECENTRALIZED ENVIRONMENT

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ABSTRACT
As a result of a unique partnership between four differing units at Johns Hopkins—Academic Computing, the Eisenhower Library, News & Information, and Student Affairs—a flexible, comprehensive, and inclusive campus-wide information system is now fully developed and highly successful at Johns Hopkins less than a year after inception. JHuniverse, as it known, has knit together faculty, students, staff and alumni across the divisions of the university and around the country in a manner that simply did not exist before, while providing the flexibility and "ownership" that is necessary to remain true to the spirit of entrepreneurial dispersion which characterizes Hopkins. By leveraging the strengths of each organization and capitalizing on the entrepreneurial nature of the institution, the prcject team was able to implement the system at very low cost while maintaining the commitment to provide universal free access in what is normally a pay-as-you-go internal economy. The result is one of the few true university-wide resources, rather than being perceived as an enterprise of the computing center, the library, or the administration. This presentation describes the genesis and development of—and prognosis for—the interdivisional collaboration, but it is also the story of how JHuniverse has helped make decentralization a win-win proposition for Hopkins.

BACKGROUND

The Johns Hopkins University is a remarkably decentralized, geographically dispersed research university composed of eight very independent schools on three main campuses in two cities, a major research division in suburban Maryland, with numerous centers and affiliates in the Baltimore-Washington region and two in foreign countries. Given such an environment, a comprehensive networked information system would seem to be absolutely essential, yet differing priorities long conspired to prevent such a system from coming into existence.

CAUSE attendees might find it difficult to believe that less than a year ago a world-renowned institution like Johns Hopkins did not have an official campus-wide information system (CWIS). This is especially striking because these systems are now commonplace among universities and colleges. However, anyone familiar with Hopkins' historical emphasis on individual excellence and resistance to just about anything resembling centralized control would not be surprised in the least. This is part of a long tradition extending back to the first president of Johns Hopkins, Daniel Coit Gilman, one of the seminal minds in the history of American higher education. In his installation address, Gilman stated Hopkins' goals as "The encouragement of research ... and the advancement of individual scholars, who by their excellence will advance the sciences they pursue, and the society where they dwell." This simple vision is in fact what gave rise to the modern American research university as we know it today. It has served Hopkins exceptionally well, but it also resulted into an institution firmly committed to independent scholarship and supporting only as much infrastructure as absolutely necessary.

Herein lies the root of a dilemma for Hopkins: in the Information Age, it is no longer possible to advance research and promote excellence in individual scholarship without an adequate information technology infrastructure. This, by it's very nature, requires common standards and goals, which are best attained through coordinated, cooperative effort. Recognizing the need to respond to this and other challenges, in 1992 Hopkins established a Committee for the 21st Century (C21) to "examine critically and imaginatively every aspect of the University's organization and programs...". C21 members were charged "to think along radical and fundamentally new lines ... to assume that many current arrangements will be outmoded and unsustainable by the end of the 1990s...". In other words, if Hopkins is to prosper and remain in a leadership role then nothing can be set aside as sacred, not even our long standing decentralization. C21 also recognized the critical role that information technology would play in any self-transformation, stating that "Universities that succeed in exploiting these technologies in a cost-effective manner will flourish; those that cannot will diminish in stature."

PROJECT ORIGINS

Despite these laudable efforts, the fact remains that Hopkins could ill afford to wait until the 21st century to establish basic institutional networked information resources. At many schools the establishment of a CWIS was officially mandated by the administration; at others it was initiated by major information providers; in most cases it is operated by or through the computing center. Given that none of these were probable mechanisms at Hopkins (there is no CIO or equivalent position, no university computing center, and even Communications and Public Affairs is decentralized), the question becomes: in an institution focused on individual achievement and where the dominant perspective is that of each separate division, how does a common information system come about? Certainly it would not spring into existence by spontaneous generation. In a sense, however, that is actually what happened, and to some extent this validates Gilman's essential thesis: individuals striving for excellence in pursuit of their goals laid the groundwork for what later evolved into JHuniverse, ultimately advancing the entire institution. The subsequent evolution of the project also reaffirms the value of Hopkins' lack of bureaucracy and willingness to encourage its faculty and staff to challenge the status quo and to implement new ideas and approaches.

Early Adopters

In 1991, faculty and staff members in several areas of the university were investigating the use of newly available Internet applications such as Gopher and WAIS as tools to enable access to research and archival information and to support collaborative work in their disciplines. These included, among others: Prof. Robert Kargon and his son Jeremy in History of Science; Special Collections and Archives of the Milton S. Eisenhower Library, primarily the efforts of staff member Brian Harrington; and the groundbreaking work of the JHU School of Medicine's Welch Medical Library with the Online Mendelian Inheritance in Man and the Genome Data Base projects, and the related Computational Biology.

In October of that year the current technical manager of JHuniverse heard a presentation on CWISes at EDUCOM, and as a result he then attended in the spring of 1992 the American Society for Information Science Mid-Year meeting on networked information systems. This proved to be an revelatory event, occurring as it did at a significant juncture in the development of this field. The conclusion seemed obvious: the combination of ever more powerful com–puters, a robust and ubiquitous network, and simple, reliable information dissemination and navigational tools would lead to a revolution in the way computers are used and to an immeasurable increase in their value for research and scholarship.

The ASIS meeting made it clear that these developments were more than simply another, albeit very effective, communications medium, and they could potentially provide much more for Hopkins than just a typical CWIS (and since JHU has several campuses, the term was never really apropos in the first place). Here, finally, was the realization of the promise of information technology to provide a solution to a problem that is otherwise effectively insoluble—to transcend the bounds of physical and political geography by providing a "virtual commons", a shared information and community space for an institution perpetually in danger of succumbing to the centrifugal forces which threaten to decompose it into a "multiversity"[1] connected only by a common name; or worse, to tear it apart altogether. It is this idea that was the inspiration for the first part of the title of this talk. Information technology is one of the few tools that could provide a way for a decentralized institution to have its cake and eat it too—that is, sharing information, collaborating more easily, and participating in a common communication environment, while remaining dedicated to the simple principle of individual excellence.

Pilot Project

As it turned out, the Unix system administrator for Academic Computing at the JHU Homewood campus had already ported the gopher server software to run on our Unix system. This was quite a pleasant surprise; that there were also several fully developed gopher-based information services already operating at Hopkins was downright exciting. An interesting challenge was how to get them to join together under one "root gopher" when each viewed itself as a separate research project with no particular interest in the larger picture. We chose not press the issue, but instead tried to make it to their advantage to cooperate. As the official keepers of the jhu.edu domain, Homewood Academic Computing established the address 'gopher.jhu.edu' and registered it with the Univ. of Minn. as the main point of contact for The Johns Hopkins University. We publicized the availability of gopher, wrote articles about the wonders of gopherspace, distributed pre-configured versions of gopher client software and offered free short courses on Internet topics. By supporting the efforts of the early adopters and making it easier for Internet users to find their services, we engendered a good degree of cooperation and over the next year brought on board many new and enthusiastic participants.

Victims of Our Own Success

By the spring of 1993, Homewood Academic Computing had established a modest but successful network-based information service. This was effectively a pilot project, even though we did not initially conceive of it as such. However, it quickly became clear that continued development of the project would not proceed without the involvement and support of other pertinent groups outside of computing. Homewood Academic Computing has a limited mission within Hopkins, and its resources are insufficient to support a full-blown CWIS. We were fortunate, however, that the project was well positioned to play into a series of converging events which were about to catapult it into a new phase.

GENESIS OF THE COLLABORATION

In the summer of 1993, talk of the "Information Superhighway" was just beginning to explode into the national spotlight. The significance of this was not lost on the leaders of three major Hopkins service organizations, who separately were investigating the potential application to their organizations and looking for ways to capitalize on the

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[1] Attributed to Milton S. Eisenhower, eighth president of Hopkins, in "A Brief History of Johns Hopkins Univerity", John C. Schmidt, JHU Press, Baltimore, 1984.

networked information revolution. These were Larry Benedict, Dean of Student Affairs; Scott Bennett, Director of the Eisenhower Library (now Director of the Yale University Libraries); and Dennis O'Shea, Director of News and Information. In various discussions with each other they recognized their common interest in and need for a campus-wide information system. David Binko, Director of Academic Computing, brought to their attention the prototype CWIS that already existed in his department, and offered this as the basis on which to build a complete system. He also noted that there were no significant technical barriers in offering such a service—all that was needed was a sound organizational basis for a widely-used CWIS.

Defining the Rationale for Action

Three of the units sponsoring the new CWIS carry on extensive service programs and need to disseminate substantial amounts of information about these services. The primary activity of the fourth unit—News and Information—is the dissemination of information university-wide. It was clear that these four organizations would carry out their missions more effectively when their clients have access to a highly flexible, technologically advanced, and easily used CWIS. They all produce numerous publications and other documents which could be made available via the CWIS, so that communication with clients would be more timely, accurate, and potentially more cost-effective. Each understood the tremendous advantages that might be realized by leveraging the substantial investment in networking infrastructure and desktop computers, which at that point was being vastly underutilized.

What is notable about this is not that the four organizations recognized their common interests and the value of working together, as this was fairly obvious, but rather that they developed a pragmatic action plan and implemented it almost immediately. This group held its first meeting in September, formalized the details of the collaboration in October, announced the project publicly in December, and went on-line in January. This kind of rapid response was to become characteristic of the project. Hopkins has remarkably few barriers to impede innovation, which is a fundamental strength of the institution. In addition, there was a marked lack of territoriality among the four sponsoring units, which is unusual to say the least.

Setting Fundamental Objectives

In order to maximize the effectiveness of the system, certain defining characteristics were agreed upon which have proved to be critical to the subsequent success of the project:

- No initial cost for information providers or consumers
- Universal access (dial-in, telnet, etc.; no login required)
- Flexibility (central coordination but local control)
- Broadest possible audience (internal, external, alumni, etc.)
- Simplicity (easy to use and to implement)

While some of these objectives were the subject of considerable debate, they have resulted in a system which is uniquely attuned to the nature of our institution and which is truly inclusive. Some were agreed upon largely because we had no alternatives, but have proven to be valuable in their own right. For instance, we cannot load information for other departments because we do not have the staff to do so. Instead, we rely almost entirely on the departments themselves to upload their data. They retain control over their information and of the directories where it is located. For our part we provide written guidelines and instructions, software tools, classes and personalized training. This system borne of necessity has lead to a genuine sense of ownership, and a high level of commitment to the project.

By committing ourselves to serving the university community in the broadest sense, we hoped to become a primary means by which the community informed itself, and in so doing developed a greater sense of itself as a community. This objective would be of value to any institution, regardless of size, budget, or organizational structure.

Distributing the Work, Capitalizing on Our Talents
To collaborate means literally to work together. In our case, none of the founding units could have successfully carried off this project on its own, so working together was a first a simple necessity. As a whole, however, we proved to be much greater than the sum of our separate capabilities. Initial organizational decisions were primarily based on the best fit of the skills and resources of each department, with each bringing a unique and complementary set of strengths to the project. The Eisenhower Library provided critical early leadership, and lent the project scholarly credibility. The participation of Student Affairs gave the project credibility with the schools and the administration due to their institutionally-critical mission. Academic Computing had the computer and network resources, technical expertise, and training skills to ensure that these vital aspects of the project were handled professionally. News and Information brought to the project their extensive communication and presentation expertise, organizational skill, and an important public relations perspective. Thus, from the very beginning JHuniverse has given nearly equal consideration to serving the local Hopkins community and to providing information about Hopkins to our extended family and to the world at large.

The ongoing leadership role of News and Information (a part of university Communications and Public Affairs) has proven to be instrumental to this project. Robin Suits of Wright State University argues in a recent paper ("Campus-Wide Information Systems: A way to leverage information technology investments to meet strategic communication goals", obtained from the author, rsuits@nova.wright.edu) that a communications office may often be best suited to running a CWIS, since it is in their charter to "focus on the big picture of cross-disciplinary communication" and because "it also is the office charged with employing the most effective tools and techniques for meeting a university's strategic communication needs". In this respect the JHuniverse team is nearly unique, and has developed a management approach which is well-suited to the evolving nature and increasing importance of these systems to the institutions they serve.

SECURING INSTITUTIONAL SUPPORT

Building a successful Campus-Wide Information System requires developing the support of those who are going to use it, presumably everyone on campus—faculty, students, administrators and staff—as well as alumni, prospective students, other academics and the general public. Because some people at Hopkins had already created their own gophers at Hopkins and due to the decentralized nature of a university in which most people are unaccustomed to centrally coordinated systems, it was doubly important to develop strong support for or, at least, acceptance of our system. We began by building formal support from the units that provided the start-up funds for JHuniverse, and informal support from the broader university community.

The four founding units agreed from the beginning that News & Information and Homewood Academic Computing would administer the CWIS. Those departments together with the other two founding units that also formed a Policy Board that would oversee the project. Initial funding for the project consisted of donations from each department based on the size of their budget, along with donations of staff time and other in-kind services. These commitments were guaranteed through FY96. One-time startup costs (mostly equipment) were evenly divided between the four units.

The project manager developed a plan detailing the responsibilities of each of the managers and the policy board. Although we have not had much need to refer back to this document, it helped clarify our respective roles and responsibilities in project, and also brought to light several philosophical issues about the goals and mission of JHuniverse that were important to discuss.

Informal Support

The only group whose formal support the managers sought in the beginning was that of the JHuniverse Policy Board. It is important to note that while the Policy Board meet four or five times between the inception of the project in September 1993 and when it went on-line last January, the Board did not become involved in the day-to-day management decisions of JHuniverse. This hands-off approach allowed the managers to develop the system quickly and avoided any of the negative effects that committees can, at times, have on projects.

Other than Policy Board, the managers did not seek formal support from the university. We did, however, inform the Provost that we were undertaking this project and requested $5,000 to help fund the networking of the News and Information Office. The request served to gain additional financial support and to inform the Provost of our activities. The Provost, in turn, urged us to make sure that the Policy Board included individuals from throughout the university since the original members were all located on one campus. In response, we expanded the board to include the director of the Welch Medical Library who was also the head of the new Biomedical Information Sciences division on the East Baltimore campus and an individual from the School of Continuing Studies' Montgomery County campus.

We spent a great deal of time soliciting additional informal support from the university community. First, we publicized our efforts in the university-wide newspaper of which the project manager, conveniently, was editor. We also called and talked regularly with key faculty members, computer administrators, divisional administrators, other staff members and students. We also talked informally with senior officials in central administration. Another form of dialogue occurred via e-mail. Surprisingly, the largest volume of mail came from alumni who were extraordinarily interested in our efforts and wanted to see if we could provide additional services such as e-mail. The project managers personally and promptly answered every e-mail letter.

We also conducted a great deal of outreach, targeting departments and offices that we felt should put information on-line sooner rather than later, and in the process we discussed the project with them and solicited what types of services and information they thought should be included on JHuniverse. Some of these meetings were one-shot deals, others involved a series of meetings over a period of months.

Early on in the process we felt that we should create an advisory board made up of faculty, staff and students to act as brain-storming group. Because we have been so short staffed and struggling to keep up with the most pressing issues, we have not created such a board yet although we will before the end of the year. Their advice will be especially important as we design a comprehensive WWW-based system.

Formal Support

This fall, the project team recognized the need for dedicated staff. The initial funding provided by the consortium is simply not sufficient to even respond to current demands of the gopher-based CWIS, much less the more complex demands of a multi-media WWW-based system. We therefore decided to approach the university for additional funding. Accordingly, we discussed with Ross Jones, vice president of the Project Manager's division, our progress on the project and the need for additional funding. That meeting ultimately resulted in a presentation the Provost's Information Systems Coordinating Council, a university-wide group of senior administrators responsible for technology-related issues. A copy of our written presentation was also given to Hopkins' president, William C. Richardson. While no commitment has been made yet about providing additional funds for the project through FY94, the response from everyone has so far been very positive.

One of the advantages of having a system in place and developing informal university-wide support has been that when we did formally present the concept to the central administration, we had a strong track record. One point which has generated a great deal of interest in these presentations is the fact that four major grants awarded to Hopkins were tied, to some degree, to the fact JHuniverse existed. A fifth extremely large grant was received, in part, because the information and expertise they develop will be made available on the Internet through JHuniverse. We have been able to show that not only is JHuniverse necessary to survive in the last few years of the 20th century, but that it also makes economic sense, generating research grant revenue and saving money in publications and marketing for undergraduate admissions.

Tapping into Emerging Institutional Priorities
The need for senior institutional support is critical at this point for JHuniverse for more than financial reasons. This fall the university released a report by the Committee for the 21st Century. A report issued by a subcommittee of C-21, states: "...the university must be committed to establishing an advanced managed interdivisional information system for students, faculty, and staff to generate, manipulate, preserve, and communicate information of all types in carrying out their education, scholarly, administrative activities."

We needed to point out to the university administration that JHuniverse was such a system, and to ensure that other duplicative projects were not created due to a lack of knowledge about JHuniverse. We also needed to become more formally involved with others at Hopkins working on information technology projects. Finally, we needed top level university support to resolve interdivisional issues. The creation of centrally coordinated information systems often highlight of the problems that can develop within highly decentralized institutions. For example, the Johns Hopkins Institutions have at least three phone books, with different and, at times, conflicting information. There was a limit to the authority that the project managers could exert to resolve these types of problems. In our presentation to the Provost, he agreed, noting that it was time for us to "come in from the cold."

Future Plans for Increasing Support
As mentioned earlier, we will be forming a university-wide committee of faculty, staff and students to serve as a source of ideas for ways in which we can expand and improve JHuniverse in both the Gopher and WWW formats. Another top priority, if we are able to expand our staff, will be expanded outreach. We need to contact and work with many more departments and offices throughout the university to help teach them how they can use JHuniverse to reach their academic, research and organizational goals. We will also continue to provide training for information providers so that they can continue to upload their own information as we move into WWW.

The Policy Board will undoubtedly be further reconstituted in the future and may become a subcommittee of some other existing university body, such as the above-mentioned Council. Additionally, we need to work more closely with other Hopkins' groups that are working on technology-related issues such as placing student registration on-line and distance learning, areas in which JHuniverse has yet not been involved.

Turning Good Intentions Into Success
In a cooperative project such as this that is going to be used by a wide spectrum of individuals, it is essential to be fair, open-minded, flexible, and accommodating. When we started this project, each member of the consortium had different needs and expectations. When the Policy Board met, it was important to explore these different philosophies. Also, we found that our vision for the project expanded rapidly. While some others in the group had not envisioned JHuniverse as being, for example, a research tool or a forum for alumni, they were willing, fortunately, to allow us to experiment.

Another important issue that arose early on was the format of JHuniverse. One of the librarians on the Policy Board was concerned that it didn't follow an organizational pattern that might have been created by librarians. However, the former Director of the Eisenhower Library noted that while this might be true, the new format might better serve the purposes of the project.

Throughout the process of developing JHuniverse—an ongoing process that may never be "completed"—we have felt that it is critical to listen and respond to both suggestions and criticisms. This is a system that everyone owns, and the more input and support we receive, the stronger it will be. In a sense we must treat our users with the same level of respect as we would customers of a commercial product, because if they do not like JHuniverse the technology exists for them simply to create their own system, and at Hopkins they can and will. This does not mean, however, that anyone within the university will be charged for using JHuniverse. The founding members of the consortium were adamant that it be a free system. While we initially planned to cover the cost of developing and administering the system by charging information providers, we quickly decided this was not practical. We continue to explore options for generating income for the project without imposing direct chargeback.

As we approach our first anniversary and begin to "come in from the cold," the stakes are getting much higher. If we are more formally sanctioned and funded by the university, we will have to build a larger, more comprehensive system. University scrutiny will increase, and there is the danger that University funding will entail centralized control, with the consequent loss of some of the of the unique features of our current collaborative arrangement. Balancing these forces will be difficult, but we look forward to the continuing challenge of providing innovative and quality service.

THE FUTURE IS NOW

As information technology continues to advance and as JHuniverse grows, there will be many issues and problems that will arise. The key for us will be to maintain that delicate balance between stability and technological advancement. Thus, it is imperative to stay informed of new developments, to keep an eye on the future and always have something in place to anticipate it, but also to not change things so often that people get frustrated. Despite the lure of better software and new organizational ideas, for instance, we try not to significantly alter JHuniverse more often than twice a year. Even so, it is important to be willing to take risks when the reward is potentially great. Our greatest reservoir of creativity and initiative is our students, and by tapping into this source we can make great strides forward very quickly. This is why we recently made it possible for students to publish their own WWW "homepages" through JHuniverse, even though we have not worked through all the administrative issues just yet. We would rather seize the opportunity while the potential rewards are greatest, and deal with any unforeseen consequences later.

We must continue to focus on content and communication, rather than on technology. If we are able to do this and to maintain the cooperative spirit that has seen us through this far, we will continue to meets the needs of the Johns Hopkins community.

Partnerships with the Deans: Delivery of the "Whole Product"

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The UM Information Technology Division (ITD) began its partnering efforts with one UM college in 1991. This year, the lessons learned from that experience are being applied as we expand the partnership concept to the other academic units.

There are four goals: advance the units' academic priorities; create closer working relationships; increase the University's information technology capabilities; and ensure that ITD products and resources support unit needs.

The major benefit to ITD comes from our increased understanding of our academic customers and in our resulting ability to create "whole products" they will choose to use. Four new partnerships provide case studies for the creation of whole products.

Partnerships with the Deans: Delivery of the "Whole Product"[1]

DESCRIPTION OF UM AND ITD

The University of Michigan, founded in 1817, is a public research university located in Ann Arbor with two regional campuses in Dearborn and Flint. The University was originally founded in Detroit and moved to Ann Arbor in 1837. There are 19 academic units on the Ann Arbor campus. The mix includes undergraduate, graduate, and professional schools and colleges, and a large teaching hospital. The total annual operating budget is approximately $2.5 billion. The community includes 25,439 faculty and staff, and 36,845 graduate and undergraduate students. The Information Technology Division (ITD) reports, through the Vice Provost for Information Technology, to the Provost.

ITD is responsible for the central computing activities in support of both academic and administrative computing, including the voice and data networks, the campus computing sites, and the administrative mainframe. We still have an academic mainframe, but we are in the process of phasing out mainframe service in favor of a distributed computing environment.

INTRODUCTION

ITD's partnership program with the deans and directors of UM academic units officially began in 1993, but in a very real sense it had begun two years earlier. In May of 1991, ITD entered into an agreement with the University's largest academic unit, the College of Literature, Science and the Arts (LS&A). Going into that agreement, we knew we wanted to work more closely with LS&A and experiment with distributed support. In a more general sense, we also knew that the kind of relationship we were pursuing with LS&A would lead us to better serve our academic customers across the University. What we didn't know was that it would develop into a new way for us to do business with the University's entire academic community. Although we were studying total quality and marketing principles, we hadn't made the leap to understanding what these lessons meant for serving the thousands of customers on our campus.

Circumstances in the spring of 1993 made us look more closely at our academic customers, especially the deans. What we saw gave us many reasons for concern. We found that the majority of the deans were alienated from current information technology activities. Major changes in the computing environment on campus—a transition away from a familiar, mainframe-based system to "new and improved" distributed computing—held potential for even more alienation.

Despite various efforts over the years, the deans had not seen ITD bringing them technology that seemed directly responsive to *their* strategic priorities. We had little ongoing involvement in their planning for the future and they had little involvement in ours. Our services were most often provided to departments or individual faculty, staff, and students, not to them directly—yet, the dean pays the bill for services acquired by departments and faculty. More to the point, the deans hold the political power on campus. It is important they view our information technology services as benefiting them and supporting their objectives.

Our partnership with LS&A and our continued study of total quality, marketing, and ultimately whole products helped us address the issues we faced. The LS&A partnership

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[1]Geoffrey Moore, Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers (USA: Harper Business, 1991).

helped us better understand the balance between centralized vs. local control. The study of whole products led us to see the value of providing more than just a core product or technology; for the product to be valuable, it has to be augmented by other services for the customer to get full value from its use. Focusing on the dean as customer gave us the push to look at value from their perspective, and the partnership program gave us the opportunity to do so.

THE BEGINNING: THE COLLEGE OF LITERATURE, SCIENCE AND THE ARTS (LS&A) PARTNERSHIP

The partnership between LS&A and ITD grew out of discussions between ITD's Deputy Vice-Provost and LS&A's Associate dean for Research and Computing about how ITD, a large, centralized service organization, could better serve the particular needs of LS&A, a large, decentralized academic organization. The college itself mirrors the diversity and complexity of the University, with over 60 departments, programs, and centers; 2,000 faculty and staff; and 17,000 graduate and undergraduate students. The partnership discussions identified two primary needs in LS&A: development and use of instructional technology, and on-site (i.e., intra-departmental) computing support for faculty and staff. ITD saw benefits in a closer working relationship with the college and the opportunity to pilot new models for distributed support. ITD and LS&A each committed financial and personnel resources to the following activities:

- an ongoing program of instructional application development. The college assigned an instructional expert to work with faculty on the promotion, investigation, and selection of projects for funding, and with ITD's Office of Instructional Technology on the development, curricular integration, and evaluation of projects. This arrangement allows the college to make decisions about which projects go forward, and to take advantage of technical expertise in ITD for the development and deployment of instructional applications in the classroom or lab. This model has proved extremely successful and has been replicated in other partnership agreements;
- on-site Unix systems administration, initially for 9 departments and centers, now for 11. The LS&A Unix systems administrators are assigned to specific departments but function as a team to work on cross-departmental projects, back each other up, and generally provide college-wide Unix support; and
- instructional equipment upgrades for faculty and instructional support staff;
- a selection committee to advise ITD on instructional software in its central campus computing sites operation;
- on-site consulting and training for faculty and staff in various topics determined by LS&A. This part of the partnership also provided for needs assessment and planning activities.

Three years later, these components have gone from pilots for on-site services to being fully integrated into the college, providing significant and measurable benefits to LS&A faculty, staff, and ultimately, students. In an era of budget constraints and concern over the cost of technology, our work with LS&A gave us insight into how we could balance centralized services with the need for local control. Departments and individuals receive direct services from the instructional and support programs in accord with their particular needs, and economies of scale have been realized through the use of teams and pools of expertise.

MARKETS, PRODUCTS, AND WHOLE PRODUCTS

At the same time we were piloting the partnership with LS&A, we were beginning to adopt total quality principles, examine our relationships with our customers and change our assumptions about marketing, markets, and products. This helped us understand why some aspects of the partnerships were so successful and gave us a conceptual framework in which to develop future partnerships.

To learn more about marketing principles, we studied and borrowed ideas from experts such as William Davidow[2] and Geoffrey Moore. Later we discovered a Kodak research publication[3] written by Michael J. Lanning and Dr. Lynn W. Phillips that discussed some of the same issues and concepts.

Reading about and practicing total quality helped us to think of our users as "customers" but did not lead us immediately to understand how to deal with the large number of customers we serve. ITD has over 40,000 individual and departmental customers to serve and satisfy. We were looking for a way to create products and services that they would choose to use without having to create a product for each customer. And so we began to think about markets. A market is a grouping of customers for particular services or products who have a common set of needs or wants and who look to one another for advice when making a buying decision.[4] But how were we to group our customers into markets?

Markets

One tool we found very helpful was to look at our customers using the technology adoption life cycle.[5] This model distinguishes technology adopters or customers by their characteristic response to the introduction of new technology and is helpful when used to cluster customers into two distinct markets: the Early Market and the Mainstream Market.

The Early Market consists of technology enthusiasts and visionaries, those who like innovation and enjoy trying new technologies. They will spend the time necessary to get new untried products to work. They have the insight to match emerging technologies to strategic opportunities to achieve a fundamental breakthrough in their business.

The Mainstream Market, by far the larger of the two markets, includes pragmatists and conservatives. Their goal is to use technology to make a measurable improvement in productivity. They may be confident in their ability to handle technology but prefer a thoroughly thought-out solution to a known problem rather than receiving the latest and greatest. Service is critical to this group of customers.

After many lengthy discussions about the application of these principles, we began to understand why some of our products and services were so successful in the beginning, when we were dealing with the innovators and early adopters, yet met so much resistance when we tried to get them used by the majority of our customers. The importance of the product itself and its unique functionality in comparison to the importance of the auxiliary services and the context in which it is used is at its highest with the technology enthusiast and at its lowest with the conservatives. We, however, were creating products as if all our customers were innovators or visionaries.

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[2]William Davidow, Marketing High Technology (New York: The Free Press, A Division of MacMillan, Inc., 1986).
[3]Michael J. Lanning and Lynn W. Phillips, "Building Market-Focused Organizations (A More Realistic Path to Business Success)", Copyright 1987-1993.
[4]Geoffrey A. Moore (pg. 28).
[5]Both Geoffrey Moore (pg. 9) and William Davidow (pg. 30) refer to this adoption curve and the resultant marketing model.

The majority of the deans, as one could predict, shared the characteristics of the Mainstream Market in terms of the adoption of computing technology for general use in their schools and colleges. If they were going to accept new technology and support the new computing environment, we would need to understand their research, curriculum and administrative goals, gather their requirements, understand the key value of each product to them, and provide them with technology that was directly related in measurable ways to accomplishing their vision. We had to find a way to walk in the deans' shoes and understand their schools' culture, financial constraints, and practices.

Whole Products

We went on to validate the model against our past experiences and the many comments we had gathered from working with our customers. This abstract understanding of what had been happening led us to the next important and helpful concept: complete or whole product.[6] This concept is summarized by Moore:

> "There is a gap between the marketing promise made to the customer—the compelling value proposition—and the ability of the shipped product to fulfill that promise. For that gap to be overcome, the product must be augmented by a variety of services and ancillary products to become the whole product."[7]

A whole product is the totality of what a customer buys. It starts with the device or service from which the customer gets direct utility and also includes a number of other factors, services, or perceptions, which make the product useful, desirable, and convenient. According to Moore, the whole product must be available from the start to satisfy the Mainstream Market.

In ITD whole product means that for each product or service we create or offer, we must think about the ancillary needs for additional software, additional hardware, network connections, remote access, training, documentation, consulting support, publicity, standards and procedures, installation, and system integration services (accounting, billing, authentication). To get our products successfully adopted by the majority of customers, we must ensure that if any of these is necessary to use the product, it is available to the customer. If we cannot provide it directly, we must seek alliances with those who can.

Identifying and understanding our customers in addition to knowing ourselves and our capabilities is the key to our understanding the reason a customer buys or uses our products. This is also the key for identifying the ancillary services and products that must be available. We believe we will be successful if our whole products are oriented toward our customers' processes. Our partnerships with the deans are a critical factor in this understanding.

By working closely with the deans as well as faculty and student on the projects they perceive to be important to their missions, we are able to understand their business, to know their processes and to assist them in innovations of those processes. Working with the deans is allowing us to refine our "customer characterizations."[8] When we go beyond just listening to our customers and learn to walk in their shoes, we can fully understand their requirements and needs and, most important, create the product that will best provide their "must have"[9] benefits. Our goal is not to leave our customers' success to chance or luck. Rather we seek,

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[6]Concept originated with Theodore Levitt, The Marketing Imagination and is used by William Davidow, Marketing High Technology.
[7]Geoffrey Moore (pg. 110).
[8]Ibid (pg. 94).
[9]Ibid (pg. 101).

through partnership with our customers, to understand their problems and solutions in their entirety and work to ensure they get the whole product.

THE PARTNERSHIP PROCESS

ITD's partnerships with the deans is one approach to the challenge of creating whole products they will choose. Our partnership program, created to provide customized access to ITD expertise and resources in accord with the priorities of the academic units, has four major goals:

- advance the academic priorities of each school or college;
- create a closer working relationship with the dean and faculty leadership in the unit;
- increase the information technology capabilities of the University; and
- ensure that ITD products and resources support school and college needs.

We identified three essential steps to the partnership process: identify opportunities; create the partnership and negotiate the focus and responsibilities; and manage the partnership. Our goal was to begin the process with five schools in the fall of 1993, but first we needed to get the deans to buy into our plans.

Before we could approach the deans, we needed to sell the idea of partnerships to the Provost. This was made easier by the fact that in April 1992, the Working Group for Academic Information Technology (a group of faculty and staff appointed by the Provost) wrote:

> "...the LS&A–ITD partnership model should be made available to all schools and colleges, so that the critical expertise and resources of ITD can be harnessed to meet unit priorities; such partnership arrangements would reflect significant unit responsibility and accountability for information technology investments."[10]

With the Provost's approval, in September 1993 we presented our proposal for partnerships to the Academic Planning Group, which consists of the 17 deans and 2 Directors of the 19 academic units on campus, and the Provost. We clearly stated the intention that they would reflect significant responsibility and accountability for information technology investment on the part of each school or college. Both ITD and the unit were required to invest significant and equivalent resources; financial commitments had to match. ITD and the school or college had to designate an individual responsible for the joint management of the partnership activities. We did not want the partnerships to be viewed as gifts.

Our proposal did not receive overwhelming acceptance at first. While all academic units on campus are coming to understand the criticality of information technology to the accomplishment of their academic and research goals, we were well aware that some units were farther along the adoption curve than others. Because our intent was to develop agreements that included matching funds and clearly stated priorities, we chose to invest time up front with some units to develop information technology plans that complemented their strategic research and teaching plans. These efforts, along with direct contact between the Vice Provost for Information Technology and each dean, calmed their suspicions and garnered their support. The deans agreed to proceed, and several of them volunteered to begin immediately.

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[10]Wendy P. Lougee and N. Harris McClamroch, Co-Chairs, "Report of the Working Group for Academic Information Technology," (University of Michigan, April 1992).

THE NEW PARTNERSHIPS

The deans who came forward had a range of needs and ideas. A few had been working with ITD already on various joint projects and initiatives, and it was a small step to incorporate these activities into partnership agreements. Others came forward with specific instructional and research goals. And others, recognizing that the campus computing environment was shifting from mainframe-centered to distributed and that the technology investment within the school had to increase, raised the need to engage in comprehensive strategic planning. We went into the discussions in January of 1994 with a commitment to forge multi-year agreements that would address these varied needs.

The School of Education: An Instructional Technology Partnership

Of the remaining 18 academic units, the School of Education was the first to enter into an agreement with ITD. Education enrolls 500 undergraduate and graduate students and has roughly 150 faculty and staff. The School had recently invested significant resources in multimedia and instructional technology, and had received a generous gift from the Prechter Foundation that allowed them to develop an interactive multimedia research lab.

The dean saw a leadership role for the School in integrating instructional technology into the higher education curriculum. The partnership, from his perspective, needed to support increased activity among the faculty for the development of instructional applications and increased investment and support for in multimedia classrooms and facilities. With ITD planning to move one of its campus computing sites into space in the School of Education building and a corresponding shift in the focus of that site towards away from general purpose computing and towards multimedia technology, a three-part environment emerged: an innovative multimedia research environment for Education faculty; a cutting edge, well-equipped multimedia classroom for teaching Education students with and about instructional applications; and an open-access, multi-media computing site where products and services could be deployed and used.

The components of the agreement emerged easily from these discussions. Funding was established for

- an instructional applications development program modeled on the LS&A partnership;
- purchase of specialized equipment and software for Education faculty and as availability allows by faculty outside of the School; and
- onsite technical support in the School's multi-media classroom.

Our negotiations also established processes for decision making. As with the LS&A agreement, a faculty member was designated to work with other faculty in the School and with ITD's Office of Instructional Technology, and the half-time staff member identified to provide support for the classroom was brought into the team of existing technical staff in the School, so that efforts could be fully coordinated. An initial equipment purchase had already been made, for a non-linear video editor, and we agreed to continue collaborative efforts on later purchases.

The School of Natural Resources and Environment: A Geographic Information Systems Partnership

The School of Natural Resources and Environment (SNRE) has 600 graduate and undergraduate students and around 115 faculty and staff. A faculty committee in SNRE had been working with staff from ITD for several months on the development of a Geographic Information Systems (GIS) facility to support research and instruction. The GIS discussions became partnership discussions, and by March of 1994 agreement had been reached on funding and priorities.

GIS technology represents a strategic step forward for the School. Remote sensing and mapping were key elements in many of the School's disciplines, but existing facilities and equipment were outdated. GIS technology is widely used as a resource management tool in the types of public, private and non-profit organizations with whom SNRE collaborates and where SNRE graduates find employment. It was clear to the dean and to faculty that the school needed to invest in GIS, and at the same time, participate in the growing campus-wide efforts as other academic disciplines found application for GIS technology and data. The SNRE dean wanted to provide a leading edge facility for the use of GIS and natural resource scientific computing, and support for the integration of GIS into the SNRE curriculum.

The SNRE faculty committee, with ITD, had already identified a key element in developing a facility: the space. SNRE and ITD agreed to renovate and refocuse an existing ITD campus computing site located in the school. The space lent itself to subdivision—a smaller research area in roughly a third of the space with restricted access to high-end GIS equipment and applications, and a larger instructional facility in the remaining two-thirds for teaching and using GIS applications and data. The instructional side would also remain an open, general purpose computing site, which allows ITD and SNRE to leverage existing resources for the maintenance of standard workstation platforms and productivity applications.

The partnership included funding for

- renovation of the space (removing a closet, building a wall between the research and instructional sides;
- Unix, DOS/Windows, and Macintosh workstations and servers;
- GIS applications (ArcInfo, Erdas, Atlas GIS, etc.);
- technical staff support for the research side and coordination with ITD Campus Computing Sites group on support for the instructional side; and
- operating costs to pay for site license and software maintenance; supplies and consumables within the facility; and equipment repair and replacement. Fees were established for the research side to recover a portion of the operating costs.

The Institute for Public Policy Studies: An Information Resource Partnership

The Institute for Public Policy Studies (IPPS), with 135 graduate students, is one of the smallest academic units on campus. With a quantitative social science focus, the Institute relies heavily on access to statistical and econometric data and information resources. Several faculty members are already well known for their work in economic policy and the national information infrastructure. The Institute Director designated two faculty members to work with us on the partnership. Our discussions focused primarily on developing an archive of social science and telecommunications research information. The archive would be a well-edited, well-structured collection of policy information, accessible through the Internet.

Such an archive would accomplish two major purposes: IPPS could provide its graduate students with experience in the development of information resources and could integrate the envisioned collection into its curriculum, and ITD could collaborate with IPPS on the technical aspects of developing an infrastructure for information resources.

The IPPS partnership represented two other elements that were echoed in several others that followed. One was the need to invest in the unit's technology infrastructure in order to take the next step forward. IPPS needed to upgrade its graduate lab and replace other workstation equipment. It also needed to increase on-site support available to the lab, the Institute's LAN, and the Unix system used as the platform for the archive. The second was the knowledge that there were other areas IPPS and ITD could collaborate on, such as garnering funding for campus-wide site licenses for commercial resources like LEXIS and Legislate and other tools for information resource development and navigation.

Funding was concentrated on four priorities:

- support for faculty to develop the archive;
- equipment funding for a Unix server and lab workstation upgrades;
- technical staff to provide on-site Unix systems and network administration for the Institute;
- developing other initiatives for the second or third years of the partnership.

The School of Social Work: A Strategic Planning and Instructional Partnership

The School of Social Work enrolls approximately 450 graduate students and has approximately 140 faculty and staff. It is one of the nation's leading schools of social work, and had recently acquired an energetic new dean. It was clear to her that the School needed major investment in technology across the board if it was to continue to make innovations in social work curriculum and research. The dean was also highly committed to building an open and collaborative community within the School, and as we began our partnership discussions she in turn opened them up to a committee of faculty and staff to assist in setting priorities. The Social Work partnership manager, assigned to assist with this planning process, became part of the committee.

The dean set forth a goal to develop the School's internal resources to take advantage of new technologies for research, instruction, and administration. Thinking long term, the Social Work computing committee conducted needs assessments and engaged in ongoing communication with faculty, staff, and students throughout the School. The list of wants and needs was long; identifying priorities was critical. The top priority emerged early in the discussions: equipment upgrades. A recent campus-wide Ethernet project had provided funding for much of the School's connectivity needs, but the workstations available to many faculty and staff were not capable of taking advantage of the higher-speed network. For Social Work to move forward on its agenda for instructional technology development and integration into methodology courses, development of distance learning projects and research initiatives, re-engineering and innovating its administrative data and processes, and taking advantage of the new distributed computing environment on campus for its electronic communication and statistical computing needs, it needed to invest in equipment and support.

As with IPPS, the partnership agreement we negotiated with Social Work included the immediate priority of capital equipment investments, with money set aside in the later years of the partnership for other initiatives that would build on the foundation laid in the first year. The Social Work and ITD representatives, including the dean, also established a communication mechanism for ongoing planning as the School's overall capability was raised. Funding was focused on four areas:

- equipment upgrades, with an additional push to establish a capital equipment replacement fund;
- instructional technology development initiatives;
- process innovation efforts for administrative data and systems;
- distance learning projects, particularly for outreach to community service agencies and social workers in the field for in-service education.

THE FUTURE: LESSONS LEARNED ABOUT WHOLE PRODUCTS

We are still at the beginning of gaining a solid understanding about whole products for an academic audience. Our partnership relationships are helping us see some of the driving forces in an academic unit—the need to show the link between new technology and academic productivity; the need for faculty to drive the integration of technology into the curriculum and research activities; the need to tap the academic spirit of experimentation and innovation by investing sometimes small amounts of money in a piece of equipment or a demonstration project; the need to keep administrative costs low in favor of building faculty quality; and the effectiveness of ad hoc communication (faculty hear information from each other more readily than from official communication from the top or from outside the unit).

Many academic units look for what they can use of what others have done; communicating about projects within each school or college as well as across all of them cuts down on reinventing the wheel, and takes a burden off individual faculty and individual units to research alternatives and options. Academic units are sensitive to the amount of time it takes to learn and use information technology; the payoff for the time investment needs to come quickly, and the transitions need to be smooth and seamless.

The partnerships themselves often include product and service development activities that will allow ITD to experiment with the right mix of ancillary services. Through the partnerships we are learning more about academic unit processes that technology needs to support and facilitate: class preparation, homework assignments and grading, grant submission, administrative information management. A key factor in this learning is making a connection to the disciplines in each school and college. Wherever possible, we have assigned a partnership manager who understands the main business of that unit and the unique ways in which technology is used there. We have also integrated the support staff assigned to each partnership with other support staff in the school or college, creating a team approach to consulting, training, and other support activities.

CONCLUSION

As of November 1994, ITD has negotiated partnerships with 13 of the 19 UM academic units, and discussions have begun with all but one of the remaining 6. By the end of 1995-96, we expect to have 19 agreements. We have seen common themes emerge, many of which fit with ITD's long-term strategic priorities, such as investing in infrastructure and equipment, developing instructional applications, developing distance learning initiatives, information resources management, and process innovation services. We have seen a major trend away from general purpose computing sites towards more specialized ones (Education and SNRE are just two examples), which will have implications for how students do their computing in the future.

Challenges have abounded, and will continue to do so. We have had to balance the need to invest in the future with the need to invest in right now. As we near the end of the negotiations and move into managing these agreements, we will need to continuously revisit priorities. Most importantly, we have established closer working relationships with our academic customers and the deans. By working together on specific planning, development, and support activities, we are truly walking in their shoes.

Models for Partnering with Education

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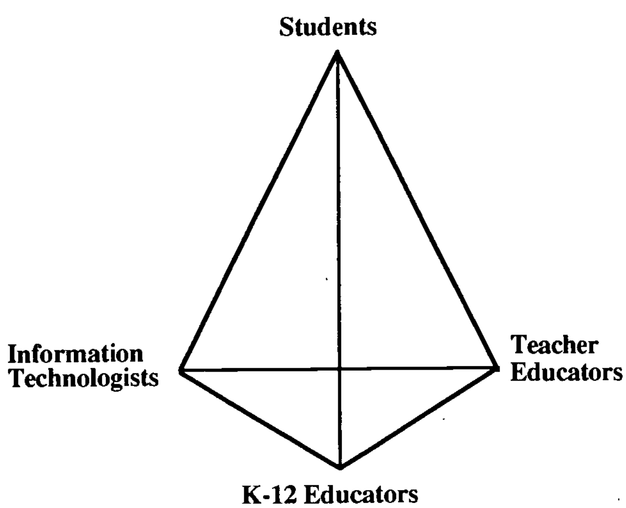
Abstract

The ultimate goal of K-12 education is the creation of students who are seekers of knowledge and skilled in its acquisition. However, limited access to sources of information such as Internet restricts achievement of this goal in most schools. A model in which information technologists partner with teacher educators who in turn partner with K-12 teachers has the potential to effect positive change in the educational environment of K-12 students. This process of triangulation incorporates the technological expertise and resources of information technology, the established collaboration with K-12 of the Colleges of Education, and the classroom rapport of the K-12 teachers.



MODELS FOR PARTNERING WITH EDUCATION

The rate of technological change is both rapid and unpredictable, while the methods for delivering educational services in our elementary and secondary schools have remained primarily unchanged. New technological developments, particularly the emergence of the national network and associated services and multimedia applications, offer renewed hope that the technology can and will significantly improve instruction for K-12 students. Technology supports different learning styles of students and allows students to spend less time with the mechanics of researching topics and more time analyzing and synthesizing the information. What are the respective roles that information technologists and teacher educators in higher education play in the change process?

Model

The ultimate goal of K-12 education is the creation of students who are seekers of knowledge and skilled in its acquisition. However, limited access to sources of information such as Internet restricts achievement of this goal in most schools. A model in which information technologists partner with teacher educators who in turn partner with K-12 teachers has the potential to effect positive change in the educational environment of K-12 students. The illustrated model (Figure 1) capitalizes on the traditional roles and delivery services of the partners, but it reflects a new awareness of technology services and needs. This process of triangulation incorporates the technological expertise and resources of information technology, the established collaboration with K-12 of the Colleges of Education, and the rapport in the classroom of the K-12 teachers.

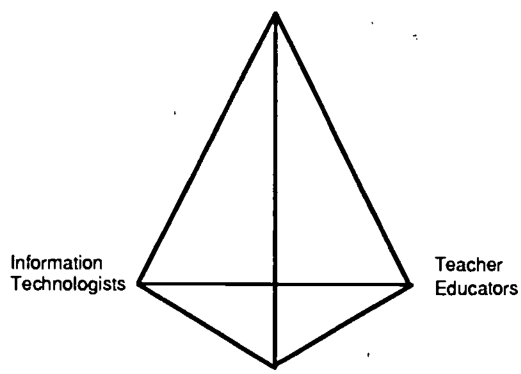


Figure 1: Model for Partnering

Technology holds the promise of supporting a student-centered learning environment, one in which students can explore and develop critical thinking skills, placing the focus on the student as the consumer, the customer. If the K-12 students are customers of the K-12 teachers, then the K-12 teachers are customers of the teacher educators and the teacher educators are customers of the information technologists on campus.

The Coalition for Networked Information (CNI) serves as a good example of a partnership model. The librarians and information technologists function in a natural synergy. The librarians are responsible for managing information content and for providing access to information while the information technologists are responsible for developing and sustaining the required computing and communications environment. There seems to be a need for a similar cooperative arrangement between K-12 teachers, teacher educators, and information technologists.

Technology in the Teaching and Learning Environment

Higher education is addressing the impact of information resources in teaching and learning. EDUCOM has announced the formation of the National Learning Infrastructure Initiative(NLII). The goal of the NLII is to demonstrate how information technology can improve learning and the cost effectiveness of instruction on a national scale. The technologies that are going to make this goal a reality will exceed those currently available over the Internet. They will utilize the emerging National Information Infrastructure(NII) and the expanded services that will be deliverable over this network of networks. The customers in K-12, the students, need to participate in this network environment and have access to information. Interaction with computers should become a normal part of the daily lifestyle and educational experiences of every student.

In Goals 2000: Educate America Act: A Strategy for Reinventing Our Schools, President Clinton calls for a collaboration of parents, businesses, community organizations and public and private agencies to be part of community-wide efforts to support students and education. Information technology professionals in higher education should play a key role in this partnership by engaging in community and campus outreach programs. The outcome of this collaboration should be the establishment of an institutional plan -- an educational technology partnership model -- that defines areas where there are opportunities for building cooperative initiatives on a grass-roots level. Educators and information technologists seem to share the vision of a new educational environment in which technology improves the productivity of the teachers and the effectiveness of the learning process. What is not so clear is the means by which this will be accomplished and the respective roles of the teachers and the technologists.

The Teacher Education Partner

The business of information technology is technology, and the business of teacher education and K-12 teachers is education. Therefore, technologists and teachers are approaching the educational enterprise from two different directions. Information technologists are creating or providing the impetus for the creation of new resources and devices for accessing and linking resources. On the other hand, educators are seeking ways to improve teaching and learning and view technology resources as potential tools to achieve this goal.

The role of the teacher educator is to project beyond what technology can do to emphasize what should be done educationally with technology. Teacher educators serve as the liaison between the cadre of knowledge and skills for effective teaching and learning of K-12 students as the trainers of K-12 teachers. The process occurs at two levels: a) at the undergraduate level, they develop course and field experiences for the preservice teachers; and b) at the inservice level, they collaborate with the K-12 teachers to redefine goals, revise curriculum and content, identify new teaching strategies, and evaluate outcomes. In the last decade, assessing the informational needs of the K-12 students, identifying and implementing technology and personnel resources, developing the content and implementing the training/delivery modes for technology based instruction, and evaluating the educational impact of the enhanced access have become critical components in the teacher education process.

Some educators hypothesize that education is changing positively due to students' exposure to computers and other multimedia tools. However, others lament that the technology infusion has weakened the curriculum and emphasized "glitz and glamour." The profession seems to be at a crossroads in terms of the role technology will play and the depth of technology preparation in preservice and inservice education programs. Support for the role of the teacher education partner is provided by the Dean of the College of Education. Budget, personnel, and facility allocations are impacted by a commitment to technology training. In addition, the dean is the key player in negotiations with campus information technology as well as the K-12 sector.

Technology Skills

Identifying the technology skills needed by a K-12 teacher must be predicated on the educational goals for the K-12 students. At the preservice and inservice levels, teachers must achieve a level of comfort with the tools before the technology is integrated into the classroom and used by students. Therefore, the curriculum for teachers must include a strong skill-based technology component: integrated software, networking, hypertext and hypermedia, CD-ROM and laser disk resources, and presentation software.

What is the most effective model for acquisition and implementation of these skills? At the preservice level, students should gain these skills in discrete courses in their first two years. As they continue in the teacher education program, they should have the opportunity to utilize the skills as they design teaching strategies in methods courses and exercise these strategies in field experiences in the schools. At this level, they should be taught using technology, allowing them to experience technology-based instruction, internalize the methodology, and learn to manage the environment. Resources within the College of Education must include a model classroom if the professors are to model effective teaching.

Collaboration traditionally exists between the Colleges of Education and the K-12 sector through preservice field experiences and continuing professional development activities. Therefore, at the inservice level, assessment, training, and development may take place outside structured graduate courses and may occur at the school site. Due to the extended time from preservice or formal graduate training to access to technological applications in the schools, teachers may lack the requisite knowledge and skills, causing inhibitions and neglect. Teachers need the opportunity to develop personal productivity skills in the school, and intense training conducted in the College of Education or in information technology.

Training

Training needs to be designed to allow teachers to be involved in content preparation rather than technology preparation; teachers do not need to be developers but rather expert managers of technology-based instruction. Training for K-12 teachers should include the following components:

* Access to technology resources and technology-based educational programs
* Assistance in the assessment of how technology will change the roles of teachers and students
* Implementation of strategic planning techniques for formulating district-wide technology plans and implementing successful professional development programs
* Adaptation of teaching strategies to use technology to promote collaborative, interdisciplinary, and multi-level instruction as technology changes
* Development of plans, techniques, and strategies to involve students directly in producing multimedia projects
* Development and effective use of school-wide networks
* Linkage of classrooms to community- and state-based networks
* Utilization of worldwide Internet resources for students

Evaluation

The training designed by the teacher educators should include an assessment component that makes the process interactive (See Figure 2). As training is delivered in the schools, its effectiveness is evaluated by teachers' acquisition of knowledge and skills. As the technology-based instruction is implemented, the effectiveness is measured by the educational impact on the students. However, traditional quantitative assessment instruments are not adequate to measure effectiveness in a technology-based curriculum. In a collaborative environment the emphasis shifts from the acquisition

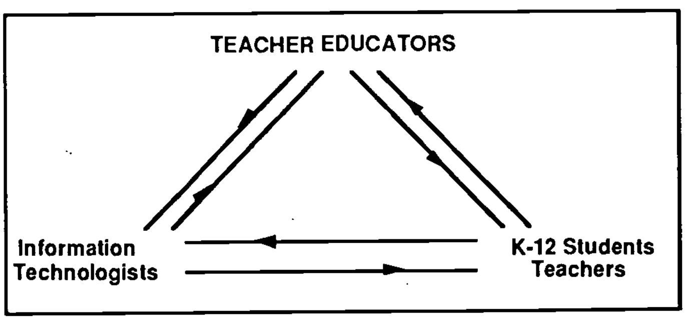


Figure 2:Interactive Planning

of facts to the application of processes to discover, associate, and disseminate information. These changes in goals and outcomes require the development of qualitative measures and training in their use. Feedback from these evaluation measures in conjunction with evolving innovations in resources and access from the information technologists provides data for revisions in content and delivery.

The K-12 Partner

Access to technology-based resources and global networks gives K-12 teachers the opportunity to make learning more relevant to students by providing more "real world" experiences. However, at this time, the concept of "networking" means "sharing printers" to many teachers. Their lack of enthusiasm for having network access may stem from their lack of knowledge of the valuable resources available to them and their students. Limited exposure, lack of quality hardware and software, and haphazard training has combined to cause technology to be viewed as an obstacle in many schools.

The goal is not "technology just for technology's sake" but rather the creation of an environment where multimedia technology is supporting a variety of important skills in a sound instructional design. Teachers can enable students to learn and practice skills to help them succeed in college and/or the workplace, expand their communication skills, emphasize higher-order thinking skills, increase their technology skills, and increase involvement in their own learning.

At the school and district level administrators are significant components of the K-12 partner in the model. Ultimately, the principal is responsible for the school strategic planning process, which includes not only curricular direction but also the financial and management support for acquisition of hardware and software and professional training for the teachers. At the district level, the administrator provides the leadership to partner with the higher education institutions and other community resources.

Examples of specific technology-based skills which K-12 teachers can employ to enhance curricular goals include:

* Publishing, which assists students with the development of writing skills and the ability to work collaboratively
* Graphics, which provides students with the tools to illustrate their ideas and develop symbolic representation
* Hypermedia, which causes students to formulate association of ideas
* Telecommunications, where students have the opportunity to network with public news services, communicate with other students, and participate in linking projects. One international linking project that has been initiated by Vice-President Gore is the GLOBE project. GLOBE provides students and teachers the opportunity to be involved in real-world scientific procedures

collecting data, finding patterns, assessing results; the expansion of cultural, social, and environmental awareness; and in collaborative problem solving

* Multimedia with video technology, in which students create personal story boards to reflect research of a topic and link the content with computer technology to create interactive productions

The Information Technology Partner

Most colleges and universities are currently in the process of building campus networks. They are attempting to integrate classrooms, faculty and administrative offices, dormitories, and off-campus residences into an infrastructure that will support the delivery of new forms of instruction and administrative services. The effective delivery of teaching and learning will be dependent upon technology models that utilize networks and interactive multimedia applications. While most colleges are at least in the process of planning for the transition to a networked environment, the planning is not necessarily happening at K-12 level. It is easy to anticipate that many K-12 school systems will be unprepared to take advantage of the emerging educational technologies.

Information technologists think of building the campus network infrastructure. At the College of Education or the K-12 level, the concern is likely to be just getting a connection to the Internet. Information technology managers talk about building a new systems architecture while school administrators and teachers are frustrated by their lack of on-line access to student records. Information technology planners envision multimedia applications accessible from every desktop when teachers do not have adequate computers to handle applications that are available today. Many schools have microcomputers that are 10 years old. Information technologists think about linking to the national network, while teachers think about just getting access to their first PC or to some adequate training.

Professional education organizations have appealed to the federal government to provide funding for connecting schools and libraries to the national network. Despite the lofty goals of the present administration in Washington, D.C., the solution does not lie solely in federal funding for computers and communications. Technology alone is not the only solution. Information technologists in higher education can provide a very valuable, but not costly, set of services and expertise to promote partnerships with K-12 school systems and to assist local communities.

Before the partnership is established, there must first be a relationship. Information technologists have to first recognize that the integration of technology into K-12 curriculum is not only a national concern but also a basic support commitment for local K-12 schools and affiliated Colleges of Education. The first step is to get a clear understanding of the educational system and the traditional processes by listening, before trying to present new or innovative solutions.

In developing a relationship with a K-12 school systems, it would seem prudent to limit the number of affiliations. Select school systems that already exist within the virtual community: local community schools; schools with strong inservice teacher training relationships; prime feeder schools that provide quality applicants; inner-city or disadvantaged school systems. Beyond the social responsibility for support to the K-12 schools, there are some financial reasons for developing direct relationships with the K-12 schools. It is likely that future federal funding for educational technology in higher education will be strongly influenced by the formation of partnerships with K-12 schools and with other technology providers. This is the case with the National Telecommunications Infrastructure Act(NTIA), which in October 1994, announced the first set of award recipients. Partnering is a major criterion in the proposal guidelines.

After gaining an understanding of the roles and needs of the technology partners, information technologists can begin to evaluate possible means of employing other elements in the partnership model. The following are some ideas of possible community and campus outreach initiatives:

Awareness

The most valuable asset that the information technologists possess is technical expertise and a knowledge of trends in the industry. Organizing awareness sessions and workshops for K-12 teachers and teacher educators or inviting them to participate in existing open campus presentations are a means of exposing them to current applications.

Strategic Planning

Information technologists have expertise in the construction of strategic plans for computers and communication. The campus planning experiences can assist local school systems to develop school, and possibly municipal, technology plans. The addition of the campus chief information officer's name to the school or community plan will add credibility as well as expertise.

Training and Staff Development

The lack of training is the one area that is likely to inhibit the acceptance of technology in the classroom. Information technologists can expand formal training sessions to include higher education teacher educators, K-12 teachers, and students in the same mix. The training should occur on two levels: a) instruction in basic skills; and b) development of a select group of teachers and students who can serve as innovators, role models, and trainers. In many cases the students are going to be more expert in the use of computer software than the teachers. Rather than avoid the issue, the model should encourage the initiative of students. Applications developed by the ultimate consumers, the students, also have the advantage of drawing attention to the positive use of technology.

Networking

Many institutions have launched community outreach projects, the most common being the support of a "free net" for local access by K-12 teachers and students to services on the Internet. Some institutions have begun to act as central clearinghouses for educational material and allowing access over the World Wide Web. There are also ambitious community-based projects, such as the Boulder Community Network in Boulder, Colorado. The University of Colorado is acting as the central information gatherer and server for a broad range of community information.

Classroom Facilities

Schools of Education need to have lab classrooms that replicate a modern K-12 classroom, not a classroom designed around old technology that may be present in the k-12 schools. Teachers are willing users of technology in the classroom but not at the expense of learning by the students. Teachers want to concentrate on class content, not technology preparation and troubleshooting. The hardware and software vendors need to design and support bundles for the K-12 classroom that are reliable, are easy to use, and provide plug and play capabilities.

Equipment

At times K-12 schools have been the recipients of outdated equipment donations from higher education institutions. This practice may only exacerbate the problem. Higher education institutions need to re-evaluate this approach to consider how to assist with acquisition of at least one multimedia network accessible desktop system. Consider the establishment of seed programs to promote the awareness and use of advanced applications.

Funding

School systems will probably always be grossly underfunded, and the primary appeal to municipal governments will be "We need more money to buy more new computers." One of the anticipated advantages of a strong partnership program is the ability to generate other sources of funding. If the school system is an integral part of a community network, the local municipal officials and businesses can witness the usefulness and effectiveness of technology. Demonstrated results will increase the chances of obtaining funding from both local and government sources.

Other Technology Partners

Information technologists already have long standing partnership relationships with the vendors and providers of technology. For example, one logical partner in the educational technology partnership model is the cable TV companies that already have coaxial cable running into homes and classrooms. Just as teacher educators can renew and maintain traditional collaborative relationships with K-12 teachers and publishers, information technologists can encourage and coordinate the introduction of other technology partners into the model.

CONCLUSIONS

Information technologists and teacher educators share a vision that technology enables the creation of student-centered learning environments that increase teacher productivity and improve the critical thinking skills of K-12 students. In the realization of that vision teacher educators are going to continue to play the pivotal role of providing formal education and imparting the necessary skills to the K-12 teachers. This process encourages the formation of a coalition on campus, a partnership between information technologists, teacher educators, and K-12 teachers. The strength of the coalition will depend largely on the conviction of the partners and the management support from within the College of Education and information technology. While information technologists will want to promote the technological components of the educational technology partnership model, it is going to take time to break cultural barriers. Information technologists can speed the process of acceptance and implementation by first establishing credibility by attending to the immediate needs for training and operational support.

BUILDING PARTNERSHIPS ON BEST PRACTICES:

NEW ALLIANCES FOR THE NINETIES

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Two major changes have evolved in the management of higher education over the past several years: 1.) repositioning, downsizing, restructuring, and reengineering, have resulted in new ways of administering institutions and, 2.) the administrative information systems (IS) needed to support the "new business model" have not been developed "in house" and are not available "off the shelf" from vendors.

This paper addresses what to do about the immediate IS support dilemma as well as lay groundwork for an overall strategy for *restructuring and the role of information technology*. The emerging role of partnerships among institutions and between consortia of institutions and service/software vendors is crucial to leveraging the gains being made through restructuring.

Context

The impact of business process reengineering is being felt on campuses across the country. In the past two years, many universities have redesigned their core administrative processes and identified dramatic opportunities to improve the quality of service to their customers as well as to reduce the cost of administration. In many of these cases, the successful implementation of the redesigned process will be greatly dependent upon the availability of a new breed of administrative software.

Changing Business Models

The administrative software in use on campuses today, whether it has been custom developed or a vendor package was designed for the business model of the 1960's, 70's, and 80's. That historical model was characterized by:

- large, "back offices" processing transactions in batch or on-line modes;
- use of automation technologies to facilitate paper processes;
- centralized controls and decision making;
- limited information in the hands of customers.

The role of administrative systems in this business model has been to provide effective ways to process large volumes of transactions and provide some capability for the end-user to view the impact of the transaction after it has taken place.

Process reengineering or "BPR" (as well as other initiatives such as Total Quality Management and Organizational Restructuring) is bringing about a fundamental change in higher education's historical business model that will have a profound impact on the systems that support it. While the creativity that is unleashed by BPR will bring about redesigns that vary by campus and process, there are several central characteristics common to all of these initiatives that will define the business models of the 1990's and beyond. These characteristics include:

- placing decisions in the hands of the customer;
- eliminating, not automating non-value added worksteps and transactions;
- placing information in the hands of the end-customer; and
- moving transactions out of the back office and into the customer's without creating an administrative burden.

In this new business model, the focus of administrative systems will shift from "back office" processing to "front office" information. The financial, development, student and human resources systems required to support the implementation of redesigned processes must move beyond automated transaction processing to support the central administration and provide the features and functions required by the end-customer. The reengineered administrative system will need to:

- provide information, not data to the end-user;
- have flexible business rules to enable processes to be customized for different customers;
- support new sets of institutional measures which cut across organizational boundaries; and
- provide an internal control framework that is invisible to the end-customer.

Reengineering, while it seeks to limit the need for technology, still requires a strong set of core administrative systems to support its redesigned processes. These systems however, will be dramatically different tan those available today. The critical question confronting those implementing BPR is what is the best way to develop this new generation of information systems.

(The following points outline the key issues to be developed during the presentation and discussion on December 1, 1994 at CAUSE94. A more detailed outline will be available for the presentation including copies of the slides used. In addition, new issues raised during the discussion will be integrated with the final text.)

<u>The Emerging "Best Practices" in Higher Education</u>

- Restructuring and reengineering
- What have we learned in the process areas (financial, student, procurement, etc.)
- Where is IS support needed?
- The Challenge of the reengineered process confronting the available software

<u>The State of IS Support</u>

- Status Quo institutions
- Institutions in transition

- Institutions "on the verge" -- ready for the next step
- Client/Server "on the lips"

The State of Packages

- What is available today
- What works and why
- How are vendors responding
- Is there life in "off the shelf"
- Encouraging words

Other Options

- Home grown
- Vendor supplied
- Joint institutional development
- Joint vendor development
- Institution/Supplier partnerships
- Resource pooling

Strategies for Action

- Consolidate and propagate restructuring/reengineering gains
- Identify commonalties of interest and administrative practices
- Develop partnership criteria and success measures and milestones
- The "pooled resource" model
- Models for collaboration and project management
- How to get started

Chasing the Boulder Down the Hill: Reengineering and Architecture at the University of Pennsylvania

CAUSE94
Orlando, Florida
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Abstract. Penn is one of the first universities to combine the reengineering of business processes with an information technology architecture. At CAUSE '93 we talked about pushing the boulder up the hill—convincing people to play when the stakes are so high, negotiating consensus, and planning for flexibility. A year later, we're running to keep up with the boulder as it plunges down the other side. Financial processes will look very different at Penn, a data warehouse for management information has been built, and the first pieces of a new client/server financial system will be in place next year. Partnership is still the issue—the pairing of reengineering and architecture, the partnership between the central information technology group and the Division of Finance, and a new set of relationships as the application vendor has joined the mix. And as old boundaries shift in the client/server world, we're finding that the old rules for partnership are changing. This session follows Penn's partnership of reengineering and architecture as it moves from courtship to reality.

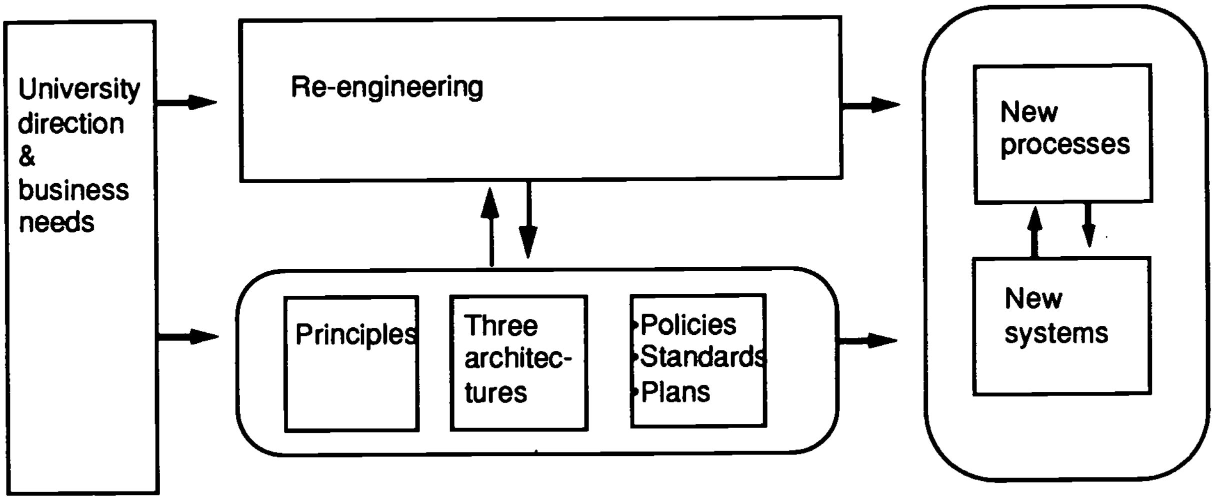
Chasing the Boulder Down the Hill:
Reengineering and Architecture at the University of Pennsylvania

Penn is one of the first universities to combine the reengineering of business processes with an information technology architecture. The intent of this multi-year effort, called "Project Cornerstone," is to streamline Penn's business processes and put in place new information systems to help make those changes possible. Cornerstone is a working partnership (keys to each other's offices have been exchanged) between the Division of Finance and Penn's central information technology group. The project pairs two methodologies—Business Process Reengineering, with its techniques for rethinking ways of doing business, and Information Engineering, which establishes an architectural framework.

Since Project Cornerstone began in 1992, Penn has redesigned its purchasing process and its basic accounting structure. We have published principles for using information technology, created a University data model, and defined a technical architecture. We have acquired from Oracle Corporation a new general ledger accounting system and a new purchasing and payables system (to be operational in 1996), along with Oracle's relational database management system and development tools. A data warehouse for management information is in the pilot stage. All will run on Penn's new SP2, a UNIX-based parallel processor from IBM.

Today's talk. At CAUSE93 we talked about pushing the boulder up the hill—convincing people to play when the stakes are so high, negotiating consensus, and planning for flexibility. A year later, we're running to keep up with the boulder as it plunges down the other side. Today's talk focuses on four aspects of Project Cornerstone—reengineering, principles, architecture, and support. We're learning to work with new boundaries and new rules as our complicated new partnerships move from courtship to reality.

Cornerstone machinery. The diagram below suggests the interdependencies that characterize Project Cornerstone. University direction and business needs are the driving force. Administrative processes are reengineered, beginning with Penn's financial functions. A technological foundation is established that includes principles and architectural models. From these flow policies, standards, and plans. The goal is new ways of working, supported by new information systems.



New metaphors. The extensive evaluation process to choose a vendor for the first Cornerstone systems highlighted the new boundaries and new rules we're learning to negotiate. In the past, our vendor partnerships were a little like shopping in a big department store, to borrow a Gartner Group analogy. We went to one store, expecting to find everything we needed. We were familiar with the store; we knew where to find the escalators and where to get a sandwich. We were loyal to the store because it met all our needs. As we evaluated potential Cornerstone vendors, we began to realize that the department store has given way to the mall. Vendors no longer provide *de facto* architectures for their customers. It's an integrator's world, and we find ourselves shopping in the various stores of the mall to pull together a solution. The vendors cooperate among themselves to draw us to the mall where we'll buy their individual products. In that world, our own partnerships with vendors are more fleeting business arrangements, based of necessity on solid negotiation and contracts.

The process of choosing a vendor for the first Cornerstone systems also highlighted the new interdependency of technologists and their business counterparts. The decision points were far too complicated for either side to act alone. The evaluation phase seemed to go on forever, but paid off in mutual learning. It laid the groundwork for the technologists to understand business issues down the road, and vice versa. Both sides began to realize how *hard* the decisions on the other side really are. In the end, the vendor decision was based firmly on business needs as well as technical soundness. This didn't happen by accident; Penn's approach includes a structured evaluation methodology.

Reengineering

Trying on new suits

Penn is a large, decentralized private research university. Many administrative processes have become cumbersome, disjointed, and slow. The division of labor between schools and central groups is not as clear as it could be, and Penn needs to improve its ability to make decisions and make them quickly.

Imagining it. Starting with the purchasing process (the first commandment of reengineering is you have to start *somewhere*), we began to imagine a new way of doing things. Schools and administrative offices will buy and pay for goods themselves, greatly speeding up the results. The central purchasing group will spend its time negotiating with vendors, providing systems and training, measuring results, and generally helping the field—acting as corporate guarantor of quality.

It was hard for the central groups to imagine letting go, to give up their checking and controlling and rekeying. And not everyone wanted to. For the sake of argument, we began playing around with the broader business rules ("OK, suppose the schools own *all* the assets; what then?"). We clarified roles and teased out assumptions as we worked our way back from extremes. We tried variations on a theme ("Say you've got satellite offices out there in the schools.") The old boundaries began to shift as we started focusing on linkages and measures.

It was mostly give and take, but some pushing was necessary. It was hard for some of us in the central groups to articulate the value we bring. If you can't define your own role, however, someone else will define it for you, and it may not be to your liking. So there was always a reason to come to the table.

Making it real. A vision is invigorating, but the time comes to make it real. Implementation is by far the hardest of the three phases of reengineering—diagnosis, redesign, and implementation. Imagining a new process is easy compared to the social and organizational changes required to make it happen. We're finding that reengineering is no more, and no less, than good management. You have to figure out what services you need to deliver and negotiate agreements that are both clear and sustainable. You have to refocus and reward employees. And you have to know when to *get out* of a line of business or adjust an employee relationship that's not productive.

We've learned some practical lessons about reengineering and we'd like to pass on a few. First, you have to have the courage to put a solution out there. Is it perfect? No. Is everything in place? No, and it never will be. But until someone comes up with a better solution, we won't be dissuaded by criticism.

Second, you have to help people see a different point of view, help them get comfortable in different roles. We asked people to try on "new suits," pairing, say, a person who manages research grants with someone from the development office. ("How do you attract funds? Where do you get leads?")

Third, you have to find rewards that work. At Penn, we made it clear that we would not invest in a new information system without first reengineering the underlying process. People are almost begging to be next in line for reengineering.

And fourth, it's impossible to communicate too much.

Principles

Keeping track of "aha" experiences

At the heart of Project Cornerstone rest twenty-six principles for using information technology, ratified by the Penn community. They include principles about administrative data, applications, infrastructure, and organization, along with a few general principles (see Appendix). The "cost-effectiveness" principle, for example, reads:

> *Information technology must contribute to the cost-effectiveness of the business functions it supports and must be cost-effective from the perspective of the University as a whole.*

We've learned a few things we would do differently if we could start over. First, we would write the principles in simpler, more direct language and we would have fewer of them. If you want people to use the principles, they have to be able to quote them. Second, it's worth asking yourself how the principles are going to *feel*. Some of our principles really sound like Penn; others are visions of what Penn could be. Both are satisfying. Others are a little preachy and didactic, and some come across as Motherhood and Apple Pie.

We've also learned some practical lessons about putting the principles into action. We are well into a number of projects that flow directly from the principles. One is a Data Warehouse for widespread, easy access to management information. A second example is the design of a new network architecture for Penn. As we use the principles to make real decisions in these projects, we're finding that the controversy and intellectual challenge lie in the *interaction* of principles. Each principle by itself seems a little obvious. It's the tradeoffs and interrelationships that are interesting. And now that costs are beginning to be attached to some of the principles, the tradeoffs are etched in sharp relief. In the Data Warehouse project, for example, people are beginning to worry about how much it will cost to have both good security (one of our principles) *and* wide access (another principle).

Second, while it's important to figure out what counts as making the principles official in your institution, that's not the same as making them useful. In our case, "official" means publication in our bone-dry, house journal of record. Our Data Administrator, on the other hand, is particularly adept at making the principles useful. It's an iterative thing, she says; you need a few projects under your belt. "Oh, that's what you mean by 'common base of data' " (one of our principles), people tell her when they hear about the Data Warehouse. She has fifteen other general-purpose, concrete examples that she uses, and she keeps track of "aha" experiences and turns them around on people. She paid a Data Warehouse marketing call to our facilities director, for example, who was thrilled with the idea that he would soon be able to get information about all categories of people at Penn. She said she wanted to jump up and kiss him because he didn't know it, but he had just bought into the "common base of data" principle. She knows the next time he wants to hold data separately, she can use it on him.

Third, each principle needs at least one champion and a natural home. The principles that seem to be going somewhere at Penn are the ones that have an "owner" (such as Data Administration). It's also important to build in continuity by assigning some of the people who drafted the principles to the projects that bring them to life. These people have used the act of developing the principles to clarify their thinking. That's something valuable; spend that experience on the right people.

Fourth, if you wait too long between ratifying the principles and beginning the projects that flow from them, the community won't make the connection.

And finally, if a concept catches on, don't worry if no one realizes it's "A Principle." While the principles as a formal document may not be widely cited at Penn, the concepts are beginning to be worked and the genre itself seems to resonate. People always seem to be saying lately, "What you need is a good set of principles for that."

Architecture

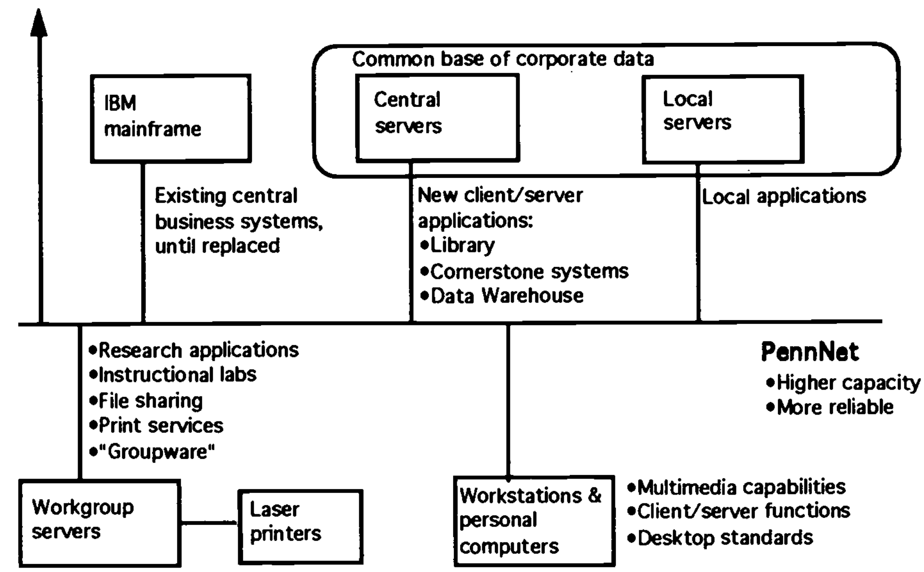
An architect's work is never done.

A technical architecture is a blueprint for making technology choices, a guide for acquiring hardware and software. Architecture is more a process than a product—with constant refinement and updating. Various pieces of the architecture are developed to different levels of detail, at different times, and according to different priorities. Penn uses a structured methodology that considers four main areas:

- The University's overall direction and business need (hard to identify in a period of senior management turnover such as Penn has seen in the last few years).
- Information technology principles (see above)
- The state of the current, or *de facto*, technical architecture
- Technology and industry trends.

Penn's technical architecture for administrative systems is known as "Direction 2000." It is a client/server architecture, focusing on servers that provide information, client desktop computers, the network that connects them, relationships with current systems, and the broader Internet.

Direction 2000—an information technology architecture for Penn



Place holder strategy. It's easy to feel paralyzed by the enormity of developing an architecture. It's important to decide which pieces to tackle first, which to defer, which to handle in depth, and which to treat cursorily. A place holder strategy helped us come to initial closure at Penn. When "Direction 2000" was developed last year, issues of networking and office automation were treated only at a very high level. We're circling back this year to fill in the gaps. (Penn's Network Architecture Task Force, the focus of another CAUSE94 talk, is one such effort.)

Web of teams. Architecture at Penn is developed by a web of campus-wide teams. Each is working on a different piece of the architecture. Coordination is a major effort. We find generally effective a combination of overlapping membership and the activities of selected individuals who "surf" the different teams to maintain focus and share information. One big challenge is keeping strategic-level groups and tactical-level groups from working against each other.

The "A" word. Some people are uncomfortable with the "architecture" metaphor to describe this level of technology planning. For many, "standards" are easier to understand than architecture. In reality, the terms represent a continuum from the highest level of abstraction (architecture) to the lowest (the actual product buy-lists). "Standards" fall somewhere in between at Penn, providing a practical interpretation of the relevant architecture while usually falling short of naming specific brands and model numbers for purchase. A good example is our new desktop standard. It is a dual-desktop strategy that recommends minimum configurations of Macintosh and MS-Windows PC's without naming specific models. Support for the minimum configurations is "guaranteed" for four years.

The semantics of standards. We learned the hard way that technologists and many in the Penn business community view standards differently. Technologists see standards as a tradeoff between one technology and another, with the goal of reducing heterogeneity. Many business people see standards as a tradeoff between technology and the absence of technology. For them, standards are raising the floor, forcing people to spend on administrative computing. It looks like a choice between administrative computing and the academic mission. Now we realize that the unusually heated discussions about desktop standards revolved around this point. "Don't tell the schools we have to choose fancy new administrative computers over Bunsen burners," our advisory groups kept saying. "But we're only trying to save you money," we kept thinking.

Support

The boundaries keep shifting.

As client/server computing brings the action to the desktop, familiar boundaries are in flux. The desktop computer and the business system flow into each other, as do once distinct areas of technology. New models of support are required.

Integrated, ongoing training. For users of the first client/server Cornerstone applications, learning to do the new business processes cannot be separated from learning to use the new technology. Penn will integrate the two kinds of instruction, and use local trainers to provide it on an ongoing basis. We believe this train-the-trainer approach, in which a central group provides course materials and pedagogical instruction, foreshadows a shift in the way training will be done at Penn more generally.

Single point of contact. With Penn's new client/server systems, the person sitting at the screen won't be able to distinguish a network problem from a desktop hardware problem or an application problem. Technologists will need to collaborate to support that person, forging new links among network engineers, developers, trainers, and hotline staff. Penn's central computing organization is therefore consolidating its separate help desks (we're calling the new entity "First Call") and establishing channels for drawing on second-tier experts.

Wherever we look, it's new partners, new boundaries, and new rules. These are exciting times to be chasing the architecture/reengineering boulder down the hill.

Appendix: Principles for information technology in administration

General

1. **University assets.** Information technology infrastructure, applications, and data must be managed as University assets.
2. **Functional requirements.** University priorities and functionality determine investments in administrative information technology.
3. **Cost-effectiveness.** Information technology must contribute to the cost-effectiveness of the functions it supports and must be cost-effective from the perspective of the University as a whole.
4. **Policies, standards, and models.** Policies, standards, models, and methodologies—based on the principles outlined here—govern the acquisition and use of data and information technology. Regular update and communication are required.
5. **Investment criteria.** Investment decisions (even those not to take action) must be based on University needs, cost-effectiveness, and consistency with standards and models.
6. **Training and support.** Penn must put sufficient effort into ongoing support of its information technology assets. Skills and experiences from across the University must be leveraged and communication channels opened.

University data

7. **Accuracy.** University administrative data must be accurate and collected in a timely way.
8. **Security and confidentiality.** University administrative data must be safe from harm and, when confidential, accessible only to those with a "need to know."
9. **Ease of access.** University administrative data must be easy to access for all groups of authorized users regardless of their level of technical expertise.
10. **Multiple uses.** Penn must plan for multiple uses of University administrative data, including operations, management decision making, planning, and *ad hoc* reporting.
11. **Purposeful collection.** A given set of data should be collected once, from the source, and only if there is a business need for the data.
12. **Common base of data.** A common base of data must be created to facilitate sharing, control redundancy, and satisfy retention requirements.
13. **Documentation.** Detailed information about University administrative data must be created, maintained, and made available.

Administrative applications

14. **Ease of use.** Applications must be easy to use for both novice and expert users. Interfaces should be similar enough to present a reasonably consistent "look and feel."
15. **Adaptability.** Applications must be easily adaptable to changing administrative and technical requirements.
16. **Data sharing.** Applications must use a common base of well defined University data and reference a common repository.
17. **Ensuring data quality.** Applications must help ensure valid, consistent, and secure data.

Infrastructure

18. **Common communications infrastructure.** Academic functions and administrative systems must share common data, voice, and video communications infrastructures.
19. **Connections within the University.** The communications infrastructure must be standardized to allow reliable, easy interaction among individuals, work groups, departments, schools, and centers.
20. **Connections outside the University.** The communications infrastructure must comply with national and international standards that allow reliable, easy interaction with those communities.
21. **Hardware and software choices.** Administrative hardware and software will be limited to a bounded set of alternatives. This applies to desktop computing, application servers, communications components, application development tools, and data management tools.
22. **Emerging technologies.** Penn must devote appropriate, coordinated effort to evaluating and piloting emerging technologies.

Organization

23. **Data stewards.** Data stewards are responsible for ensuring the appropriate documentation, collection, storage, and use of the administrative data within their purview.
24. **Process owners.** Process owners are responsible for developing and maintaining the standards, structures, and applications that ensure the quality and cost-effectiveness of specific administrative processes.
25. **Information Systems and Computing (ISC).** Information Systems and Computing provides leadership, infrastructure, standards, services, and coordination that permit Penn to take full advantage of its information technology assets.
26. **Schools and administrative centers.** Schools and administrative centers are responsible for creating data and using information technology to meet the objectives of their organizations.

Partnering Within the Institution and Beyond

A. Wayne Donald
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July, 1994, marked the beginning of an aggressive campaign at Virginia Tech to replace approximately 30 core administrative applications -- moving from a mainframe to a server-based environment in a 3-5 year period. This presentation describes the reasons Virginia Tech officials felt this aggressive implementation schedule was essential, and how the institution is approaching the many project management issues associated with such an effort.

The initiative involves partnering with several different university offices, users, state agencies, and both hardware and software vendors. Redirecting personnel and providing a comprehensive training program dedicated to the administrative systems project has been a major factor for implementation. In addition, re-engineering efforts to promote change in business processes to better "fit" software solutions is important in meeting project goals.

This is a project that will impact how Virginia Tech functions, and is projected to provide more efficient and effective processes to better serve customer needs. It's an exciting project that will have its obstacles, but Virginia Tech officials are confident of success.

Partnering Within the Institution and Beyond

Challenges for Higher Education

Institutions of higher education are facing some of the most challenging times in the history of their existence. Each meeting of system boards, university boards, federal and state education officials, and state legislators brings with it an air of anticipation -- what will we be asked to do this time? This situation is forcing colleges and universities to change, and the change most often becomes a major issue on campuses "because it alters the power bases and comfort zones of people" (O'Leary, 1992).

Academic leaders and administrators are being challenged to evaluate (1) how they can respond to escalating costs with decreasing resources and (2) what management techniques are most effective in working environments for productive change. As was so well stated by Dean Robert Bates, of the College of Arts and Sciences at Virginia Tech, "The three R's in education these days aren't reading, 'riting, and 'rithmetic. They are reviewing, restructuring, and renewing" (Bates, 1994).

The challenges facing institutions of higher education are overwhelming, but if they are to survive and maintain their role in society, they must face the reality that fulfillment of their missions must be accomplished in different and more efficient ways. All constituents associated with these institutions need to be involved in planning and implementing the needed changes. Working together with students, professors, counselors, staff, administrators, researchers, and even outside constituents such as the local, state, and federal governments, other institutions, and business and industry can create a productive team environment that will greatly impact all responses to the challenges of change.

The State Impact on Local Change

Fiscal belt tightening and the continued decline in state financial support are demanding that colleges and universities examine the way business is conducted (Bates, 1994). Since early 1990, Virginia Tech has been feeling the impact of budget reductions from the state government. The results have been a reduced operating budget, increases in tuition and fees, layoffs, and elimination of positions. These measures have impacted overall business operations, academic and research programs, outreach opportunities, and the spirit and morale of faculty and staff, and yes, even the students (Donald and Naff, 1992).

Virginia Tech felt that it was facing what appeared to be a continuing trend for the Commonwealth of Virginia, so the university began a series of initiatives to review, restructure, renew, and reallocate resources that would prepare it for the apparent declines in support. Phase I was designated as the actual budget reductions, and administrators initiated a Phase II effort in 1993 for each academic and vice presidential unit to develop specific goals and objectives.

The most recent action at the state level has been a request from the Council of Higher Education and the Secretary of Education that each state institution submit a "restructuring" plan. The Governor and 1994 General Assembly requested these plans "to effect long-term changes in the deployment of faculty, to ensure the effectiveness of academic offerings, to minimize administrative and instructional costs, to prepare for the demands of enrollment increases, and to address funding priorities as approved by the General Assembly" (*Restructuring Virginia Tech*, 1994). Fortunately for Virginia Tech, the Phase II initiatives that the administration had already requested positioned the university to prepare a rather detailed plan that, in the words of President Paul Torgersen, would position Virginia Tech to "become the model land-grant university for the 21st century." The *Restructuring Virginia Tech* document contains numerous actions and initiatives for restructuring -- several that emphasize delineating innovative ways for harmonious teamwork with both internal and external resources.

Partnerships for Progress

Partnering is a management technique that has been recognized for quite some time. However, the concept has now found its way into the management issues facing higher education today. For example, the 1994 CAUSE Annual Conference has a track dedicated to partnering and a pre-conference seminar that focuses on partnering concepts.

Whether the partnering concept is viewed as a consortium, collaboration, team, or actual partnership, it is a method for gathering parties working on a common goal. The *Restructuring Virginia Tech* document emphasizes partnerships as one of the central themes for restructuring and lists several examples of existing partnerships with public schools, community colleges, other universities, private industry, and local and state government (*Restructuring Virginia Tech*, 1994). Another possible partnering concept is not mentioned in the list -- partnering within the institution. Because Virginia Tech has been involved in total quality management efforts and has used teams for the last few years, the idea of "internal" partners was probably overlooked in the list, but this method is a very productive way to manage change.

Administrative Systems Initiative

A major project to improve the University community's work/service environment has been approved at Virginia Tech. The effort would not be possible without both internal and external partnerships or using team concepts for innovative productivity. A description of the project is included here from a recent article that appeared in the campus newspaper for faculty, staff, and graduate students (November 3, 1994). It also gives some background information while introducing Project ENABLE to the general university community.

> *Project ENABLE is the name selected to identify one of the most significant and aggressive endeavors ever undertaken by Virginia Tech. As an integral part of the Virginia Tech restructuring, the University has recently committed to a major initiative dedicated to improving the University community's work/service environment.*
>
> *The Project ENABLE initiative focuses on replacing all of the University's major administrative computing systems with new state-of-the-art systems. A special feature of this replacement strategy is the intention to complete the project on an aggressively accelerated and fast-tracked schedule. Project ENABLE also focuses on redesigning the fundamental business processes underlying administrative functions targeted for replacement computing systems.*
>
> *Aside from the fact the state has mandated all higher education institutions to develop and implement major initiatives to improve the efficiency and effectiveness of their operations, the need for a major restructuring at Virginia Tech has become apparent. Decreased financial support from the state combined with generally diminishing resources, obsolete information systems, and ineffective automation tools have resulted in a work environment characterized by overpowering workloads for employees and a*

general inability to provide efficient and effective quality service. The objective of Project ENABLE is to provide a multi-faceted response designed to address these problems directly and aggressively.

Since Project ENABLE's objective is indeed aggressive, it should not be surprising that the primary goals for Project ENABLE are equally aggressive and ambitious. The project's goals include:

- *enhancing the quality of services provided to the University community,*
- *increasing efficiency and productivity of the University's resources, and*
- *improving the collective work environment.*

Other initiatives are underway at Virginia Tech that clearly support the Project ENABLE goals. Information Systems is in the process of developing more effective philosophical and practical approaches to overall information management. This will enhance accessibility to information and impact the way everyone interacts with administrative processes and systems. Other projects include the Faculty Development Initiative and the Administrative Workshop and Literacy Project, both designed to provide financial, technical, and educational assistance to faculty and staff making the transition to new hardware and software systems; and, an ongoing communications infrastructure improvement program designed to accommodate the enhanced computing systems. Several University initiatives that complement Project ENABLE have been described in the recently published document RESTRUCTURING VIRGINIA TECH. The complementary role of these initiatives will become increasingly more apparent as Project ENABLE moves forward.

One particularly interesting feature of Project ENABLE is the unique approach being used to organize and manage the project. Project ENABLE is organized around cross-functional and multidisciplinary teams. The team approach greatly enhances management and organizational flexibility and provides the project with a variety of benefits that would not be possible working in a traditional work environment. Project ENABLE teams are composed of both technical and functional/operational personnel. The latter provides the opportunity to get those most familiar with the day-to-day operations and special needs of the processes being redesigned directly involved in the project. Project ENABLE will realize the benefits of more productive thinking, increased coordination, greater levels of employee satisfaction and development, and enhanced organizational productivity. These teams are being staffed through a reallocation of resources within the University.

One final note of curiosity - an answer to the question "Why the name Project ENABLE?". The word ENABLE was chosen because it so accurately reflects the overall intention of this innovative project. The dictionary defines ENABLE as the process of "supplying the means, knowledge, and opportunities to be or do something". That is exactly what the people of Project ENABLE will be doing as they proceed with the work of redesigning the University's administrative processes and computing systems. They will definitely be "Enablers of innovation ... enabling the University to be its best!" (Spectrum, 1994).

A point early in the article suggests the need to consider partnering. Having a replacement strategy designed to complete the project in an aggressively accelerated and fast-tracked schedule requires considering any cooperation effort that can contribute. This might involve vendors, other institutions, or even state agencies that initiated regulations or schemes that created the situation.

Another significant point from this article of introduction is the reallocation of resources to form cross-functional and multidisciplinary teams. The team approach is one method of partnering across the various institutional structures that creates an environment for harmonious interactions.

Establishment of Project ENABLE

When the higher education administration committed to this major administrative systems initiative, it was clear that a strategy needed to be put in place that would be aggressive but yet attainable in a short timeframe. The strategy adopted by management to establish Project ENABLE quickly has several key directives.

- Secure University-wide approval and support
- Assemble an aggressive and productive staff
- Create a team concept that instills motivation
- Establish a communications structure that will garner support
- Utilize a "fast-track" implementation schedule
- Implement a shift in technology architecture
- Emphasize the need for business process analysis and redesign
- Focus on the project as a "period of transition"

Space constraints of this paper do not permit covering each of these directives in detail, however, the key directives that have impacted partnering efforts at Virginia Tech are discussed briefly.

<u>Securing Approval and Support</u>

Once the key administrators (President, Executive Vice President, and Provost) agreed to the initiative and the strategic directives, other constituents were updated through a series of presentations by the Vice President for Information Systems. A project of this magnitude could never be done in a vacuum, nor could it be done with only the limited resources in one segment of the University, such as Information Systems. The inclusion of all appropriate segments and personnel at the earliest states of the project made it possible for all to understand that sacrifices appropriate to each might be required in order to ensure success.

Project accountability has been placed with the Vice President for Information Systems. The overall project leader was chosen for experience in leading a major project and as someone without a lot of "baggage" in the administrative systems areas. The individual selected came from the communications area and was a leader in the successful installation of a major communications systems at Virginia Tech in the late 1980s.

The Executive Vice President at Virginia Tech has always acknowledged that personnel from the administrative offices should be involved in any systems work since they are the ones who use the systems daily and are, in most cases, the ones most affected by any changes. The Executive Vice President is a champion of Project ENABLE and he and other key administrators have been able to secure broad campus approval for the goals and objectives.

Creating a Team Concepts and Partnerships

When this initiative was approved, the area of Information Systems had 20 people dedicated to administrative systems -- a far cry from the number of people needed for the project. It was made clear that for the project to succeed, the Vice President for Information Systems and the project leader would be allowed to "go after" any person as a participant -- yes, any person.

Key administrators where willing to listen when they were approached with the concept of partnering. People began to understand the importance and advantages of using cross-functional teams in this aggressive project for administrative systems. Support staffs had been established for a number of years in many of the key administrative areas (mainly finance and student systems) and they became targets for the new project from the start. However, these established support staffs were not the people needed to lead many of the administrative projects that would be part of Project ENABLE. Consequently, the University Controller and the Personnel Director were two of those asked to partner with the project. The result has been that an Associate Controller has been assigned full-time to lead the finance effort, and the Assistant Director of Personnel Services will lead the human resources effort full-time. In addition, personnel from the budget office, the office of institutional research, the registrar's office, admissions, the office of internal audit, the information systems areas, and other key areas have been assigned either full-time or part-time to Project ENABLE.

A project of this size obviously needs tremendous support. Some areas of support may not require full-time effort, yet the participation is critical for success. The Vice President and project leader again were able to work with different organizations to establish partnerships for support teams. For example, an Administrative Client Team in the Computing Center is working closely with Project ENABLE to place new Apple Macintosh computers in administrative offices. The Server/DBMS Team, also in the Computing Center, maintains the Oracle database software, helps define server needs, maintains server hardware and software, and provides professional training to Project ENABLE personnel and customers. There are other such partners that work with security, workflow, public relations, training, and so on.

Fast-tracked Implementation and Partners

Strategies for a fast-tracked implementation of "core" administrative systems include purchasing application software from an approved vendor or vendors, using an open systems UNIX operating environment, and utilizing a relational database engine. These strategies have already led to partnerships with outside vendors and laid the groundwork for opportunities with other.

- Virginia Tech currently has a site license with Oracle and is constantly examining ways to improve the partnership in both the academic and administrative arenas.
- A contract has been signed with the SCT Corporation for a human resources system. Project personnel are continually researching ways to work more closely with the vendor to relate the needs of a large research institution.
- Apple Macintosh computers have been selected as the hardware for faculty workshops, administrative offices, classrooms, and labs. Apple continues to work with Virginia Tech to enhance its relationship.

- Apple and Virginia Tech are partnering on the AOCE software and the way it can be used for workflow applications.
- Virginia Tech is a member of the Mandarin consortium and is gaining experience while contributing to future development on the product.
- Financial personnel are partnering with NACUBO on benchmarking information for establishing various measurements for improvement.

This list could be enlarged, but the point is made that outside partnerships are very helpful in any endeavor. In most cases, both parties have something to offer and something to gain from the experiences.

Another opportunity that exists for outside partnerships is with other institutions and with state agencies. The University of Virginia and Virginia Tech are teaming to offer graduate courses in Northern Virginia, while Penn State and North Carolina State are working with Virginia Tech to share extension specialists and other resources (*Restructuring Virginia Tech*, 1994).
Virginia Tech is currently involved with particular state offices to secure more decentralized administration. If successful, such decentralization could be carried over to internal partnerships among the colleges. Efforts are also underway to utilize the State Council of Higher Education, the Secretary of Education, and others.

A Period of Transition

Project ENABLE provides a major period of transition for Virginia Tech. In a reasonably short period of time, new administrative systems will be installed in a client/server environment that will eliminate a dependency on proprietary hardware; a new technology architecture in all administrative and academic offices will provide increased desktop capabilities; and business processes will change to provide more efficient and effective administrative operations. None of these achievements can be realized unless significant partnering occurs within university departments, rank and file staff, faculty, state agencies, other institutions, vendors, private industry, and others. The partnering and team concept will be essential to ensure that the future environment will be acceptable and will "enable" the institution to be its best.

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A special appreciation is extended to other members of the Project ENABLE Staff Support Team for their efforts in promoting the project, and for contributing to the November 3, 1994, *Spectrum* article. Members of the team are Anna Dickerson, Becky Glazener, John Krallman, and Richard Stock.

EXEMPLAR! A Consortium for Administrative Software Sharing

by Kenneth C. Blythe
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Folks, we are being left behind. While our institutions are wanting to move forward faster with information technology, we in administrative computing, often find ourselves challenged by the pace. In spite of all that we've learned in 30 years of mainframe computing, the life cycle of the typical administrative computing project is still way too long. Our institutions are considering distributed computing because they think that we take too long and perhaps distributed computing will break the cycle of delay that is plaguing most administrative computing organizations these days. Our budgets are declining while price/performance improvements are virtually guaranteeing the obsolescence of our computer systems and the business processes that they support.

So, what are we to do? This paper will discuss one of the most undeveloped yet most important ideas to come on the scene in sometime, the idea of sharing. Sharing is not new, it was one of the founding principle of CAUSE more than 25 years ago. Higher education is a choice arena for sharing because of the openness and frequent interaction between institutions of higher education. There is a willingness in higher education to share their works, including computing systems, with others. In spite of the willingness, openness and frequent interaction, sharing is a relatively undeveloped method for handling the backlog in administrative computing applications. While there has been much written about the alternatives of build versus buy, there is very little intellectual development of the success factors of sharing.

A CONSORTIUM FOR THE 1990'S

EXEMPLAR is a consortium of universities that want to share "sound practice" administrative computing applications. In addition, these universities have the common characteristic of sharing a single software architecture, Software AG's toolset, including tools such as ARCHITECT, CONSTRUCT, NATURAL, PREDICT, and ADABAS. Another way of looking at EXEMPLAR is as an extension of Software AG's tools to allow colleges and universities to share administrative computing applications quickly and economically. There have been other attempts at sharing higher education administrative computing applications in the past that were not generally successful because the "choices" were too numerous; there were too many alternatives of hardware and software representing too many different business processes from too many different schools. EXEMPLAR is intentionally limited in scope to Software AG users to increase the probability of success.

EXEMPLAR is just getting started. It is an outgrowth of CAUCUS, the higher education user group for Software AG products. The purpose of EXEMPLAR is to *create an environment for collaboration and sharing of best practice administrative computing applications between higher education institutions.* EXEMPLAR offers the possibility of sharing software developed at one institution to another by serving as a conduit for transferring and, at the same time, adding value to the software. Acting as a *clearing house* and *"matching"* service, EXEMPLAR provides consortium members the ability to discover best practice applications that can be added to their libraries without major expense.

WHAT IS BEST PRACTICE?

To restate the purpose, EXEMPLAR is a consortium for exchanging best practice applications. What is best practice? Here are the elements:

- Represents Best Business Processes - First and foremost, best practice computer applications represent best practice business processes. It is a fundamental goal of EXEMPLAR to share software applications that elevate business processes because they have good business processes associated with them. EXEMPLAR is not only software sharing but best business process sharing as well.

- PREDICT Data Models - The next element of best practice is a normalized data model. Many institutions would be satisfied just to share data models because they are the first approximation of the entities and attributes of best business processes. These days, the entities in a data model are also the first approximation of objects, representing building blocks toward object oriented programming. Whatever they are called, entities or objects, EXEMPLAR will maintain them in its repository to be shared with others.

- ARCHITECT Entity Relation Diagrams - Best practice also includes entity relation diagrams prepared with NATURAL ARCHITECT. Entity relation diagrams help the recipient institution to understand relationships between entities and attributes that are included in the PREDICT data model.

- ARCHITECT Data Flow Diagrams - To round out the design, best practice also includes data flow diagrams on which applications are based.

- Application Models - Best practice also means computer programs that do not have institution-unique attributes embedded in them. EXEMPLAR wants to exchange application models based on NATURAL CONSTRUCT rather than application code. We believe, as a rule of thumb, that 90% of an application is functionally generic while 10% is institutionally specific. The goal of EXEMPLAR is to simplify the transfer of functionally generic part in the form of NATURAL CONSTRUCT models. Best practice applications are those provided as CONSTRUCT models.

- Written in NATURAL - It goes without saying that best practice applications are those written entirely in NATURAL. The value of NATURAL is obvious. Among other things, it insures that applications can be shared that are readily understood by the recipient programmers (who already know NATURAL.) NATURAL insures that there is no need for programmer retraining. NATURAL is also a 4th generation language that is easily understood by accomplished technicians.

- Structured NATURAL - Not only are best practice applications developed in NATURAL using CONSTRUCT models, they are also developed using the structured form of NATURAL (versus the reporting form).

- Documentation - Best practice applications include a complete set of data, system and program documentation.

Having agreed on best practice, how do we obtain (find) such applications? The answer is the essence of EXEMPLAR. There are no applications today that qualify completely as best practice. Some are close but none are all the way. The purpose of EXEMPLAR is to combine the energies of a consortium of institutions to arrive at best practice.

THE EXEMPLAR BEST PRACTICE PROCESS

It is an underlying premise that it takes more than one institution to achieve best practice. Limited resources and unlimited demands prevents each institution, on its own, from achieving best practice with its own administrative computing applications. In general, when an institution develops an application on its own, it will shortcut many of the best practice elements because their technical staff understands the intimate details of the application. Target dates, budgets and other practical necessities prevent us from achieving best practice the first time around.

EXEMPLAR tries to compensate for first time expediencies with the best practice process. This process has four distinct stages described below:

Stage 1 - Database Buildup

The first stage of the best practice process is to survey higher education Software AG users to identify those who have applications in each of 26 subject areas. The steps involved are:

Database Buildup
• Send Survey
• Gather Data
• Record Survey Results in Database
• Publish Results for all Originators
• Maintain the Database
• Respond to Inquiries

In addition to identifying the institutions that have applications, the survey also identifies the institutions that need applications.

Stage 2 - Matching Service

Using the EXEMPLAR database, it is possible to cluster the needs and haves for each of 26 subject areas. As the survey results are published, there will be a natural tendency to match, informally, those schools that need applications with those that have.

EXEMPLAR will use the matching information to form Advisory Panels for each of the 26 subject areas. Advisory panels will be made up of individuals from each school that either needs or has an application for the purpose of examining the applications that are available in the EXEMPLAR database. To form the advisory panels, EXEMPLAR will first seek one individual from one of the need/have schools to serve as the trail boss or leader of the advisory panel. The trail boss will form the advisory panel and lead it through the examination of candidate applications. It is likely that the trail boss will have a strong interest in (affinity for) the applications. In fact, the trail boss will probably be from a school that wants to be an early recipient (scrubber) of the application. Here are the steps in Stage 2:

Matching Service

- Appoint a Trail Boss
- Form an Advisory Group
- Review Candidate Applications from the Have Schools
- Select the Applications that are Most Likely toBecome Best Practice
- Determine Original Development Cost of the Selected Application
- Continuous On-going Advisory Role

At the conclusion of this stage, we have a single application that has been selected by members of peer institutions to be most likely to be transformed into best practice. Once this selection is made, EXEMPLAR will distribute the information to all consortium members with a positive recommendation. EXEMPLAR will also try to identify one school to be the scrubber for the application.

Stage 3 - Scrubbing

Scrubbing is the place in the EXEMPLAR process where the selected application is transformed to best practice. In the scrubbing stage, a second school, different from the originating school, agrees to take the application and add the necessary value to make it best practice. The scrubbing school will take out any programming that is institution specific. The scrubber will also prepare documentation and fill in any of the missing elements of best practice. The steps of the scrubbing stage are:

Scrubber

- Search for Scrubber
- Pass Application from the Originating School to the Scrubbing School
- Scrub the Application
- Adhere to Best Practice

The application, will be transferred from the originating school to the scrubbing school at no charge. EXEMPLAR will facilitate the transfer by providing transfer documentation and support. Intellectual property rights for the application will be retained by the originating school even though the scrubbing school adds value. The added value of the scrubbing school is returned to the originating school as fair compensation for the free use of the original application.

Stage 4 - Repository

After the application has been selected by the EXEMPLAR Advisory Panel and scrubbed to make it best practice, it will be turned over to EXEMPLAR for keeping and distribution to other members of the EXEMPLAR Consortium for a fee (the fee is set at 10% of the original cost of developing the application by the originating school). The steps of the repository stage follow:

Repository

- Obtain Copy of Source Code and Documentation from Scrubber
- Freeze the Application at a Release and Version Level
- Prepare Final EXEMPLAR Documentation
- Integrate, to the Extent Possible, the Application with other EXEMPLAR Application
- Transfer Application and Request to Consortium Members (for 10% of the Development Cost)
- Insure that Usage Rights, but not Property Rights, are Transferred with the Application
- Determine Cycle of Update to next Release and Version
- Arrange, as necessary, for Training and Support of the Application for a Fee

EXEMPLAR will maintain current versions of the application with source programs and documentation for quick and easy transfer to other institutions.

The four stages of the EXEMPLAR best practice process are intended to raise the quality of all applications that are eventually kept in the repository. It may be that it will be necessary to include applications in the repository, at first, that will not satisfy the full range of best practice requirements in order to fill out the repository from the beginning. In this way, EXEMPLAR will be able to satisfy early member interest with less than best practice but good solutions nevertheless.

BETTER THAN THE ALTERNATIVE

Not to confuse, but there are some very good administrative computing applications in higher education institutions that are somewhat less than best practice. In some cases, these very good applications may be included in the EXEMPLAR repository because they are better than the alternative (having no application). The EXEMPLAR Executive Committee may decide, on the recommendations of an advisory panel, to include a very good application in the EXEMPLAR repository. The Executive Committee can even decide, in some cases, to add an application that is very good to the repository before it is scrubbed if there is sufficient interest among the EXEMPLAR members.

This better than the alternative selection process is only a temporary measure until real best practice applications come available. Remember, there are no best practice applications available today that meet all of the best practice requirements. This better than the alternative process will allow early exchange of very good applications as a placeholder until best practice replacements are available.

When a <u>better</u> <u>than</u> <u>the</u> <u>alternative</u> application is included in the repository, it will be clearly marked as such to avoid confusion among the members.

EXEMPLAR has to (1) raise applications to best practice requirements and (2) accept very good "early" placeholders until best practice applications are available to replace them. It is the responsibility of the EXEMPLAR Executive Committee to waive best practice standards in those cases where it is necessary to achieve full range of early applications for EXEMPLAR members.

PROGRESS TO DATE

The EXEMPLAR administrative office was officially established at Penn State University in September 1993. Survey forms were sent to 148 higher education Software AG customers in November 1993. Fourteen surveys have been returned to date and are being clustered into <u>have</u> and <u>need</u> categories. The following chart shows the results to date for one category, student recruitment and admission:

Student Recruitment and Admissions
Survey Results

	Need	*Have*	*Share*
Brown University		✓	
College of William & Mary		✓	
Georgetown University	✓		
Indiana University of PA		✓	
McGill University		✓	✓
Miami University	✓	✓	
Pennsylvania State University		✓	
University of Alabama, Birmingham		✓	✓
University of California at Santa Barbara		✓	
University of Delaware		✓	
University of North Florida	✓		
University of Wisconsin-Oshkosh	✓		
University of Wisconsin-Stout	✓		
Washington State University	✓		

Notice that there are five schools that need a student recruitment and admissions system, eight schools that have systems and two schools that will share their systems with others. This presentation could be reproduced over again, with different results, for each of the subject areas.

The Inventory Management System (IMS) of Cornell University has been scrubbed already and is available for sharing today. IMS has been scrubbed by Penn State University and returned to Cornell to incorporate the scrubbing changes. IMS represents a wonderful business process that has saved Cornell and Penn State University both thousands of dollars. The same application can be transferred to other institutions for as little as three months of effort and $30,000 (10% of original cost of development by Cornell). IMS will be included in the EXEMPLAR repository this Summer (1994).

Another application, Penn State's award winning Electronic Approval SYstem (EASY), has been scrubbed by McGill University and is also available for sharing today. The EASY system has been approved by auditors as an electronic replacement of paper forms. This system is an essential element of streamlined business processes of the future because it enables institutions to eliminate paper and streamline day-to-day operations. Penn State estimates that EASY, when it is fully implemented, will save $850,000 per year.

In addition, there are at least twelve other applications that are looking for scrubbers. Many of these are currently being prepared for inclusion in the EXEMPLAR repository with the assistance of Software AG system engineers and personnel from the institutions that are *willing to share them.* They are:

- On-Line Report System (ORS)
- EZ Forms
- MVS UNIX Scheduling
- Department Obligations
- Student Kiosk
- Central Tables
- Misc. Accounts Receivable
- Schedule 25-Front-End
- Student Housing
- BSR Front-End
- Cash Receipts
- Work Orders

<u>TRAIL BOSS</u>

One very effective way for an institution with a *Need* to obtain an application is for it to become a Trail Boss. Being a trail boss means your institution is the first to work with an institution that *Has* and is *Willing to Share* an application you want to implement. You work together to have the application "scrubbed" to meet the requirements for inclusion in the EXEMPLAR repository and at your institution. By becoming the trail boss and "scrubbing" the application, you receive the application free of charge. The fee of 10% of the original development cost that was incurred by the source institutions is waived. Not a bad deal at all!!! The obligation for your institution is to work closely with the source institution to insure that the software application being shared meets the criteria for inclusion in the EXEMPLAR repository. These criteria are:

1. Application runs under current version of SAG products
2. Application is in production
3. Has complete documentation

More specifically the application should have its NATURAL programs, maps, DDMs, local data areas, etc. unloaded via SOFTWARE AG's UNLDMAIN utility onto a 6250 bpi 9-track magnetic tape. If UNLDMAIN is not available, then its equivalent should be used. Accompanying the tape should be:

- The name of the utility used to unload the application.
- The processor and operating environment on which the application is executing.
- The version of NATURAL it is operating in and mode (structured or report).
- The number of program modules, maps, DDM, local data area names, etc.
- A list of program names, map names, DDM names, local data area names, etc.
- A DBA contact name, phone number and Email ID.
- Any other documentation that will be beneficial, including structure charts, data flow diagrams and data dictionary.

CONCLUSION

EXEMPLAR provides another alternative to buy vs. build which is sharing; with EXEMPLAR we can buy, build or share. Sharing has been tried many times in the past with modest success because those sharing attempts were not conceived or structured for success. The EXEMPLAR Executive Committee wants to increase the probability of success by reducing structural barriers. Until now, sharing has been a slipshod operation with little commitment (or investment) on the part of either the originator of the application nor the recipient. EXEMPLAR will reduce the barriers by:

- Surveying Software AG Users.
- Providing a knowledge base of available applications.
- Developing a short list of good applications.
- Selecting Advisory Panels to review the short lists to select one for becoming best practice.
- Maintaining best practice and very good applications in the EXEMPLAR repository for other schools to share (at a fee of 10% of the original cost of development).

This process is intended to create the right opportunities for schools which have high-quality applications to pass those applications to scrubbers so that they can be made into best practice applications for other schools that need them. EXEMPLAR is the most advanced effort by educational institutions to share the burden of best practice administrative computing applications.

CAUSE 94

Track II

Focus on the Customer

Coordinator: John D. Busby

CUSTOMER-CENTERED COLLABORATION: LIBRARIES AND IT

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In the Fall '94 *CAUSE/EFFECT*, which focuses on library and Information Technology relationships, collaboration is variously defined as "working together toward shared group goals" [1] and "the process of shared creation." [2] In both of these senses, collaboration between librarians and information technologists is seen as valuable, even necessary. The need for these two groups to collaborate arises from convergence of their missions, user demands for coordinated services, competition for resources, and advances in electronic storage, retrieval and sharing of information. Moreover, the pace of technology requires rapid yet flexible responses, not protracted haggling over territories, roles and responsibilities. What's needed are strategies to accelerate the collaborative process; strategies adaptable enough to deal with change yet creative enough to foster both internal and external cooperative efforts.

Furthermore, these strategies should be seen as a means to the end of satisfying customer needs for integrated information services. Moving from separateness to synergy can be facilitated by the selective use of certain popular management methods. These techniques include the use of teams, changes in reporting structures, integration, cross-pollination, management dictates, as well as elements of some popular external-stimulus approaches such as Total Quality Management (TQM) and Business Process Re-engineering (BPR). The success of these strategies in the collaborative setting depends upon library and computing leaders' willingness and ability to embrace a common vision, articulate a clear direction, share risks and accept new responsibilities.

Rosabeth Kanter recently described eight conditions for successful collaboration between organizations. [3] She argues persuasively that truly advantageous partnerships require real commitment to the relationshipsthemselves, and not mere attention to the benefits of any one specific deal. Like good marriages, relationships between libraries and computing organizations need to meet certain criteria for ensured success. Among these, Kanter lists:

- individual excellence of the each of the partners independently,
- long-term goals of each organization which include the relationship itself as an important strategy
- the partners' complementary skills and assets
- investment of resources
- open flow of information
- integration developed through working linkages and connections
- the relationship's formal status within the institution
- integrity as displayed by mutual respect between the partners.

STRATEGIES—TEAMS, TQM AND BPR

All these methods have promise for dealing effectively with the problems facing our institutions today: shrinking budgets, retraining the workforce, demands for accountability and lack of coordinated services.

Although many schools and businesses are adopting these strategies as panaceas, there are significant difficulties which can sabotage their wholesale introduction and success.

First, these solutions are very resource-intensive—requiring additional staff, money for training and consultants—at a time when most institutions are strapped for resources.

Second, they take a long time to achieve results when the crisis in higher education demands rapid response.

Third, maintaining current operations and services while undertaking organizational change of the magnitude suggested by TQM and BPR is very difficult.

Fourth, using consultants to introduce these new programs may become an addiction. Also, consultants often present packaged training plans not suited to your organization or its culture. Finally, much of the literature and research focuses on business models of the adaptation of these techniques. There are significantly different variables to consider in an academic setting. Rather than adopting any one approach entirely, librarians and IT professionals may find portions of the techniques promote improved customer service, synergy, adaptation to change, and re-organization of outmoded structures.

Teams

In all three strategies, the use of teams is seen as a positive force for worker empowerment, customer satisfaction, coping with change and the breaking down of organizational barriers. According to Jon Katzenbach a team may be defined as "... a small group (less than 20 persons) with complementary skills, committed to a common purpose and set of specific performance goals. Members are committed to working together to achieve the team's purpose and hold each other jointly and fully accountable for the team's results." [4]

Using teams to promote synergy will only be successful under certain conditions. Across and within the organizations, teams only thrive where there is:

- excellent verbal and written communication
- a high level of interpersonal trust
- authority residing in the team for decision-making.

What is typically missing, both within an organizational unit and across the organization generally, is a clearly articulated and commonly embraced understanding of:

- the mission of the parent and constituent organizations
- team purposes and objectives
- service level agreements
- reward structures for team participation [5]

In addition, a teams approach requires significant commitment of resources by the parent organizations. To embark half- heartedly upon teams-building, i.e., without proper allocation of resources for training and planning, is to court disaster. Performance is doubly hampered when teams are allowed to stagnate or are not supported enthusiastically by upper management. Teams can be successful only if properly planned and adequately supported.

TQM

Another popular management strategy for improving service operations is Total Quality Management. While TQM evolved with Edward Deming in the 1950s, it was not until the mid to late 80's that it became popular in this country. The Malcolm Baldrige National Quality Award [6] was established in 1987 as a private/public partnership to encourage quality in American companies. Definitions of quality vary from Crosby's brief "conformance to requirements" [7] to Deming's more detailed 14 points. [8]

Most quality approaches, though, have the following elements: customer focus, empowerment of all employees, strong emphases on training, teams, benchmarking and continuous process improvement. The strengths of TQM are that it:

- focuses on the customer

- can lower costs while providing better, more timely service
- brings strength and depth to organizations by empowering employees
- provides a structured method for improving processes and measuring results

The danger in this strategy is that the process can become an end in itself, rather than a means to improve customer satisfaction and business processes. An excessive proliferation of teams and overemphasis on training, without addressing customer needs and institutional goals, can sometimes result.

Both teams and TQM are best used when there is a specific customer need to be addressed, explicit requirements and measurable gains. A hypothetical example may illustrate: a user survey shows that customers need more help with Internet navigation. A team comprising staff from several levels of both the IT and the Library organization is formed to design, implement and evaluate a program of on-line consulting within a specified timeframe and with frequent measurement of user satisfaction and service levels.

Business Process Re-Engineering (BPR)

The most recent management trend is business process re- engineering. This strategy involves a fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical contemporary measures of performance: cost, quality, service and speed. BPR is broader in scope and takes longer to implement than most Quality programs. It is far more revolutionary, requiring reinventing, making sweeping changes in management and organizational structure. In a reengineered process, the work units change from functional units to process-oriented teams. Jobs change from simple tasks to multidimensional work, so that workers achieve a greater sense of completion, closure and accomplishment. [9]

In BPR the typical functional division in computing is discarded in favor of process-oriented team. At the University of Idaho, hierarchical and functional structures were disbanded to create a flat organization, with no staff member reporting to anyone but the top management team. This reorganization facilitated equal and open team recruitment. Now employees see themselves as team members rather than as aligned with a particular functional area.

Some useful attributes of BPR are:

- it is customer driven
- it facilitates worker empowerment, with authority for their responsibility
- it forces a wholistic rather than a piecemeal examination of processes

Problems occur when organizations adopt programs such as BPR without regard to local conditions and values. Unlike TQM, BPR is radical—it requires, by definition, the changing of a process rather than its improvement. It should only be embarked upon if there is commitment from the top to pursuing a radical solution; resources to facilitate that change— consultant support, money and time for training—and recogniton of how BPR will impact operations.

Common themes running through all three strategies—teams, BPR and TQM— include: the importance of focusing on the customer, the need for management support and change as a constant. As service organizations, libraries and IT have a primary mission of assessing and satisfying the needs of their customers. Although this has always been true, the new management strategies emphasize refocusing on what it means to be "customer centered".

FOCUS ON SERVICE TO THE CUSTOMER

One of the fundamental requirements for customer service in a collaborative environment is that the partners have the same definition of the client base of customers. At the very least, they must explicitly agree on various categories and on the prioritization of those customer needs. The University needs to agree, and have articulated a vision to support that customer base. For example, in a large, public research university, the customers include the faculty, staff and students; they probably also include the taxpaying citizens of the state. The needs of these constituent groups may sometimes conflict. Even if they are in harmony, it is important to agree upon prioritization.

Focusing on the customer means measuring success by customer- defined criteria. For example, successful computing for a research physicist may mean faster CPU cycles and broader network bandwidth while her secretary may define good service as a speedy answer to his help desk question. Therefore, it is important to understand and focus on what the customer considers good service and to prioritize the level of service in accordance with the mission of the overall organization.

When librarians and IT professionals define joint projects, it is helpful to apply what the University of Washington Libraries calls a "customer-centered filter". Additions or deletions to services and products must be decided according to what the primary customer base needs most. This can help settle disputes between partners, help to reach consensus and negotiate to "yes" on the myriad of good ideas often presented.

One of the difficult issues libraries and IT organizations need to focus on is the need for a single point of contact for the end user of the Internet. With the goal of improving faculty use of the Internet at Seattle University, a librarian, computing user services staff and a faculty member collaborate to offer a course on using the Internet for research. The course is taught and designed by the faculty member, with library assistance in identifying the best resources; advertising, scheduling and coordinating is done through the information technology office.

Understanding and improving the processes begins and ends with customer-centered requirements. [10] Constant evaluation of services both separately and jointly involves measuring baseline service levels and improvements by conducting qualitative and quantitative customer surveys. At Harvard University's Office of Information Technology, the service improvement process begins with identifying the customer output requirements and the process to improve. The next steps are to analyze, measure, improve and evaluate the service. Through the entire process, the customer's perspective must set the course.

MANAGEMENT SUPPORT AND STRATEGIES

One key to success with a collaborative approach is top management's support for the strategy. Not only must the leaders believe in the collaborative effort, they must articulate that belief in terms of a shared mission, vision and goals—in meetings, jointly published statements and other visible indicators.

Statements of collaboration must be backed by resource allocation. Allowing mid-level managers to control their budgets is a clear indicator of high-level support. Risk-taking and innovation should be promoted and supported through reward and recognition. Another consideration in resource allocation is the development of service level agreements—who will do what, provide what, in what time frame, with what response time. Anita Lowry's article on "The Information Arcade at the University of Iowa," gives a recipe for success which includes "Documented agreements regarding the respective responsibilities for and contributions to the project, with specific commitments in terms of personnel, funds, and other resources." [11]

At the University of Washington, the University Advisory Committee on Academic Technology, beginning in 1988, recommended the building of strategic relationships between Computing & Communications and the University Libraries. [12] They also recommended increased use of centrally maintained hardware and advocated 100% building connectivity by 1997 using tcp/ip protocols. Many projects have come to completion through the joint work of the Computing & Communications and Libraries organizations. In all cases, resources were allocated within all participating groups, and University funding was made available as well.

By promoting and rewarding cross-organizational teams, mid- level managers can enhance synergy. Providing adequate resources involves training in such team skills as facilitating, brainstorming, achieving consensus, problem solving and conflict resolution. Team members' rewards should include linking team performance with individual employee evaluations. Team training requires providing sufficient staff backup so that team members can suspend regular duties in order to train for the team's work.

With the customers' satisfaction as the overarching goal, it becomes important to focus on process and service rather than organizational structures and functions. Individual skills, not sterotypes and hierarchy are the considerations in building a successful team. For example, the librarian with technical skills and the programmer with documentation skills may be the most appropriate team members for developing manuals on Internet navigation.

Managers can build flexibility and responsiveness into teams by encouraging interlocking memberships and by assuring authority to carry out decisions made. At Seattle University, the Associate VP for IS built a CWIS team to include not only a programmer, Help Desk Manager and the public services librarian, but also the University publications officer, the Business School computing coordinator and a representative from the largest end-user community, the students. Team members are given a budget to accomplish tasks that require additional resources.

CHANGE AS A CONSTANT

From top management on down, openness to changing traditional patterns and structures must be encouraged and seen as a positive and inevitable force. Change should be expected and even anticipated as a source of opportunities. Library and computing managers should—both separately and jointly— review evolving roles in their organizations. Rather than competing for niches, it may be advantageous to adopt an inclusive attitude which views library and information technology positions as all part of the same "job family". [13]

Managers create the environment and provide resources for change; staff identify opportunities for improvement and implement change. Listening to customers and to each other is an important part of this process. Regular time together— in joint meetings, shared working spaces, collaborative projects—encourages communication and questioning of current practices. Used appropriately, job sharing spreads expertise and responsibility for operational functions across units and organizations.

Changes made for change sake, however, should be avoided, especially if they are technology, not customer, driven. For example, user interfaces to campus wide information systems should not be capriciously modified; instead, enhancements can be accumulated, allowing time between releases for the system's users to catch up.

Change is also an important component of continuous quality improvement. Once a process is identified for improvement, the steps in the process include planning for change, trying it out, checking to be sure results are what was expected, making adjustments, implementing the change, and making it part of the systems and processes being managed. Once a successful change is implemented, its productive components can be identified for use in other situations. [14] This notion of re-using best practices is what is behind the concept of benchmarking.

BENCHMARKING

Determining where and when change is appropriate is easier when regular assessment of processes and customer satisfaction is being performed. Benchmarking, an important component of both BPR and TQM approaches, is one such assessment tool. It can connote constant statistical monitoring of processes; but more broadly defined, benchmarking means measuring your own organization's performance in qualitative or quantitative ways against other similar organizations which are models of successful or efficient operation. Both types of benchmarking can be used to improve customer service. In addition, if librarians and information technologists observe and implement each others' best practices, collaboration increases and products and services shared between organizations improve. The first step in benchmarking is to determine what services to measure; these should include processes which are important to your customers. The next step is planning the benchmarking project and choosing a team leader. Before studying others, it is important to understand the factors that affect your own performance. The next step is studying others, searching out leaders who have demonstrated successful collaboration and improvement of services, preparing questions, and performing the study. Conference presentations and conversations as well as professional literature can help identify successful models to study. Learning from the data collected about others is the fifth step. The final step is determining how to use the results in the organization. [15]

Librarians and information technologists can share best practices/successes with one another, particularly in the user services area. At Seattle University, the library liaison program, which pairs librarians with departments and colleges for collection planning and development, served as a model for a "customer service representative" in IT. Computing staff designated as service reps are paired with a liaison in each college or administrative area for communication about technical needs and changes as well as for planning new information technology services and training programs.

OUTSOURCING TO EXPAND RESOURCES: PROS AND CONS

Another practice which has been useful in the business world and adopted by some libraries and computing organizations is outsourcing; that is, using external resources to offer services that have traditionally been provided internally. Outsourcing can provide resources and expertise that would be difficult if not impossible to provide in-house. Small computing organizations, for instance, often cannot afford the staffing resources required to plan and implement a campus network and must outsource wiring and even installation of network cards and software to contractors for a limited period of time. Outsourcing has its dangers, however. Top financial managers can be persuaded by vendors that it is a panacea, sometimes without careful consideration of the potential consequences. When not used selectively, outsourcing can lead to dependency upon external resources. When goals, deliverables and timelines are not clearly established by the contractingorganization, a lack of control can result. Just as with teams, well developed service level agreements between the parties are critical to its success but not easily developed or monitored.

Outsourcing training to introduce new concepts and techniques—including Teams, TQM and BPR—is often more effective than using internal resources. Trainers who have expertise in these techniques are brought in to train staff, train the trainers, and/or recommend a course of action to improve service delivery and collaboration. Many consultants, however, recommend "packaged" approaches not customized to your environment. If the techniques do not suit the local culture, there is little chance they will be adopted.

To cut costs of employing outside resources, librarians and information technologists should consider sharing them. Having these two professional groups attending the same classes also promotes communication and synergy. Sharing in- house trainers is another strategy for facilitating cooperation and saving money.

NEGOTIATE RESOURCES FOR SYNERGISTIC RESULTS

Such leveraging of resources can be done internally as well as with external consultants. In the following two examples, libraries and IT organizations achieved synergistic effects through collaboration in situations where resources were scarce.

University of Washington's experience

Leveraging resources can be accomplished with cross- organizational teams, which share staff, pool dollars and provide cross-training opportunities. In 1992 the University of Washington undertook to replace its automated library management system and to build a campus-wide information system. The campus was (and is) dedicated to open networking, a uniform interface to information resources, and a collaborative approach to campus-wide computing.

In accord with the University Advisory Committee on Academic Technology's directive, [16] the Libraries and Computing & Communications (C&C) have jointly built an information system for the campus which includes administrative information, computing technology policies, procedures and events, the libraries' online catalog, locally mounted abstracting and indexing databases, and Internet searching tools.

They pooled funding and secured a matching amount from the University in order to replace the existing proprietary (Geac) library management system (ILS) with one which could be snugly integrated with the campus tcp/ip network. C&C's Information Systems and the University Libraries jointly negotiated a contract with Innovative Interfaces, Inc. for their unix-based ILS. This was all part of the manifestation of a well-articulated vision for networking, workstation deployment and information technology across the campus. That vision is an essential element of collaborative change in any complex environment.

Public access to information and bibliographic data had been provided by the joint development of both a graphical and a character-based user interface (Willow and UWIN/Wilco). The Health Sciences Library and Information Center, in conjunction with Computing & Communications' Information Systems (IS), had earlier developed the X11/Motif based GUI (Willow, a general purpose information retrieval tool for use with MEDLINE. With librarians and faculty guiding the functional design, and the IS programming staff using the most efficient development tools, the mix of expertise proved very successful. Willow functionality was then adapted for the lowest-common denominator interface—character-based vt100. [17]

Because the Innovative database is maintained in the libraries, using the Innovative "off the shelf" system, Librarians and programmers worked on small development teams, one of which produced a MARC format loader for our BRS Onsite system (which Willow and Wilco query). Librarians provided the MARC expertise, and helped the programmers to map appropriate tagged fields to BRS paragraph structures. Outsourcing was used again to preprocess the library catalog by a service provider. The Libraries now regularly sends its data out incrementally, to be "massaged" by authorities preprocessors.

In this way, a careful mix of outsourcing and local, joint development was used in order to meet the common goals in a timely fashion, and with the resources we were able to bring to bear. By Fall, 1994, most of the teams had disbanded, having achieved their charges. The new services were absorbed into the operational stream, and cross-divisional advisory groups were appointed to oversee the services.

Seattle University's experience

Another library development project, this at a much smaller institution, used collaborative teams, resource sharing, top management support, and flexible boundaries to achieve the goal of meeting customer needs for an automated catalog available anywhere on and off campus.

When a new Associate Vice President for Information Services arrived at Seattle University in the fall of 1991, funds had been set aside for a library project, but the Library Director did not have access to them. Because of her recent experience in implementing an automated library system and a campus-wide network elsewhere, the Associate VP was charged by the Provost to lead the automation project with the Library Director and was given funding for the project.

Examining the technology resources of the Library, she decided to ask the University Cabinet for additional funds to acquire microcomputers and to begin to network within the Library. Simultaneously, a campus-wide network project was being proposed, with future access to the library holdings from anywhere on and off campus as one of the primary benefits. The Cabinet request for additional funding was accepted, and library staff training in office automation and networking was initiated by IS.

The automation team was composed of equal numbers of IS and library professionals. Information Services contributed an under-utilized RISC machine to run the library system. They also agreed to manage hardware and network maintenance, to prepare and monitor the overall project plan and to perform financial and technical analyses of alternatives. The Librarians developed evaluation tools and scenarios for examining functionality and setting priorities. A champagne toast ended the planning phase of the project.

Relationships, however, were sometimes strained. Librarians disliked the name "information services" being given to a computing organization and were suspicious that IS was trying to take them over. After the selection, an implementation team including IS focused on technical details, but another team, LISP (Library-IS Partnership), undertook the task of building bridges and identifying projects "beyond OPAC." The AVP served on the Search Committee for a new Library Director, who now chairs the group. Because of the monthly meetings of LISP, the Library became a key partner in developing SU's CWIS and the Library and IS now offer Internet courses jointly developed and taught.

Start Small

Clearly the projects just described are an accumulation of many small cooperative and collaborative efforts. To start, projects should be small and well defined. Efforts should address customer needs and use the special skills of each organization. Milestones in the pilot can be acknowledged and recognized as successes. Rewards should reflect appropriate levels of compensation and varying motivations. With a small success accomplished and recognized, larger collaborative projects can be initiated.

CONCLUSION

The theme of Library/Information Technology collaboration is a popular one, as evidenced by CAUSE's dedication of an entire issue to this subject. Numerous case studies document schools which have attempted collaborative efforts, benefitted from them, and described the lessons learned. Chances for successful collaborative projects, however, are increased if certain strategies are employed from the outset. Many of these techniques are already familiar as part of current management trends for using teams, promoting quality, and re-engineering the organization:

- focusing on customer needs first
- getting top management support
- developing and articulating joint mission statements and service agreements
- planning for change and continuous process improvement
- building flexibility into organizational structures
- benchmarking services and processes with peers
- outsourcing where needed to expand resources
- negotiating ways to achieve synergistic effects
- starting with small projects before moving to more ambitious collaborative efforts.

Footnotes:

1 Sara Kiesler, "Working Together Apart," *CAUSE/EFFECT,* Fall, 1994, p. 8.

2 Michael Schrage, *Shared Minds: The New Technologies of Collaboration*, (New York: Random House, 1990) p. 40.

3 Rosabeth Moss Kanter, "Collaborative Advantage: the art of alliances; successful partnerships manage the relationship, not just the deal," *Harvard Business Review*, July/August, 1994, p. 100.

4 Jon R. Katzenbach, *The wisdom of teams : creating the high-performance organization* (Boston, Mass.: Harvard Business School Press, 1993, p. 24.

5 Ibid., p. 30.

6 Mark Graham Brown, *Baldrige Award-Wining Qualifications: How To Interpret the Malcolm Baldrige Award Criteria* (Milwaukee: ASQC Quality press, 1992).

7 Philip B. Crosby, Quality Is Free (New York: McGraw Hill,1979) p. 15.

8 W. Edwards (William Edwards)Deming, Quality, productivity, and competitive position (Cambridge, Mass.: Massachusetts Institute of Technology, Center for Advanced Engineering Study, 1982.

9 Michael Hammer and James Champy, *Reengineering the corporation : a manifesto for business revolution* (New York : Harper Business, 1993, p. 11.

10 "The Harvard Quality Process", Harvard Office of Information Technology ("handout" at CAUSE '93 session)

11 Anita K. Lowry, "The Information Arcade at the University of Iowa", *CAUSE/EFFECT*, Fall, 94, p. 44.

12 University Advisory Committee on Academic Computing, Robert O. Watts, Chair, "Report on Library Computing at the University of Washington." February, 1990, p. 1.

13 Anne Woodsworth and Theresa Maylone, *Reinvesting in the Information Job Family: Context, Changes, New Jobs and Models for Evaluation and Compensation*, Cause Professional Paper Series, No. 11 PUB3011, Boulder, CO: CAUSE, 1993.

14 "The Harvard Quality Process", handout.

15 Connie Towler and Douglas Remick, "Change in the Trenches: Continuous Improvement of Service Processing," CAUSE, 1993.

16 University Advisory Committee on Academic Computing, p. 1.

17 Willow/Wilco are trademarks of the University of Washington. They are copyrighted, but are available free of charge. Information about the systems is available at: http://www.cac.washington.edu/willow/home.html

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Making Order Out of Chaos with a Computerized Lottery

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Abstract

All undergraduate students at MIT are required to take a certain number of "HASS-D" (Humanities, Arts, and Social Sciences Distribution) classes. The enrollment for each class is limited, leading to competition for spaces.

In the spring of 1994, the HASS office introduced a new system for assigning students to classes. Students ran an application (available on the approximately 800 Athena workstations, plus dialup servers) which allowed them to select up to six classes in order of preference. After students had made their selections, a lottery program made assignments, giving students as close to their top choice as possible, and sent email to the students telling them of their assignment.

The lottery has been run for two semesters, and has consistently given over 90% of students their first choice. Once we took a global view of the system, it turned out that there was no problem matching students with their desired classes.

1 Background

At the Massachusetts Institute of Technology, there is a requirement that all students take a certain number of humanities classes, to ensure that their education isn't *entirely* technical! These classes are referred to as the "Humanities, Arts, and Social Science Distribution" ("HASS-D") classes. Because each of these HASS-D classes requires more writing than is typical for MIT classes, and because the classes are expected to allow for more discussion than large lecture classes, enrollment in each class is limited to 25 students.

As of June of 1993, the system for selecting students was completely ad-hoc; students appeared at the first meeting of a class they were interested in, and if more than 25 appeared, the instructor used a lottery (or whatever other mechanism he or she wanted) to cut down the enrollment.

This was frustrating for both faculty and students. Faculty did not know how many students wanted to attend a particular section until after classes started, and often lost valuable teaching time running unpleasant lotteries. Students were forced to attend multiple classes or risk being shut out of their top-choice classes. If they were lotteried out of a class, they had to scramble to find another class with a vacancy. The result was general confusion for both students and faculty for the first few weeks of each term.

It was known that there was enough space in the offered classes for all students wanting a HASS-D to get one. However, the chaotic selection system obscured this fact, and produced the impression that there weren't enough seats to go around. With this in mind, the assistant dean of Undergraduate Academic Affairs came up with the idea of using Athena, the MIT academic computing system, as the infrastructure for a new package which would allow students to apply for classes and receive their assignments electronically.

2 Expectations

The expectations of this package were that it would:

- Let approximately 2000 students, using the Athena computer system, view a list of available HASS-D classes and rank their choices in order of preference. The selection package would remain running and allow students to make and edit their choices from the end of the Fall 1993 semester through the beginning of the Spring 1994 semester.

- Shortly before classes were to begin, the package would download the students' selections to an administrative PC, where statistics on over- and under-enrolled classes would be generated, and the lottery would be run.

- Finally, it would send the lottery results back to Athena, where all students would receive email telling them of their assignment. In addition, a file listing the classes which still had space would be made public, for those students who were unhappy with their assignment or who wanted to take additional humanities classes.

3 Challenges

There were a number of challenges in designing and implementing this package, both in the "front end" (the student selection application) and in the "back end" (the administrative package used by the HASS office.)

First came the students' privacy. We required that the package be secure from snoopers who wanted to find out other students' selections and assignments. We decided to meet this requirement by using a Kerberized client/server architecture, with the database residing on a secure machine, and each student being authenticated to the package via Kerberos.

Because the application would be run only twice a year, it must be made as simple to use as possible. This was especially critical on the student side, as it would be impossible to give individual coaching to two thousand students. The package also had to be robust enough to survive a barrage of procrastinating students all making their selections at the last moment.

The package must be absolutely fair. We decided that all students would be treated identically. There would be no priority given to seniors, to students with particular majors, and so forth. Furthermore, the lottery algorithm should be proven robust and non-deceivable; that is, there should be no way to manipulate the package by making strange selections.

In addition, the HASS office had some specialized requirements for their part of the application. Because of their policy that a student lotteried out of a class one semester would be automatically admitted to it the next time it was offered, they needed a special report of students not receiving their first-choice class, to be used for reference the next semester. This, in turn, required that there be a "back door" for manually placing students into classes, to be used for the previously lotteried-out students, for desperate seniors requiring one more class to graduate, and the like.

4 Architecture

The package was partitioned into three major sections: The student portion of the package (the "front end") would run on the Athena Unix machines, and the HASS office portion (the "back end") would run on a 486 PC in their office. In addition, the lottery algorithm itself was prototyped and developed on the Unix side, but eventually run on the PC.

The "front end" included the following components:

- A front-end student selection client, in both Motif (for workstations) and Curses (for dialup) use. This client would present the available choices for HASS-D classes and allows students to select up to six of them, in order of preference.

Students would be able to revise their selections as many times as they wanted during the selection period.

- A database server, to maintain the student selection data. This server must use Kerberos authentication to secure its connection with the selection client.
- A collection of automated scripts to transfer data from the Athena enviroment into the back-end application, and vice-versa.
- An email package to send out the final assignments.

The "back end" application for the HASS office provided the following abilities:

- Remote configuration of the Athena client. (That is, turning the student selection client on and off, editting the list of classes available and the explanatory text, and so on.)
- Moving class and selection information back and forth between the front- and back-ends.
- Manually assigning students to classes.
- Producing reports, including class rosters, lists of over- and under-enrolled classes, and lists of students not receiving their first choice.

5 The Lottery Algorithm

We spent a significant amount of time selecting the lottery algorithm to be used for assignments. This type of bipartite matching is a well-known problem, informally known as the "stable marriage problem." We wanted to assign as many students as possible to their first choice, while not rewarding students who made only one choice. (Since we wanted to encourage students to make as many selections as possible.) After prototyping three algorithms and running them on data from previous years' student selections, we selected the one which appeared to be most appropriate. In informal terms, the lottery algorithm worked as follows:

- Begin by assigning all students to their first-choice class.
- Step through all classes which are now overenrolled. Randomly remove students from these classes until they are back down to their maximum enrollment.
- For each student who was removed, step down his or her list of alternate choices and assign this student to the highest choice with space available.

In this algorithm, a student's alternate choices are not looked at unless the decision has already been made to remove him or her from the class. Thus, making alternate choices only makes it more probable that a student will receive a desirable class if he or she is lotteried out of the first-choice class, and does not reduce the chance of being assigned to the first-choice class in the first place. We publicized this algorithm widely, so that rumors of how to "fool" the lottery would not circulate.

Ironically, the choice of algorithm turned out to be almost irrelevant, because there were enough spaces for almost all students to get the classes they most wanted. No matter which algorithm was chosen, it would have had an effect on very few students.

6 Development

Coding of the package, with two developers working half-time, began in September 1993. The Athena portion of the system was complete and operational for December of 1993, so that students could begin making their selections as they completed their final exams. The administrative portion was completed shortly thereafter.

7 Running the System

Each participant in the system has a limited, simple, view of how the system works. As a particular student would see the system, she ranks her choices from a list of classes, being sure to list in first place the class she has pre-registered for with the Registrar's office. Just before classes begin, she receives her lottery assignment by email. From the HASS office's perspective, they begin by sending out the list of offered classes and some explanatory text, and later collect the students' choices. After running the lottery, they send the results to three places: The students, the professors, and the Registrar's office. An individual professor simply receives a piece of paper with the class roster on it, and the Registrar's office receives a list of students not receiving their first choice, so that the students' pre-registration information can be updated.

The system, though, is actually more complicated than perceived by the participants. Figure 1 shows a schematic view of the system. Each virtual component of the system is depicted by a box, and the numbered arrows indicate the flow of information between components.

7.1 Preliminaries:

The selection process requires some manual operations each time it is started. First, an administrator for the database server machine must clear out the database of all previous student selections, and the HASS office must supply some configuration files for the selection client.

The HASS office has control of all text appearing on the front-end client's screen. (Figures 2 and 3 show the main screen as seen by the students.) Each semester, the office must send over the text to appear on the welcome screen, the list of classes to select from, and the text which appears above the list of classes. (The office can change this text at any time, even after the selection process is already in progress.) They also can turn the client on or off remotely. The movement of these configuration files is shown as arrows 1, 2, and 3 in Figure 1. They are sent via FTP ("File Transfer Program") to a transfer point on an Athena workstation, where a periodic script checks for new arrivals and moves them to a public location in AFS ("Andrew File System") space. Once these files are in place, any student running the enroll or xenroll application will see the latest information.

7.2 Making selections

Once the database has been cleared and the client configured, the HASS office turns on the application. This is typically done at the end of the semester, so that students can make their choices for the next semester as they complete their exams or during break.

For the remainder of the selection period, the package operates automatically. As students make their selections, they are stored in a database on the Athena side. A script on the database server machine periodically copies the contents of the database to the FTP transfer point, where the HASS application can take them. This process is shown via arrows 4, 5, and 6 in Figure 1.

7.3 Running the lottery

At the end of the selection period, the HASS office turns off access to the selection client. Getting a final copy of the database contents requires a phone call to the administrator of the database server machine, to make certain that no students are still running the client. (Work in progress is not stopped when the HASS office deactivates the client, and there are always several students still working at the deadline!)

After the last students have saved their choices, the HASS office takes a copy of the database onto their package. (Arrow 7) They then do whatever manual operations are necessary, such as assigning students who were lotteried out of their first choice last year, and then run the lottery. After examining the results, if everything looks sane, they transfer the results back to Athena (Arrows 8 and 9), and begin printing out their class rosters. (Arrow 12)

7.4 Sending out the results

For the next few hours, two processes operate in parallel. On the Athena side, the database administrator begins a script which steps through the list of class assignments and sends out email to each student with his or her assignment. (Arrow 10) To avoid clogging the mail servers, these messages are sent at a deliberately slow pace (roughly one every six seconds) which means that it takes three or four hours for all messages to go out.

Simultaneously, the HASS office prints out rosters for each of the several dozen classes. They also determine the list of classes which still have space available (the threshold for "available" is adjustable) and send this list to Athena, where it can be viewed by those students who are either unhappy with their assignment or simply are looking for an additional class to take. (Arrow 1, since this counts as a configuration file.) Finally, as a convenience for the students, they create a list of students not receiving their first choice, along with the class that they *were* assigned, and provide this list to the Registrar's office so that the students' official schedules can be updated with the assigned classes. (Arrow 11)

8 Outcome

In the first running of the package, we included a one-week lag time between halting the selection client and running the lottery. During this week, the HASS office identified oversubscribed classes, and asked the departments to consider adding sections to them. As a result of this, four sections were added, providing an additional hundred seats in the most popular classes! When the lottery was complete and the smoke cleared, 93% of students had received their first choice.

The following semester, we decided to eliminate the one-week lag time and to send out assignments almost immediately (twelve hours) after taking the choices from Athena. This time, even with no extra sections added, "only" 90% of students received their first choice! Table 1 summarizes the results of the two lottery runs.

	Spring 1994		Fall 1994	
Total students entering	1206		2014	
Receiving 1st choice	1119	(93%)	1806	(90%)
Receiving 2nd-6th choice	64	(5%)	126	(6%)
No assignment	23	(2%)	82	(4%)

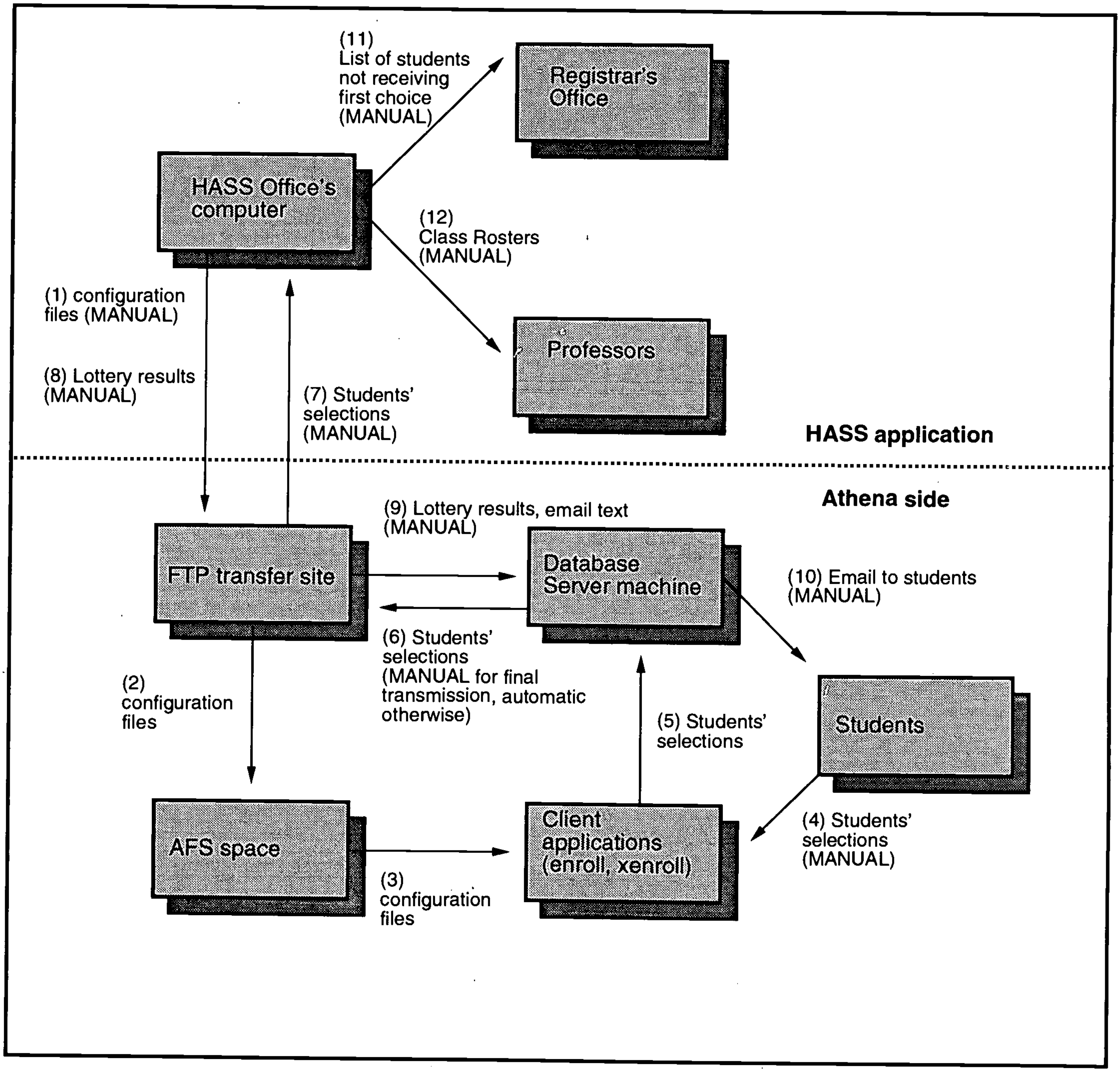
Table 1. Rank of assignments given to students

These results show that, in spite of students' previous perceptions, there in fact was no serious mismatch between the classes offered and the number of students wanting to get into these classes. Even for the second use of the package, when we did not add any additional sections, the vast majority of students were able to get into their first choice class.

The previous start-of-semester chaos had merely been an artifact of the old process. Once we took a global view of the assignment process, it turned out that there was no problem matching students with their desired classes. But the only way to discover this was to look at the process as a whole, and not from the viewpoint of individual students and instructors.

We consider the HASS-D lottery package a great success! We have used a variation of the package in Fall of 1994 for the Freshman housing lottery, which also went much more smoothly than before it was computerized. We believe the next step is to make the package into a generalized lottery system, which will no longer require a knowledgable Unix administrator to set up and run it.

Data flow for HASS-D lottery system



All operations begun manually or requiring human intervention have been flagged with "MANUAL." Otherwise, data flows automatically via a variety of cron entries. Step 6, the final transmission of students' selections to the HASS application, requires a large Moira query to be run in order to expand the Athena logins into MIT ID's and full names, and is done once only. Interm transmissions are automatically sent with dummy data in the ID and name fields.

Figure 1. Data flow in the HASS-D lottery system

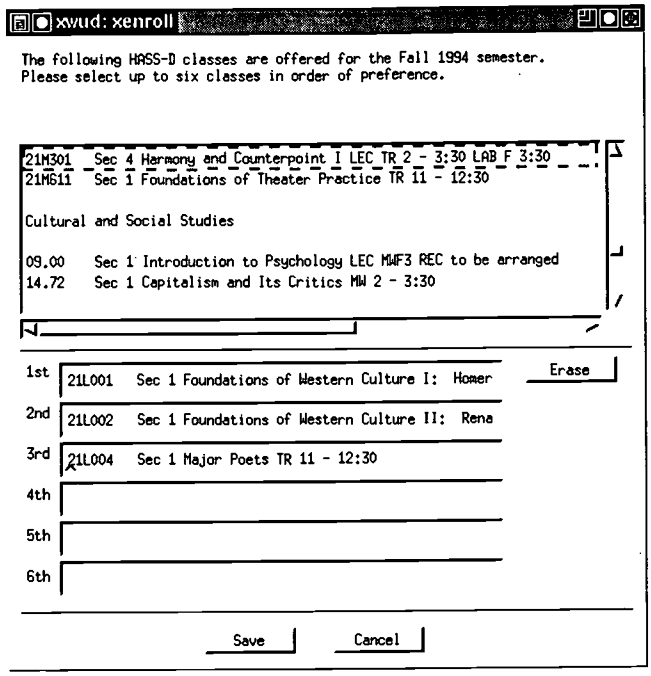


Figure 2. Motif version of student selection client

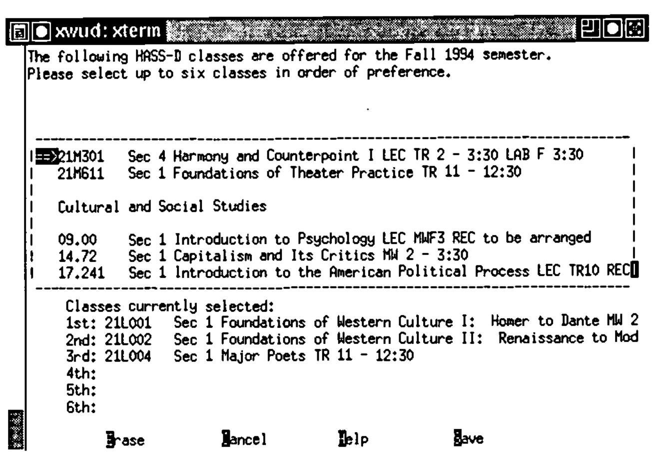


Figure 3. Curses version of student selection client

CUSTOMERS AS PARTNERS IN THE INFORMATION TECHNOLOGY PLANNING PROCESS

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The Information Technology Planning Project at the University of Minnesota included a large-scale customer needs assessment. This presentation provides background on the Project and highlights how customers were involved in planning. Techniques included a Customer Council, focus groups that concentrated on particular customer roles (e.g., administrative, research), a customer survey which collected information on technology use and priorities for information technology initiatives, and a series of visionary "think tank" sessions which brought industry and higher education leaders to campus. We discuss project findings, note comparisons between customers and information technology providers, and outline impact of the project on the University.

WHY DO A STRATEGIC INFORMATION TECHNOLOGY PLANNING PROJECT?

"All too often, computing plans are focused on technology itself, rather than on how technology enables faculty and students to achieve some of the key instructional or research goals of the institution. If it is to have a strong chance of succeeding, the plan cannot be distinct from or tangential to the overall academic mission of the university—indeed, the plan must flow from an understanding of the mission..." Hawkins (1989, p. 231)

At the University of Minnesota, we realized the need for a strategic information technology plan to guide future planning and investments in information technology and to support the University's mission in teaching, research, and outreach. Both the University and the field of information technology are changing, and changes in both arenas impact future computing and information strategy. To remain a premier institution, the University must have a well-defined information technology strategy that creates an integrated electronic environment with cost-effective decisions about resources.

Like other institutions (Breivik, 1994; Fleit, 1994) we wanted to talk with our faculty, staff, and students about their work and how information technology supports what they do. We did not want to conduct a self assessment of information technology services; we wanted to discover the needs of customers and how information technology supported these needs now and in the future.

Therefore we embarked on a strategic information technology planning project that allowed us to obtain in-depth, qualitative and quantitative information on customer needs. Originally we envisioned an ambitious five-step process: review University strategic direction, assess customer needs, assess the existing information technology investments already made by the providers of information technology, develop strategic information technology architecture, and develop tactical implementation plans.

In this paper we will mainly discuss the one-year process for assessing customer needs, but also will describe how we engaged information technology providers in this process. In addition, we will present our findings and discuss the project's impact on the University.

HISTORY

The process for defining an information technology strategy for the University of Minnesota community began in 1992 when senior University management created an Advisory Users Committee (AUC), with a charge to create a vision of computing and information technology for the University. The AUC vision states:

> *We envision an electronic environment, a common space, that invites members of the University community to make use of distributed information technology in realizing our land-grant mission. In addition we wish to involve members of the community at large in this collaboration. This environment will be tolerant of diverse computing platforms, provide access to global information resources, and will value innovation. (August 12, 1992)*

The vision along with some preliminary strategies for achieving it received endorsement from the University President's Cabinet, the University Senate Committee on Computing and Information Systems, and the University Senate. The vision was widely shared with academic units and key University information technology personnel.

To implement the vision, senior management chartered an Information Technology (InfoTech) Steering Committee, which recommended an approach focused on establishing the linkage between the University's strategic requirements and its ability to use information technology and to address the needs of academic and administrative units. The Steering Committee consisted of the Associate Vice President for Academic Affairs, the Associate Vice President for Finance and Operations, the Director of Administrative Information Services, a former chair of the Senate Committee on Computing and Information Services, and the two co-chairs of the InfoTech Planning Team. The Steering Committee then chartered the InfoTech Planning Team consisting of people from academic and administrative computing, student affairs, university networking, libraries, graduate school, and collegiate unit instructional computing.

To begin the project, we conducted an internal and external environmental scan: internally by reviewing University strategic planning efforts and previous information technology planning documents, and externally through review of peer strategic plans.

At about the same time the information technology planning process was beginning, the University of Minnesota was starting to transform its vision, "University 2000 (U2000): A Road Map to the 21st Century," into plans and reality. The U2000 vision describes a University committed to improving its position as one of the world's premier research universities, improving the environment for teaching and learning, enhancing its commitment to service and outreach, providing a user-friendly environment, and expanding its commitment to diversity. The University is developing and using criteria for measuring its success in meeting these objectives. We reviewed U2000 planning documents, kept informed, and shared information with the U2000 planning committee throughout the project.

The team also reviewed 11 previous information technology planning efforts at the University of Minnesota and created a "Common Themes" report that highlighted issues that occurred in more than one report. Among these common themes were needs in the following areas: goals and vision, an appropriate organization to support information technology, integrated planning, appropriate funding models, better use of human resources, information technology standards, infrastructure support, user support, better access to institutional data, and applications to support the mission.

We also conducted a thorough review of peer strategic plans. The team reviewed profiles of strategic directions, innovative projects, organization structure, and funding models from other universities by looking at publications from such resources as EDUCOM, CAUSE Information Resources Library, Coalition for Networked Information (CNI), Corporation for Research & Educational Networking (CREN), CICNet, MRNet, HECB Telecommunication Council, and the METNET telecommunications consortium. We continued to track developments in these areas as the project progressed.

While conducting this environmental scan, we rarely found detailed information on *how* data was collected from customers. Early on we decided that it was important to not only obtain information from customers, but to allow customers to engage in conversations and share information with people from multiple disciplines. Therefore, we created a formal project organization and process for collecting customer information to achieve this goal.

HOW DID WE INVOLVE CUSTOMERS AS PARTNERS?

Customer Input Organization

We had three objectives in developing our method of obtaining information from customers and providers: obtain in-depth, qualitative and quantitative information on customer needs; validate the AUC vision; and promote sharing of information. To help us with this process we formed and worked with a Customer Council, Customer Council Liaison Group, and Provider Council. Three separate Listservs allowed efficient and effective communication with these large and diverse groups about meeting dates, project updates, and change in plans.

Customer Council. The Customer Council consisted of 150 individuals nominated by their college dean or chancellor (up to 4 people from each college with a balance of faculty, administrative staff, technical staff, and students) or central administrative department head/director (up to 3 members). Customer Council members were invited to participate in the project through involvement in focus groups, through council meetings, and through filling out a survey.

Liaison Group. We created a 15-member Customer Council Liaison Group as a representative subset of the full council. This Liaison Group met with the InfoTech Planning Team to review approaches to gathering data and was heavily involved by providing substantive and constructive feedback on the structure and content of drafts and final drafts of our written reports.

Provider Council. We created a 15-member Provider Council from the large central units important in the information technology infrastructure on campus—academic computing, administrative computing, telecommunications, libraries, media resources, and printing and graphics. Providers met to discuss their technology perspective and experiences with information technology at the University of Minnesota, discuss the customer assessment findings, and to fill out a survey.

Data Gathering and Information Sharing Techniques

After talking with four University of Minnesota national experts on strategic planning, we decided on the following techniques for reaching our goals of data gathering and information sharing:

Technique	Purpose
Focus groups (Customer Council)	-obtain qualitative data focused on information technology needs -provide an environment in which people could engage in conversations that would impact their own view of information technology needs (Krueger, 1988)
Revision/Feedback sessions (Liaison Group)	-provide feedback on data gathering and information sharing techniques -provide substantive feedback on drafts of reports
Survey (Customer and Provider Council)	-provide quantitative information on customer use of information technology -provide a prioritization of possible "next step" actions the University could take to meet information technology needs

Monthly Council meetings (Customer and Provider Councils)	-share preliminary and final data analysis and progress of strategic planning efforts -provide "visionary think tank" sessions. We invited leaders from industry and higher education to campus, including speakers from DEC, IBM, Apple, US WEST, Silicon Graphics, the Blacksburg Electronic Village project, and the Universities of Indiana, Wisconsin, and Michigan -share information and develop future collaborative partnerships

Early in our process it became clear that many people had difficulty envisioning how they would be working and using technology in five years. Many were caught up in day-to-day tasks of using the information technology already on their desktops, finding money to upgrade hardware/software, or hiring research assistants. Therefore we decided to schedule the think tank sessions in order to stimulate visionary ideas among the council members. These meetings also allowed people from multiple disciplines to meet, listen to and discuss new ideas, and share information.

FOCUS GROUPS

Process

We conducted 21 focus groups from August through October, 1993. Ninety eight people attended the focus groups (some attended several). An outside consultant with skills in strategic planning and focus group facilitation moderated the focus groups; InfoTech Planning Team members served as assistant moderators. Participants self selected into the following functional roles and corresponding focus groups: administrative (49 participants), instructional (18), outreach (17), research (16), and student (19).

A pilot focus group was conducted to refine our procedures and questions. Focus group participants completed a pre-focus group survey, which requested that they read the AUC Vision and begin thinking about their information technology needs. The focus group questions asked about their current work environment and information technology use, future requirements, exciting information technology projects, and their reaction to the AUC vision statement.

During the focus groups, assistant moderators took notes and tape recorded the session. After each focus group, the assistant moderators collected completed pre-focus group surveys (68 total). Through re-listening to the tapes and reviewing their notes, they created organized notes for each session, which maintained confidentiality in participants' responses and included information from the pre-focus group surveys. The consultant reviewed and provided feedback on all organized notes.

One team member then took the organized notes from a functional area (e.g., administrative, instruction, outreach, research, or student) and created the report for that area, incorporating feedback from the consultant, InfoTech Planning Team members, and Customer Council Liaison Group members.

Reports

As stated above, we created five functional reports that provided *detailed* information about administrative, instructional, outreach, research, and student needs. The reports had three parts:

- specific examples of information technology use
- comments on what is working and not working in terms of information technology
- key information technology challenges and next steps the University should take in order to meet customer work needs

We also created an overall summary report from the focus groups, *Summary of Focus Group Findings*. The purpose of this report was to highlight common findings between all functional groups and to present our recommendations for future information technology planning.

Finally, we created an 11-page list of exciting information technology projects in which customers are involved at the University of Minnesota. In addition to the name of the department related to the project, this list included a brief description of the innovative use of technology for administrative, instructional, outreach, research, or student use.

SURVEY

Process

A survey on customer use of information technology and prioritization of possible "next step" actions for the University was conducted in late January and early February of 1994. Response rates were 67% for the Customer Council (96 surveys) and 77% for the Provider Council (10 surveys).

The InfoTech Planning Project Team worked with many groups to develop this survey. Customer Council members assisted in developing the items on proposed next steps through participation in small groups at a Customer Council meeting; groups were assigned the task of listing and prioritizing the things the University should do to better support information technology. From these lists, review of other survey instruments, review of focus group suggestions for next steps, extensive discussion with the project team and Steering Committee, and input from information technology experts at the University, the survey was refined.

In the survey, respondents were asked about their use of information technology and then asked to rate a variety of actions the University could take to improve information technology usage. We grouped these actions into three broad categories: (1) General Services (including Information Technology Infrastructure, Labs and Facilities, and Consulting Support); (2) Specific needs/activities, and (3) Policy & Planning (Information Technology Policy Development, Funding, and Vision & Planning).

The picture of our customers that emerged was that of a group with primarily administrative duties (51% of the sample), although half of the sample also reported either primary or secondary job duties in instruction or instructional support, outreach, or research or research support. Relatively few of the group (about 5%) reported that being a student was their primary role. The group was almost evenly split between men and women, and most of the group (78%) ranged in age from 30 to 49.

Reports

We created a report, *Findings from the Information Technology Customer Survey,* from the survey results. This report provides a:

- Description of how customers use technology (e.g., hardware, software, networking needs)

- Prioritization of possible "next step" actions the University could take to meet information technology needs
- Discussion on agreement between providers and customers on the priority of next steps

WHAT DID WE CONCLUDE FROM THE CUSTOMER ASSESSMENT?

Detailed accounts of our findings can be obtained by asking for our reports from the CAUSE Information Resources Library (see Bibliography for titles). Below, we briefly describe major highlights from our focus group and survey findings.

Focus Group Findings

In the *Summary of Focus Group Findings* report we provided the President's Cabinet, deans and unit managers with an executive summary highlighting five major findings from all focus groups:

1. Information technology supports a wide range of user activities and extends throughout the University community. Participants provided many examples demonstrating how information technology assists in their activities, and helps them reach local, state, national, and global communities.

   Participants emphasized that information technology is pervasive and provides opportunities to build new relationships. Participants stressed that without information technology they literally could not do most of their work and that it is technology that gives them a competitive edge.

   Participants stated that information technology supports the daily functions of communicating, collaborating, writing, visualizing, and working with information, all of which facilitate the creation, sharing, and preservation of knowledge. Participants made it clear that their use of information technology requires a continuum of information technology based on the context of use.

2. Participants described common attributes needed in order for them to be productive in their work environment and provide the foundation for future information technology planning. Participants want information technology systems and services that are: accessible, user focused, accountable, reliable, timely, easy to use, flexible, and accurate.

3. Participants discussed five key information technology challenges the University needs to address so that people can be successful in their work:

   - Assess and address the information technology **support** we need.
   - Develop **environments** that allow us to efficiently and effectively use information technology to conduct daily functions that support key University activities.
   - Develop appropriate **policies** to meet our information technology needs.
   - Develop **funding models** to meet our information technology needs.
   - Develop an appropriate **organizational structure** to meet our information technology needs.

   In addition to key challenges, participants provided many examples of specific next steps that administrators, providers, supporters, and users of information technology could implement in order to meet key information technology challenges. We shared these next steps with University providers of information technology for their planning use.

4. In general, users supported the AUC vision and major objectives. Participants viewed information technology planning as important and wanted it to continue.

5. Participants discussed in degrees of detail current exciting projects that administrators, instructors, outreach personnel, researchers, and students are implementing. We published this list on the University of Minnesota Gopher.

Survey Findings

The survey provided us with a rich amount of data indicating that customers and providers of technology considered most "next step" items important. We choose two key questions to examine to summarize the data in a useful way for management and central administration:

- Which items do customers and providers consider to be top priority?
- Do customers and information technology providers agree on the priority of next steps?

Which items do customers and providers consider to be top priority? Table 1 below lists the top four items for customers and providers and each item's average rating. It is interesting to note that all but one of these items are policy and planning items. One item refers to general services, specifically consulting and support. Customers and providers seem to value policy and planning efforts. Both customers and providers want the need for information technology at the University promoted to the legislature. They also agree that we need more funding for developing the people resources that support and use information technology.

Table 1. Top four items for customers and providers

(Based on average rating—Top priority, do now (4), Valuable, do soon (3), Useful, but not critical (2), and Not necessary (1))

Item	Customer	Provider
Customer and Provider "Top 4"		
Promote the need for information technology at the University to the legislature.	3.7	3.9
Provide more funding for developing the people resources that support and use information technology.	3.5	3.7
Customer "Top 4"		
Provide a place for information technology planning in U2000 and ongoing strategic planning efforts throughout the University.	3.6	3.6
Ensure disaster prevention/recovery plans for centrally-provided information and services are in place.	3.5	3.1
Provider "Top 4"		
Reorganize information technology units under strong leadership.	3.1	4.0
Provide more help line/help desk service to adequately cover times of peak demand.	3.4	3.7

Do customers and information technology providers agree on the priority of next steps? Overall, we concluded that the providers do have a good sense of what their customers need. Despite the overall agreement among customers and providers, there were a few items whose average ratings differed by .4 or more, which suggest areas where customers and providers may differ or may need to educate one another. These are shown in the Table 2 below; items where the difference was statistically significant are marked by **.

Only four of these items had a 3.3 or above rating by either the customers or providers, and of these four only two had a significantly different rating. Customers feel more strongly about the need to ensure disaster prevention/recovery plans for centrally-provided information and services, and providers feel more strongly about the need to reorganize information technology units under strong leadership. Both of these items need to be addressed. In all cases, customers and providers need to articulate *why* these needs are top priority.

Table 2. Customer and Provider response differences (.4 or more)
(Based on average rating—Top priority, do now (4), Valuable, do soon (3), Useful, but not critical (2), and Not necessary (1))

Category and item	Customer	Provider
Information technology infrastructure		
Strengthen campus network security (e.g., break-ins, forgery, eavesdropping).	2.9	3.3
**Ensure disaster prevention/recovery plans for centrally-provided information and services are in place.	3.5	3.1
**Provide services and support that will facilitate disaster prevention/recovery planning in individual units.	3.1	2.6
Consulting and support		
Expand help desk/help line coverage to include evenings and weekends.	2.8	3.3
Provide basic information technology training as a part of staff orientation and freshman core curriculum.	3.1	2.7
Improve support for user selection of hardware and software (e.g., clarifying requirements, documentation, consultation).	2.8	3.2
Broaden expertise of support staff to include high performance workstations.	2.7	3.1
Broaden expertise of support staff to include adaptive technology (e.g., Braille output, voice synthesizers).	2.4	2.9
Specific needs and activities		
**Provide more extensive on-line hours for major administrative systems (e.g., student records, LUMINA).	3.0	2.4
Information technology policy development		
**Reorganize information technology units under strong leadership.	3.1	4.0

WHAT IMPACT DID THE PROJECT HAVE ON THE UNIVERSITY?

While it is not always possible to clearly identify outcomes from the project, we believe that the project's work and the relationships that it has fostered have been instrumental in a variety of areas.

1. **Impact on University 2000 strategic planning.** During the planning project we shared preliminary findings and project progress with the U2000 University-wide planning team. Final project reports were distributed to all deans, along with other U2000 strategic planning documents, as part of collegiate planning instructions. We presented our findings to the Deans' Council and discussed the InfoTech strategic planning effort needed to ensure customers have access to the information technology they need in order to be leaders.

2. **Providing impetus for ongoing information technology planning.** Several on-going commitments resulted from the Project. The senior vice presidents have agreed to focus information technology planning. Our Associate Vice President for Academic Affairs has established an ongoing staff position for Information Technology policy development, planning, measurement, and evaluation. An Information Technology Advisory Council and ongoing Customer Council, along with cross functional working groups, will support the planning efforts.

3. **Impact on budget planning.** Project data were used in three of the four major themes in a request to the legislature for additional funding. And information technology is prominently featured in the biennial request submitted in October, 1994.

4. **Creation of new relationships and cross functional collaboration.** An added benefit was the collaboration among team members, Customer Council, and Provider Council. We viewed many episodes of business card swapping and heard people share ideas about pedagogical practices, hardware tips, software advice, multimedia classroom access on campus, and new administrative processes and policies.

5. **Prototype multimedia projects.** Students in a Rhetoric Multimedia Document Design course had the opportunity to develop three- to five-minute multimedia presentations highlighting six of the exciting information technology projects discussed during focus groups. Students in this course targeted the President of the University of Minnesota as their main audience. They were asked to develop short presentations that the President could use to highlight how information technology, as demonstrated by these exciting projects, is helping the University accomplist its missions of teaching and learning, research and discovery, and outreach and service. The students interviewed the faculty and designed and developed the multimedia presentation. This proved to be a stimulating learning experience for students: they engaged in active learning; worked in groups; interacted with a "real" audience, someone besides the instructor; learned multimedia computer skills; considered multimedia design issues; and presented their final projects to high-level University administrators.

6. **Digital Media Center.** A new Digital Media Center, which will provide technical and design support for faculty and staff using multimedia for teaching, research, and outreach, will open in early 1995. Specific goals include providing central staff and services to help faculty and teaching assistants bring multimedia technology to the classroom, serving as an umbrella organization for research, investigating how new technology enhances teaching/learning, and providing state leadership for "train the trainer" programs.

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Distance Education: What's Up?

by
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December 1994

DISTANCE EDUCATION: WHAT'S UP?

By the year 2000, multiple and seamless links will exist between homes and industries, driven by the converging computer, communications and television technologies. Coupled with telecomputer, telephonic TV, cable and satellite access, such evolutionary phenomena will soon permit widespread availability of diverse forms of information, education, services, and entertainment for all.[1]

SOME THOUGHTS ABOUT LEARNING

If Rip van Winkle were to drop in on one of our classrooms today he would probably feel right at home. In the front of the classroom is a single, isolated instructor still using a chalkboard with little else to support his/her craft. After all, this approach has endured for hundreds of years and there is almost no convincing evidence that either television or computers has changed the basic instructional model or challenged its underlying academic culture. So, why bother?

A reality check would say that today's instructor is not a dedicated craftsperson, but a highly-trained professional needing the technological support of a wide range of developers and resources. We must understand that technology can give us the management and instructional resources that enable us to meet the needs of every student, not just the few who would learn without us. We should be using technology to increase faculty productivity and student performance.

The question to be asked is not whether to use the technology, but rather how best to use the technology.[2]

DEFINING DISTANCE LEARNING

It is probably an understatement to say that there are as many definitions of distance learning as there are techniques for teaching. Perhaps, it will suffice to say that distance learning involves a wide spectrum of techniques, methodologies, and media. As a minimum, it is usual to describe distance learning as instruction that involves more than one of the senses, has an educational purpose, and includes several modules of instruction, taught over time. A more formal definition follows:

Distance education can be broadly defined as the transmission of education or instructional programming to geographically dispersed individuals or groups.[3]

Given this generalized definition, distance learning has been in existence for decades and now appears to be on an up-swing. Correspondence courses, the earliest form of distance education, began in the late 19th Century and was formalized an as institutional option as early as the 1930s. Instructional television was a much-touted distance learning model in the 1960s. However, ITV fell far

[1] Alexander Schure, "Towards a New 'Distance Learning' University," T.H.E. Journal, March 1994, p. 32.
[2] Terry Kolomeychuk & Diane Peltz, "Assessing the Effectiveness of Interactive Compressed Video at the University of Minnesota," TDC Research Report No. 20, University of Minnesota, December 1991, p. 4.
[3] U.S. Congress, "Linking for Learning," Office of Technology Assessment, cited in Florida Distance Learning Report, Tallahassee, FL, March 17, 1992, p. 7.

short of early expectations. Perhaps, today's telecourses and educational programs will reach many new learners in diverse settings.

Thus, distance learning takes many forms. From voice and audio-graphics teleconferencing to microwave networks to full-motion video, distance learning has many levels of sophistication, interactivity and costs. ***No one delivery mode is superior to all others.*** Each system has its pros and cons. Research has shown that learning can take place with all types of distance education systems. But, some subjects lend themselves to certain systems better than others. Cost is also a prime consideration in choosing a delivery system. Most institutions engaged in distance learning programs will ultimately find themselves employing many different techniques, technologies and methods to accomplish its educational missions.

OVERCOMING RESISTANCE TO CHANGE

Regardless of the noble motivation, change is something we humans resist. Thus, going into a program of teaching at a distance will evoke reactions from the participants in ways that are hard to rationalize. Which is the point. Many reactions or responses are not rational. But, we should be prepared for them and ready to work through them. Lack of know-how, loss of control, and loss of privacy are grounds for educators' reluctance to embrace distant learning programs.

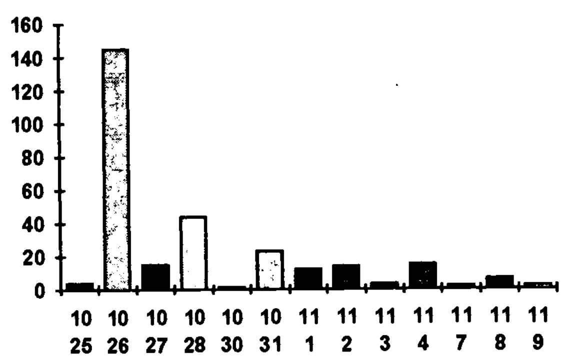
A SURVEY OF DISTANCE LEARNING

Against this background on distance learning, it became apparent that theory and observation can only take you so far. Thus, it was decided to do a brief survey of colleges and universities to see how things are going in distance education. Rather than follow the traditional, extensive, rigorous experimental design methodology and sampling process, a quick and dirty e-mail survey was used.

Through the auspices of CAUSE and its Institutional Database resources, a six-question e-mail survey was sent to the 850 or so campus "institutional representatives." The survey design was patterned after the highly effective CAUSE Postcard survey that has been used for several years to sample issues in higher education IT.

Survey details. On October 25th, the Internet spread this survey out all over the world. The survey produced 300 responses or a 35 percent response rate. Interestingly, the Internet respondents made 50 percent of their replies in the first 24 hours. The chart below shows the frequency of response on the vertical axis and the date (month/date) across the horizontal axis.

E-mail Response Times



Also, of interest was the 10 percent response coming from international CAUSE members. Finally, in this area, about 6 percent or over 50 responses came back by FAX. This reflects that the campus rep has an Internet connection but the people working in distance education probably don't.

DISTANCE EDUCATION IS "IN"

The basic question in any topical survey is whether it is "in" or "out." Intuitively, we know that higher education is into distance education and has been since the 1930's but how big is it?

Credit and Non-credit Programs. When asked the question, over ***55*** percent of the respondents said that their campus was involved in distance learning--the majority doing ***credit*** courses, but half of those involved in distance education were also doing ***non-credit*** programs.

CAUSE asked this question during the development of its ***1994 CAUSE ID Survey***. With a 38 percent response rate, they reported that ***57*** percent were involved in distance learning.[4] So, keep in mind that the following discussion of responses refer to about ***165*** colleges and universities that "do" distance education.

Courses and Enrollment Per Semester. Another interesting aspect of these programs is that when they get started, they seem to be fairly large. For example, on average, campuses engaged in distance learning offered ***22 courses*** each semester. In terms of student enrollment, the campuses reported that they had an average of 500 plus students enrolled each semester.

Planning to Get Started in Distance Education. There were 42 percent of the institutions that indicated that they were not involved in distance education. Of those, half of them said that they plan to get started in distance education within the next 3 years. And, almost all (98 %) of those doing distance education said that they would expand their programs over the next 3 years. One could conclude that distance education is on the move.

As a means of reviewing the various options in distance learning available and in use today, the following section provides such a review.

A REVIEW OF DISTANCE LEARNING OPTIONS

A comprehensive and complete review and discussion of all the options that can be a part of distance learning is an heroic goal to be accomplished in a few pages. So, what is provided is a list of the options, as a means of demonstrating that range. Then, some of the options are discussed in their particular situations. Finally, it should be observed that the technology is moving at such a pace as to make it impossible to say that this is anything more than a snapshot of today's options.

- **"Remote" the Facility**
- **Correspondence**
- **Audio Conference**
- **Electronic White Boards**
- **Computer-Networked Interaction**
    - **Internet Linkages**
    - **Bulletin Board Systems**

[4] Janet Munson, Randy Richter, & Mike Zastrocky, CAUSE Institution Database 1994 Profile, Boulder, CO: CAUSE, November 1994, p. 123.

- **Video-Based Education**
  - **Video Tape (video taped lectures)**
  - **Broadcast Video**
    - **Local Origination Channel TV**
    - **Private (University) Broadcast**
  - **One-Way Video/Two-Way Audio**
  - **Videoconferencing**
  - **Two-Way, Interactive Video**

Again, as mentioned above, rather than discuss each of the distance learning options, the following section contains a few vignettes of how these approaches are being used in colleges and universities today.

A Discussion of Some of the Distance Learning Options

◆ "Remote" the Faculty

One of the simplest ways to teach in remote locations is to move the faculty to the distant learning site or hire adjunct faculty on location for that purpose. For the most part, this is probably the good model to use for many subjects where the instructor is the "subject matter."

◆ Correspondence

The use of correspondence courses as a means of reaching distant learners around the world has been in use for decades and most especially since World War II when many veterans were hurrying to complete their educational void. Also, the easy access to air mail played a key role in speeding up this method of learning. What distinguishes the correspondence learners are that they have to be self-motivated and disciplined. They have to be the type of student that learns by reading and writing. Listening and speaking are not part of the process. Further, they miss the opportunity of social interaction and learning from other students.

◆ Computer-Networked Interaction

Thomas Edison State College (NJ) has developed a system of high-quality, flexible, and accessible undergraduate education supplemented by a computer delivery initiative called ***Computer-Assisted Lifelong Learning*** or CALL. The Guided Study program provides students with semester-based independent learning courses. Students receive a course syllabus and various learning materials, usually a combination of basic texts, video materials, and learning guides.

As a real-life, time-proven distance learning application, consider this approach for enhancing mathematics at Florida State University. For decades and perhaps centuries, this type of instruction has consisted of the teacher working problems in class and the students practicing that skill in-between classes. To make the process more focused, this FSU instructor started to use the ***Internet*** with his class. All assignments were given in that manner and the student could ask questions of the instructor with an expectation of a reply within 24 hours. This system improved instruction and the success rate of the students for several reasons. First, the instructor was more in tune with the problems of the students and could teach to their need. Secondly, the students felt a personal interest was given them, even if through a computer.

◆ **Video-Based Education**

Some states, like Florida, have spent a considerable amount of money building an infrastructure to promote distance education. There are currently over 100 ITFS (Instructional Television Fixed Service) channels licensed to educational institutions. A satellite network, called SUNSTAR, has placed steerable C and Ku band satellite receiving dishes in 35 sites, including one at each of the 28 community colleges service areas.

◆ **Videoconferencing**

⇒ Arizona State University (ASU) formed a second campus and was immediately faced with need to hold cabinet meetings with staff in both locations. The solution was to acquire a modular PictureTel 4000 viedoconferencing system for each campus location. This approach was so cost-effective in terms of traveling and time that a PictureTel M-8000 Bridge was added to the system and now the three state universities in Arizona hold all of their Council of Presidents meetings via videoconferencing.

◆ **Broadcast Video**

Another goal of The New School in NYC is to become an "information provider," by becoming a producer of programming for delivery by common television carriers, such as the Public Broadcasting System. They are also exploring opportunities to exploit the emerging "video on demand" technology through partnerships with telephone and TV cable companies.

◆ **Two-Way, Interactive Video**

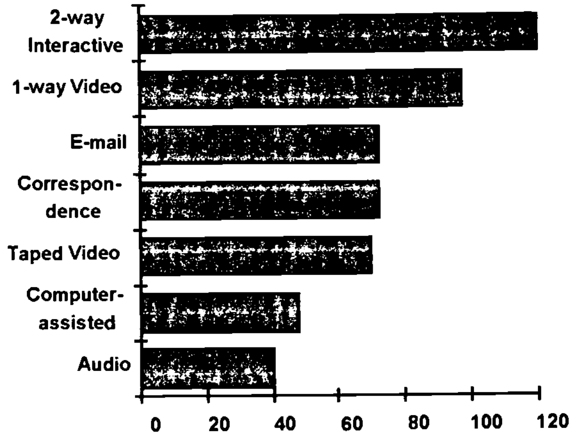
The State of Georgia has made an executive decision to fund 100 Compression Laboratories, Inc. (CLI) Rollabout systems for education in 1994. At a cost of about $50,000 each, these rollabouts will be part of an even larger program of video technology for distance education. By 1995, the State will have 500 such distance learning sites. The educational plan to use this technology is yet to be developed, but the Governor wants to be sure the infrastructure is in place to support video-based learning throughout the State.

From this point on in the paper, the data from the survey will be integrated into the text by referring to the it as "***Survey Results***."

Survey Results:

Somewhat surprisingly, the survey found that the dominant technology for the delivery of distance education was ***two-way, interactive TV,*** as reported by 120 campuses, with one-way TV a close second with 98 colleges and universities. E-mail and correspondence rounded out the top four with about 75 responses each.

Technology for Delivery
(Multiple Answers)



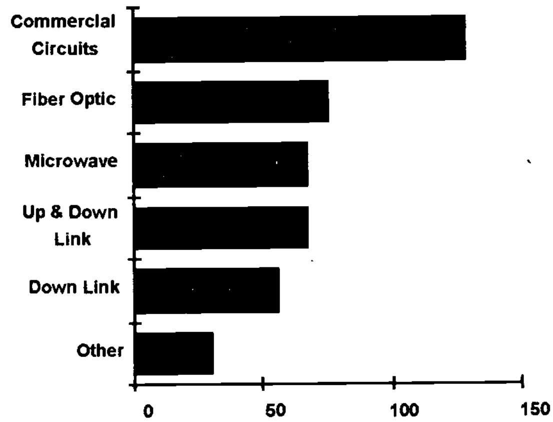
TRANSMISSION METHODS

An integral component of the technology used for the delivery of distance education is the "how." By this it is meant, by what technology with the materials be transmitted.

Survey Results:

The colleges and universities involved in distance education validated that they use many methods to deliver the "signal." And, interestingly enough, there was a dominant response.

Transmission Methods



Regardless of whether you call it "land lines," "commercial circuits," or "the phone company," the vast majority of colleges and universities are using the public telephone system to deliver distance education. Again, the option allowed for multiple answers, but 128 our of 160 respondents indicated that they used commercial circuits or land lines to transmit their programs.

The next most popular transmission medium was listed as fiber optics at 76 campuses. The confusion that might have come from this answer is that we do not know if it is fiber on the campus or the respondent's belief that most commercial circuits are now fiber, at some point is the system. So, one might add these two together as a single dominant medium. At any rate, we are doing a lot of "earth" transmitting and using microwave as second (67 campuses).

REPORTING RELATIONSHIPS

Another major issue in the establishment and implementation of distance education programs is where the unit or function reports within the organization. Many would point out that effective programs are more a result of ***developing networks of relationships*** than on equipment.

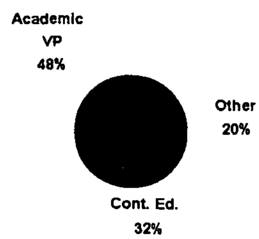
Another lesson for success teaches us that leaders at the highest levels of the organization are involved and success is more likely if visible support comes from the Prez. The University of Nebraska at Lincoln developed what is now known as Nebraska CorpNet with a chancellor pushing from the top down through the vice chancellor for academic affairs, and thence to the dean of engineering. CorpNet provided on-site training for business and industry using live broadcast TV.

Yet, the bottom line is that the unit must report somewhere. Since presidents are busy people, it is normal to place the unit within one of the operating units. Again, the higher in the organization the better. So, what's up?

Survey Results:

Where units report within organizations is often an indicator of support and importance to the mission of the college or university. Thus, the campuses were asked where distance learning reported within their organization. Almost half (***48 %***) said that it reported to the ***Academic VP/Provost*** and the other large vote (***32 %***) went to the head of ***Continuing Education***. The remaining 20 percent were largely indicating that the program reported to their academic unit, department, school, or college.

Reporting Relationships



STAFF COMPENSATION

Providing appropriate compensation for the faculty and staff in recognition for additional effort and gains in productivity has always and will continue to be a challenge in terms of fairness, in both the short and long run. As colleges and universities move into various new teaching modes, whether at a distance or not, it would be ideal if the issue of changes in compensation packages would not need to be addressed until new models can be tested and refined. Experience has demonstrated that once "bonus" or overload programs are begun, it is difficult to modify them, especially in a downward direction.

Survey Results:

Another issue concerning the faculty role in distance education programs is that of visiting the remote sites. In those cases where the instructor is "beamed" out via a video signal, is the faculty member obliged to go out an visit the students, person-to-person? Happily, it was reported that ***70*** percent of the institutions reported that main campus instructors ***visited the distance learning centers***.

LIBRARY SUPPORT

Effective distance learning often suggests that innovative consideration has been given to several forms of student and academic support, such as the library, and provide staff resources and facilities to make the remote learning site comparable to a normal campus experience.

The library staff should be working to expand its distance learning programs. For example,

⇒ To provide immediate response to requests for articles, it might be necessary to cease the lending of the serials collection to "Reference Only."

⇒ More of the collection might have to have duplicate copies which might reduce the range of materials otherwise purchased.

⇒ Assuming distance learning students will have access to the on-line catalog, additional resources would be needed to provide them materials by fax, mail, or e-mail. A similar financial impact would be felt from the use of commercial document supply services, such as Uncover.

Like other forms of "student support," some consideration should be given to the identification of staff resources to make the remote learning site comparable to the normal campus experience. At remote sights, what might be needed is a jack-of-all-trades type of individual who would be capable of handling library, computer, communications, and student services support. But, perhaps that is expecting too much from one individual. It might be more realistic to identify an *ombudsman*-type of individual who would know whom to contact back at the main campus to address particular faculty and student needs. The goal in all of this is to assure that the "distant campus" gives every indication of being the same as the main campus.

Survey Results:

Of those institutions reporting distance learning programs, ***74 percent*** said that they provided library support services to their students who were remote from the main campus.

OTHER ISSUES--LARGE AND SMALL

In the process of assembling the survey, several issues came to mind and were included in the final instrument that went out over the Internet. These results have been brought together as a summary of interesting issues.

Tuition and Fees. The perception of many is that the student must bear the financial burden for bringing education to them at remote sites. Yet, when asked if the tuition/fees are the same for distance learning as regular, on-campus courses, ***90*** percent said that they were the ***same*** or equaled to those paid by on-campus students. Of those who said that they were higher, the average represented an 11 percent higher tuition or fee.

Just Part of the Regular Academic Program. For 52 % of the campuses, distance learning is a regular part of its regular academic course offerings.

It's Old Hat!. One has the misconception that everybody has been doing this distance education thing for years. Yet, the reality is that the technology, need, and interest in all coming together within the 1990s for it to become a popular thing for higher education to do. In fact, the majority (61 %) of the respondents said that their distance learning program had been in operation ***less than 5 years***.

Part of a State-wide System. All of us like to have company. This is especially true with new technology and educational programs. So, it is not surprising to learn that 52 % of the campus in the survey indicated that their program was part of a state-wide system or network.

Keeping-up With the Others. In 76 % of the campuses, it was felt that the distance students fared as well as the campus students.

CLOSING THOUGHTS

As a closing to this discussion about distance learning, it might be interesting to record some of the thoughts of others as a means of reminding ourselves about some issues and concerns about distance learning.

The California State University formed a system-wide commission to examine the role of emerging technologies as a means of addressing the three concerns that dominate virtually all discussions of higher education in this decade--***student access***, ***academic quality***, and ***fiscal efficiency***.[5] The Commission reached several interesting observations:

- *Teaching and learning in the information age will be* ***less print-oriented*** *and classroom-bound than ever before.*
- *It will need to be* ***less labor-intensive*** *and more portable and modular in formats and delivery.*
- *The* ***home*** *and the* ***workplace*** *may become the classrooms of tomorrow.*
- *Instructional and support services will be based on the* ***convenience*** *of the consumers rather than that of campus constituencies.*
- *Education that is truly* ***learner-centered*** *ought to be delivered directly to the individual at a time and in a place determined by the learner.*
- *The recent "****marriage****" of computing and various forms of telecommunications can be expected to increase the scope and pace of technological innovation almost beyond imagination.*
- *Most estimates suggest that the technical means for integrating the two dimensions of non-traditional instruction--****delivery and format****--are only a few years away.*[6]

[5] Stephen L. Daigle & Patricia M. Cuocco, "Alternative Educational Delivery," CAUSE Exchange Library, CNC9238, December 1992, p. 1.
[6] Ibid., pp. 2-9.

REENGINEERING ADMINISTRATIVE PARTNERSHIPS

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ABSTRACT

In a renovated research building, Delaware's student services have been reengineered. Students no longer travel the campus in search of service. The functions of billing, collection, cashier, registrar, dining services, financial aid, ID card, parking, and long distance telephone service have been merged in a partnership of process and technology, and located in a single building.

The Student Services Building follows a "branch bank" model with a large lobby where self-service technologies enable students to perform routine business; providing easy access to transcripts, grades, schedules, financial aid and billing information. An open counter is staffed by "generalists" from several campus units who have been cross-trained and provided technologies to enable them to deliver a variety of services.

This successful merger of business units was facilitated by the application of appropriate technology and has resulted in staff reduction, cost containment, and improved customer service and satisfaction.

REENGINEERING ADMINISTRATIVE PARTNERSHIPS

Background

The decade of the 1990s presents a unique set of problems and challenges for colleges and universities. It is a time of shrinking budgets offset by demands for improved and expanded services. Institutions face keen competition to attract and enroll qualified students. Once enrolled, students and their parents, faced with seemingly endless increases in costs, scrutinize more than ever how their tuition dollars are spent. The current climate demands that we spend these dollars wisely, not only to instruct and educate our students, but to build positive, lasting relationships with our alumni-to-be.

Colleges and universities have mobilized to meet these challenges by initiating programs, some campus wide, that employ management methods now in vogue. Total quality management and process reengineering programs, though they may in themselves be old methods with new labels, represent sincere efforts to improve the way we do business. Invariably, efforts involve information technology resources and invoke the power of these resources to solve problems, streamline processes, enhance instruction and improve service to students.

This paper will provide a look at one approach to the challenge, that of the University of Delaware. As a case study, this paper will focus on the specific problem of improving student services in the face of the 90s dilemma of greater demand on fewer staff and fewer dollars. It is an approach that utilized elements of process reengineering, creation of administrative partnerships among many student service units and the judicious application of the University's investment in information technology.

Institutional Objective: Improve Student Services; "Think of Yourself as a Student".

To begin the decade, the University of Delaware formulated its short and long range plans in a campus wide effort called "Project Vision". A central theme and strategic goal of the plan is an enriched undergraduate experience, not just in the classroom but in every aspect of campus life. In 1990, as he assumed the presidency of the University, Dr. David Roselle urged deans, directors and managers to "think of yourself as a student" while implementing Project Vision plans in academic and administrative units. For directors and managers of administrative units, this meant a close examination of administrative services from the students' perspective and a complete reevaluation of how we conduct business with our primary customers.

While Project Vision implementation began to take shape in the Fall of 1990, the University had just completed a major conversion of hardware and software systems, including migration to a fully integrated student system. From a system perspective, administrative units had acquired a significant resource which could and should be used to its maximum to improve student services. SCT's IA-Plus Student Information system (SIS Plus) is a fully integrated system for demographic information, student records, financial aid, housing, billing and collections, and admissions data. The system is run on an IBM 3090 600E under MVS CICS. The underlying DBMS is ADABAS and access to ADABAS is through direct calls in COBOL. The system runs very efficiently and will return a 26 page internal transcript or a complex degree audit to the screen in less than 6 seconds. Staff in those units were no longer limited in their access to information and, through participation on the Student Information System Task Force, had gained an understanding of the needs and interdependencies of their colleagues in other administrative areas. An integrated student information system and a new, more collegial attitude among staff provided a foundation on which better, more efficient student services could be built.

One long standing issue that the Student Services Planning Group felt needed to be addressed had to do with the physical condition and location of the offices responsible for student services. Administrative units were scattered across the campus so that it could take several days for a student to find and visit them all. The offices were not well configured for student traffic and not well arranged given the new technological tools available. The Registrar's Office, for example, was designed and constructed when the University's student population was only 5,000, one forth of what it is today and the Cashier's Office was located in a basement off a long, narrow corridor that allowed for only two cashiering stations. Neither office was connected to the campus network. To accomplish our institutional objective of improving administrative services, it was essential that this problem be addressed.

A Central Student Services Facility

In the summer of 1991, a small but centrally located building of approximately 11,400 square feet of assignable space became available. The space had previously been used as a research laboratory but it was thought that it could be renovated and serve as a central facility for student services. A preliminary study concluded that the idea was feasible provided the interior of the building was gutted and renovated in its entirety. The Student Services Planning Group was then assigned the task of designing the interior of the building around the services that would be dispensed there and support the service delivery with every available technological tool.

The prospect of having a facility designed specifically for student administrative services was both an opportunity and a challenge. The Planning Group knew from the start that the facility would serve the University into the distant future and the design was critical to its long term utility. Of necessity, the first task of the Planning Group was to set very specific goals and objectives (Table 1) for the new facility. These provided a useful structure against which a reengineered process or design idea could be tested.

<u>TABLE 1</u> **STUDENT SERVICES BUILDING GOALS AND OBJECTIVES**

Goal: Quality and Efficient Service to Students	
Objective:	• Change Academic Policies • Question Past Practices • Streamline Procedures • Become "Student Friendly" • Use Concept of Being Serviced by "Zero or One" Person.
Goal: Teamwork Among Administrative Units	
Objective:	• Foster Cooperation Among Units • Focus on Institution Goals over Individual Unit Concerns • Be Willing to Reorganize When Necessary • Be Willing to Cross Train Staff
Goal: Apply Technology to Fullest Advantage	
Objective:	• Use the Campus Fiber Option Network • Take Full Advantage of the Data Base Environment and Its Integration • Ubiquitous Access

With a set of goals and objectives in hand, the Planning Group's next task was to decide which administrative services were to be located in the new facility and how they would be structured. Since the facility when renovated could provide only 11,400 square feet of assignable space, it was not large enough to accommodate all personnel from each service unit. Services and staff were carefully selected and targeted for permanent location in the new facility based on the frequency and number of students served. For example, the registration and cashier functions typically deal with each student in each enrollment period while others provide services on a less frequent basis. Concurrently, policies and procedures pertaining to student services were evaluated, and where necessary, changed to fit the student service goals. Staff from service units were selected on the basis of their frequency of student contact and a number of jobs were redefined, clustering the student service tasks in selected positions and distinguishing them from processing or "back room" tasks. In the end, the new facility houses on a permanent basis the Cashier and Accounts Receivable operations in their entirety, portions of the Registrar's and Financial Aid Office services, Dining Services, Student Telephone Services. In addition, provisions were made in the building design to accommodate activities of other units, specifically Public Safety, Housing and Student Life, on a temporary basis.

The Banking Industry Model

The process of planning the new facility included contacts with other colleges and universities and with industry in an attempt to find a model similar to what we were trying to achieve. Contacts and visits with other colleges produced some new ideas but a comprehensive services facility in which a student could attend to a variety of administrative tasks in a single stop seemed to be non-existent. A model, however, did exist in the business world, specifically in the financial industry's branch banks. The branch bank model fit the student service objectives in many ways; service was quick and efficient, the customer could be selective in how he or she dealt with the bank i.e. by phone, by mail, at an ATM or in person, and financial

Table 2

BANKING INDUSTRY MODEL APPLIED TO STUDENT SERVICES

TRANSACTION TYPES

20%	60%	20%
SELF HELP	ROUTINE STUDENT BUSINESS AND INFORMATION ASSISTANCE	SPECIALIZED ASSISTANCE
Closed Circuit TV: Post specific student-related information from all areas. Information Packets: Drop Boxes: Registration Fee Payment Kiosks Access to Student Information UDiscover	Generalist: Respond to information requests from all students; deliver routine services. Direct students to appropriate source of help. Routine Business: ID Cards Cashiers Financial Aid Registrar Public Safety Dining & Debit Housing Long Distance Phone Service Student Paychecks Event Tickets	Specialist: Provides assistance that requires attention above the routine business transactions. Financial Aid Registrar Accounts Receivable Dining Services

institutions seemed to be on the forefront of using technology to support customer service operations. Applying the branch bank model to the planned student services building, parallels could be drawn quite easily. For example, the self service and ubiquitous access objectives could be served well by ATM type machines or by Interactive Voice Response devices. The bank model served too as a guide for staffing the facility and distinguishing the routine tasks accomplished by someone generally trained (bank teller) from those with special training in a specific function (loan officer). The Planning Group adopted this generalist/specialist model (Table 2) and devised the plan for the new facility accordingly.

Technological Support

Technology to support the new facility involved purchasing new workstations and utilizing software with attention focused on getting the most service for the fewest dollars. Existing software was modified to provide new functionality and, when necessary, new software was purchased and customized.

Each staff person in the Student Services Building has a personal computer (PC) work station. Additionally, 6 PCs are located at the Service Desk counter and 5 at the Cashiers counter. The PCs were purchased in the summer of 1992 and are 386SX machines costing about $1500 each. At the Service Counter the PCs are equipped with numeric key pads for services that require a PIN. At the Cashiers counter the PCs are equipped with a journal printer for the register tape and an OCR scanner for processing bill and student loan forms to support the additional functions of a Cashiering operation. All PCs came installed with Microsoft Windows 3.1.

Microsoft Windows provides for multiple sessions resulting in a quicker response to a student's request. The Cashiers PCs always have one session running the Remittance Processing system, a DOS application, and another session running a terminal emulation session to SIS Plus. Windows supplies the means to switch from one application to another quickly and easily.

Another group of PCs in the Student Services Building are the "kiosks" for self-service student access. The kiosks are also standard $1500 PCs. The CPUs are stored in a locked cabinet and some keys on the keyboard have been physically disabled to prevent students from re-booting the PCs. A staff person logs the kiosks on to the IBM MVS Student Information system each day. The kiosk application was developed by modifying SIS Plus using MIS staff. New screens were developed and existing COBOL programs modified to interface to the new screens. Functionally, a student enters his/her student identification number (SID) and a personal identification number (PIN) on the authorization screen and then can view an unofficial transcript, grade report and class schedule for current and previous terms, financial aid information, billing information, and address information. The student name and number never appears on any kiosk screen to protect the student who walks away from the kiosk without returning it to the authorization screen. The kiosk application is character based and is very popular with the students.

Another self-service PC for students provides access to "U-Discover", the campus gopher client for world wide access. This service includes the full schedule of classes for future terms weeks before the booklet is published; lists of open courses updated nightly and the final exam schedule. Students can also read through listings of apartments to rent, job opportunities, and general information. U-Discover also provides access to the same personal data available through the kiosks. A menu option labeled SIS+ Personal Access uses gopher software modified in-house to provide for encrypted authentication. When that menu option is selected, the student is prompted for SID and PIN. Then an unofficial transcript, grade reports and class schedules, financial aid and billing information can be viewed. Students can also submit a change of address request using SIS+ Personal Access. The current address information is displayed and the student types over it to make a change. The change is sent as a mail message to a staff person in the Registrars Office who reviews or corrects it before mailing it to an application that updates the Student Information System address segment. This eliminates the keying of hundreds of address changes each term by the Registrars Office staff.

The Cashiering software was purchased from CORE Business Technologies of East Providence Rhode Island. The software is designed to be customized with regard to screen layout and validation processing. The customization is written in C++ and can be maintained in-house or by CORE. Initially, all transactions were transferred using FTP to the IBM mainframe after the office closed each day. In the fall of 1994, the Cashier's Remittance Processing system was enhanced to interface real-time to the HP Unix ID card system for posting of flexible spending (FLEX) account deposits. This interface is written in C++ and sends a TCP/IP packet across the network to a server running on the HP machine. The server was written by Harco Industries of Phoenix Arizona. The application will set up a new FLEX account if the student does not already have one or will post a deposit to an existing account. Prior to this enhancements students were told that FLEX account deposits would be available "tomorrow". Now they are told the money is available immediately.

Also in the fall of 1994, an ID card production system was purchased to capture a digital image of a student and print an ID card in full color on white PVC plastic. The system was purchased from Goddard Technologies and was customized by Goddard to interface to the Harco ID database that controls student privileges and access on campus. The Harco Industries server is also used in this application to implement the real time interface. The images are stored as .JPG files on a SUN unix server so they can be used in other applications. It is no longer necessary to take a new picture of the student to replace a lost ID card resulting in a cost savings. However, some students consider this a drawback. We recently learned that some students lose their cards intentionally because they do not like the picture.

An imaging project currently under development will replace an obsolete microfilm reader for transcripts that pre-date our on-line system. The microfilm reels were converted to .TIF files on compact disk. The paper indexes were keyed by data entry staff and loaded into an ADABAS file. A client server application was developed in C++ to provide an index search and image retrieval system. It interfaces to an image viewer developed for this application using Image Basic from Diamond Head Software, Inc. The transcripts can be viewed and printed for mailing. The quality is better than that printed from microfilm and the Student Services staff saves time because index and images are on-line. Once the system is operational it will be made available to Dean's offices and the Alumni Office reducing the dependency of these offices on the Registrars Office for transcripts not available in the Student Information System (pre-1972).

Outreach Efforts

The Student Services Building at the University of Delaware opened in August of 1992 as the center piece of the institutions efforts to improve student services. It has been in operation two full years and has become a hub of student activity on campus. It has also spawned a number of services that are now provided outside the confines of the building. They are a direct outgrowth of the planning process and provide a useful complement to the central facility.

Interactive Voice Response applications (IVR) were developed to expand student services beyond the Student Services Building. The IVR system is from Perception Technology and the IVR application development tool from Touchtalk, Inc. Dubbed UDPHONE, the first IVR application was developed for registration. The application uses a component of SCT's IA-PLUS Student Information System. Grade reporting was implemented the following year also using a component of SCT's software. Two other student oriented IVR applications are UD1-BOOK for renewing library books over the phone and UD1-CARD that interfaces to the IBM mainframe and the HP Unix mainframe for changing personal ID numbers, suspending a lost or stolen card, checking FLEX account balance, dining points balance, and remaining meals.

The development of a secure gopher client for accessing personal student information system data provided us with the means to distribute access to that data across campus. In the fall of 1993 all residence halls were connected to the campus network. Students may purchase an Ethernet connection for their computer in the residence hall and have access to their personal data. The secure gopher client is distributed initially on diskette to students. Later upgrades can be downloaded from a software library available on a gopher server. This semester over 600 students have requested Ethernet connections up 300% from last year when it was first available. For students not in residence halls, the secure gopher client has been installed in all public computing sites on campus and on PCs in the Student Center and several Dean's offices.

Results, Measurable and Perceived

The University of Delaware chose to deal with the challenge of improving student services in two distinct but related ways: by creating an environment in which student services are dispensed from a central facility and by using to the fullest extent possible the University's investment in computing technology. The results are measurable by the simultaneous reduction of staff and budgets in most of the units involved and the increase in productivity. With better access to a broader spectrum of information, staff are better prepared to serve students. The perception among students is that doing business with the University is much easier now. They can very quickly and conveniently dispense with the administrative necessities of enrolling in college. Perhaps the greatest testimony to the success of this effort at the University of Delaware is an editorial which appeared in student newspaper and read in part:

> **"The end of another school year... 'The Review' spends its time reevaluating the past year's memorable events, judging the highs and lows... Cheers go to the new Student Services Building. Finally, a student can take care of a multiplicity of needs, at one time!"--From 'The Review', Friday, May 21, 1993.**

"THE CONSULTANCY: A TEAM APPROACH TO DEVELOPING PARTNERSHIPS WITH IT CUSTOMERS"

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ABSTRACT

One of the critical challenges facing any IT organization is the alignment of its services and technology applications with the overall goals and objectives of the institution. This alignment requires in-depth understanding of the customer's needs and an unbiased diagnosis of how information technologies can or cannot be used to meet these needs. In the fall of 1993, the Information Technology Services division of the Maricopa Community Colleges, created a group called "The Consultancy Team" with the stated purpose of forming partnerships with customer departments to provide a business approach to problem resolution rather than a technical approach. Over the last year, the Consultancy Team approach has evolved into broader based cross-functional teams as Maricopa has begun its APOLLO Project, a two-year partnership project between Maricopa and the Oracle Corporation for the replacement of all administrative systems at Maricopa and the joint development of a new Learner-Centered System. This session will focus on the environmental issues that created a need for the consultancy approach to partnering with customer groups, and will explain the evolution of the Consultancy Team from its original configuration to its current state, giving examples of how The Consultancy works with customer groups in both continuous improvement and business process reengineering efforts.

"THE CONSULTANCY: A TEAM APPROACH TO DEVELOPING PARTNERSHIPS WITH IT CUSTOMERS"

The Environment

Current literature is filled with references to changes that are occurring in the management structures of today's major corporations and institutions. In their book, *The Challenge of Organizational Change,* Rosabeth Moss Kanter, Barry Stein and Todd Jick give this opinion:

> "A universal model for organizations is developing, especially for large organizations, as a result of the changes we are seeing in the external environment. This model describes more flexible organizations, adaptable to change, with relatively few levels of formal hierarchy and loose boundaries among functions and units, sensitive and responsive to the environment; concerned with stakeholders of all sorts--employees, communities, customers, suppliers and shareholders. These organizations empower people to take action and be entrepreneurial, reward them for contributions and help them gain in skill and 'employability.'" (1)

It is unfortunate, that this description of the "new organization" of the 90's does not describe very many of our higher education information technology (IT) organizations.

Every IT organization in higher education is facing three major organizational issues as we move into the middle of the 90's. These issues are: (1) the need to reassess the organizational structure of the IT department; (2) the need to reassess how IT departments interact with our customers; and (3) the need to remove boundaries within the IT organization, itself, between the IT organization and other units within the institution, and between the institution and external groups.

<u>The Need to Reassess the Organizational Structure of the IT Department</u>. IT departments need to reassess their organizational structures because it just isn't "business as usual" anymore. The move of computing power out of the computer center and into the hands of the end users has changed the role that the central IT organization is asked to play. The ways in which we have vertically organized IT staff around specific technologies or applications, is not "in sync" with the movement of our institutions toward Total Quality Management (TQM) and the accompanying emphasis on teams and teamwork. The demand for IT specialists, while at the same time, the need for generalists to deal with business-related issues, is inconsistent with the ways we

have traditionally staffed our IT departments. And, finally, the old job titles and competency sets that were the mainstay of the IT department of the 70's and 80's will no longer suffice. Our IT professionals are being called upon to radically change their skill sets in both the technical as well as nontechnical areas. New job titles and new competency sets call for new organizational structures.

The Need To Reassess How IT Departments Interact With Our Customers. There are two major problems with the way in which IT organizations have typically related to our "customers." First, over the years, we in IT organizations have convinced ourselves that OUR customers are the business offices, the human resources departments, the admissions departments, or, in the case of academic computing, the faculty. We have lulled ourselves into believing that if we take care of OUR customers, they will take care of THEIR customers. This luxury of allowing ourselves to be one or two steps removed from a major portion of our constituencies cannot continue.

Secondly, the way in which we listen to, communicate with, and serve our more traditional customers within the institution--the human resources and business offices, the student services and admissions department, the faculty, etc.--must change. We must recognize that the leadership and sponsorship role of information technology initiatives is shifting away from the IT organization and into the user community, and that identification of the real owners and customers of technology-based systems must be recognized. We must focus more on the customer/owners of the technology systems rather than on the technology itself.

The Need To Remove Boundaries. In higher education institutions, separate internal organizations have historically been established to deal with academic vs. administrative computing, or voice vs. data communications, or audio visual services (i.e., video) vs. computing. In the past three to five years, however, technology developments that merge voice technologies with computing such as touch tone registration or computer-based facsimile, not to mention the common network infrastructure needs of voice and data communications, have blurred the lines of responsibility for these technologies. Technology advances in the transmission of digital video across local and wide area networks have resulted in new applications for desktop video conferencing and multi-media instructional delivery. Networks and the hardware/software connected to them are "neutral" and can/should be used for both academic and administrative purposes. Convergence of technologies and the accompanying growth of end-user computing are forcing the IT organization to reassess how it works, moving more to a cross-functional team approach than the traditional, "dedicated" technologist approach.

The Consultancy Team

The Maricopa Community Colleges have definitely felt the impact of all three major IT organizational issues. Added to these pressures have been the pressures of antiquated administrative applications, increasing user demands, changing technology. This pressure reached its peak in the fall of 1992, following the defeat of a major bond referendum which had been designed to provide Maricopa with the resources to upgrade its infrastructure, administrative applications, and desktop technology. There was no money; the picture was grim; and the need to provide innovative solutions to customer problems had never been greater.

The answer that was devised to meet these tremendous needs was the development of an internal IT group called "The Consultancy Team." The goals of "The Consultancy Team" were:

1) to link IT applications to business strategies,
2) to provide unbiased diagnosis of business information needs,
3) to provide a business-oriented approach to problem solving rather than a technology-oriented approach, and
4) to deal with the need for both specialists and generalists in meeting customer needs.

In its original form, The Consultancy Team consisted of a strategic consultant, a technical consultant, a training consultant, and a quality facilitator. The role of each of these individuals was as follows:

Strategic Consultant. The strategic consultant worked with customer groups to identify business problems and to access the appropriate technologists within the IT organization to provide solutions. The strategic consultant convened the team and created the agenda for the meetings. This individual was also responsible for documenting the process through team notes and flow charting tools.

Technical consultant. The technical consultant provided initial technical support for the strategic consultant and assisted in identifying and documenting the technical expertise that might be required for the business solution.

Training consultant. The training consultant assisted in the development of training programs, job aids, etc. in support of identified business solutions

Quality Facilitator. The quality facilitator facilitated group discussions and assisted the strategic consultant in group problem-solving analysis and activities.

When a business problem area was identified, the consultancy team worked with a cross-functional team to identify the "true" business problem and to identify possible alternative solutions. The key members of the cross-functional team were the business area experts, individuals who either worked in the business area on a day-to-day basis or were impacted by the business area. In addition, the team included one or more of the following "types" of individuals: systems programmer, network professional, ad hoc reporting specialist, and possible vendor partners.

The initial work of the team process utilized a continuous improvement approach. The team documented the existing processes and sought opportunities for improvements. The process of questioning and analyzing the business area for this level of detail provided an opportunity for the team to see areas of redundancy or other inefficiencies which could be improved. The potential solutions were not always technical solution but also included modifications of the user's processes.

The APOLLO Project

In July of 1994, the Maricopa Community Colleges signed a contract with Oracle Corporation to replace all of our administrative systems including human resources, financial records, student information and electronic mail.

One component of the contract includes reengineering the current processes which are traditionally considered to be part of a Student Information System. Axiom is the subcontractor providing the consulting services for the reengineering effort using a methodology that they call Business Renewal™. As a result of the Oracle contract and the commitment to utilize Axiom's Business Renewal™ methodology, Maricopa has expanded it's team approach to involve additional individuals from within IT department and from the ten Maricopa colleges.

Applying the knowledge gained from The Consultancy Team, the APOLLO project teams have been expanded to include the following roles: a customer project coordinator paired with an IT coordinator, business area experts with cross-functional representation, a renewal analyst (our prior strategic consultant), a trainer/recorder, a technology lead, an operations lead, a database administrator, a data administrator, a designer/developer and a network administrator. Each individual on the team has a role to play in addition to his/her responsibilities as a team member.

The first phase of the APOLLO project included the establishment of four early victory teams. These early victory teams provided the opportunity for the team members to "practice" their roles before proceeding to work on the major project components of APOLLO, particularly the expansive process of rethinking the ways we serve learners and the development of the new Learner-Centered System (LCS) - formerly referred to as Student Information System or SIS.

During the Spring semester of 1995, the LCS Renewal project teams will be identified and will begin documenting the "to be" activities for our future "Learner-Centered System". The activities will be analyzed for value added based on cost of the innovation as well as time spent on task. The process will also review the organizational structure required for the "to be" process and the impact it will have on personnel. By Fall semester, 1995, the design and development of the new Learner-Centered System will begin and lead to implementation by Winter of 1996.

Conclusion

Through our research we have found that there is no "cookbook" approach to the process of using cross-functional teams to better serve our IT customers. Each of our teams is taking the tools and techniques we have learned and is applying them in ways appropriate for the scope of the team. We have learned that the team concept is an effective way of analyzing and documenting the business area processes before reaching the conclusion of automating the process. The initial teams have been a learning experience for all of the participants. The knowledge gained will be applied to future teams in the form of modification and clarification of team roles and team processes. The end result, we believe, will lead to a solution that is customer focused, with joint support from both the customer community and the IT organization.

Footnotes

1. Rosabeth Moss Kanter, Barry Stein and Todd Jick, *The Challenge of Organizational Change* (New York: The Free Press, 1992), p. 3.

Reengineering for the 13th Generation

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Abstract

America's 13th generation, born 1961-1981, is the impatient, quick-and-dirty generation. They play video games that stress action, acquisition and one-on-one heroism; they have sound bite attention spans; and they like short term tasks with observable results. For them, life is fast, complex and entertaining. They use programmable computers, VCRs, and telephones, have access to 24-hour banking and cable TV, and transact business with cards instead of cash.

This paper will describe the development of partnerships among information technology and administrative and academic departments at Boston College to deliver information and service to this self-sufficient generation in a fast, familiar, intuitive way. Business practices and information systems have been reengineered to provide new ways of presenting, transmitting and processing information; and office procedures now offer one-stop service that automatically routes information throughout the university for simultaneous processing.

Today's Students - America's 13th Generation

This generation of students is America's most ethnically, culturally, and economically diverse. They follow the GI generation, born at the turn of the century; the silent generation, born 1925-1942; and the well-known boom generation, born 1943-1960. Instinctively, generations have provided for the next; but with the 13ers, things began to change. Today 80 percent of college students work an average of 26 hours a week. Before the first GIs hit their 65th birthday in the mid-60s, the elderly age bracket was the nation's most poverty-prone; in 1975, this distinction jumped to the 13er child age bracket, where it has remained.

America has spent the entire 13er life cycle favoring consumption over investment, living beyond current income, and raiding the future to make up the difference. Today 87 percent of college students have a credit or charge card or have access to one used by their parents. Two-thirds of college students participating in a national survey had experienced at least one of the factors that demonstrate poor money management or a lack of knowledge about money and spending including bounced checks, credit card balances that were at what they described as at "an uncomfortable level", and late payment of bills.

In the 1940s, the very thought of making babies propelled young soldiers and Rosie-the-Riveters to victory over fascism; in the 1950s, baby-making was just standard suburban behavior; by the 1960s, the very thought drove young couples to doctors to prevent it. A child's world was unerringly sunny in the 50s, overshadowed by adult arguments in the 60s, scarred by family chaos in the 70s. In the 50s, nearly every movie or TV show was fit for kids to watch; come the 60s it was touch and go; come the 70s, forget it. The quality of the new teacher recruits remained high through the 50s, became suspect in the draft-pressured 60s and sank (along with teacher salaries) through the 70s. Adolescent sexual discovery meant free love in 1970, herpes in 1980, AIDS in 1990 (Howe and Strauss, 1993).

In the 1960s, birthing became unfashionable, and did not regain its status until the early 1980s when *Baby on Board* signs first appeared and social trends started shifting away from neglect and negativism toward protection and support. Divorce rates receded somewhat, teacher salaries gained ground, and a flurry of new books chastised parents for having treated kids so poorly in the 1970s.

Many of today's teens have grown up fending for themselves. Between marital splits and working parents, teenagers are responsible for far more decisions than other postwar generations, and they're being asked to take on more adult tasks. They shop for themselves, do their own laundry, and get dinner for themselves.

The 13ers are often thought of as directionless slackers, but they have developed skills in areas their elders don't know as well and are at times afraid to learn: telecommunications and computer technology. With their time for exploration, teens spend hours searching through the vast online domain of Internet. America Online features Compton's Electronic Encyclopedia, DC Comics and M-TV news. Prodigy also has an encyclopedia, and downloadable games as well as games that can be played online, bulletin boards and live chats. Internet news groups include a vast array of information about computers, travel and recreation. Electronic mail allows students to communicate with friends in other parts of the country and the world.

Baby boomers grew up shopping at downtown department stores and Woolworth's. Eating out was an infrequent treat at the local dairy bar, diner or restaurant. McDonald's and strip malls changed all that. In *Generation X* Doug Coupland points out it doesn't matter where you're from since everyone has the same stores in their malls. A walk through Siam Square in Bangkok will take you past Burger King, Kentucky Fried Chicken, TCBY Yogurt and a Hard Rock Cafe.

In the 1960s students leaving for college packed the family car with clothes, a typewriter and a hot pot. In the 90s nothing less than a Jeep Cherokee will do to transport the computers, cordless phones, VCRs, TVs, CD players, microwaves and other electronics necessary for civilized living. Teens call the shots on a broad range of purchases. Their necessities are our luxuries.

On college campuses mealtime once meant steam tables, mystery meats, a set menu and a snaking service line. Today the latest wave on campus is the food mall, which has moved west to east across the country. It's a mirror of the outside world where students use declining-balance electronic debit cards to graze at the same places they've eaten at for as long as many of them can remember. To the generation that cruised malls and hung out at fast-food joints, the food is reliable and familiar.

In the 1960s parents and their offspring collected green stamps. In the 90s, it's frequent flyer miles. Students can accumulate miles, scroll through and participate in various Internet news groups to plan their trips, communicate via e-mail with friends who reside in and around their destination, send a FAX to arrange accommodations and tours even in the remotest parts of the world, bring their cellular phone to call the park ranger if they get lost, and use their credit card when they run out of cash.

On college campuses students are members of an increasingly diverse society. The international student population has grown 30 percent over the past decade, more than half from Asia pursuing degrees in business, engineering, physical and computer sciences. In 1992-93 foreign students made up 22 percent of the student body at MIT and 15 percent at Harvard. Minority students account for 20 percent of the enrollment at four-year colleges and over 25 percent at two-year institutions.

Coupland talks about today's Global Teens, collegians who live their lives together. They shop, travel and squabble in packs. They're moderate in behavior, use no drugs, drink very little, enjoy good coffee, watch videos and eat popcorn. They love clothes and insist on the finest labels. They shop at the Gap, Limited, Structure, and Armani. They live at home. When they travel, they go together, and once they arrive, they make daily telephone calls to those who couldn't come. They will be part of the workforce in the technology-based global marketplace of the future.

The 13th generation is thought to be an apathetic and apolitical generation, weaned on Vietnam and Watergate, absent of heros. But they are active in community service for the homeless, disadvantaged and abused, and having a young president and vice-president has reawakened a spirit of public service to a generation that was losing interest. They have grown up witnessing declines in economic opportunity, stable relationships, housing, safety and hope for the future. Now they want to help shape that future.

Reengineering the Process

13ers are frustrated by lines, bureaucracy and hassles. Wherever they see useless tangles or time-wasting processes, they look for a quick bypass. They're total quality consumers. Our goal in reengineering student systems has been to eliminate those useless tangles and time wasting processes.

Total Quality Management (TQM) theory encourages administrators to engage in systemic thinking about the constant improvement of all processes that deliver value to customers, and to organize work around the needs and preferences of those customers instead of within traditional departments. Walls are disappearing and students, staff and faculty are working together to design and deliver services in convenient, appropriate ways (Marchese, 1993).

Reengineering is another term used when basic assumptions about the way things are done are reexamined. The goal is to go beyond the automation of an existing process, and design systems that fit the needs of the customer. Reengineering encourages designers to use technology to do things that are not already being done, to recognize a powerful solution and then seek the problems it might solve. The aim should be to cross boundaries among offices, reduce inefficiencies and duplication of effort, locate decision points where the work is performed, and make use of appropriate technologies (Penrod and Dolence, 1991).

Data should be captured once at its source and then reside in the system for the benefit of all authorized users. Access and utilization strategies are essential to maximize information system abilities to achieve and maintain institutional health. Access implies that all individuals who need information have it available when they need it. Utilization implies that the system provides the information in a form clients can use and readily interpret.

At Boston College the Information Technology division has formed partnerships with administrative offices on campus to deliver service to students and staff across a variety of platforms including Consumer Transaction Terminals (CTTs), microcomputers with graphical user interfaces (GUIs), and touchtone telephones. The strategy is to capture data at the source, allow end-users to process their own transactions, and give employees comprehensive views of information that enable them to perform their work effectively. The first step toward distributed access came with the introduction of the *U-VIEW* system.

U-VIEW - Just like an ATM

In February 1989, students were given access to their records at an ATM-like Consumer Tranaction Terminal called U-VIEW. After inserting their ID card and Personal Identification Number (PIN), they could view and print their own academic, biographic, and financial information. 13ers immediately understood the familiar interface, which was easy, fun and available after business hours.

Students since that time have used the menu-driven system to select transactions that display their class schedule, grades, grade point average, rank in class, final exam schedule, home and local address and telephone numbers, financial aid award, student account and vehicle registration. Using other transactions students see the status of their guaranteed student loan check; their advisor's name, office number and telephone extension; their registration appointment time; their library account; and their financial clearance status. Students can also request degree audits. To maximize the number of transactions processed, the system always features an item of the day, which is displayed as the first item on the first menu. For example, at the end of the semester "print grade report" is the item of the day.

Not only did the students benefit from U-VIEW, but the administrative offices noticed that students were not visiting them for mundane services anymore. When students did come to an office, they were prepared with a U-VIEW printout and knowledge of their status. Managers started shifting their staff orientation to in-depth customer service instead of data entry and dissemination. Reengineering was starting to make a difference.

There are now seven devices on campus, dedicated to providing fast, visual displays of a limited set of functions. The devices are convenient for a residential population, but they were not suitable for thought-provoking transactions like registration, and that's where the longest lines were. It was time to explore voice-response technology, which brought us to our next development: *U-DIAL.*

U-DIAL - No More Lines

In October, 1990 a touchtone, voice-response application for registration and drop/add called *U-DIAL* was added. The touchtone, voice-response system resembles systems developed at other institutions. Students processing registration by telephone enter their student ID number, their Personal Identification Number (PIN) and their registration access code. The registration access code is printed on the student's registration form, distributed to the student's advisor, and when the advisor releases the form, the student is clear to register.

U-DIAL allows students to add and/or drop courses, list their courses, and obtain the current status of a course. The system checks for time conflicts, corequisites, and restricted courses.

The real advantage of *U-DIAL* for students is the availability of the system from almost anywhere in the world and the chance to modify their schedules anytime after registration through the last day of drop/add. The telephone is an ideal medium for students, it's intuitive, requires no training, and suits their mobile lifestyle. There is, however, a limit to the amount of information that can reasonably be spoken, e.g. schedule of classes, and the type of information that can be captured, e.g. address changes.

Students needed something that allowed them to see the range of information available on U-VIEW, process the registration functions of U-DIAL, and complete additional transactions. This led to the development of U-VIEW Plus.

U-VIEW Plus - Seeing is Believing

One semester after the introduction of *U-DIAL*, *U-VIEW Plus*, a terminal-based student access system, was added. Using terminals, students can enter and view their entire schedule, simulate various scheduling options, search for open sections of courses, and display information about courses including titles, instructors and meeting times. "This is the most convenient way to register," said one senior. "No long lines and no busy phone!"

Directions for using *U-VIEW Plus* are printed in the registration publication, but students usually arrive at the terminal with no instructions, expecting the computer to lead them through the transactions. Now logon instructions are posted at each terminal, the menu displayed after logon shows available options, and each screen contains instructions for completing that transaction. All update and display screens are designed for minimal cursor movement by the student. The student just enters course index numbers and hits the enter key.

Users of *U-DIAL* and *U-VIEW Plus* rated them positively, but the majority of students were not convinced that *U-VIEW Plus* had advantages over *U-DIAL*. "The telephone is more convenient," said a sophomore management major. The terminal interface was not intuitive to a population unaccustomed to moving a cursor, hitting an enter key, typing commands like *done*, *save* and *quit*, or using a reset key to unfreeze a cursor. It took a graphical user interface designed on Macintosh computers to move the majority of the traffic from telephones to microcomputers.

U-VIEW Plus - Welcome to the Macintosh

The Boston College computer lab houses over 100 Macintosh mircrcomputers, 20 DEC terminals and 20 IBM microcomputers. Most students who use a device to complete a class assignment or paper select a Macintosh. They're lost without a mouse. *U-VIEW Plus* for the Macintosh lets them use that mouse and familiar Macintosh icons to point-and-click their way through registration. The new interface is more intuitive; it denotes commands with pictures or icons and limits the amount of keystroking. "Hey, this is like channel surfing! I've never used a computer before and I was finished with registration in a few minutes," exclaimed one freshman 13er.

Despite having various levels of computer knowledge, students register with no training or written instruction. Upperclass orientation advisors and staff from the registrar's office assist new students during their registration session in the computing facility. While new students welcome the chance to ask questions and request help, upperclass students usually ignore the staff member on duty in favor of seeking help from peers at adjoining computers, which reassures us that our systems do not destroy community and communication.

Students who like to go it alone can click on the tutorial icon or the help icon. Few do. As they move through the registration process, additional information is provided. If a course entry generates an error message, a new icon appears and clicking on it brings up a help screen of error message definitions. Some errors generate an additional exclamation point icon and message, which helps the student resolve the error easily.

The highlight of the system is the course search and select option. By clicking on an icon of a magnifying glass, and entering a department prefix and number, groups of related courses are shown with current displays of course availability. Selecting a course is as easy as using the mouse to set the pointer on it, clicking, clicking next on the checkmark icon, and the student's schedule reappears on the screen with the new course.

With the introduction of the GUI, the traffic on *U-DIAL* stabilized, and the number of students using *U-VIEW Plus* quintupled. We learned that the more devices and platforms we offered, the more students used the system. And with the addition of Mail Drop for sending e-mail both on campus and over the Internet, the use of GUI's continues to grow.

The GUI was created with a front-end development product called "Both" by Connectivite. This tool allows the design of Macintosh-type objects and associated scripts which send both transaction names and the input required by existing mainframe applications. Communication between the Macintoshes and the IBM host is driven by the "Both" application through Avatar's Netway 2000 gateway.

In recent years more students are making use of a computer and a modem at home or in their dorm room to dial in to *U-VIEW Plus*, which means they are using the terminal interface rather than the GUI. The motivation to use it came when grades were displayed on *U-VIEW* and *U-VIEW Plus* as they were posted on *U-VIEW*. New students also seem more confident with the remote dial-in option, using it to register for classes if they are unable to come to an orientation session.

When the dorms are networked in September 1995, workstations sold in the campus Computer Store will be bundled to include the GUI. Additional functionality will be added to the system at that time. In the meantime we have begun to move further toward the paperless office by automating the completion, approval and routing of forms.

Electronic Forms - Nuke the Paper

Information traditionally flows between offices on paper forms. Some forms are notifications that require no approval, like address changes. Others require approval or followup action, like withdrawal forms. Most require audit trails or tracking throughout the processing of the form. And 13ers hate forms.

Think about the trail students follow to complete routine transactions like processing course withdrawal, pass/fail, and change of major. They journey from office to office to discover the source of the appropriate form, then it's off to obtain the required signature(s), and finally, if they haven't lost patience, they deliver the form for processing. Are all these steps necessary?

Withdrawal forms are often among the worst offenders, requiring signatures from a range of administrative offices. What the various offices need is the information that the student is leaving; they do not add value to the process by seeing the student.

Since their first visit to Disneyland, students have come to expect fast, pleasant, reliable service. Electronic data interchange (EDI) has revolutionized the process of sending and receiving transcripts, awarding transfer credit, certifying student attendance, and applying for admission. Now our internal business practices and information systems are being reengineered to provide new ways of presenting, transmitting and processing information.

At Boston College administrative offices have joined with Information Technology to offer one-stop service that automatically either completes a transaction or routes information throughout the university for simultaneous processing. Information is captured at the source, each field is edited when the data is entered, the form is transmitted to the recipient or approver who acts on it immediately, and notification can be transmitted back to the originator or to other parties on campus.

In May 1993 electronic forms were introduced to a broad base of users within the University when withdrawal transactions processed by the student's academic dean and the Office of Undergraduate Admission were transmitted electronically to other administrative offices. The result was more timely transmittal of information, faster processing of associated outcomes like refunds and housing changes, broader distribution of information to offices with a need to know, elimination of a redundant database of withdrawals, and of mailing and printing weekly withdrawal reports.

Other forms transmitted electronically include change of major, readmission, class lists and grade change acknowledgements to faculty, and credit memos.

Future Developments

The systems described above are only the beginning of what students will soon be able to accomplish. Statewide networks, links with feeder schools and Internet will allow students to tour the campus, estimate their financial need, search the catalog or library holdings, complete admission or financial aid applications, check the status of their applications, send a transcript, view a transfer course equivalency table, or obtain a credit evaluation and degree audit from their desktop.

Expert advising systems can be designed that will prepare a graduation path with optimum sequencing of courses. Courses that are offered biannually could be scheduled in advance, and students could relax knowing that courses leading toward graduation will be completed on schedule.

Universal messaging allows messages originated in one medium to be automatically translated into another so that users get their messages no matter how they access their mailboxes.

Chip card technology, which turns a student ID card into a computer, can be used to store and update information each time the card is used.

Conclusion

Are the days of personal service at an end? The 13th generation relies on the consistent, mechanized quality and service of *McDonald's* and *Pizza* Hut, the well-ordered, self-service of *The Gap*, and the remote, overnight service of *Land's End* and *L.L. Bean*. This coupled with their lifetime use of remote controls, telephones, VCRs, bank cards and computers makes them well disposed to controlling their environment and their choices. The human touch may not be as important to them as it was to previous generations.

The benefits to institutions that take advantage of the predisposition of these students by implementing do-it-yourself systems include reduced staffing needs and greater employee satisfaction. Staff who no longer process routine transactions or answer the same questions are freed to become more service-oriented, more technical and more knowledgeable. Systems must be reeningeered for staff as well as students so that they can easily access the information they need to resolve the more complex queries from students that they are unable to handle themselves. For example, the resolution of a registration question may involve the need to retrieve information about the student's financial aid and account.

The challenge for higher education the 1990s and beyond is to unleash the creativity of its students, instructors and administrators through new services and features made possible by information technology. It will be essential to rethink the essence of our business in order to improve the quantity, consistency and availability of the services that institutions of higher education provide. From inquiry to registration, from advisement through extracurricular life to graduation, the content and delivery of the collegiate experience is being redefined everyday. Reengineering for continuous improvement to serve the 13th generation is one way of envisioning an institutional response to this challenge.

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Growing the Customer-IS Partnership in System Development

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Abstract

The System Development Life Cycle (SDLC) process has been adopted at a major public university in the southwest to direct the development of automated and non-automated systems on campus. This paper discusses the problems and opportunities that spurred the consideration of SDLC, and the customer's involvement in the development of policies and procedures, and testing and improving the process, as well as the customer's critical role in implementing the process. The results of early projects and lessons learned are shared with the reader.

Introduction

It is now a generally accepted fact that the customer's role is vital to the success of any system development project. However, the customer's comprehension of what is involved in system development is often sketchy at best. Rare is the customer who understands the systems approach to solving problems - to first define the problem, to identify requirements of a solution, to explore the feasibility of alternatives, etc. For too long, information services organizations have sought, assumed, or been assigned too much responsibility for these activities. The lack of customer satisfaction with the results should not be a surprise to anyone.

Southwest Texas State University is implementing a Systems Development Life Cycle (SDLC) methodology that strives to address these issues. SDLC identifies tasks to be accomplished and outlines mutually interdependent responsibilities of customers and system designers during the development process. It provides customers an understanding of the work and participation expected of their units in obtaining a desired service or product. It is a single, uniform approach applied consistently to system development projects. The use of SDLC should result in a product which is right for its intended purpose, which meets customer expectations, and which is delivered on time and at a reasonable cost to the University.

This paper describes the problems and opportunities that provided impetus for action, the process used in developing the methodology, the policy and procedural documents that evolved, and the results and conclusions to date.

Background

The Institution

Founded as a Normal School in 1899, Southwest Texas State University has evolved into a comprehensive public institution with an enrollment of 21,000 students, the 7th largest institution in the state of Texas and the 8th largest in the United States without a doctorate. SWT is located in San Marcos, a rural area halfway between Austin and San Antonio.

Internally, SWT is governed by President's Cabinet, comprised of the President, the Executive Vice President, and the Vice Presidents of Academic Affairs, Finance and Support Services, Student Affairs, and University Advancement. The information services function at SWT is known as Computing Services and reports to the Executive Vice President. Computing Services (CS) is comprised of three (3) service areas: Computer and Network Support Services, Information Systems and Services (ISS), and Systems Software Services.

The Technology Infrastructure

Computing Services administers two (2) computer centers equipped primarily with Digital Equipment Corporation (DEC) hardware. The academic center houses a DEC VAX 8820 and a DEC ALPHA-AXP 7000-640. The administrative center is equipped with a DEC VAX 7000-630 and a DEC VAX 6000-620. The two (2) centers form a mixed mode cluster, with OpenVMS 6.1 as the operating system. Several MicroVAX, ALPHA-AXP, and other servers and workstations are also housed in these centers. In addition, SWT has implemented a multi-protocol Campus Wide Network comprised of FDDI, extended 802.3 Ethernets, Novell and AppleTalk LANs. Students, faculty and staff utilize a diverse collection of over 2,500 microcomputers, most of which are connected to the Campus Wide Network. Another 500 VT series terminals are connected to the OpenVMS cluster in various ways.

Problems and Opportunities: Impetus for Action

Migration to VAXcluster

Between 1976 and 1989, the SWT ISS department had developed applications to address information processing needs in virtually every campus department. Applications ranged from the more typical financial, student, and human resource information systems, to police, housing, library, and physical plant systems. All of these applications were developed in-house on DECsystem-10's, and utilized a common, highly integrated, non-redundant database. With the imminent demise of the DEC-10 architecture, all administrative applications and the entire administrative computing environment had to be replaced.

In January 1989, a special Migration Steering Committee, with representation from each university division, was established to monitor the migration, enforce development restrictions, and establish priorities for allocation of scarce resources. Three (3) years later, SWT completed the migration of administrative computing applications from the DECsystem-10's to a VAXcluster platform. Administrative applications were replaced through in-house re-engineering, in-house conversion, or purchased software. Some of the purchased software required extensive customization.

The migration was successfully completed in three (3) years due in part to support from the administration. With help of the Migration Steering Committee, enhancements and new development were severely restricted, limited almost entirely to externally imposed mandates. To expedite the migration and support subsequent operations, the administration also funded additional positions in CS and customer departments. There was a down side to the development restrictions: by the end of the migration, pent-up customer demand was at an all-time high.

Ineffective Priority-Setting Processes

With all this pent-up demand, the issue of setting project priorities quickly became critical. Everyone recognized that SWT could not go back to the pre-migration method of prioritizing requests. Prior to the migration, ISS time had been allocated among the university divisions in fixed hour amounts. Each division had its own priority committee responsible for maintaining a wish list of "things to be done". There were no criteria for measuring the importance of a request, just some generally accepted guidelines like:

- o If it is Payroll, it must be important.
- o If it is Registration, it must be important.

- o If the Vice President said to do it, just do it.
- o If the Legislature wants it, do it first!

These priority committees met irregularly to determine what requests had been completed, why ISS had not completed more of the requests on the list, what new "top" priority items should be added to the list, and how many of the items were now a "number one" priority. With the exception of a few university initiatives, ISS decided which "number one" priorities would be addressed. In 1976, this method of prioritization actually worked well. Automated systems were few in number and relatively simple, therefore maintenance requirements were low and resources for new development were adequate. Over time, the number and complexity of systems increased while resources remained static. As a result, maintenance increased, development decreased and completion of requests became more and more infrequent.

Divisions began to jealously guard their time allocations and an informal process developed that benefitted privileged customers. The same customers always enjoyed the lion's share of the resources. No division was willing to dedicate any of its allocation to university-wide projects; however, they still expected these projects to be completed. No division was willing to allocate time for the changes necessary to keep current systems viable.

Inconsistent Level of Customer Satisfaction

Access to an official priority list or the informal "privileged" list was still no guarantee of customer satisfaction. Many requests for new development or system enhancements were verbal, often a result of a hallway conversation. While customers regarded these verbal requests as the end of their responsibility, ISS expected (and waited for) a little more detail. Whenever these requests fell through the cracks the result was frustration for everyone.

Even when a project did get off the ground, customer satisfaction was often low because the accepted methodology for system development did not include customers. Responsibility for all phases of system development rested primarily with ISS. At best, when partnerships were strong and responsibilities were shared between ISS and the customer, good system design practices and a successful project with a satisfied customer resulted. At worst, the customer abdicated responsibility for system functionality and workflow, projects were not successful and the customer was not satisfied. There was definitely a pattern: customer satisfaction was directly proportional to the extent of customer involvement in the process.

Inadequate Customer Training and Process Documentation

Many customers assumed that if a procedure was automated, then ISS was responsible for both workflow documentation and all training. While ISS provided procedures for operating the software, these procedures were rarely included in any overall office workflow documentation, because no such document existed. By default the procedures for operating the software became the office workflow documentation. The software began to dictate office procedure, customers effectively lost control of their office operations, and the ISS analyst responsible for that application became the expert in customer office operation.

While it was generally understood that ISS provide initial training on newly implemented systems, customers expected that ISS continue to provide training whenever necessary. This expectation and the lack of workflow documentation meant that current office staff were not prepared to train new employees without ISS assistance.

ISS was frustrated; they did not have the resources to provide offices with procedure manuals and training for all new employees. Customer managers were frustrated, realizing that they had become too dependent upon ISS.

Internal Mandates

Internal mandates were another problem. "Internal mandates" have implementation deadlines set without adequate data, planning, or forethought. They commit the institution to action without regard to the impact upon stakeholders, projects already underway, and resource commitments already made. A project name and a due date is all there is.

A typical scenario might be as follows: The President, Provost, or Registrar promises delivery of a long anticipated Telephone Registration system within a year. Trouble is, the Information Systems Manager and the Telephone Services Manager find out about the "commitment" and the associated implementation calendar in the campus newspaper. Every person on campus has a different definition and expectation of telephone registration, but they all share the same date of delivery.

Islands, Orphans, and Cannons

SWT is like many campuses in that departments enjoy considerable autonomy with investments in technology. Even the most up-to-date and clearly articulated standards will be ignored in the face of gifts-in-kind and grant requirements. FREE = GOOD, right? Just as night follows day, the result has been the inevitable "Islands of Technology" where hardware and software incompatibilities abound. But not to worry, "The experts in CS can make everything work together, or else they must not be very good."

Orphan systems are another common problem -- outsourcing at its worst. A department hires a consultant (translation, Computer Science graduate student) to develop an application they need because ISS is too backlogged. The application is written using obscure languages or tools that the graduate student wanted to learn, but which were otherwise new to the campus. The graduate student documents nothing and cares little about maintainability. Eventually he/she graduates and leaves for parts unknown with the source code. But not to worry, "The experts in ISS can fix it and support it in the future, or else they must not be very good."

And let's not forget "loose cannons", the self-appointed experts who know how to do everything they've never done. They can be easily recognized by the way they begin their sentences: "All CS has to do is ..." or "Why can't CS just ..." or "At Utopia U., we did it this way ..." are favorites. But not to worry, if it's been done anywhere else, then "The experts in CS and ISS can and should make it happen here, or else they must not be very good."

Internal Audit Findings

An Internal Audit finding in February 1991 was critical of SWT's system development methodology. The major issues were that customer involvement was minimal, customer requirements were not documented, cost management was nonexistent, and project schedules had no credibility. The Auditor recommended that the University adopt a formal system development methodology.

All these problems led to the inescapable conclusion that SWT needed something significantly better.

Developing the SDLC Methodology

Forming the SDLC Team

To begin addressing the problems identified, the System Development Life Cycle (SDLC) Team was appointed by the President in June 1991. The Team was comprised of at least one member from each of the five (5) divisions at the University, two (2) members of CS, and a representative of Internal Audit ex officio. Faculty, staff, and administrative constituencies were represented. The Team was charged with drafting a policy and procedure document that outlined mutually interdependent responsibilities of customers and systems designers during the system development process, and offering an appeals process for conflict resolution.

Adopting a Philosophy

The first action of the SDLC Team was to develop a philosophy to guide its work. That philosophy emphasized partnership between customers and ISS. It stressed communication between stakeholders and designers of the system to insure the development of a product which was right for its intended purpose, and which was delivered on time and at a reasonable cost to the University.

Adapting a Model

The Team began with a model, "Understanding the Systems Development Process" (Long, 1983), that defined system development as a five (5) phase process. In addition, the Team referred to the IEEE software requirements specifications prototype outline (IEEE, 1984), Boehm's book Software Engineering Economics (1981), several articles from the CAUSE exchange library, etc.

One of the early challenges was taking a model developed for the corporate world and adapting it to higher education in general and SWT in particular. Some of the differences include: the motive of the institution is not profit, but expansion of services within existing resources; ISS can't politically refuse to work on a project; customers are not accustomed to budgeting for technology. To the Team, the most important elements to be added to the model were well-defined deliverables and responsibilities for those deliverables. With these things in mind and guided by their philosophy, the SDLC team adapted its model to the SWT culture.

Expanding the Team's Charge

The SDLC model was documented in the form of a university policy/procedure statement. The initial optimistic deadline for a draft document was five (5) months after the SDLC Team was formed, but it was not that easy. In that time, the Team developed their first draft, but circulating it to several customer groups and incorporating their feedback added eight (8) additional months before the revised draft was delivered to the President.

In addition to delivering the policy and procedure document, the Team recognized the need for some companion activities to insure success. These included:

- Completion of a resource impact study.
- Completion of a pilot study.
- Identification of SDLC's impact on current policies and organization.
- Education of the university community to the process, and gathering feedback from potential stakeholder groups to improve the process.
- Development of a separate, detailed procedure manual to allow more flexibility in the policy statement.

While the charge to the SDLC Team was initially limited to the drafting of a policy and procedure statement, they knew that successful implementation of SDLC would require that upper management address certain issues. The Team recommended to President's Cabinet. First, the membership and structure of priority setting committees had to be strengthened. Second, an oversight body with a university-wide perspective on resource allocation had to be established. Third, President's Cabinet had to be dissuaded from establishing "internal mandates" without regard to resource availability. Fourth, improved communication and tracking mechanisms had to be developed.

The Team was given authority to present the draft policy and procedure to various groups of customers across campus. True to a commitment to customer involvement, over a period of two (2) months, members visited all the division councils, academic support and school councils, plus Faculty Senate, Staff Council, Computing Services, and the area functional analysts. With the comments received from these groups and the results of the first phase of the pilot study, the Team revised the SDLC policy and procedure document, which was officially disseminated in July 1993, two (2) years after the Team was appointed. The Team's charge was expanded to include oversight of the pilot study, development of training curricula, development of the procedure manual, and review of the process's impact on other SWT policies and organizational structures.

The SDLC Document

The purpose of the SDLC document is threefold: to define the six (6) phases that all SWT system development projects will follow, to identify and assign the attendant tasks and responsibilities, and to specify the responsibilities of the oversight body, the System Development Council. The document also directs the reader to the procedure manual for greater detail. The six (6) SDLC phases, familiar to IS professionals but not to their customers, include:

Phase I - System Initiation and Feasibility Study
Phase II - System Analysis

Phase III - System Design
Phase IV - Programming
Phase V - Conversion and Implementation
Phase VI - Post-Implementation Evaluation

Perhaps the greatest aspect of the SDLC document is the delineation of responsibilities to five (5) major groups of players: customers, feasibility study and project teams, area functional analysts (AFA), ISS, and upper management. These groups and the responsibility assignments are described here.

Customers. The SDLC process is designed to return control to customers and stakeholders by requiring their involvement. They are assigned responsibility for documenting the current system, documenting requirements of the new system, examining alternatives, providing human resources, monitoring progress, reviewing formal requirements and system design, testing and formally accepting the system, completing procedure documentation, and monitoring the system for enhancements and corrections. This drastic increase in the level of customer involvement is the greatest change to prior practice and the greatest risk to success: SDLC will fail if it does not demonstrate that the quality benefits justify the intensive customer time commitment.

Feasibility Study and Project Teams. Customers are the primary members of both the feasibility study team and the project team, and it is strongly suggested that a customer lead both these teams. These leaders do not need computing expertise. They need to be good at time management, people management, detail work, task coordination and project tracking, and most importantly they need to be champions of the projects. Other members of these teams include ISS and CS representatives, AFA's and other stakeholders identified.

Area Functional Analysts. While a customer is or should be the team leader, a great deal of responsibility falls on the "Area Functional Analyst" (AFA). This position was created during the VAX migration to act as a liaison between customers and Computing Services. The AFA reports to the customer's department or division, which gives the customer control over more resources specifically dedicated to system development. The AFA assists the customer in preparation, submission, and communication of service requests and plays a leading role on the feasibility study team. The AFA also participates heavily on the project team in detail requirements definition, design review, acceptance testing, and training of customers.

ISS. ISS now concentrates on screening and categorizing service requests, and in the system design, integration, and programming phases. Basically, the responsibility for project initiation, feasibility study, functional analysis, product implementation, and post-implementation evaluation shifted from ISS staff to the customer.

Upper Management. Upper management's responsibilities include understanding and judging the relative value of projects, committing the resources at their disposal, monitoring progress, and providing timely policy decisions which affect the process itself.

Developing the SDLC Procedure Manual

As a result of the feedback received from the community, the policy and procedure document was condensed. It became apparent that the process was complicated enough to warrant an operational manual to help people implement all six (6) phases of the SDLC process.

In the manual, each of the six (6) phases of the process is detailed in operational steps. Each step includes a brief narrative of the associated procedure, identification of the parties responsible for and involved in that step, and the deliverable outcomes expected. Due to the rather "laissez faire" attitude of customers prior to the SDLC process, the Team was very concerned about clarifying responsibilities so that ownership of the process indeed rested with the customer. In addition to narratives, flow charts of each phase and examples of deliverables are included in the manual to support those customers for whom "a picture is worth a thousand words".

The customers have had the manual for SDLC Phases I and II since December 1993. In Summer 1994, feedback from customers was incorporated and revisions were distributed. The first draft for Phases III-VI is currently in the hands of several readers, whose feedback will be incorporated in the version distributed in December 1994.

<u>New ISS Policies and Procedures</u>

Early on, the SDLC Team recognized that ISS policies and procedures were poorly communicated and generally misunderstood. Customers simply did not know how ISS resources were allocated or how to get ISS resources focused on their needs. The migration had imposed restrictions, structures and processes that were no longer needed, and the pre-migration methodology had been happily forgotten by all. Customers needed new structures and processes to fill the void, to help ISS serve them.

To address that need, and to act as a companion with the SDLC policy and procedure statement, ISS drafted a document entitled "Obtaining Administrative Information Systems and Services". In this policy/ procedure statement, ISS provided a detailed explanation of:

- o how ISS staff resources are allocated,
- o how ISS services are requested, and
- o how projects are initiated and their scope is assessed.

<u>ISS Resource Allocations</u>. ISS staff resources are allocated in two (2) ways: by activity type and by activity area. The policy statement defines five (5) activity types and establishes annual targets for the percentage of total ISS staff hours to be invested in each activity type. These types are burden (30%), maintenance (20%), enhancement (20%), development (20%) and research (10%). Articulating these targets has given the customers a more realistic perspective of what ISS does, and how ISS spends its time.

The second method of allocation is by activity area. This method identifies the ISS FTE's devoted to specific applications and services. It provides customers with an idea of how ISS resources are spread across the customer base. It tells them how many ISS staff are involved in the support of general database administration, student records applications, human resource applications, internal ISS training, etc.

By publishing the ISS resource allocations by both activity type and by activity area, ISS has eliminated some of the "secrecy" and customer suspicion about ISS activities. Customers now have an increased understanding of the ISS resources available, where and how they are invested, and the need for customer prioritization of requests.

The ISS Service Request. Past audit findings were critical of the fact that significant modifications were often made to applications without written authorization, and the modifications were often made without input from others who might be impacted by the change. ISS also found that customers were dissatisfied because applications sometimes treated symptoms without solving the root problem, and/or did not meet the customers' expectations.

To address these issues, the ISS policy statement defines a process for requesting services that focuses on problem and/or opportunity definition and communication of the request to all stakeholders. The policy specifies that service requests include a title, a goal statement and supporting objectives (by which satisfaction of the request will be measured), a description of the problem or opportunity to be addressed, and a list of known stakeholders. Implementation methods and solutions are specifically EXCLUDED from the problem/opportunity description, and the request must be published to solicit feedback from stakeholders.

Area functional analysts and ISS staff readily and regularly assist customers in completing service requests to assure that the problem is stated, not just a solution. In addition, helping customers with requests provides an early idea of the scope of the request and sometimes even eliminates the request if the solution already exists.

Assessing the Scope of the Request. A well-written request and feedback from stakeholders provides the information necessary for the customer, the area functional analyst, and the ISS analyst to determine the size, complexity and general scope of the project. This information allows them to get general answers to questions like:

- o Is this an enhancement, development, or research activity?
- o How might other customers and applications be impacted?
- o What needs and opportunities exist for integration?
- o What are the major constraints?
- o What customer resources are available to satisfy the request?
- o Are current hardware/software/network capacities adequate?
- o To what depth should alternative approaches be pursued?

And most importantly,

- o What SDLC activities and prioritization level(s) are appropriate for this request?

Responding to Recommendations of the SDLC Team

The SDLC Team recommended to upper management several policy, procedure, and structural changes to assure that SDLC worked well. The Team submitted recommendations related to priority setting, an oversight body, mandates, and improved communication and tracking mechanisms.

Improving Customer Prioritization and Commitment of Resources

SWT is no exception to the shrinking of financial resources afforded to higher education. SWT's student:faculty ratio is 20:1 and its student:staff ratio is 17.5:1, so human resources are extremely limited as well. One of SDLC's goals is to apply these resources where they provide the greatest return on investment in pursuit of the strategic plans of departments, divisions, and the University as a whole. To do this, customers must decide where to invest, not only their own resources, but ISS resources as well. They must actively participate in leveraging these investments to provide the greatest benefit at the least cost to the University.

Priority-setting bodies at SWT have improved. They are following the letter and the spirit of SDLC, and are consciously making priority decisions. ISS is no longer in the position of having to choose from among dozens of top priorities.

Under SDLC, the appropriate level (department, division, and university) of prioritization is determined by the size, scope and complexity of the project.

Department. Departmental prioritization is all that is necessary if the customer or requestor, ISS, and the stakeholders all agree that the scope of the request is limited enough to address it at that level. Generally, this means that the request can be satisfied using resources that are readily available to the customer, and with little or no impact upon other departments. A department must set the initial priority of each request it originates relative to its other pending requests.

Division. If the customer/requestor, ISS, or a majority of stakeholders believes that the request is large enough, complex enough, or has significant impact outside of the requesting department, then divisional prioritization is required. Requests receive divisional prioritization via whatever mechanism is established by the division vice president; this mechanism is usually a division priority committee.

University. If a request requires commitment of resources normally allocated to offices outside of the requesting division, or has a high risk and/or visibility, or is considered of strategic importance to the University, it must obtain a university-level priority. University-level priorities are established by the System Development Council.

Addressing Mandates

An issue related to priority-setting which was improved by the SDLC process was the handling of mandates, both internal and external. Internal mandates were set by President's Cabinet (PC); external mandates came from state and federal agencies.

Internal Mandates. Perhaps the most sensitive recommendation of the SDLC Team dealt with PC's habit of endorsing project implementation dates without regard to the impact of that decision on available resources and current project calendars. PC readily agreed to restrict its endorsements to support for ideas, and to rely on the feasibility study to identify method, resources, and timeline.

External Mandates. Prior to the establishment of SDLC, customers tended to abdicate much of their responsibility for defining how state and federal mandates would be addressed. Whenever such a mandate was received, the memorandum from the mandating agency was simply forwarded to ISS, along with a directive to "make sure we can comply with this." It was not at all uncommon for ISS staff to be working directly with personnel from the mandating agency, rather than from specifications provided by university staff. SDLC has changed all that. External mandates are now handled in the same way as any other request. A service request that defines the problem, goals and objectives is submitted and must be prioritized like any other request. This change has had many positive results. Customers are aware of the impact of external mandates on other projects and scarce university resources. They are more involved in determining the scope of the mandated project and methods for compliance, and have begun to see the opportunities in external mandates. Where before, SWT might derive no direct benefit from complying with an external mandate, customers now take the opportunity to address local needs at the same time.

Establishing an Oversight Body

The administration endorsed the establishment of an oversight body for the SDLC process. This body, the System Development Council, oversees system development, prioritizes and tracks university-wide projects, makes policy and procedure revisions necessary as the SDLC process evolves, resolves conflict among divisions, and sponsors the development of SDLC training resources. This Council is chaired by the Executive Vice President, and includes one representative from each division, as well as two ex officio members, the Director of Computing Services and a representative of the Academic Computing Committee. The divisional representatives lead their divisions' priority-setting bodies and have the knowledge and authority to commit divisional resources to projects.

Improving Communication and Tracking Systems

As one might expect, involving an expanding number of customers created additional communication problems. Priority committees and project teams needed a better way to communicate service requests and track the status of projects. To meet this need, an electronic conference is being pilot tested. The conference serves as a repository for service requests, feasibility study results, and other SDLC deliverables. As projects move through the six (6) phases of SDLC, those with access to the conference will be able to follow the progress of the projects and comment on developments. The conference opens up the process and indirectly increases the accountability of those involved.

Initial Project Experiences

Below are snapshots of a few early projects which have used the SDLC methodology. These experiences helped reinforce the belief that imposing structure on the decision-making process (SDLC) would result in a product which better satisfies the customer.

Pilot Project

SWT's pilot project was the emergency tuition loan program management system. The members of the feasibility study and project teams were initially resentful of the amount of time they had to invest in the project by following SDLC guidelines. However, when the project was complete they acknowledged that they had a better product than they would have had using previous methods. They were forced to talk across departments and divisions and solved problems that previously would not have been discovered until much later.

Student Health Center

To paraphrase a Health Center staff member, "I thought SDLC was only a bureaucratic hoop. But after two (2) previous attempts at automating our system, the feasibility study experience forced us to define and document the different but related needs of doctors, nurses, receptionists, pharmacists, and others on the Health Center staff. And for the first time we had a comprehensive document to use in evaluating solutions."

Budget Development

The SDLC process has helped to control some rogues who would advance hidden agendas at the expense of solving the problem. Feasibility study team members used the SDLC process to maintain focus on the problem and kept the University from making an expensive mistake.

Payroll

The feasibility study team for the electronic payroll deposit project involved university employees in the design of a new earnings statement. SDLC helped the Payroll Office recognize that they are not the user of the earnings statement. For the first time employees had an opportunity to define what information they needed from their payroll system.

Changes in Attitude

Several major changes in attitude and expectations have been among the most important outcomes of the SDLC process. First, there is broader campus understanding that customer satisfaction (quality) is directly proportional to:

- o The level of customer involvement.
- o Communication of stakeholder and customer expectations.
- o The mix (Stakeholder types) of involved customers.
- o The leadership of one or more customers as "Champions".

Second, the implementation of any campus-wide methodology of this magnitude is a long-term commitment of resources. As a result:

- o SDLC policies and procedures are recognized as continually evolving.
- o Attention to customer support needs are addressed through continuous investment in the procedures manual and training activities.
- o Priority committees have increased in number, size and representation and are becoming leaders in making SDLC work.

Conclusions: Some Rules for Success

"CUSTOMER FOCUS", "SATISFYING THE CUSTOMER", "EMPOWERING THE USER". These are some of the buzz phrases of the '90's, especially within TQM. These are worthy goals, but they can only be accomplished in systems development when management grants and the customer accepts responsibility as a full partner. SDLC is not a perfect solution. Neither was MBO, nor is TQM. It is up to the people to make any of these work.

As a result of the SDLC experience, SWT has accepted certain truths as basic to the understanding and operation of the process. Reviewing the following "pearls of wisdom" before developing a similar SDLC process may help others save time, organize debate, and limit unrealistic expectations:

- o SDLC does not create new resources; it just uses them more effectively and more efficiently.
- o Prioritization is often a determination of what won't get done.
- o Some worthwhile projects will never get done; customers will still hear "no", but now it will be "no, because ...".
- o Customers will have to spend more time planning and managing projects.
- o Priority committees, and especially their chairs, are critical to making the process work, and these individuals will develop necessary expertise at different rates.
- o It will take time and training to turn customers into project managers.
- o Estimates will be awful at first but will improve with experience.
- o Focus on the "WHAT", i.e., delineate WHAT deliverables are needed.
- o Focus on the "WHO", i.e., delineate roles to be filled - WHO does WHAT
- o Allow flexibility with the "HOW", i.e., formats and methods.

At SWT, the SDLC process in its early implementation has proven successful due to the involvement of the customer, the reliance on a tested decision-making process, the development of simplified procedures for guidance, and a degree of flexibility in choosing from among the suggested SDLC steps and the ordering of those steps. In addition, the institution is better able to establish realistic expectations for project development within limited resources. At SWT, it looks like SDLC is working.

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CAUSE 94

TRACK III

INFORMATION AS A STRATEGIC RESOURCE

Coordinator: Martin Ringle

DEVELOPMENT OF AN ELECTRONIC INFORMATION POLICY FRAMEWORK

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The University of North Carolina at Chapel Hill, like many other universities, is attempting to manage an unprecedented demand for electronic information in myriad forms. The dispersion of organizational responsibilities makes it difficult to address the confusion and contradiction arising from issues of availability, responsibility, and confidentiality. An early policy study led to a report on major issues and the formation of a management council with membership representative of units having management and budget responsibilities for pan-university information technologies -- library, networking, and computing organizations, for example.

This report summarizes the strategies and rationales employed in creating the council and in developing a policy framework articulating the electronic rights and responsibilities of the university community and the public. It describes the "case testing" strategy currently being used to evaluate the framework and the plan for continuing its development, garnering support for it, and implementing it. This paper also explores the potential interactions of this policy with those of other agencies.

The purpose of this paper is to report the evolution and current status of a "A Policy Framework for the University's Network: Electronic Rights and Responsibilities at the University of North Carolina at Chapel Hill" (UNC-CH), developed by a partnership of information technology, library, and administrative leadership. This description of the framework and the processes that shaped and continue to guide its implementation may prove useful to others who recognize new, technological windows on old issues in the following scenarios:

* A teenager dials into a machine at a university in his city. From that connection, he establishes a connection to another machine at a distant university. This machine allows him to establish an Internet connection and thereby a connection to alt.sex. His father and the press in his city express outrage that the two universities separated by miles have conspired electronically to lead America's youth astray.

* The FBI, suspecting that a nefarious hacker has broken into a machine in the physics department at a university, demands a copy of that machine's fixed disk from the department chair. The chair seeks legal counsel and is advised to comply with the FBI's demand. The FBI now has a copy of many files that are considered private by their creators in the department.

* A state auditor advises a university chancellor that the university should have a special university policy to guide the personal use of university-owned computers and related electronic property, including e-mail. The tenor of the advice is 1) that all personal use should be prohibited, even it adds no incremental cost and possibly contributes to professional development and an environment of open expression, and 2) that digital technologies demand special personal-use policies different from those formulated for other university-owned property.

* An administrator finds himself having to respond to requests for large amounts of data from administrative data files, for public use, in the format requested. How can he cost effectively respond to such requests, mandated by law, while doing his best to provide data that accurately describes the university, is not misleading, and protects individual privacy?

* Libraries and other university agencies have leased network access to commercial databases. How can licenses for access to such databases reflect the broadest access possible to meet information needs of university users, avoid costly duplication, and be enforced and supported through user support services?

* University administrators from units all over campus search for information to support reaccreditation and find that institutional data was not readily available when the need arose.

* Individual departments and schools create World Wide Web home pages because the technology is available. Little, if any, consideration is given to the quality of the information, how it will be maintained or what standards should be incorporated.

Each of the above scenarios is based on an event that informed or continues to inform UNC-CH's work on the policy framework. In fact, new examples supporting the need for a coordinated institutional policy arise almost daily.

An Overview of UNC-CH's Policy Framework

The policy framework developed by this partnership is appended to this report in its present form. It describes the nature of the University's network and proposes a set of overarching University-wide rights and responsibilities for both consumers and producers of networked information. The overall goal is to make information needed by the University's various constituencies as accessible and useful as possible. The document is only a policy framework, a statement of philosophy, but it should be read with the understanding that unit-level producers/providers of information resources will be required to develop policies and practices consistent with this University-wide framework. The framework document implies several directions that depart from current practice at UNC-CH:

* The University will have ultimate responsibility for all official, institutional information generated at unit levels. Current policy, in contrast, places this responsibility solely at the unit level. The University will expect units to act as responsible stewards of the information that they generate. Stewardship will include the responsibility to prepare and manage information in compliance with University-wide standards and practices.

* The University will expect the units to "publish" institutional information in a comprehensive manner on the University network with enough searching, browsing, and "mining" capabilities to provide aggregate information about the people and other resources of the unit. Such information includes, for example, information about students, faculty members, unit expenditures, and other fiscal activities. Many units will choose to use electronic publication to provide information about the content and direction of their academic programs and activities, but academic work remains the private property of individual scholars, students, and staff members except as dictated by external funding agencies, state and federal policies, or various contractual arrangements. The intent is to "open" official, institutional information at the unit level to all members of the University community and to anyone who has Internet access from anywhere. Current practice, in contrast, exhibits much less openness. The formats of the electronic presentation of information will be carefully designed to be broadly useful, permitting the University, within the scope of the law, to reject requests for information in other formats that are not easy to accommodate.

* Information embodied in University-owned digital storage and transport media will be considered private property except when specifically intended to be an official University communication or record or when otherwise treated by a contractual arrangement or federal or state laws. This includes non-official electronic mail, which presently is not consistently viewed as private.

The first two directions are an attempt to open the University's "official" institutional records to a broader audience, especially within the University. Open access to information is increasingly important to the University's competitive position at a time when intellectual capital is encroaching on physical capital as the driving force in the world economy and order. Indeed, openness is becoming the expectation in North Carolina, as this recent statement from Governor Hunt suggests: "Members of the public and the media need to have access to this computerized information about their state government, and we should make those records as accessible as possible." In contrast, the third direction is an attempt to put a "privacy" stake in the ground in an area where the law is unclear and is often uninformed on the nature of the digital revolution.

Nor is the University immune to the pressures forcing all institutions -- public, non-profit, and commercial -- to become more accountable and cost-effective. Academic governance for years has modeled the "flat" structures touted today by the corporate world as essential to competitiveness. But the effectiveness of the flat model is dependent on the open flow of information. Now for the first time, paper-moving impediments to openness can be mitigated by capturing, storing, and sharing information across digital networks. The new technologies can advance educational quality in a timely, cost-effective manner by improving collegial decision-making with the support of nimble administrative and business processes and an open information policy.

Evolution of the Policy Framework

In 1992, the University's Advisory Committee for Information Technology (ACIT), responding to events such as those described in the opening scenarios, appointed a subcommittee to outline key issues and considerations that a University-wide information policy could help address. (The University's two chief academic officers -- for academic and health affairs -- created the faculty- based ACIT to advise the associate provost responsible for the University-wide network and the University's central investments in academic computing and classroom technologies.) The subcommittee drew upon campus expertise as well as the experiences of other universities.

During the subcommittee's deliberations, the two academic officers and the University's chief financial officer created the Information Resources Coordinating Council (IRCC) to coordinate the management of pan-University digital information stores and technologies distributed across organizational boundaries that intersect only in the Chancellor. The Council includes library leadership, academic and administrative information technology leadership, and the chair of ACIT. ACIT then decided that the work of its subcommittee on information policy was more appropriately the domain of IRCC. The following is an accounting of the issues and methods that led to the current draft of the policy framework, beginning with the key issues defined by the ACIT subcommittee.

Issues to be Considered in an Institutional Information Policy

An information policy should acknowledge that there are complex legal, ethical, technical, governance and economic issues that need to be addressed. Defining these issues does not necessarily mean that the way to deal with them is clear. Networked access to electronic information is still a new phenomenon to many users and institutions, thus an institutional policy should provide some guidance, but be flexible enough to allow the lessons of experience to mold practice. Some basic assumptions and operating principles set the stage for defining the University's role. These may ultimately be incorporated into official policy, if they are supported by the University community. With these assumptions and operating principles in mind, the subcommittee then defined issues in three key areas: legal/ ethical, technical, and governance/ economics.

Basic Assumptions
Four basic assumptions provided the foundation for defining our key policy issues:

* It should be possible to provide timely access to needed information to members of the University community from a desktop workstation, regardless of its location and format. This assumes the availability of a network infrastructure, including distributed computing resources and communications and also assumes external and internal compatibility.

* It should be possible to find a balance between the rights of individuals, as authors and as users of information, and the responsibilities of the institution to make information available to support scholarship and service. This is a fundamental balance between privacy and access.

* It should be possible to adopt universal standards of data access and integrity to help achieve this balance.

* It should be possible to define different classes of users of institutional information with different access privileges, and to regulate such access accordingly.

Operating Principles
Three operating principles define how the University will behave in fulfilling its policy obligations:

* The University will define the information which it is responsible for making available electronically, putting itself in the role of electronic publisher/distributor. This role requires (a) access mechanisms such as network infrastructure and policy governing who uses it; and (b) availability of the information over the network.

* The University itself will not regulate access to information for which it is not responsible. This will be the responsibility of the author. However, the University should support unregulated access to information under conditions specified by its authors.

* The University will define access privileges to its information for classes of users.

Legal and Ethical Issues
The key legal and ethical issues revolve around concern for protecting an individual's right to privacy, and protecting the rights of authors and distributors. The policy must enforce individuals' privacy and identify classes of information protected by law and federal regulation. It must recognize protection currently in place in federal grants involving human research subjects, for instance.

The policy must also be sensitive to the needs of its community of both knowledge creators and users, protecting the legal rights of authors/distributors, protecting contractual agreements in software licenses, and facilitating and complying with archival requirements. Many of these questions are currently being debated nationally, in an attempt to find a common ground for ensuring that information in electronic form can be made readily available to support scholarship and discovery in a manner which protects the ownership rights of authors and distributors while taking advantage of opportunities for improved access via networks.

The policy must represent the basic rights of authors and distributors as well as protect access to confidential or sensitive information. These are ethical as well as legal issues. Authors and distributors have the basic right to acknowledgment, the right to privacy, and the right to determine the form, manner and terms of publication and distribution of one's own work (these are spelled out in the EDUCOM code, for example). An institutional information policy should provide mechanisms for safeguarding these basic rights. Further, the policy will need to define the institution's role in protecting access to sensitive or potentially objectionable information, versus its role in supporting an individual's right of free expression. These are some of the most difficult issues to tackle in an environment which at present allows highly unregulated access to academic information, while tightly controlling access to most administrative information.

Technical Issues
The institutional information policy should support the adoption of technical standards and practices which ensure appropriate accessibility and security of data, and appropriate data integrity. The policy must ensure that data is reachable in a usable format by authorized users. Standards for connectivity will address access to data through both direct (e.g. ftp) and indirect methods (e.g. sneakernet). Standards for authorization will suggest methods for authentication and encryption of data, to protect its accessibility by eligible users. Standard data formats should be recommended by the policy, to ensure the widest possible readership. To assure quality control and data integrity, the policy must ensure that data is stored, backed up, and transmitted according to standards and protocols that preserve data integrity. Standards and responsibility for archiving and accurately transmitting institutional data should be guaranteed.

Governance and Economic Issues
If the institutional information policy defines the University's role as publisher/distributor of certain kinds of information about the University, then it also should identify which units in the University are responsible for guaranteeing access to that information. Some of the key questions about governance include:

* Who is responsible for ensuring appropriate access to institutional information? This role includes the legal, ethical, and technical responsibilities outlined above, to promote appropriate access to and availability of institutional information. It also includes educational and consultative responsibilities to promote the appropriate use of institutional information. In addition, it includes fiduciary responsibility for providing and maintaining information resources. This information policy framework suggests that University schools and departments which are responsible for the content of information can also be responsible for all of these aspects of access to that information, given a strong policy and infrastructure.

* What is the University's responsibility for access to non-institutional information? The policy framework suggests this responsibility rests with the author, not with the University.

* Who determines the rights and privileges for different classes of users? This includes addressing the question of whether access to electronic information should be free or fee-based.

Developing the Policy Framework

These key issues and guiding principles articulated by the ACIT subcommittee shaped the first policy framework document. After discussion and revision, IRCC then "proofed" the document by applying test cases to the key concepts. The test cases included discussion of current electronic mail problems and practices, a meeting with the University Registrar to discuss the fit with current practice and planned direction for student information, and a meeting with representatives of a grass roots staff initiative aimed at coordinating and developing standards for document imaging initiatives. The policy framework was demonstrated to be highly compatible with the desired directions in the areas tested. Thus far, the only omission exposed by case testing is a lack of archiving considerations. Some current practices for electronic mail contrast with the philosophy stated in the document and may require specific policies if the framework is officially adopted.

The resulting version of the framework was then presented to a group of University vice chancellors -- those responsible for University academic, research, and business matters. The vice chancellors voiced strong concern about protecting the privacy of academic research conducted over electronic networks. They agreed that using the term "institutional information" would initially clarify the distinction between public and private information, while recognizing that many of the difficult issues would surface again during implementation and the evolution of a governance structure to resolve disputes. The meeting ended with an agreement to obtain feedback on this policy framework from deans, faculty, administrative officials, and perhaps the Employee Forum.

Garnering Support and Gathering Feedback

Four focus group sessions have been conducted to date: a group of ten faculty members or their representatives, the deans in Health Affairs, the deans in Academic Affairs, and a brief meeting with the Executive Committee of the Faculty Council. Well in advance of each meeting, each participant received a copy of the draft policy framework and a letter describing what was to happen and why such a policy was important. A few days before the meeting, they received a list of potential benefits and a list of questions to consider for the discussion.

Reviewers thus far have generally accepted the policy framework and have agreed on the need for and utility of a set defining principles to guide development of future policies and procedures. They have also recognized that early involvement at the highest levels of the administration would encourage more sound and consistent policy decisions in the future.

All except the Faculty Council group had difficulty separating the policy framework from the issues which will have to be resolved during implementation. Concerns from all groups fall within three primary areas: 1) financial, training, and other infrastructure support for implementation of such a framework, 2) definition of "institutional" data, 3) concerns about privacy.

Given the budget constraints of departments and the University, some faculty questioned whether the expectations raised by the policy framework were realistic, while others, noting the growing amount of institutional data already on line, wondered about the need for such a policy. Many faculty wondered if they would be able to utilize on-line resources without time, incentives, and support from department chairs and deans to familiarize themselves with new technologies.

Many participants wanted a specific definition of "institutional" data to be provided to them -- an example of participants' difficulty in separating conceptual framework from implementation. In response, IRCC members reiterated their hesitation to try to determine what should and should not be "published" online without input from departments during the implementation process.

In addition to echoing these concerns, the deans also indicated a desire to see the central administration adopt a pan-University "vision" of the use of electronic information and were very receptive to the idea of the Internet as a marketing tool for their programs. Some also worried that more available information would increase individual workloads through requests for more details or requests for services. The deans clearly want to have high level involvement in determining what is institutional data, and high level commitment to addressing the cost issues. They agreed that this is not a technology issue alone.

Privacy and appropriate use issues were discussed, but did not seem to be as pressing a concern to most faculty members. Most agreed that a proactive stance on these issues would help guide the University's decisions on policies in the future, and would place the University in a stronger position in the case of a legal entanglement over these issues. There was, however, strong agreement among the deans that faculty and other University employees need to be made aware of the unique qualities of electronic mail as a means and store of information. The deans expressed concerned that many people still look at email as a secure and highly protected medium.

Future of the Policy Framework

At this point, the policy framework has received general support from the groups contacted, though many have expressed significant concerns about the implementation issues and the process for determining how implementation will proceed. The remaining groups, staff from business and finance divisions and other academic support staff, will likely be concerned with the same issues and have similar problems in responding to the framework. Some of these difficulties will be addressed by modifying future focus group sessions.

In general, people have a hard time "getting into" a discussion about something that is abstract and outside their experiences. The scenarios presented in advance of the discussion help, but not enough. More stage setting could help people understand why information policies are important as might a vision statement. It might also help to craft some futuristic scenarios to balance against the present day scenarios we have now: What would it be like if this framework were in place? Providing participants with a brief summary of the issues (legal, ethical, technical, governance) that will need to be addressed may also help focus discussion on the framework itself. The remaining difficulty in past sessions is that participants have focused almost exclusively on departments as providers of information, rather than consumers. In the future it would be worthwhile to specifically inquire about departments' data needs.

After completing the focus group and feedback sessions, IRCC will modify the framework document and continue the effort to increase awareness, gain further acceptance, and define an implementation process. The council will also undertake additional work in specific policy areas such as those surrounding access and use of academic information such as library information, intellectual property, and personal use of University equipment.

The overall goal of the policy framework is to make information needed by the University's various constituencies as accessible and useful as possible. This goal is only possible if the policies and practices of the individual units are guided by a consistent philosophical framework. The development of such a framework in a highly decentralized and complex environment is possible only through a partnership with library, information technology, physical plant, and faculty members.

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A Policy Framework for the University's Network

**Electronic Rights and Responsibilities
at the
University of North Carolina at Chapel Hill**

The University develops and manages a physical and social *learning infrastructure* to the economic, social, and cultural benefit of the state and the nation. This learning infrastructure increasingly depends on information in digital form and on digital technologies for communicating, sharing, and analyzing such information. Indeed, digital infrastructure is fast becoming a prerequisite, not only for a more effective and efficient University, but for a better informed and more responsible citizenry.

For example, a centrally supported digital network provides a means to *publish* much of the University's official, institutional information for the benefit of both the University and the public. The University, acting through its central administration, is responsible for this information, but centrally coordinated infrastructure and guidelines for publication shift the locus of responsibility for publication and stewardship to the academic and administrative departments that are the sources of most of the information. Similarly, the central administration and academic and administrative units share responsibility for the hardware and software used by the University community to analyze institutional information and other information accessible through the network. Digital infrastructure thus becomes a primary medium in a *federal* model for balancing responsibilities and encouraging collaboration and public service.

This federal model enables, and the University is committed to, an open flow of information within the University and between the University and the public. The Information Resources Coordinating Council, as the font and guardian of this philosophy, coordinates the development and management of the implied centrally supported digital infrastructure and related services. The Council also formulates the institutional policies that frame the related *rights* and *responsibilities* of the institution, those who serve it, and those whom it serves. All members of the University community are responsible, along with the institution, for good citizenship and informed stewardship in a digital democracy. The Council prepared this document to describe these institutional and individual rights and responsibilities and to provide a framework for governing the University's digital infrastructure and implementing the operational practices that determine its utility to the University and the public.

I. THE NATURE AND PURPOSE OF THE UNIVERSITY'S NETWORK

The Network

The University of North Carolina at Chapel Hill operates, through its central administrative offices, a wide-area (inter-building) digital transport network that interconnects local-area networks operated by academic and administrative departments that have agreed to adhere to the University's Uniform Wiring Policy and to the network management policies coordinated by the Office of Information Technology. The resulting network of networks is the "University's network." It is one of the institutionally-operated networks that make up the global Internet and that adhere to the open standards and protocols adopted by the Internet Engineering Task Force. In addition to an Internet gateway, the University's network also includes a gateway to the North Carolina Information Highway. Through its gateways to the Internet and the North Carolina Information Highway, the University's network becomes an extended global network that provides access to information and information processing technologies, only a fraction of which is under the stewardship of the University. This extended network and the resources accessible through it serve two primary purposes in the framework of the University's mission.

To Enhance Institutional Effectiveness and Efficiency

By having access to the University's network and its resources, to include its gateways to the Internet and the North Carolina Information Highway, the faculty, the staff, and the student body can communicate and collaborate among themselves and with their counterparts elsewhere who can connect to the Internet or the North Carolina Information Highway. Network connections are a starting point for internal collaboration and efficiencies, for extending the reach of the University, and for expanding the resources available to the faculty, the staff, and the student body. But the University's network is a powerful lever for institutional effectiveness and efficiency only to the extent that network connections are easily established and broadly available, are accompanied by easy-to-use services and accessible and reliable mission-critical information, and are based on the standards that guide the development of the Internet and the North Carolina Information Highway.

To Publish Institutional Information about the University

The network's gateways to the Internet and the North Carolina Information Highway are the primary means by which the University meets its responsibility to the public to *publish* much of its institutional information in useful digital formats. By publishing this information via the University's network, mostly in the form of institutional databases, the University not only meets a public obligation, but serves its own goal of continuous quality improvement in a distributed management model that depends on the free flow of information and that is essential to academic effectiveness. Institutional information, whether for the public or for internal purposes, therefore is published on-line in an open, democratic framework designed to encourage 1) consistent and ready, affordable access to digital information, 2) stability and reliability from the inquirer's perspective, 3) integration among disparate databases with minimal duplication in capturing, storing, and maintaining these databases, 4) useful, unifying perspectives on the University's programs and resources, and 5) information literacy and the use of institutional data in decision making.

II. CONNECTIONS TO THE UNIVERSITY'S NETWORK

Centrally Supported Connections for the Faculty, the Staff, and the Student Body

Members of the faculty, staff, and student body have the right to connect to the University's network and, through it, the Internet and the North Carolina Information Highway. This right and the resulting right to the University's information services and applications described in section III carry the responsibilities that attach to the use of any University resource. Any revocation of any of these rights, in whole or in part, is subject to the normal due process available to any member of the faculty, staff, and student body.

The University centrally provides two fundamental modes of connection for the faculty, staff, and student body: (1) *direct* connection via Internet protocols through reasonably convenient, centrally supported computer labs on campus and (2) *dial-up* connection via a centrally operated pool of modems connected to the switched public telecommunications network through Southern Bell's Chapel Hill Exchange -- to accommodate those who have a computer, a modem, and telephone service and who find themselves in circumstances that do not allow direct connections.

Departmentally Supported Connections for the Faculty, the Staff, and the Student Body

The University's academic and administrative departments have the right to connect their computers and local-area networks to the University's network provided that they agree to adhere to the University's Uniform Wiring Policy and to the Internet-compliant network management policies coordinated by the Office of Information Technology. Departmental connections provide an additional route by which some members of the faculty, staff, and student body connect to the University's network. Those eligible to exercise such rights of connection as are granted by a department assume responsibilities imposed by the department, which must include the responsibilities described in the first paragraph of this section as applying to those who employ centrally provided connections.

Centrally Supported Connections for the Public

One of the reasons that the University operates gateways to the Internet and the North Carolina Information Highway is to provide mechanisms for the public to connect to the University's network, primarily to give the public a standards-based interactive digital path into the University's published institutional information. This means that anyone anywhere with a connection to either the Internet or the North Carolina Information Highway, whether through a commercial on-line service or otherwise, also has a connection to the University's network and thereby has access to a vast collection of the University's institutional information in a useful digital form. The University, however, has no obligation, beyond that to its faculty, staff, and students described in the preceding two paragraphs, to connect individuals and organizations to the Internet or the North Carolina Information Highway.

III. INFORMATION SERVICES AND APPLICATIONS

Information Services and Applications for the Faculty, the Staff, and the Student Body

Members of the faculty, staff, and student body who connect directly or through one of the University's dial-up lines to the University's network have the right to, and easy access to, a collection of centrally supported, standards-based network applications and services for 1) communicating with others via the Internet (using Internet-based e-mail and news groups, for example) and 2) locating, retrieving, storing, publishing, and analyzing the University's published institutional information on the University's network. These centrally supported standards, applications, and services are deployed to provide ease of connection and use and to comply with, and contribute to, the direction of the Internet and the North Carolina Information Highway. This maximizes the probability that any resource on these extended networks will be readily accessible through the University's network to any member of the faculty, the staff, or the student body who is eligible to use it. It also helps to ensure that the University's resources will be accessible, as appropriate, to other networks and computers connecting to the University's network through the Internet or the North Carolina Information Highway. The University thus draws on the resources of the larger networking community and contributes to it.

The University's network is a large capital investment incurring very substantial continuing operating costs. Nevertheless, the marginal costs of centrally providing a connection and basic services to any member of the faculty, staff, and student body are currently negligible, and so the University centrally levies no individual per-use charges. Accordingly, connections and basic services are provided to the faculty, staff, and student body in a context not unlike that defining the use of University-owned telephones to make telephone calls within the Chapel Hill Exchange area. Basic connections and services 1) are reasonably convenient and free to responsible members of the University community and 2) are the portals to extended services, some of which incur individual per-use charges that are paid in a variety of ways.

Information Services and Applications for the Public

The University also grants access rights on an as-is basis to its published institutional information and to selected software resources on its network to anyone anywhere with a connection to the Internet or to the North Carolina Information Highway. Such information includes, but is not limited to, 1) information about the University and its policies, resources, demographics, and management as maintained in institutional databases and 2) selected academic resources in digital form, to include the catalogs of the University's libraries in the form of the On-Line Public Access Catalog operated by the Triangle Research Libraries Network. To advance the University's mission, other digital information and resources also are available on a selective basis to anyone with a connection to the University's network, but the University has no general responsibility in this regard. Access to information may be constrained, for example, by commercial licensing agreements. At the other extreme, free access to information may derive from cooperative arrangements between University departments and federal and state agencies. For instance, all official documents of the Clinton administration currently are on-line on the University's network as a service to the global Internet community.

The University is aggressive in publishing its institutional information and other important information resources on its network for public access. Within the terms of software licenses and other resource constraints, the University also chooses to provide access to standards-based software tools that allow inquirers to locate, display, capture, and analyze published information. In designing and publishing its digital databases, the University makes every effort to comply with the law by protecting that information which by law is protected from disclosure and by disclosing that information which by law is public. In designing data formats and applications for publishing information on-line in a way that optimizes the usefulness of vast stores of raw digital data, the University makes no distinction between access by the public and access by members of the faculty, staff, and student body. The design philosophy seeks to provide any inquirer with relational flexibility in aggregating data and spotting trends but, through aggregation, to protect data elements that by reasonable management and community standards would be considered private -- an individual's salary, for example.

Any University-owned computer or local-area network connected to the University's network provides a means to share mission-related digital information or resources with the public through the gateways to the Internet and the North Carolina Information Highway. The University assumes the responsibility for ensuring that such information is published in digital form by requiring its departments to assume responsibility for the institutional information that they generate. As the steward for institutional data that it collects, a department must comply with the University-wide standards and implementation guidelines overseen by the Information Resources Coordinating Council.

IV. PRIVACY, CONFIDENTIALITY, AND FREEDOM OF EXPRESSION

The University expects members of the faculty, staff, and student body to become familiar with individual and institutional responsibilities to protect confidential information and with the risks to privacy inherent in digital technologies. Good citizenship implies familiarity with the possible states of dynamic digital streams sent or received via the University's network and static digital files stored on University property. For example, digital streams constituting e-mail communications might traverse public and private networks over which the University has no authority, and they might be broadcast or duplicated by a recipient without the permission of the sender. Just as with printed documents, the University owns and archives digital communications having the official sanction of a department. Otherwise, the University considers static digital files and dynamic digital streams to be private and does not disclose their contents, except as required by contractual obligation or state or federal law. To ensure reliability, however, the University reserves the right to employ backup, storage, and recovery systems throughout its digital infrastructure.

University departments that serve as stewards of an information resource available to the University community at no charge and without contractual obligations have the right, within the limits of prevailing laws, to store the details of any inquiry to, or use of, the information resource. This right can be practiced, however, only if the inquirer is notified at the time of connection of the intent to store any identifying details of the would-be transaction and is given the option to disconnect immediately with confidentiality preserved.

The University respects encryption rights on its network and may itself encrypt information and transactions when secure confidentiality is an obligation.

All existing guarantees of freedom of expression extend to those who use the University's network as a medium of expression.

Strategic Information Resources: A new Organization

Presented by:
Dennis Aebersold
Vice President for Strategic Information Resources

Gordon A. Haaland
President

Abstract

The President and Provost of Gettysburg College decided at the end of 1993 that, given the importance of technology in the strategic plan for Gettysburg, they would make the bold move of merging the Computing Services Department and the Library into a single division called Strategic Information Resources. The new division was to report to a newly created Vice President position, which would in turn report to both the President and Provost and serve on the President's Council. This paper describes the steps to date of the process which was used to effect the merger.

I. Why Merge?

In response to what we see as the way of the future, Gettysburg College has been and will be devoting significant resources to information technology as it is known in such functional areas as the Library, Computer Services, Telecommunications, Management Information Systems, and the Print Shop. These are all areas responsible for helping members of the college community gain access to, store, retrieve, and analyze information.

A liberal arts curriculum has proven remarkably effective in helping students master new technologies and synthesize new material. Gettysburg College intends to continue to develop strategies to promote the use of advanced information technologies in the College's instructional programs. We have already built an enviable computer network, an achievement recognized by CAUSE in 1993 when we received honorable mention for the CAUSE networking award. It is increasingly clear, however, that the information network is just a prelude to the larger information world.

The increasing availability of information in electronic form and the ability to analyze that information on the computer will dramatically change the way we teach and learn. By the twenty-first century electronic information technology will have transformed the workplace, nationally and internationally. If we are to meet these transformations and provide our clientele with superior service we knew that our information structures have to change. Our instrument of change is the integration of the Library and Computing Services into a single Division: Strategic Information Resources. This Division has been placed under the direction of Dennis Aebersold, Vice President for Strategic Information Resources and formerly Associate Provost for Computing and the Sciences. Our approach is intended to provide students and faculty members with the best possible support as they work in an environment shaped by the "information revolution" that is already upon us. This step is one that we believe all institutions of higher education must take eventually. We expect that the timing of this move will contribute to our competitive advantage as an institution in a crowded educational marketplace.

Predictions are risky, but it is already plain that, rather than waiting months for the latest research to appear in printed form, scholars will have electronic access to (research) as soon as it has passed the test of peer review. The printed materials to which that research refers will also increasingly be available over the network in electronic form. Large collections of primary texts are already available electronically or will shortly become so. Standard reference materials can already be purchased on CD-ROM and accessed from an appropriately-equipped desktop computer. Sound, images, and other non-print media can also be transmitted electronically. Only to gain access to rare books and manuscript materials will one be compelled to visit a traditional library, and even some of these materials will be available in digital form, just as they are now available on microfilm.

II. Aligning Strategies

The merger of library with computing services falls in line with the strategic goals of the College. Recognizing that technology will continue to play a major role in education at all levels, with special implications for the way teaching and learning happen at the college level, Gettysburg has set as primary goals 1) to develop the best possible computer-based information resources and programs; 2) to promote exploration of the curriculum and co-curriculum using technology and 3) to provide appropriate access to these resources.

As we looked at the service demands of our community, the rapid pace of change of technology, and the direction we wanted to take, we realized that the existing administrative structure did not suit or support our vision of the future. In the interest of dramatically improving operations in the new division Gettysburg embarked on a 6 month program intended to enable us to define the strategic direction the new division should take and to articulate the changes to process, organization, people and technology required to make our vision a reality.

Our vision is, simply, to create one information service organization on campus. Before, the Library and Computing Services were competing as providers, creating redundancies in information provision, some overlap of skill sets, and constant battles between old and new ways of operating. Among the benefits of a combined organization are the elimination of unhealthy competition between departments, the effective utilization of complementary skill sets, and the ability to build a more flexible and responsive organization.

While we are still in the project planning phase, we do, realistically, anticipate certain results. First, we believe this is the way of the future and that our efforts will situate the College in good competitive position in the future. Second, we are being very careful to align the strategies for Information Technology and the new Division with the strategies of the College. Third, we will make more resources available to faculty and students and eliminate inefficiencies in operations.

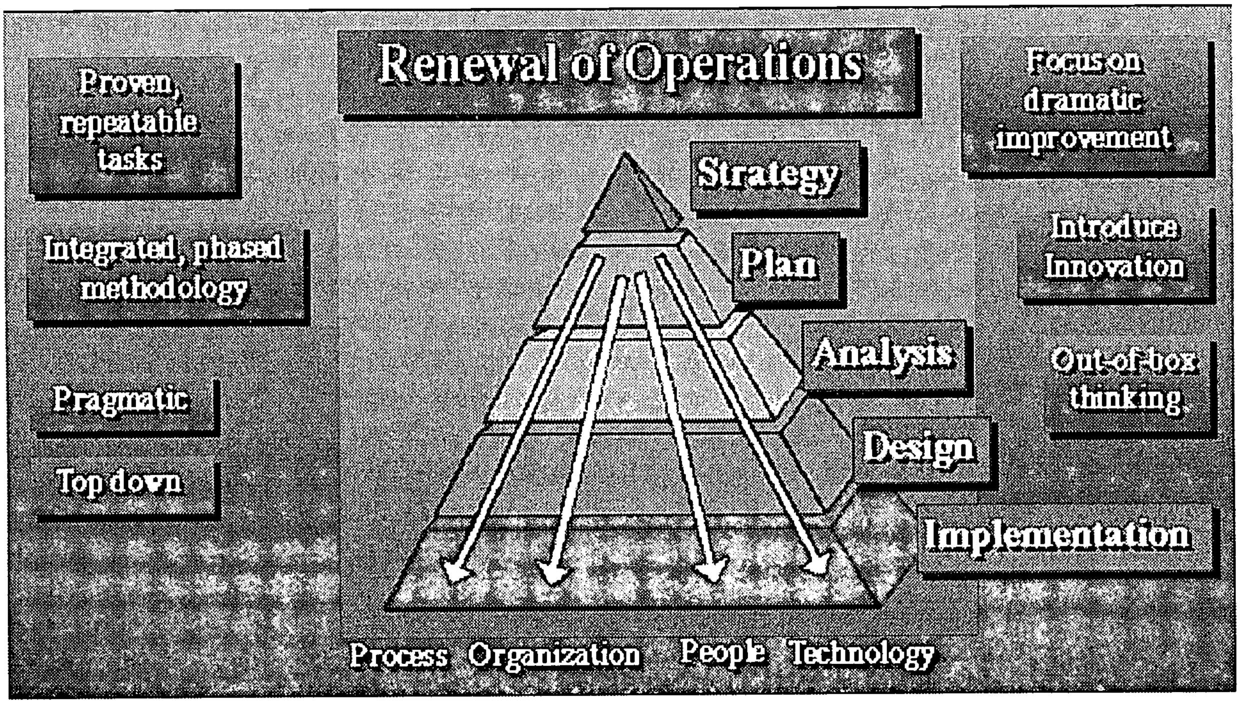
III. The 'How' of Change

With the help of the Business Process Renewal (BPR) evaluations we will eliminate redundancies in the things we provide. We plan to decrease cycle time, or the time it takes to do such things as acquire a new book, catalog it, or install a computer. Through increased efficiencies we will lower costs, improve competitiveness and hopefully delight our customers.

The merger was announced in January 1994; in February 1994 the Vice President moved his office to the Library to get a better understanding of the culture, to get to know the Library staff, and to signal the start of the merger process. Merging the two divisions has clear advantages from an operations standpoint but it has brought on other expected issues on the human resource side that are not easy to work out on paper. Differences in job expectations, for example, work habits, and the cultural environments in computing services and the library polarized the two groups initially. The announcement of the merger had left the librarians and the hourly employees in the library feeling very uncertain about coming events. There was no open hostility but there was considerable distrust and some feeling that the administration had not approved of employee performance and was sending in troops to whip them into new shape. To clarify what the issues were, we conducted a cultural assessment survey of both staffs, which produced surprisingly positive results. The study showed the two departments to be 180 degrees apart on questions like "do you exist in a 'Reactive...Proactive' organization?"; "Open to Change...Resistant to Change? "; "flexible work environment... strict work environment"? When the two groups were asked where they would like to be in the future, the alignment of the cultures was almost perfect. It was at this point that we knew that a true merger of the two organizations into one division would be possible. We began the merger process in June, 1994.

We demanded radical change in both organizations. We were looking for flexibility that did not exist in the library, and we had to increase the speed of service and the quality of service in the computing area. We intended to cut costs but we did not start with a mandate to cut employees. Our methodology for change was Business Process Re-engineering which we chose to call "renewal". Michael Hammer defines BPR to be "The fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service and speed."[1] Thomas Davenport defines re-engineering as process innovation. He states "Process innovation initiatives start with a relatively clean slate, rather than from the existing process. The fundamental business objectives for the process may be predetermined, but the means of accomplishing them is not. Designers of the new process must ask themselves, "Regardless of how we have accomplished this objective in the past, what is the best possible way to do it now?"[2]

Our approach did not start with process but rather with strategy. We felt it important to build a foundation for the new organization where employees had a deeper understanding as to what we were trying to create and that was tied to a mission, with strategic and tactical goals. We also felt it of paramount importance to have a measurement architecture in place that would allow us to know how well we were achieving our goals. Our approach was top down (work through a core team) based on strategy and considered in parallel, people, organization, technology and process, which we believe to be all parts of a single whole.



We developed a three-phase plan that started with initiation and moved through direction setting to innovation.

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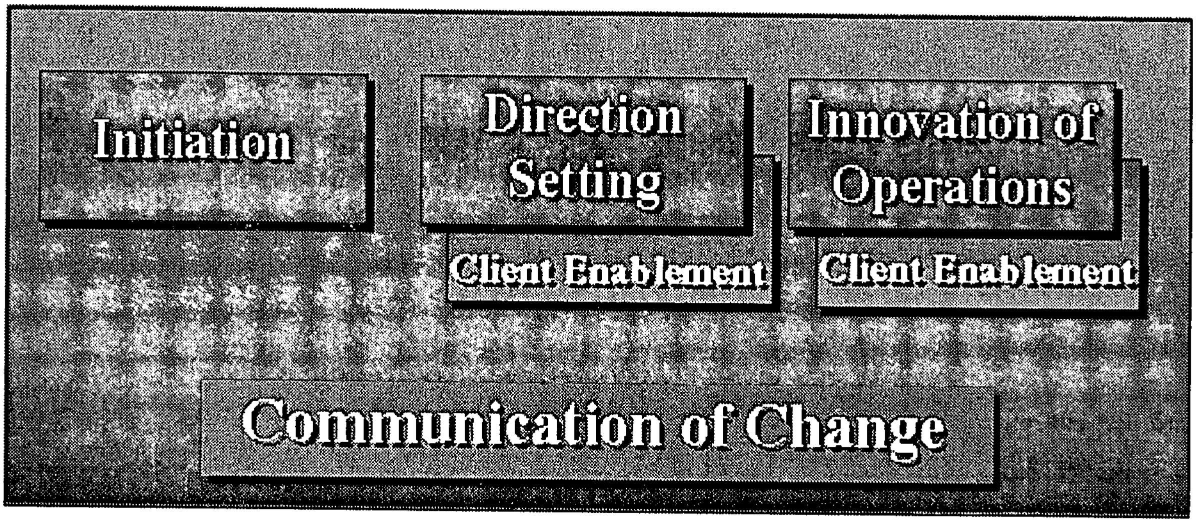
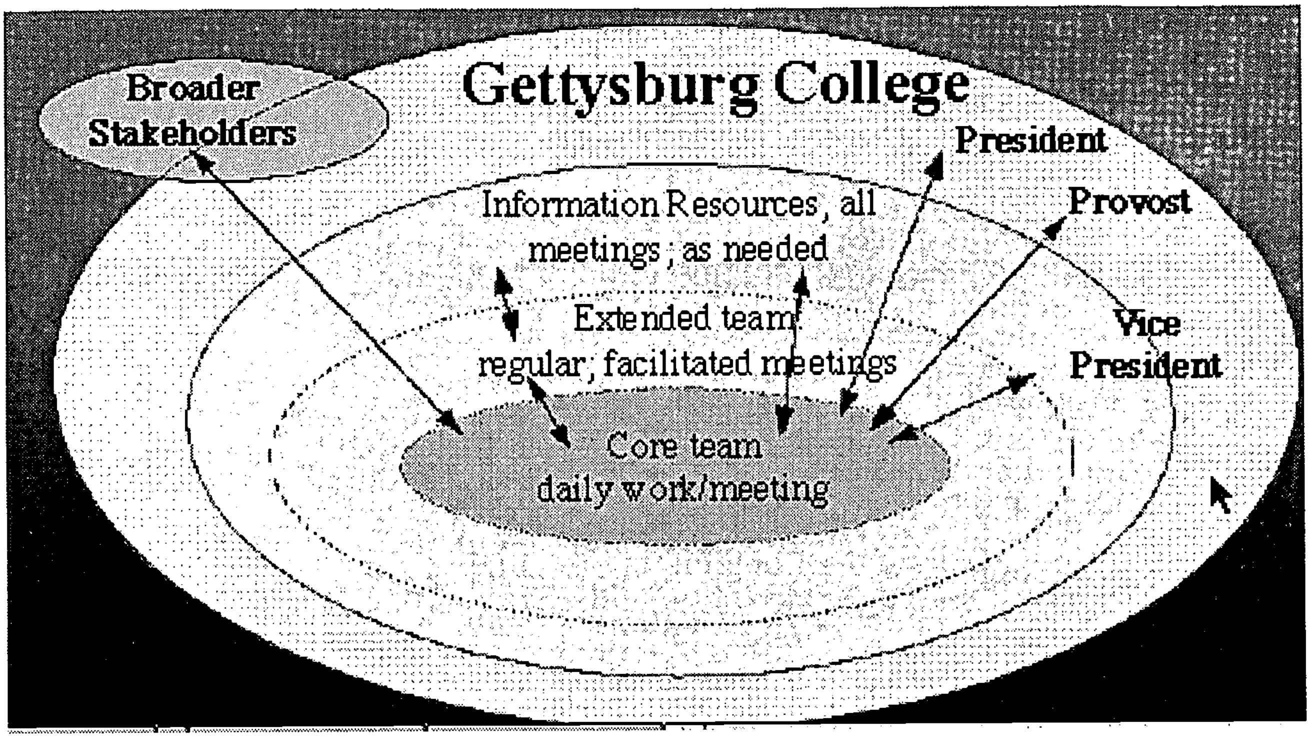


IV. Time Lines and Expectations

The BPR project was designed to span five months starting in April of 1994. We actually started in June and will be finished just before Thanksgiving. Upon commencement of the project a core and extended team was set up to undertake the creation of project deliverables and manage project communication and process.

The core team was comprised of three staff members plus the Vice President who shared in the input, analysis and interpretation of business process renewal (BPR) phases. Communication with the rest of the division was established from the beginning as a critical aspect of the project. We established concentric circles of communication, with the core team at the center, an extended team comprised of eight staff in the next ring, and the rest of the division staff at the periphery. The extended team's job was to update and solicit input from the division staff and interpret the work of the core team. Each extended team member conducted small group meetings with a prescribed group--and each group contained members from the library and computing services staff. At the height of discussions over the summer, the core and extended teams met weekly, and small groups met every other week.



The core and extended teams developed mission and values statements at the start of the project which were then presented to the entire division for discussion. The final revised statements served as the foundation of change and imparted to staff a sense of the culture and climate of the future organization.

Mission Statement:

The information resources division develops and provides information services and resources needed for the learning environment at Gettysburg College.

Values Statement:

The division fosters an atmosphere of open inquiry and continuous education for all staff. This demands a highly qualified, flexible and team-oriented IR staff committed to excellence and the values of the educational experience.

Following completion of these, lengthy discussions about what the new organization would actually do and what improvements we wanted to make on current service led us to distill three major goals for the organization. The goals simply state what we want to do and how we want to do it.

Goals:

1. Provide Information
2. Enable Organizational Success

3. Maintain a top-quality organization, consistent with customer needs

Goal setting based on our vision of an innovative, wall-less, fast-service organization brought us to the next phase of innovation: activity modeling. An activity model will represent at a high-level all of the activities necessary within the scope of the project and provides the opportunity to eliminate cumbersome, redundant, and other non-value adding activities from the future organizational design. Cataloguing a book, for example, or installing a computer are both means of providing access to information. Once these types of connections were made, all activities could be defined at higher levels and then related to the goals. If an activity did not fit, it brought into question its usefulness as well as called attention to the comprehensiveness of our goals. The cross-checking exercise helped us ask questions like: is it the role of the division to do X? What value does activity X have to the organization? Do we still want to do this?

Some 45 activities comprehensively described the organization and all its functions, from personnel management to equipment maintenance and information resource expansion. In order to plan for the future, the core team's charge was to identify the key cycles of tomorrow's organization: this would provide the structure for organizing the future division.

What constitutes a cycle? An event that triggers a chain of activities--such as a request for a book. Mapping out cycles brings into focus business processes and provides some of the real substance of organizational change. As we discussed a book request, for example, we moved through acquisitions, cataloging and circulation and revealed a larger picture. These access tools were essentially delivery systems. The goals to provide information and maintain a top-quality organization made us question whether or not we wanted to deliver this information in this way, and how quickly we wanted to deliver to best benefit the learning environment. The question brings into play the role of people and technology in the process of delivering information, and how they would relate in the new organization--people, organization, technology, process--bringing us back to the pyramid. In almost all cases, the successful completion of a strategic cycle will result in value added to one of the stakeholders--faculty, students, administrative staff--of the College. The cycle model is evaluated in terms of time and/or value added that it provides to the organization.

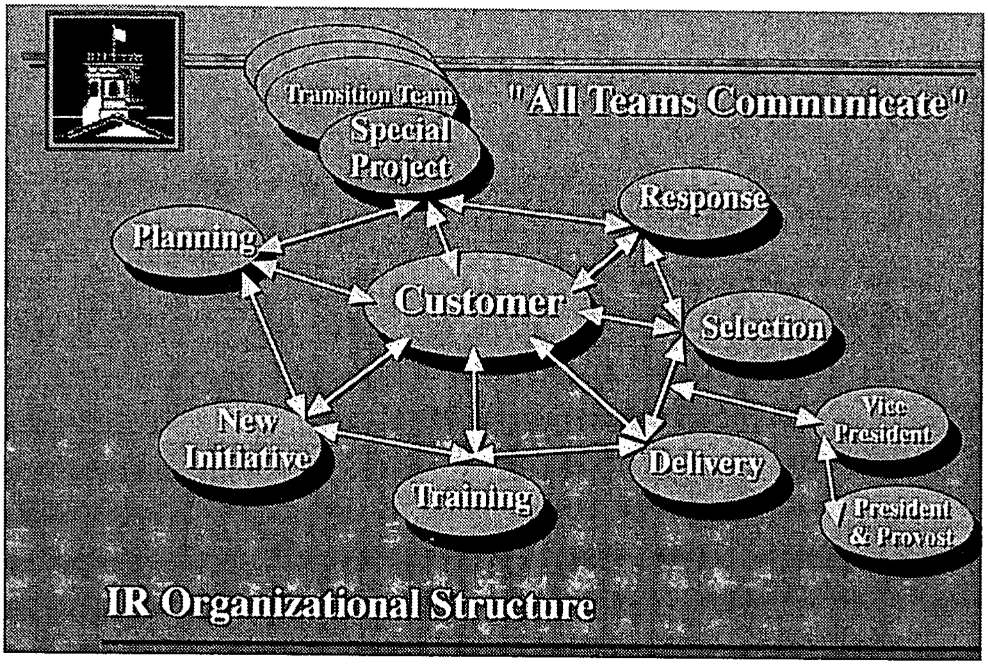
Organizational structure begins to emerge from the cycle and activity models, after they are grounded in internal cultural criteria, such as create an atmosphere of open communication and promote a learning organization that encourages self-development. From the cycle model, logical units of work and organizing criteria form the basis for preparing organizational structures.

In order to allocate resources into the structure, activities need to be defined in terms of the knowledge, skills, abilities and personal characteristics (KSAPs) of the people who will be performing them. Process, not task, becomes the focus. While this sounds eminently logical, it is not trivial. In our case, we spent a session with the entire staff matching 'KSAPs' to activities. Not surprisingly, many people had a hard time conceptualizing job functions not described as specific tasks, such as "cataloging serials", but rather as activities, such as "select acquisition". Nevertheless, KSAPs provides the basis for placement of staff in a new organization.

What are some of the personnel problems that arise in such a process? Most are predictable. "Where does my old job fit in the new organization?" produces one form of anxiety. Another form corresponds to identity. People still identify themselves as library and computer services staff and take an 'us versus them' attitude toward their new colleagues. Fear of change sparks rumor about which heads will role and what jobs will be eliminated. Everyone knows that anything and everything is open for restructuring and this fuels resistance to change. Communication helps to dispel most of these problems, but it is also clear that not everyone will be happy with new arrangements and we expect to see some fall-out.

V. Transition and Change management

Change is managed by the adjustment of resources--people, organization, technology, process--around a strategy. Not only do we need to create a new organizational structure, but we need a transitional structure because not all change can happen at once. We plan to integrate 3 BPR teams in the next months, and another three by the second quarter of 1995. The first teams to be formed are Planning, Response and Training. The next three will be New Initiatives, Operations and Selections.



The teams will receive extensive training on team work and self management. The organization will have no bosses; the transition team will help coach the other teams through difficult new procedures like evaluation and rewards. We believe we will begin to reap benefits but June 1995 and we hope to be operating comfortably and efficiently by Jan. 1996.

1. Michael Hammer and James Champy, *Reengineering the Corporation* (Harper Business,1993) p.32.

2. Thomas H. Davenport, *Process Innovation,* (Harvard Business School Press, 1993) p.11.

CAUSE '94
Distributing CWIS Information Management

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Abstract

A campus wide information system is only as good as the information in it. Once a CWIS is in place a tremendous amount of effort is needed to "stock the shelves" with information. Removing obstacles in the data maintenance path is just as important as making the data accessible to users. Placing full control of the data in the hands of its "originators" increases the quality and quantity of information available.

The Dartmouth College Information System (DCIS) has developed a number of tools used to enhance the information publishing and maintenance process. A locally developed client-server database update system provides easy to use links between standard personal computer applications used to develop and maintain databases and the database delivery systems. Automated format conversions, integrity checks and update authorization are the principal features provided by the update system.

Distributing CWIS Information Management

The Context

Dartmouth College has been developing an extensive Campus Wide Information System (CWIS) for the last four years[1]. This client-server system is widely and heavily used and operates in an environment where virtually all faculty, students and staff have a networked Apple Macintosh® computer. The system hosts highly structured data that can be located and retrieved through sophisticated database managers. The retrieved information can be displayed with extensive typography and embedded images (eg. Figure 1). The CWIS is much more than a shared file server, as it answers complex research questions for users.

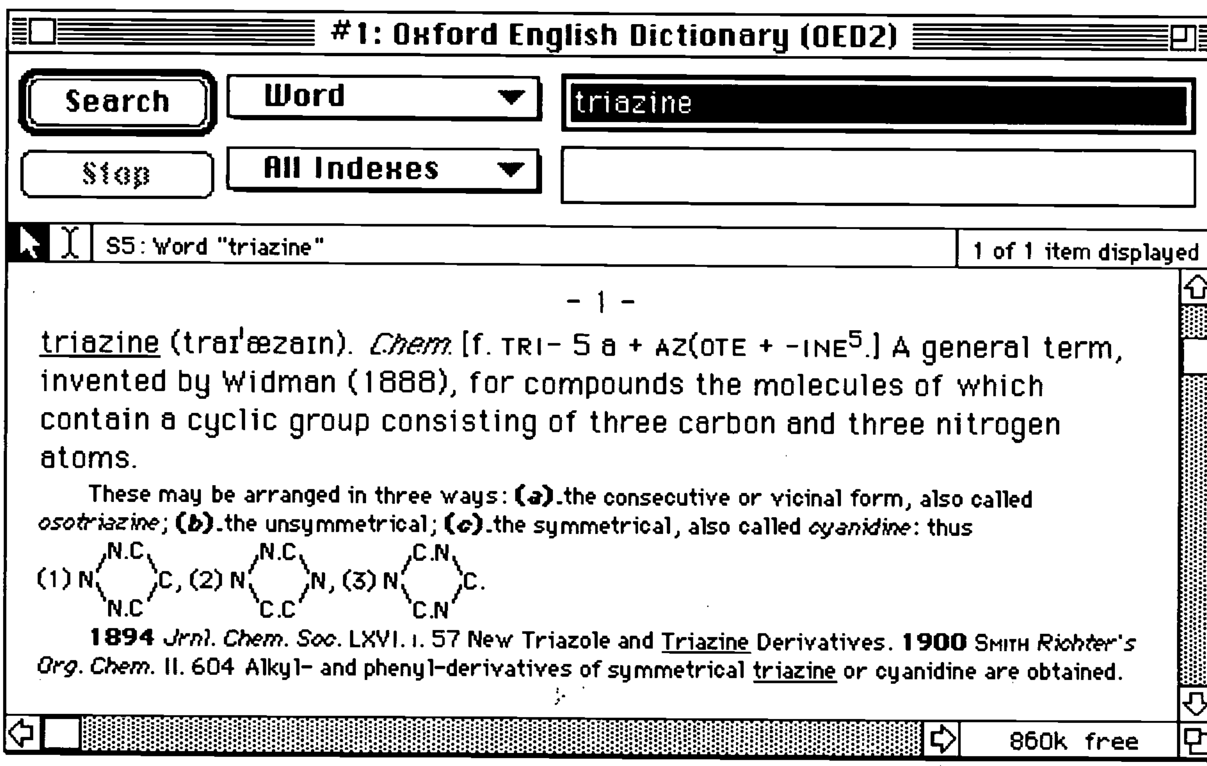

Figure 1- Online Library

The Dartmouth College Information System (DCIS) servers have been adapted to a number of different database management systems using commercial and academic software. Access to local information such the Oracle based administrative systems and gateways to other services on the internet are provided. DCIS is portable and installed at several other institutions.

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[1]Robert J. Brentrup, "Building a Campus Information Culture", *CAUSE/Effect* , Vol. 16 No. 4 Winter 1993, pp. 8-14.

The two database management systems most frequently used at present to "publish" information in DCIS are the BRS[2] and PAT[3] commercial systems. Both of these systems run on UNIX computers. At Dartmouth these UNIX systems are now workstation-class computers with expanded disk storage capabilities.

The Problem

One of the primary factors limiting growth of DCIS was the rate at which new information sources could be developed and the amount of labor required to keep existing ones up to date. The computing staff at Dartmouth is small. As DCIS became more popular we found ourselves facing a long list of requests for assistance to place some portion of the institutional information base on line. Our ability to respond to these requests became a bottle neck and source of frustration. Even if adequate staff resources existed, their skills are best deployed on further extensions and development of the system.

It became apparent that it is crucial to decentralize the development and maintenance of new information resources. At Dartmouth and probably most campuses, many offices and many people already generate and update valuable information. Harnessing that diffuse manpower in an organized way is the key to the continued growth of a CWIS. The primary obstacle to remove at Dartmouth was the complexity of "publishing" on the UNIX-based DCIS servers.

Current Publishing Practices

Many administrative departments are in the business of publishing information. In many cases the source data are already prepared and maintained on desktop computer systems. Periodically the information is printed and distributed. The CWIS is another and increasingly popular method to "publish" information. Its greatly enhanced distribution speed is the most important reason. By publishing on the CWIS the most current information is always available and it is easier to locate specific sections. In some cases the cost and labor associated with paper delivery can be avoided. There is, however, a need to identify the structure of the data in more detail to permit the computer systems to index and display the data more intelligently.

Unfortunately the desktop systems used to enter and maintain the original information generally lack both the software and the processing power to provide database services to large numbers of users. For example DCIS typically supports thousands of database sessions daily and several hundred simultaneously. The workstation systems that can solve these problems are however more difficult to use and need to be relatively closely controlled to

[2]a product of Dataware Technologies
[3]a product of Open Text Systems Inc.

ensure high reliability and data security. For example, users would need to learn to use the workstation operating system and have accounts, while system managers would have to create and maintain these accounts. To resolve this dilemma DCIS has developed a new database-update system which enables the originating offices to add to and update information resources almost as easily as the rest of the campus uses these resources.

Variations on the Theme

Although not called a "campus wide information system" at the time, Dartmouth has had elements of this idea in the computing environment since the first computer systems were installed on campus in the 1960s. The Dartmouth College Time Sharing system (DCTS) supported a number of institutional databases and provided shared libraries of programs. In 1985 a large AppleShare file server capable of supporting several hundred simultaneous users was implemented on the DCTS hardware. Known as "PUBLIC" this server is a distribution center for the entire campus for programs and general administrative and academic information. This worked for Dartmouth because the campus also standardized on the Macintosh computer so everyone had access to this "CWIS"[4] and knew how to use it once they knew how to use the Macintosh Finder.

These predecessors of the current client-server environment particularly the PUBLIC file server, had some interesting attributes when looked at as an "information publishing" tool. PUBLIC was the first place one would look for information. It had a very simple interface for users and information providers: you simply copied files from or to the server as you would with any other Macintosh disk. Locating information on PUBLIC is accomplished by manually opening and closing each folder or by using the Macintosh Finder's *Find File* functionality with which you can search for files by name. You typically browse through the various folders until you find what you are seeking. As the amount of information grew larger, this approach became more difficult and time consuming. But the simplicity of the PUBLIC file server, particularly for information maintenance, allowed it to be easily used by most members of the Dartmouth community.

Locating information can be greatly enhanced by going beyond the shared file-server model. The primary step is to provide content indexing. While some information sources fit very nicely in the file-server model, there is another class of databases (eg. library catalogs and reference works) that are too large and complicated for this approach to be reasonable. This is the class of information that DCIS first addressed four years ago. The files are large, in most cases, and

[4]For many other institutions their first experience with this kind of shared information resource was the Gopher system. For Dartmouth the main appeal and use of Gopher has been to share information with the world outside the campus.

internally highly structured (ie. fields and records or tagged elements define semantic structure and display attributes). This structure allows users to formulate detailed questions and receive quite specific answers to their inquiries.

An example best illustrates this point. "Rental Housing Alternatives" was originally a program to which one connected on the time sharing system. You answered a few predetermined questions, such as "Are you interested in apartments or houses? summer or year round?" Based on your answers an appropriate portion of the "database" was selected and transferred to your terminal. You then read through the list to identify the items of interest.

Taking this same data and describing the regular internal structure of it for a database manager allows the user to ask specific questions such as "find furnished houses in town X and price range Y to Z" and subsequently end up with a list of items matching only those criteria. Such specific results are possible because of the additional effort invested in providing more structure and some uniformity in the data and having software that can use multiple indexes and value comparisons. Retrieving the whole list is still easy.

Project Objectives and Results

The goals of the updating tools project were to make the database creation and update process as simple as possible, to empower users with moderate computing skills to be able to control the process, to eliminate the need for knowledge of "mini/mainframe" database maintenance tools, to eliminate the administrative overhead of creating and maintaining accounts on server systems and most importantly, to eliminate the need for continued assistance from the software development staff.

The solution DCIS developed is another client/server system that allows staff who are not computing professionals to "publish" their own structured information on the CWIS. The update client application runs on the same desktop computers used to prepare the data. Several other tools were developed to streamline the process of preparing, checking and transferring updates. Together these tools create an efficient link to move the data from the originators' desktop workstations to the CWIS central computers. The update clients and servers are now in production use and spreading rapidly.

Some of the current examples include:

- Student phone directory
- Career Services, leave term jobs
- Student newspaper
- Art History department slide collection
- Computing newsletter
- Photo records catalog
- Instructional Services media catalog

- Rental housing alternatives
- Student employment opportunities
- Used computer equipment for sale

Design Considerations

The inspiration for this solution was motivated by having to handle these requests and be involved in the update process. After a while a pattern of usage emerged. We attempted to automate regularly repetitive tasks in order to make the process as simple as possible.

We wished to address three important aspects of database maintenance. For *reliability* it is important to not allow incorrectly formatted data to be added to the database. For *security* it is important to prevent unauthorized modifications and to limit update access to approved personnel. To insure the *integrity* of the database it was most desirable to have its creator in control of its maintenance. The database creator is the best judge of correctness and timeliness.

A number of different Macintosh software packages are being used to prepare the databases depending on their requirements. The most popular at present is Claris FileMaker®. By adding an export script to the FileMaker database, the export process is accomplished in one command. The Acius 4D™ application is another popular tool used to create departmental databases. Export procedures can be programmed in 4D, and it has built-in functionality to produce single table output in common forms for export.

On the CWIS server side a number of different database managers are being used. Each database manager has some specific strengths from which certain types of data sources benefit. Each has a required import data format that needs to be accommodated and specific loading programs to build the database and create the index points. These details of the database management system should be transparent to the update user.

The database update requirements vary as well. Some of the files are added to on a regular basis (eg. the campus computing newsletter and the student newspaper). Others are periodically republished in their entirety. It is also desirable to be able to easily fix data errors in a previously posted update. This requires that identifying the proper portion of the information be straight-forward.

How DCIS Update Works

The database creator prepares the source data on his or her Macintosh. Some use a Macintosh database manager such as FileMaker as an input tool. Other applications use a word processor or even a document editor such as

Aldus PageMaker®. Next the database creator exports the data from these applications into text files. Then he or she converts the export files to the input form of the database manager used to publish it. This step describes the internal structure to the database manager. This operation is typically a mapping of database field names or the addition of SGML[5] tags. Several Macintosh utility applications have been developed by DCIS to perform or assist this step. One converts FileMaker export files to the BRS load format. The file converter provides a table driven field mapping. Another checks the integrity of an SGML markup. The SGML analyzer has user configurable markup symbols, lists the nested tag structure of the document, the entity references used and the extended ASCII characters in the file. Structure errors are diagnosed and located by line number and context.

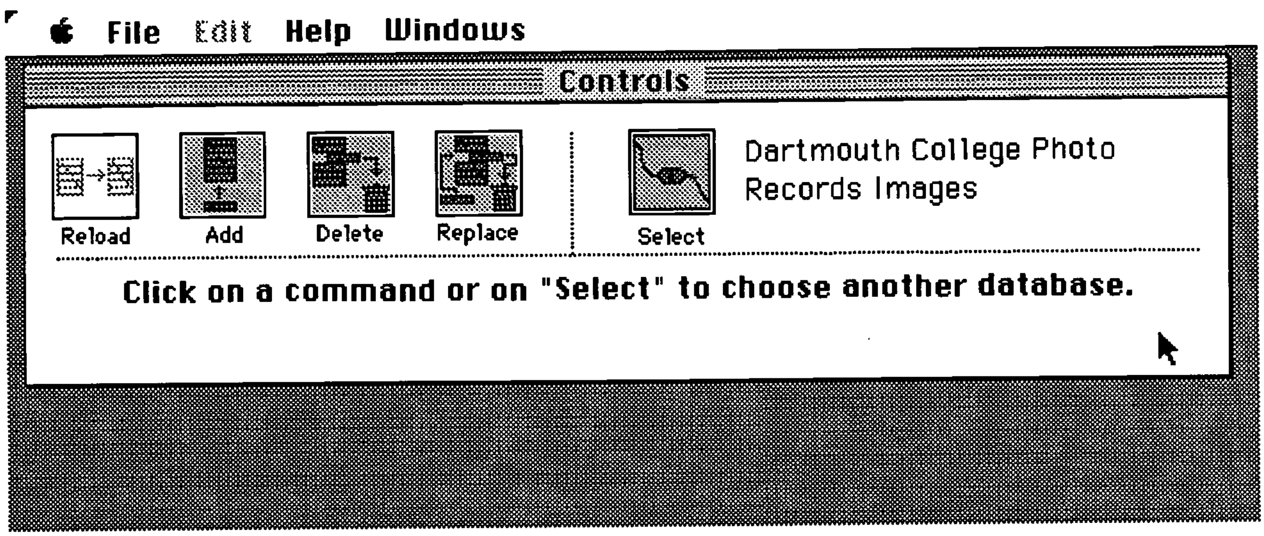

Figure 2- DCIS Update

The database provider then runs the DCIS Update client (Figure 2) to transfer the data to the server. The update client connects to the update server and gathers the list of databases available for update. The client prompts the database provider to select the database they wish to update (Figure 3). The client then checks the identity of the user to determine which of the databases available are open to updates from this individual. The person is authenticated by entering their network services password, which is checked against the campus wide "Dartmouth Name Directory." Tables in the update server list those people who have been given "write" access to a database.

The database provider then selects the update function desired from the available buttons. The system supports reload, add, delete and replace operations, which are enabled depending on the needs of the particular information source and the functionality of the underlying database manager. The update program

[5]Standard Generalized Markup Language

prompts for any other information it needs, generally just an identifier for the update set and the data file to use. Only appropriate data file types can be selected preventing another possible cause of errors. The data file is transferred to the appropriate server machine, which starts to run the update script.

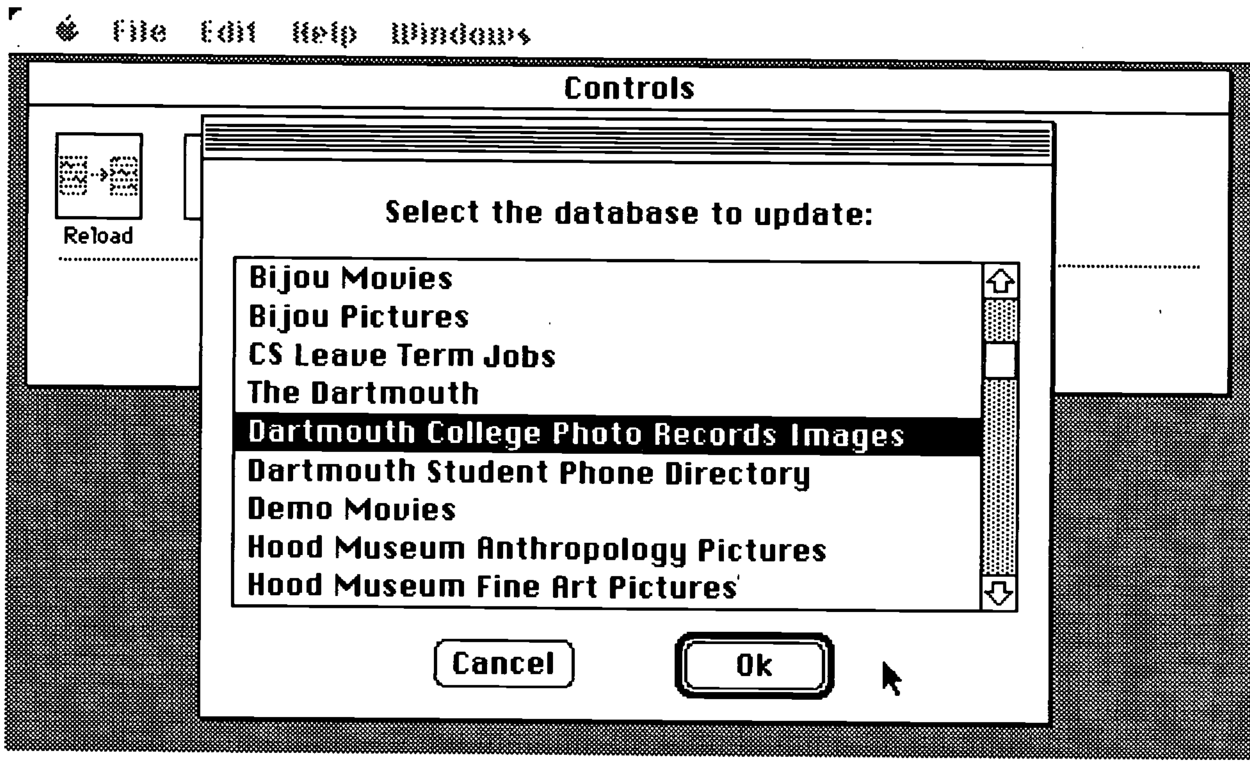

Figure 3- Database Selection

The update server runs a script to handle the requirements of a particular database. The script handles both consistency checks and runs the various vendor-supplied server database maintenance utilities needed for this update. The update script first verifies the input data, often running a format checking program which must succeed in order to continue the process. Next the script attempts to process the update transaction. In some cases several periodic updates are merged into a single file. Next the script runs the database manager's loader or index building programs. A log window shows progress and provides diagnostic messages. Finally the success or failure of the operation is reported (Figure 4). The log messages can be mailed to a DCIS staff member for diagnosis in case there is a problem. On-line help is available.

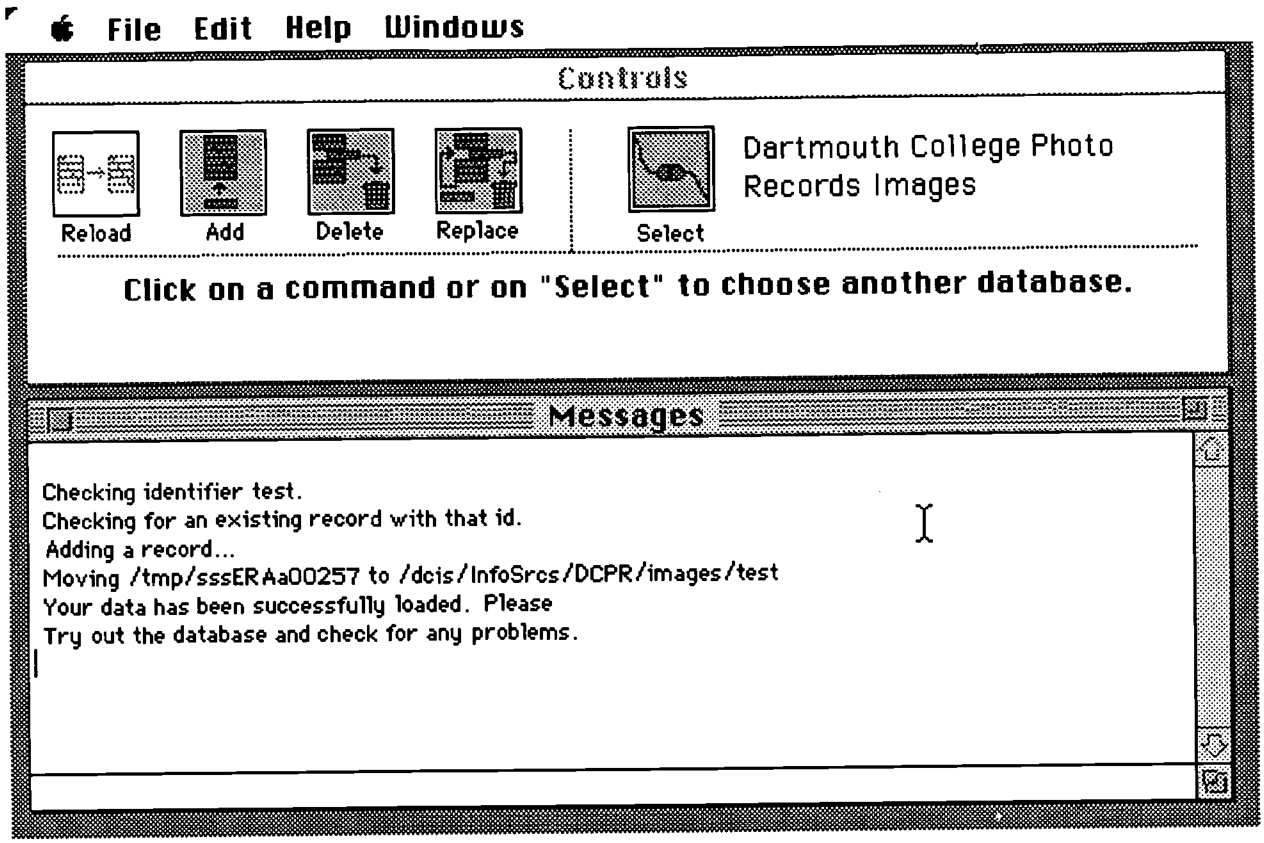

Figure 4- Update Complete

Evaluation

The DCIS update system has proved to be quite popular and has successfully accomplished the task of transferring the ongoing maintenance of the database to the originating office and freeing up the DCIS development staff. Several of the databases are being updated on a daily basis. Others monthly or as the need arises. Prior to this project "regular" updates were not getting processed on a regular basis. Some of the databases supported by the update system are among the most popular resources on DCIS.

As the DCIS system continues to expand, an increasing number of uses for the update system are being identified. The client will run on almost any Macintosh. The servers are small, fairly portable and adaptable to other database systems. The system has also been easy to configure for additional databases. This project has measurably increased the usage and local satisfaction with the DCIS effort.

A SMALL SCHOOL VENTURES INTO THE WORLD OF THE CWIS

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In late 1992, Kenyon College in Gambier, Ohio, had just completed its campus network infrastructure. This new environment provided an institutional "integration" that enabled Kenyon to consider the possibility of a campus-wide information system, or CWIS.

Kenyon began its planning by investigating many other CWIS on the Internet. In the process, the most important issues to be addressed in launching a successful CWIS were identified. This paper discusses those issues and provides a guide to other small schools in getting started.

A SMALL SCHOOL VENTURES INTO THE WORLD OF THE CWIS

By the fall of 1992, Kenyon College, a liberal arts school of 1500 students in Gambier, Ohio, had just completed its campus network infrastructure, which provided network access to virtually all campus buildings. The campus community was communicating via email and beginning to share much information electronically. The time was ripe for Kenyon to consider how to utilize this new environment to more fully integrate its wide variety of information resources into a campus wide information system, or CWIS.

At that time, a task force from Information & Computing Services (ICS) began looking, via the Internet, at other campuses with a CWIS. Since Kenyon's financial situation allowed very limited personnel and financial resources for such a project, ICS had to find a way to build a CWIS at the "right price."

At that same time "gopher" was beginning to become a hot topic on the Internet. It was the gopher software developed by the University of Minnesota that gave us the breakthrough we needed to proceed with our CWIS, since gopher was not only free, but also enabled us to provide both local and Internet resources to the campus.

We began planning for KCInfo (as we called our CWIS) by collecting from the Internet all the information we could find about other CWIS, so that we could learn from their strengths as well as their weaknesses. We contacted many CWIS managers for ideas on how to go about getting started. By sifting through all this information, we were able to identify a dozen issues that had to be addressed by ICS before launching KCInfo. These issues included:

* Needs & Resource Assessment
* Ownership Issues
* Access & Privacy
* Personnel Needs
* Content Standards
* Policies & Policy Boards
* Main Menu Design
* Marketing Strategies
* The Coordinator's Role
* Sponsors & Information Providers
* Ongoing Development
* Evaluation

The following discussion of these issues is meant to provide a general "game plan" to help other small schools considering a CWIS to take those first steps in getting started.

DO WE REALLY NEED A CWIS?

The first question we asked ourselves was, "Do we really need a CWIS?" In our present situation of budget restrictions, would the service a CWIS provided to the campus really be worth the money, time, and work required to develop it? What compensating benefits could it offer?

Our conclusion was that KCInfo would greatly improve access to a broad range of college information as well as Internet resources. It would organize in one central location information that would be available anytime and from any workstation connected through the campus network or via a dialup modem.

As an alternative to printed information, KCInfo could significantly reduce the use of paper on campus. Although it would not completely replace paper, hardcopies of electronic documents would be printed only at the user's discretion; thus they would not be wasted on users who had no real need or desire for them.

NEEDS AND RESOURCES: FINDING A MATCH

Our next task was to assess our current resources to determine what we needed to make KCInfo a reality. Kenyon's all-campus network was our biggest asset, since it provided universal access to computing resources. The network was connected to a cluster of DEC VAXes connected to workstations, half of which were terminals and half microcomputers. With half the campus still using terminals, we realized that the software to run the CWIS would be have to be installed on the VAX mainframe to be accessible to all. In the future, as we evolved into a microcomputer-based campus, we could migrate to a distributed system with connections to a dedicated machine set up as our gopher server.

Using a timeshare environment for our gopher server was not ideal, since it might put a strain on the VAX cluster when usage became heavy. A separate, dedicated machine would have been preferable, but was not possible at the time, so we plunged forward on the VAX to get started. Should system overhead present a problem due to the growth of the CWIS, relatively cheap add-on memory and disk storage could be purchased as needed.

Because of budget and personnel limitations, we couldn't afford to allocate staff time for developing our own CWIS software. Given these limitations, the increasingly popular "gopher" software seemed to be the perfect solution for Kenyon, since the software itself and its maintenance would cost us nothing.

Gopher's simplicity of design and protocol made it very appealing, and it had already become a standard on the Internet. It offered an easy-to-use hierarchical menu structure and a minimum of keystrokes for the user to learn. Information retrieval was simple because the user wasn't required to know the location of the information. It could easily be expanded by simply linking up to another "server," either locally or remotely.

Gopher had other important features that made it seem the right choice for Kenyon. It provided access to all kinds of Internet resources, regardless of their type or location. These resources included: WAIS and Veronica search tools; Archie and anon ftp archives; gateways to online library catalogs; multimedia using RFC1341 MIME email extensions; SQL interfaces to databases; and links to thousands of other gopher servers worldwide.

Besides hardware/software considerations, we took into account the intangible yet real time savings and productivity increases that a CWIS could offer. Anyone seeking college-related information could find it more readily. College departments were able to update and distribute their information more efficiently.

OWNERSHIP ISSUES: WHOSE CWIS IS THIS ANYWAY?

In talking to individuals who had implemented a CWIS at other campuses, we learned that information "ownership" had been a big issue. Because of possible legal implications for Kenyon, it was important to make a clear distinction between the role of the institution and those who sponsor the information in the CWIS. The college simply provided a vehicle (KCInfo) that acted as a "collector and storer" of the information, similar to a library. The role of the sponsor of the information is that of "author/editor/publisher." By not editing the information stored in KCInfo, Kenyon would not be responsible for information that might later be found to be illegal, such as copyright and privacy infringements, libelous or derogatory information, etc.

Therefore, as "owners" of the information, the sponsors assumed full responsibility for the accuracy, quality, legality, and appropriateness of their information. ICS insisted that each sponsoring group create its own internal process of review and approval of any documents provided to KCInfo. The sponsors were charged with selecting a representative to become their "information provider," who would be responsible for the editorial management of the sponsor's documents (which covered writing, formatting, proofreading, posting, and deleting documents).

To identify ownership, every document in KCInfo was required to have a header at its beginning, containing the name of a contact person responsible for the information so that questions and problems could be directed to the proper source.

ACCESS AND PRIVACY

A gopher-based CWIS is available not only to campus users, but to anyone with Internet access. It is important that sponsors understand this concept of open access before they begin to plan their information. There are different ways in which gopher software can restrict access to certain files and menus (and also by IP address). But since KCInfo was set up to improve information sharing among campus members, it was not to be used for confidential or restricted information.

Regarding the issue of privacy, ICS had to address two concerns: user privacy and data privacy. We had to be careful, in any analysis of usage statistics, that the data would not be used to identify individual access of documents. Libraries have long been aware of the need for user privacy in the area of book selection, and Kenyon had to be sensitive to this as well in regard to electronic documents.

Data privacy considerations in light of the FERPA act require that personal information (such as an individual's home address and phone number), not be made available for public access without giving that individual an opportunity to withhold it. This had to be discussed with potential sponsors who might inadvertently include inappropriate personal information in their KCInfo documents.

PERSONNEL NEEDS: WHO'S GOING TO DO THE WORK?

The financial climate at Kenyon was such that there was no chance of hiring additional personnel for KCInfo, so the time involved in implementing and maintaining it had to be carved out of ICS staff time. It was imperative that ICS train those who would be responsible for providing the information to be as self-sufficient as possible. After contacting several other schools about their CWIS personnel needs, we mapped out a tentative personnel "duties" list. (The actual time spent on KCInfo development and maintenance is also included here as well):

* System administrator: Manages the CWIS software and hardware; performs upgrades, migrations; customizes as necessary. Estimated time per week: after the initial installation/test period, 1-2 hours ongoing. Upgrades and any special streamlining "tools" would take additional time periodically.

* Coordinator: Marketing and public relations work; design of CWIS main menu; day-to-day management of CWIS development; training & support of information providers; recordkeeping. Estimated time per week: about half-time for first several months of development; then 5-7 hours ongoing.

* Sponsors: Responsible for information content; define and organize information; develop internal review and approval process; select information provider(s) to post and maintain their information. After initial planning process, additional time would be required only as new menus and documents were planned.

* Information Providers: Responsible for editorial management of documents; after initial learning period, the time needed for preparing documents for KCInfo should not be more than required for most paper-based documents.

CONTENT: MEAT AND POTATOES OF THE CWIS

Although it may seem obvious, the selection and organization of the information (content) is THE most important consideration if the CWIS is to be well-used. It should contain information that is informative and even entertaining because it has to motivate the user to want to explore it further. The menu structure must be organized in such a way that the novice user can find the needed information intuitively. One of gopher's nice features is that the same information can be accessed from multiple locations in the menu structure, thus providing users with more than one logical "path" to follow.

Defining and organizing information requires time, and it cannot be rushed. Getting sponsors to understand the importance of this planning phase is the key to the success of the CWIS. Information that is not well-written or menus that are poorly organized will simply not be read, and the CWIS will be bypassed.

By making the sponsors and information providers responsible for all aspects of the "content," ICS did not have to spend staff time on proofreading, formatting, or posting the information to KCInfo. As mentioned earlier, each sponsoring department or organization determined its own internal review and approval process for information targeted for KCInfo. Questions about the information were directed to the contact person identified in the document header and so they did not take up ICS staff time.

If we had not distributed responsibility for content, ICS would never have had the staff resources to handle the CWIS implementation or its ongoing management. We trained the sponsors and information providers to be as self-sufficient as possible so that we could then concentrate on the system management responsibilities that only ICS could perform.

Early in the project certain content and formatting standards were established before any information was allowed to be posted to the CWIS. Some of the standards set for the Kenyon environment were:

* Appropriateness: Appropriate information was defined as information that may be of general interest to members of the Kenyon College community. Advocacy, commercial advertising and sales, libelous or derogatory information, and confidential information were deemed inappropriate.

* Currency: Information providers must review and update information regularly; otherwise, it could be deleted after notification to the provider.

* Accuracy and Quality: Documents were to be error-free in terms of spelling and grammar. The quality of workmanship should be the same as that of paper-based information.

* Copyright: Existing copyright and privacy laws must be honored; sponsors were required, if necessary, to obtain copyright approval from the author.

* Format: Standards were set for converting wordprocessed documents to ascii format, which was required by gopher; conversion procedures (from WordPerfect to ascii) were established.

When these standards were decided upon, the coordinator included them in the Information Providers Handbook which was used in the training workshop. (This handbook can be found in KCInfo at gopher.kenyon.edu by following the menu path: About KCInfo/Interested in Posting Information to KCInfo?).

POLICIES AND POLICY BOARD: GUIDE, WATCHDOG AND REFEREE

Other campuses had experienced many problems when setting up their CWIS because they had no clear guidelines to follow and no means of settling the inevitable conflicts that arose because of differing opinions. Examples of these issues were: disagreements on the design of the main menu; personnel responsibilities; copyright, privacy, and other legal issues; ownership issues; lack of content standards; access issues, etc.

ICS decided that a policy document and a broadly-based forum to oversee KCInfo would be good "preventive maintenance." We set up an ad hoc committee to write a policy document that would be in place before KCInfo was opened up to receive information.

The policy document defined the membership of the policy board, which represented the various college constituencies. This board would oversee the development of KCInfo, enforce the policies set by the policy document, and settle conflicts. (A copy of the KCInfo Policy Document is available in KCInfo at gopher.kenyon.edu under the main menu topic "About KCInfo").

DESIGNING THE MAIN MENU

Before any information could be posted to KCInfo, the main menu had to be designed. Deciding upon the main menu topics was critical because they had to be broad enough in order to include the wide range of information to be made available to the campus. Looking at many other institutions' main menus and deciding which categories were most appropriate for ours was a helpful start. Listing all the various departments and services that the college offered also gave us a good idea of what kinds of information we had to work with and how we might best categorize them.

Once the topics were set for the main menu, we set up a "prototype" menu. We wanted feedback about the appropriateness of the topics. Were they broad enough, inclusive enough to cover the information to be posted by the many and varied campus groups? The main menu remained flexible during this test phase, but after a limited time, it was then "frozen," ready for posting information.

This prototype menu was skeletal, with a very limited amount of information in it, but what it had was useful or entertaining enough to draw the reader into browsing through it. The local information that was put in already existed, either on paper or online somewhere else: campus directories, newsletters, calendars of events, computing and library information, announcements, course listings, etc. Putting this information into KCInfo made it much easier to find, which served to illustrate its potential as a "one-stop" information resource.

Since gopher enables one to browse the Internet, we included several Internet resources as enticements, such as the U.S. Weather Service, White House Press Releases, the Internet Hunt, and other interesting gopher sites.

MARKETING STRATEGIES

For a project of this kind to be successful, we had to market the idea to several audiences: first, to the staff of ICS, since they would be responsible for a new resource that required much cooperation and support among the staff to get it started; second, to the upper management of the college, since their support was necessary to motivate the sponsors to get involved; and third, to the campus in general, so that they could see the value of KCInfo in providing them with readily available, easy-to-find information.

We used the KCInfo Policy Document itself as an important marketing tool. To obtain approval for the document and the proposed KCInfo Policy Board, we had to go before the senior governing board of the college to present our "vision" of KCInfo, answer their concerns, and ultimately gain their support. The policy document was a symbolic statement that we saw this resource as an invaluable tool for all constituencies of the college and intended it to be developed in a purposeful, responsible manner.

In the beginning it was important to create publicity and interest in whatever way possible: an initial college-wide email news release with an invitation to attend a demonstration of KCInfo; introductory meetings and workshops for potential sponsors and information providers; articles in college newsletters describing its features; monthly email messages describing new information areas; personal contacts with key department heads to persuade them to participate, hoping that by doing so they would encourage other departments to do likewise.

THE COORDINATOR: CHEERLEADER AND TRAINER

Once the groundwork was done, the next step was to select the right person to manage the day-to-day development of the CWIS. There were several important qualities to look for in a coordinator, among them excellent organizational skills. This person would assist the sponsors in organizing their information and selecting an appropriate location for it in KCInfo.

Especially important was having a "vision" of a fully integrated and operational CWIS, and being able to communicate this vision to the campus. Much of the preliminary work involved marketing and cheerleading, but they were necessary in getting the campus "hooked" on a CWIS.

The coordinator had to develop good recordkeeping tools to keep track of the growth of the menu structure and the information providers. Good records were essential in troubleshooting problems effectively. They were also important in developing tools to streamline the operation of the KCInfo.

The coordinator was also responsible for the training and support of the information providers. This included: developing a training workshop for them; writing a handbook of guidelines; developing ways of streamlining the preparation and maintenance of documents; and phone consulting.

KCInfo itself had to be monitored regularly. This meant spot-checking the documents for inaccurate and out-of-date information. When first beginning, information providers will need reminders to review their documents. This can be done with a monthly email message, which can also be used to request feedback from the information providers.

INFORMATION PROVIDERS: THE WORKER BEES

As mentioned earlier, the information providers were given responsibility for the editorial management of the information for a particular sponsor. They had to be trained in formatting, updating, and posting documents to KCInfo, and deleting them when they became obsolete.

All information providers were required to take an initial training workshop for this purpose. There were NO exceptions to this rule. This workshop covered: job responsibilities; standards; a demo of KCInfo; help in organizing information and setting up a work environment; and instruction in preparing and maintaining documents. The Information Providers Handbook was written for this workshop and contained all the above information for later reference.

ONGOING DEVELOPMENT: KEEPING THE WAGONS ROLLING

KCInfo passed through some distinct phases in its development. In the preliminary or "evangelistic" phase, the coordinator had to work hard to motivate potential sponsors and to interest the campus in using KCInfo.

After some initial training workshops were held, there was a very gradual growth during the next six months, as a few of the key departments came on board. But by the end of its first year, the number of documents in KCInfo had grown to nearly 1,000 and the number of connections to it per week increased to nearly 10,000. As more information was added, the usage increased and as usage increased, more potential sponsors came on board, as they began to realize its potential. It became difficult to keep up with the demand for workshops and menus.

It is important to keep in mind that it took about a year for KCInfo to become truly useful, when the point of "critical mass" was reached. This was the point where people began to consider KCInfo as an integral part of campus life. The pendulum had swung, so to speak. During this phase, good recordkeeping became especially critical in order to keep the growth organized and under control.

The coordinator must continue to remain "tuned in" to new developments on the Internet affecting gopher and to new resources that might be added to the CWIS. Regularly collecting and organizing information from the CWIS-L listserv and other Internet newsgroups helped us to incorporate important new features into KCInfo.

As KCInfo grows, so will the need for new tools that will streamline and even automate posting and file maintenance. Some of these tools have already been developed at other gopher sites. Some examples are: automatic expiration of documents; document conversion into ascii format; automated transfer of information into the CWIS; reports on "what's new" in the CWIS; document access statistics for information providers; programs that identify "dead" links to other servers, full text and keyword search tools. Many of these are available upon request. The UMN gopher or the CWIS-L listserv are good sources of help.

EVALUATION: LOOKING FOR FEEDBACK IN ALL THE RIGHT PLACES

As with any new project, it is important to get regular feedback in as many ways as possible. This can be done, of course, with periodic surveys and questionnaires. Patterns of growth can also be plotted from gopher usage logs, which also can provide document access statistics to information providers.

Some of the most valuable feedback is less formal: suggestions from users via a "comments" box on the main menu; followup with information providers; email from remote viewers; the CWIS "image", revealed subtly in references to it in conversation and campus publications.

Even negative feedback is valuable in providing ideas and impetus for improvement.

CONCLUSION

The explosion of information in our society today requires that we, as information technology experts, find the most efficient tools for accessing that information and presenting it in a meaningful way. KCInfo has become that kind of tool, providing access to a broad range of information at a relatively inexpensive cost to users wherever they are and whenever they may need it.

Although KCInfo was intended as a supplement to other forms of information distribution, it has already replaced some kinds of paper-based communication and promises to significantly reduce the use of paper over time. One of its biggest benefits is that it has greatly improved access to information for the campus and has increased communication among all groups: students, faculty, staff, alumni, parents, and friends of the college. And as it has grown, it has been instrumental in promoting a greater "cohesiveness" in the life of the Kenyon community.

Providing Access for the Scholars Work Environment (SWE)

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California

California State University, Los Angeles provides a common interface for all academic PCs, MACs, Clones, Workstations, etc. connected to the campus backbone. This encompasses all full time faculty, many academic staff (approximately 1400 user nodes), and 34 academic labs. This fully distributed system has some 27 network servers, 18 subnets, and supports nine different operating systems. The SWE interface appears on any desktop machine when it is booted and provides icon and pull down menu access to the many digital resources (*Information Resources*: reference, text, numeric, image and relational databases; *Computing Resources*: application, print, file, timeshare and client/server services; *Communication Resources*: mail, bulletin boards, electronic conferences, network news and list servers.) available through the campus, CSU, regional, and national networks. This paper will discuss the longer term goals, conceptual objectives, primary technical barriers that had to be overcome, the network design, an incremental development plan, and the academic utilization of the releases of SWE.

Providing Access for the Scholars Work Environment (SWE)

INTRODUCTION

In 1985 California State University, Los Angeles (CSLA) created an information resources management (IRM) division headed by a vice president as chief information officer (CIO) for the institution. The resulting organization encompassed all computing, communication and network units and policy responsibility for all information technology on campus. The CIO was initially charged to plan, develop and implement (1) a campus-wide communication system and network, (2) an academic computing environment, and (3) an integrated administrative system that would meet the needs and help prepare the university for the educational challenges of the twenty-first century.

By the early 1990's the basic infrastructure for the accomplishment of these broad based goals had been built. A digital telephone system and fiber optic network had been installed. A fully distributed academic support system with 34 computing laboratories, 27 network servers, and 18 subnets supporting nine different operating systems was in place. And, integrated administrative systems developed in DB2 were operational.

One very important contributing aspect to this progress was the adaptation of a strategic planning and management methodology to the decision making processes of the institution. In early 1986 CSLA selected the Shirley Strategic Planning Model[1] as the best alternative for implementing a strategic planning process campus-wide. In addition to the university strategic plan, some nine institutional tactical (action) plans, including an IRM plan, were designated to be developed and directly coupled to the budgeting process of the campus.

GOALS FOR SCHOLARS WORK ENVIRONMENT

The Shirley methodology was specifically modified to accommodate information technology planning[2] and the first draft of a *Strategic Plan for Information Resources Management at California State University, Los Angeles* was issued in July 1986. The following quotation from that initial planning document pointed to the eventual development of a scholars work environment (SWE) for the academic community at CSLA.[3]

> Planning for student and faculty access to information resource technologies at Cal State LA is inexorably linked to curriculum planning and development. Curriculum methodologies must be appropriate to the desired educational objectives; namely, literacy in content and literacy in discipline specific tools and techniques. Information resources technologies, essential tools and techniques required in all professional fields, must be learned concomitantly with the content of one's own field. ... Timely and adequate access to these appropriate "educational tools" are becoming a standard expectation of both students and faculty alike in all academic disciplines. Areas which

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[1] Robert C. Shirley, "Strategic Planning: An Overview," Successful Strategic Planning: Case Studies, *New Directions for Higher Education,* No. 64 (San Francisco: Jossey-Bass, 1988), pp. 11-12.
[2] James Penrod and Thomas W. West, "Strategic Planning for Computing and Communications," *Organizing and Managing Information Resources on Campus.* (McKinney, TX: Academic Computing Publications, Inc., 1989) pp. 117-137.
[3] *Strategic Plan for Information Resources Management,* California State University, Los Angeles, July 1986, p. 29.

formerly depended solely on access to large mainframe systems are now committed to the selection of computing power and software appropriate to the instruction and learning of each course.

By January 1988 the IRM plan endorsed a California State University (CSU) System needs assessment declaring that faculty needs for desktop computers uses included: (1) facilitating the development and updating of lecture, laboratory, and self-instructional materials, (2) enhancing the management of courses, (3) promoting the effective integration of computing into courses (by facilitating the preparation and pretesting of computer-based materials and student assignments, allowing students and faculty to interact as the students work on those assignments, and making easier the development and sharing of data bases and innovative courseware), (4) enhancing student advising, (5) providing means for instructional and scholarly activities such as data acquisition and analysis and bibliographic searches, and (6) facilitating the deliberations of university committees.[4] The full design model for SWE was completed and set forth in the 1991 IRM plan. It had seven primary goals.

Human Factors Design. The organization of the system interface (what you see on the screen and how the resources of the network are presented) is based on the way people work and the intellectual tools being applied.

Client-centered Work Environment. The network resources are to be organized around the work environment and the logical center of the work environment is the individual. Each individual can organize the available resources to construct a unique work environment and the logical system of the network will recognize the individual and reconstruct the "virtual" work environment at each session.

Heterogeneous Network. The network resources are to be supplied by multiple vendors and the adoption of "open systems" standards is to allow for procurements to be based upon price/performance criteria.

Hierarchical Compute Platforms. A range of computer resources are to be available across the network. This allows network clients to assign compute and file service tasks to the class of machine appropriate to the job(s).

Distributed Network. The resources necessary for the session are localized. The resources of the network are distributed throughout the system on the basis of utilization. The unique resources are available across the system.

Fully Integrated System. The information technologies for support of academic programs are integrated into a campus-wide network which appears and functions as a unified resource.

Transition Strategy. The aim is to move from the existing environment to the target environment without loss of system functionality or a devaluation of client (faculty or student) expertise.[5]

The primary objectives then in developing a SWE were to make information resources available to the entire academic community, to lesson the learning curve to negotiate a complex network, to provide an easy way for scholars to know about available resources, and to economically provide a wide range of instructional and research applications to an extensive and varied academic audience.

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[4] Donald Carder, "Faculty Access Requirements," *Strategic Plan for Information Resources Management,* California State University, Los Angeles, CA, January 1988, pp. 38-39.
[5] Donald Carder, "Design Strategy," *Strategic Plan for Information Resources Management,* California State University, Los Angeles, CA, July 1991, pp. 25-26.

NETWORK DESIGN AND TECHNICAL CHALLENGES

The majority of computing resources used for instruction and research at Cal State LA are part of a campus wide, distributed network known as the Instructional Support Information System (ISIS). The ISIS network includes public access facilities with desktop machines for academic computing; data communications systems providing access to local, regional, and national networks; large computers and servers providing shared computational, storage and printing services; and digital messaging services for student/faculty and peer communications. In the framework used for the design of SWE, the computing,

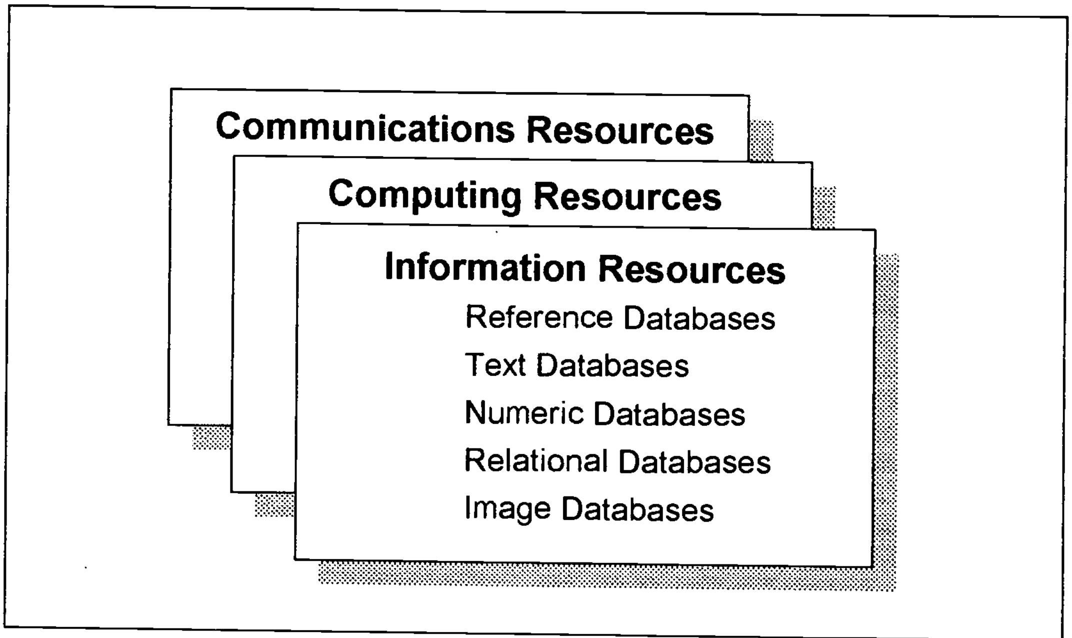

FIGURE 1. RESOURCE SCHEMA FOR ISIS

information and communications resources (see Figure 1) of the system are known as the *resource schema* and the purpose of SWE is to provide a map of those resources.

The backbone for the ISIS network is a FDDI ring. Each of the academic buildings is connected to the backbone via a router which can support up to 12 Ethernet subnets and two FDDI subnets. The ISIS servers are UNIX systems, ranging in size from a mini supercomputer to Intel based systems. The majority of servers are SunServers. The primary servers used for the student and faculty /home accounts are large SunServers and are being attached directly to the FDDI ring via the FDDI subnets. Approximately 10 percent of the desktop workstations are UNIX machines, 20 percent are Macintoshes, 30 percent are Intel machines running MS-DOS, and the balance or about 40 per cent of the academic desktop workstations are MS-Windows based machines. Virtually all of the 1400 workstations are connected to the network via an Ethernet subnet. Some 600 of the workstations are in faculty offices (all full time tenure track faculty) and the balance are in open access labs and computer classrooms.

In addressing the design of the SWE, the primary objectives for SWE (previously listed) had to be balanced with the need to make the operation and management of the ISIS system as efficient and economical as possible, from the perspective of the system administrators. The critical factor in accomplishing both the objectives for SWE and the management of the ISIS is to achieve coherency i.e., to ensure that the ISIS system as a whole has logical integrity and consistent behavior. For both the end user and the systems administrator the structure of the system has to make sense and the way tasks are to be accomplished has to be consistent and predictable. However, the perspectives of the end users and the systems administrators as to what would give the system coherency were initially very different.

From the systems administrators perspective, the ISIS was made up of a set of distributed systems hosting heterogeneous resources. This view of the system derived from the functional definitions of and relationships between the ISIS system components. To achieve coherency, in this view of the system, the implementation of the enabling technologies used to deliver network services has to be rational and the operation of the system as a whole has to be predictable. The systems administrators view of the system (or the way the system is defined and operated at the network and operating systems level) is known as the *logical schema*.

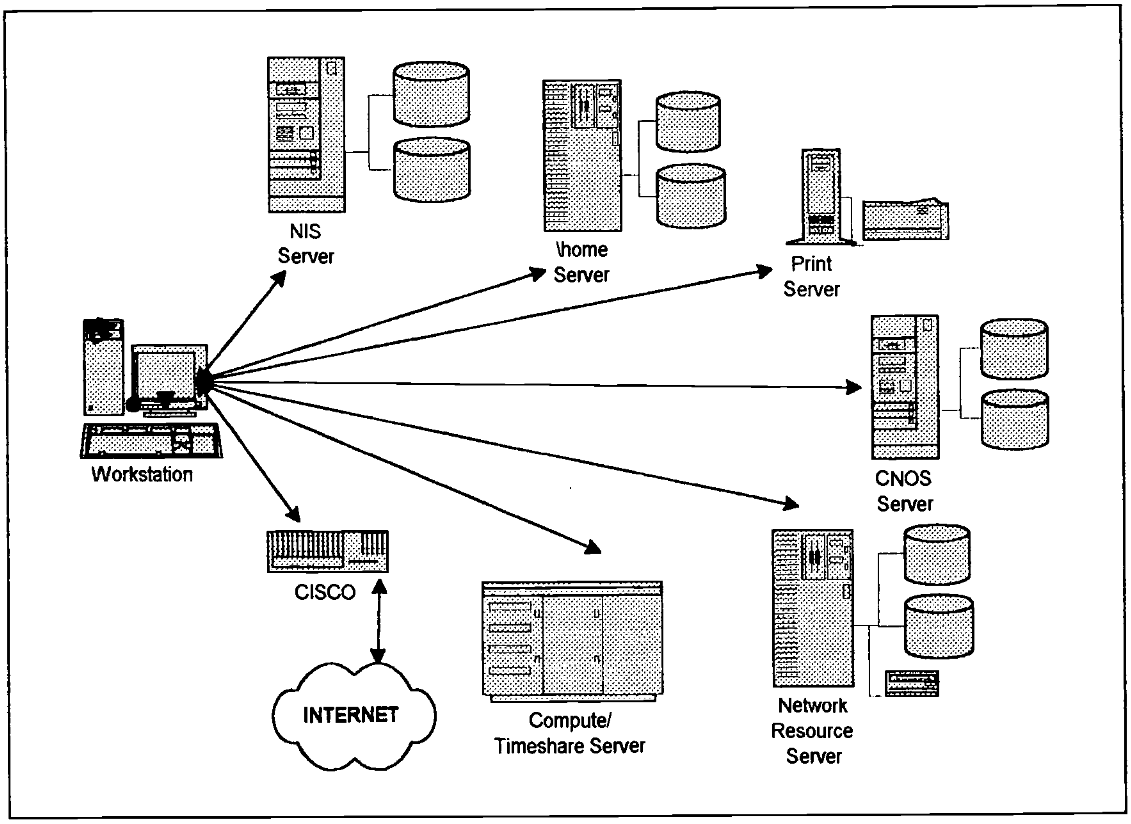

FIGURE 2. A VIRTUAL WORKSTATION IN A DISTRIBUTED COMPUTING ENVIRONMENT

From the perspective of the end users, the ISIS system was a complex array of distributed computing, information and communications resources accessible through an even more complex and often baffling network technology. Frequently, users had no idea nor did they care what system they were on or how they got there. To achieve coherency and make the resources of the ISIS useful from this perspective, resources must be presented in such a way as to make them readily accessible and applicable to the pursuit of academic activities. The end-user's view of the system, or the way the ISIS is presented to the end-user is known the *systems architecture*. Together, these three views, *resource schema, logical schema,* and *systems architecture* provide the model for the design of SWE.[6]

The technology used to implement the logical schema is Sun Microsystems' Domain Name Service (DNS) and the Open Network Computing (ONC) suite of service and protocols. The network services elements which make up the ONC suite are; (1) the Network File System (NFS) which provides access to remote

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[6] Frederick P. Brooks, Jr., *The Mythical Man-Month* (Reading, MA: Addison-Wesley, 1975) p. 45.

file systems; (2) the Network Information Service (NIS) provides authorization and authentication services and the ability to automatically mount and unmount resources for network computing; (3) the Network Lock Manager which allows users to coordinate access to common information by providing file and record locking across the network, and (4) REX (Remote Execution) which allows users to execute commands or programs on remote systems.

The ONC technologies enable a microcomputer on the network to operate as a "virtual workstation," (see Figure 2) attaching to resources such as printers, disk drives, and CD-ROMs as though they are part of the local machine. One early problem was that the *systems architecture* provided by the ONC services was inadequate for a complex information environment and required a level of expertise beyond that of most users. For those who could master the network technology, there was the additional hurdle of knowing and keeping track of what resources were available. The task, then, was to develop an additional layer for the *logical schema* which would make the resources readily accessible and map the *resource schema* to a *systems architecture* which would be meaningful to the scholar.

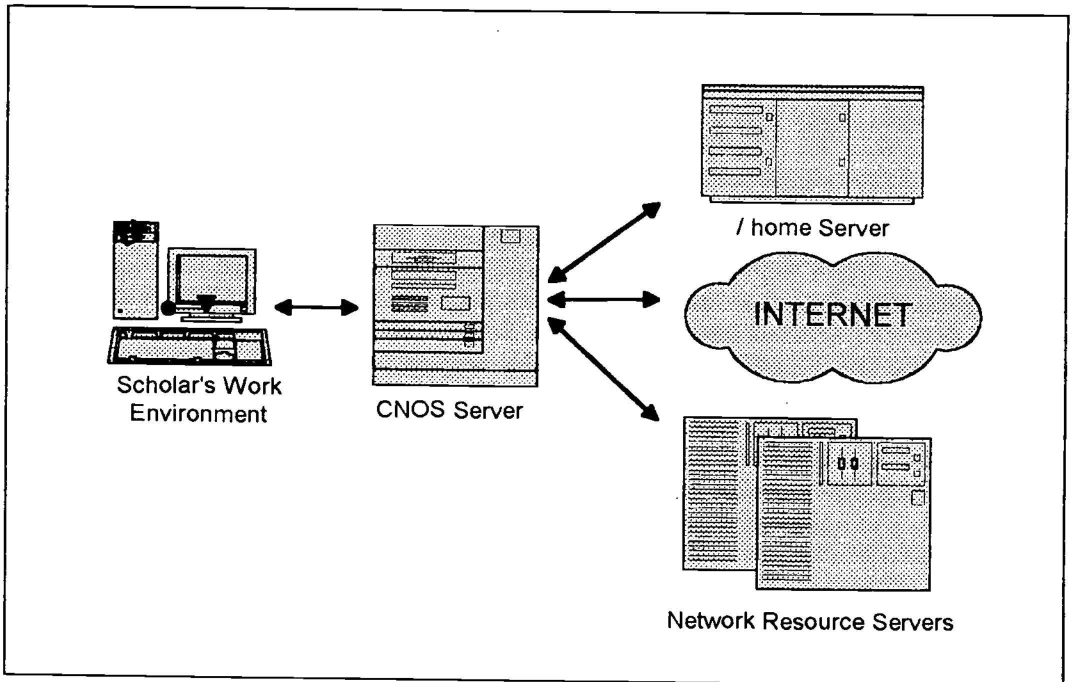

FIGURE 3. CNOS SERVER MAINTAINS NETWORK RESOURCE INFORMATION.

Since the desk top computers of the ISIS have heterogeneous operating and presentation environments, client/server technologies were chosen to present the *resource schema* in the metaphor of each native environment. In this model, the client software is the *systems architecture* or SWE, presenting all of the resources available to the "virtual workstation" as a coherent whole. The server technology maintains the intelligence about where and how to access the resources of the ISIS (see Figure 3). The server software is known as the Campus Network Operating System (CNOS). In the design framework, CNOS is an additional layer of the *logical schema*. CNOS resides on the UNIX servers. SWE applications have been developed for MS-DOS, MS-Windows, UNIX and a Macintosh version is currently in development. To accommodate the different needs of the end user and the systems administrator, and to ensure coherency and logical integrity for the *logical schema* and the *systems architecture*, the design responsibilities were divided. The SWE team focused on the needs of the user and the CNOS team focused on the "backend" or the enabling technologies.

The objective for the SWE design team was to create an electronic work environment which facilitates the integration of SWE resources into the information handling processes of the teacher, learner, and researcher. The organizing principle of the design was to be the practices of scholarship. The design had to accommodate the way scholars work, supporting the flow of scholarly activities as a unified process. It should reflect the following:

- scholars acquire new skills based on existing skills;
- scholars identify and seek out diverse pieces of information (documents, data sets, sounds, and images) on the basis of commonly known and meaningful attributes;
- scholars organize their work, materials, and information around their own knowledge;
- scholars seek and find information in the larger universe (all available sources) of information and move it into a personal collection which is relevant to their work.

The flow of information into the work environment is complimented by the flow of analysis, commentaries, new theories and ideas back out to the community at large (see Figure 4). Accommodating the flow of information into and out of the scholar's work space is a critical function which must be supported by SWE.

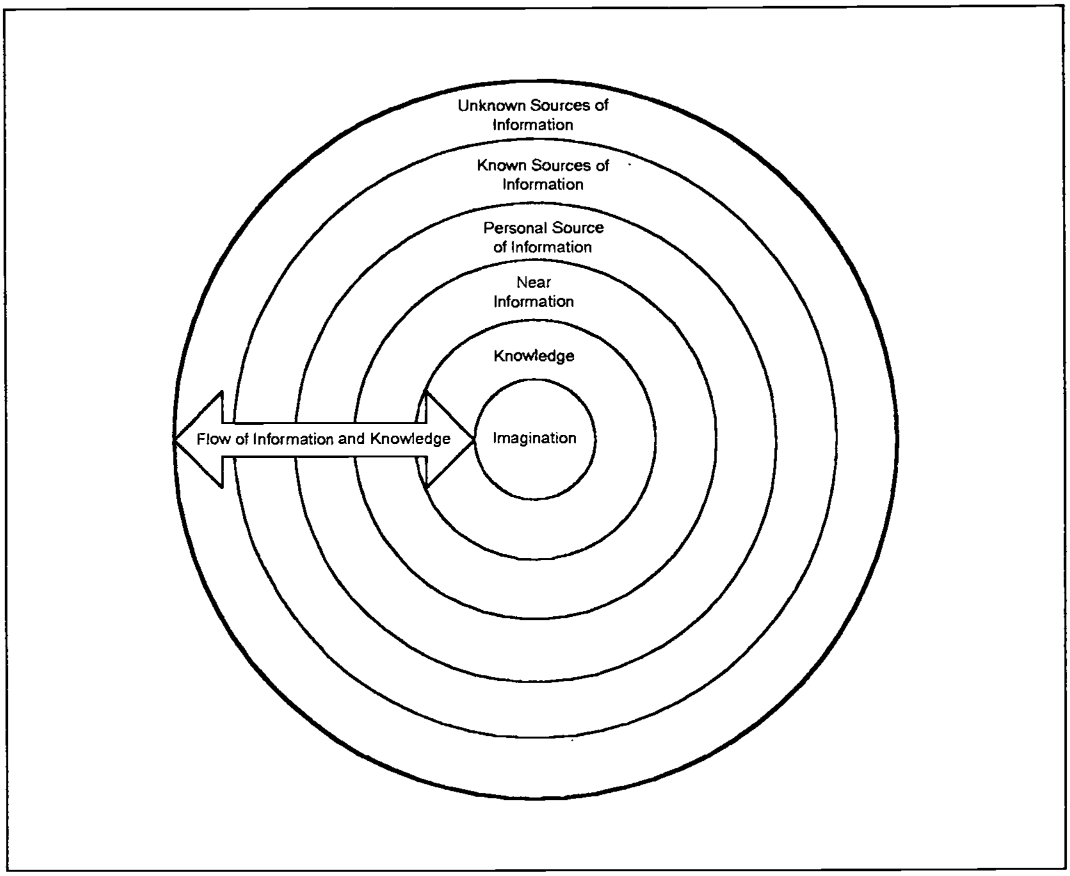

FIGURE 4. FLOW OF INFORMATION INTO AND OUT OF SCHOLAR'S WORK ENVIRONMENT.

The principle challenge to the CNOS design team was to make the system dynamic. There were four fundamental conditions in the academic computing environment which could only be addressed with a dynamic system. First, the relationship between the resource schema and the presentation technologies had to be dynamic. One of the critical problems which had to be addressed was the broadcasting of meta information. SWE had to pick up information about new resources available via the network dynamically. Second, the system had to be user sensitive. Students do not have personal workstations on campus. If the goal for a "client-centered" work environment was to be met, the system had to support the dynamic configuration of virtual workstation based on the unique needs of an individual at any desktop workstation accessible to students in any laboratory. Third, the system had to be workstation sensitive. The desktop environment was heterogeneous. The system had to match the capabilities of specific machine to software versions and devices. And fourth, the design had to be location sensitive. To reduce network traffic and optimize performance, the system had to connect workstations to the closest appropriate server and avoid unnecessary routing over the backbone.

In summary, the academic computing environment at CSLA must include all of the computing, information, and communications resources relevant to scholarship. The system should be established as a distributed, fully integrated work environment. Access to the distributed resources should be possible from all environments in which scholarly activities take place. The distributed resources available through the network should be presented to the individual scholar as a coherent whole. The presentation of the whole system at the scholars work station should be done in such a way as to make it possible for the system to become an integral part of the teaching, learning, and research processes. The electronic work environment and the scholar's workstation should facilitate the free flow of information and ideas between teachers and learner and their peers. Finally, the system should operate efficiently and economically.

IMPLEMENTATION STRATEGIES

To initiate the SWE/CNOS project, it was decided to develop prototypes for the subsystems software. The intent was to address the most critical service needs and to validate the feasibility of the foundation technologies. A fairly simple methodology was adopted for the first prototypes. A set of preliminary design goals were developed for the whole fully featured system. Implementation objectives were established, and analyzed in terms of their order of dependencies and based on those dependencies a schedule for development was established. This established a preliminary implementation plan for a series of subsystem prototypes. Over the course of the project, progressively more complex prototypes (prerelease's to the fully featured product) were developed, tested, and installed as operational modules.

A more complex methodology became necessary to maintain progress on the project. There were several serious tactical problems in the design and implementation of the SWE and CNOS which had to be accommodated in the methodology and management practices. First, the size and scope of the project relative to the limited availability of human resources made it necessary to have a prolonged life cycle; for all intent and purpose it was open ended. It took two years to deliver a product which met the initial design goals and implementation objectives. Second, the ISIS system at both the resource and the logical level was constructed using "off the shelf" proprietary technologies which were evolving and changing over time. The detailed specifications of the subsystems technologies could not be known until the final phases of each implementation cycle And third, many of the service problems this system was intended to solve were critical and had to be addressed as quickly as possible. It was necessary to deliver functional modules over the course of the project to address the most critical service problems. And, these modules had to be incorporated into the long term design. In summary, this was a large, complex, and long range project targeted to solve pressing problems using technologies which were not fully known.

The length of the project life cycle combined with continued changes in the enabling technologies was a threat to the logical integrity for the logical schema and systems architecture. Several techniques were used to address this problem. First, "open systems" standards were adopted. These standards were incorporated into the IRM plan in 1987. Second, the analysis and design process was done iteratively, key to the release of prototypes. Each iteration included: a re-assessment of the service needs and priorities, an analysis of the enabling technologies, testing compatibility for integration in the ISIS, and review and modification of design goals and implementation objectives for CNOS and SWE. And finally, responsibility for the systems software on all workstations attached to the network was assumed by the Academic Technology Support (ATS) unit. This included the operating systems, presentation management packages such as MS-Windows and X.Windows, network software, and SWE. These packages were bundled into a product known as the System Software Suite and distributed in releases which had been tested for compatibility.

ACADEMIC UTILIZATION OF SWE

The academic utilization of SWE has two perspectives. The first is institutional. It is imperative that the academic community understand how to operate in a complex distributed network to find and use the numerous available resources. Therefore the training that is provided from Academic Technology Support focuses on acquiring the basic skills needed to comprehend and utilize the SWE (which enables easy identification and utilization of desired resources). This is supplemented by the Library which has chosen to use the Environment section of SWE as the organizing principle for the training they offer to faculty and students. They also provide discipline specific training focusing on specific network resources appropriate to different sectors of the university.

The second perspective is individual. Some faculty use SWE to organize and specifically identify network resources for student usage. For example, to create an icon for a particular class which directly connects to resources required in that class, e.g., databases, a bulletin board, etc. Others may wish to focus the use of SWE as an access tool to the various databases and information repositories available on campus and off. One professor has eliminated the use of a readings text altogether in a graduate seminar that explores current issues in the field.

FUTURE RELEASES OF SWE

The most recent release of SWE (just being implemented) includes *Explore*, a facility allowing a scholar to "click" on a pick or an icon and pull down one page of information describing the resources available. It will also provide direct access to World Wide Web (WWW) and other significant search elements on the Internet. Future releases will move to an object-oriented interface for the workspace, introduce *Near Information* which will integrate personal information management tools with annotation, note taking, and theme development tools, enable frequently used picks and icons to be dragged from the Environment into personal workspaces, and introduce the ability to automatically publish resource locations in the Environment. CNOS will be expanded to keep track of each scholars unique configuration and to provide it wherever that individual signs on the system.

MATCHING THE ORGANIZATION TO THE SYSTEM

The organization primarily responsible for the development, administration, and support of the ISIS system, including SWE and CNOS, is the Academic Technology Support unit. ATS has been reorganized six times since its creation in 1986. Part of this was due to growth; the organization has grown from one manager and two full time staff with approximately 20 student and graduate assistants to two managers and over 30 full time staff with some 50 student and graduate assistants. But the primary reason for the reorganizations (and the growth) has been the need to adapt to the entity being created and supported. Currently, there are six work groups.

- The Administrative Office Group which is made up of two clerical and two managers and is responsible for fiscal, personnel, and user support.
- The Instructional Technology Group which is made up of nine facilities managers, trainers, and consultants and is responsible for user support.
- The Network and Distributed Systems Group which is made up of five network and systems administrators and is responsible for the UNIX servers, network management, and the development and maintenance of CNOS.

- The Network Information Services Group which is made up of four analysts and software specialists and is responsible for the development and support of information services, the systems software for workstations, network applications and administration of SWE.
- The Systems Development Group which is made up of five systems analysts and programmers and is responsible for procurements, product and project management.
- The Technical Services Group which is made up of five equipment technicians and is responsible for the wiring plant, facilities installations, and workstation maintenance.

A continuing challenge for ATS is organizational integration reflective of and comparable to the integration attempting to be achieved with the systems being installed. During the initial growth period, when the focus of the organization was development, the primary instrument for organizational integration was project management. The Systems Development Group drew upon the personnel resources of all the work groups to put together project teams to bring up new systems and to develop the administrative procedures to support those systems. On completion of a project, ongoing support and administration was turned over to the work groups. The ATS organization is flat and the management of the work groups is dependent upon informal communications systems such as Email and a BBS, but the management tools are fairly traditional. The creation and growth of the other groups were driven by development and support issues.

As the system matured, however, projects have ceased to be the driving force for integration and adaptation. It is the responses demanded by increased systems utilization and user input regarding the effectiveness and efficiency of the systems architecture which are driving the refinement of systems and services. The project managers are involved in changes to the system much less frequently and the group supervisors tend to have a much more vertical perspective of the system and lack the understanding or sensitivity to the whole system to ensure true systems integration and coherency in the systems architecture. A solution for this problem is not offered, and it is believed that the current method for managing operations is not as effective as it needs to be. A decision has been made to experiment with the techniques of total quality management. The emphasis on crucial processes and service outcomes, which translates into coherency for CNOS and SWE, are very intriguing.

CONCLUDING OBSERVATIONS

During the course of development, implementation, operation, and evolution of this system some lessons have been learned that are seen as important and worth sharing.

"Whole Systems" View. The system must be viewed as a whole. This was anticipated in the early stages of the project which was dominated by design and development. The system had to be viewed as a whole to achieve logical integrity in the design. As the project matures, it has been learned that maintaining a "whole systems" view is equally important for administration. In the first three weeks of the 1994 fall quarter there was at least a 50 percent increase in utilization for the system as a whole and a 100 to 150 percent increase in load for some of the larger servers in the system. This demanded treating ISIS as a dynamic, fluid system. It was necessary to begin "floating" or redistributing services on a daily basis to balance the load across the whole system. This was possible because the system is viewed by the user as a whole, *vis a vis* the SWE interface, and is viewed by the systems administrators as a whole by virtue of the fact that they could match the complete inventory of services to all resources within the system with minimal interruption of services.

A Single Solution Strategy. The development of the Scholar's Work Environment and the Campus Network Operating System have become the organizing principle to all of the ATS organization's attempts at offering technology solutions to the university. Initially, the use of SWE as the avenue for offering services to the campus came from the ATS organization. Increasingly, however, the use of SWE as the organizing principle for the definition of needs has come from the academic community. Faculty, librarians, and student organizations have all asked to contribute to the extension of SWE services.

In fact, SWE is a wrapper for a fully integrated, heterogeneous, distributed computing system. But faculty and academic planners do not think in terms of "fully integrated, heterogeneous, distributed computing systems." SWE has become a metaphor for describing the information, computing, and communications resources needed to carry out scholarly activities in a complex information environment. It is much easier for students and faculty to define their needs in terms of new services they would like to see as picks from the SWE menus. As a consequence, the focus of all of the ATS work groups is increasingly being driven by extensions to and enhancements of SWE.

"... [T]he real power of technology is not that it can make the old processes work better, but that it enables organizations to break old rules and create new ways of working..."[7] It is believed that the SWE is creating new ways of working for researchers, educators, and students at CSLA. Although quite promising, it is too soon to declare a breakthrough; however, the hope is that this technological enabler will soon contribute to far more efficient and effective outcomes for the community of scholars who are utilizing it.

[7] Michael Hammer and James Champy, *Reengineering the Corporation* (New York: Harper Business, 1993) p.90.

SERVING STUDENTS WELL SERVES US

Vice Chancellor W. Russell Ellis, Undergraduate Affairs
Tim Heidinger, Computer Services Manager, Undergraduate Affairs
Bjorn Solberg, Director, Student Information Systems
University of California
Berkeley
California

The University of California at Berkeley is taking important technological steps to dramatically improve access by students, faculty and staff to student information. Using mainframe, client/server, and voice response technology, students can enroll in classes, find out their grades, or check their financial aid by telephone, and soon can look at their records from computers at campus kiosks, labs and dorms. This case study of how we got there profiles forces of centralized versus distributed computing that threatened derailment and coalesced into partnership.

SERVING STUDENTS WELL SERVES US

Vice Chancellor W. Russell Ellis:
The first two years in my position as the head of student services on the Berkeley campus I was focused on the issues and concerns of Undergraduate Affairs and its relationship with the campus as a whole. I eventually turned my attention to technology because we were confronted by a number of forces that challenged our traditional methods of providing service to students. My contribution to the implementation of technology within the Division has been to focus the collective expertise, energy and money. Looking back on it now, I see that the forces which came together in the early 1990s forced the evolution of the roles and partnerships between Undergraduate Affairs and Student Information Systems as we wrestled with adversity, change, and technology.

Let me tell you a little about our setting. The University of California, Berkeley, is the oldest campus in the nine-campus University of California system. Situated across the bay from San Francisco, we have a rich legacy of tolerance, diversity, student activism, faculty governance, and independence as exemplified in the decentralized nature of computing on the campus. The campus organizational chart shows the complexity of the administrative structure.

I had been a Professor of Architecture before becoming Vice Chancellor for Undergraduate Affairs, a division which consists of 21 service and administrative units that support the educational mission of the University. These services include administrative activities such as admissions and record management as well as programs providing tutoring, student orientation, summer activities, and teaching improvement. The division works closely with its diverse collection of client groups: faculty, undergraduate and graduate students, staff, and the campus administration. The division's highest priorities are to invigorate students' educational experiences and to facilitate their academic progress, from developing their interest through early outreach, to optimizing their ability to perform in the classroom, to helping to prepare for graduate school or careers.

But by 1991, the campus and Undergraduate Affairs was besieged by a number of trends which I anticipated would become more intense and which could not be ignored.

- budget cuts
- increased student fees
- staff decreasing rapidly as a result of early retirement programs and layoffs
- increased work loads
- the general societal environment was becoming less friendly towards the university
- basic changes in K-12 education due to inadequate financing, overcrowded classrooms, the array of social problems, cuts in college preparatory

curriculum and high school counseling services which was having its effect on what and how the university provided services

I knew that we had to use technology as a tool for making significant strides forward. Technology had been used for years to automate many of the processes associated with selecting, financing and registering students. We had been making progress at providing students and staff with accurate and timely information, but my vision of technology was not automation. My desire was for students and staff to incorporate technological advances into their view of their roles and positions in a changing world.

In the Fall of 1990, I appointed a Divisional Computing Committee with four objectives:

- Establish a set of goals and directions for Divisional computing to achieve during the next five years
- Establish priorities for use in allocating computing funds during the annual budget process
- Increase the level of awareness by Division managers about computing issues
- Create a division wide commitment to address student service computing needs

The following spring, the committee completed a report about issues and computing priorities for the division. Another committee charged with implementing recommendations of the first committee was appointed. At about the same time, I implemented an overcut in the division's budget to create a computing reserve in order to fund computing initiatives.

In January of 1993, I appointed the Computing Implementation Group, consisting of five persons, chaired by Tim Heidinger, who at that time was the lead programmer in the Office of Admissions and Relations with Schools. My instructions to Tim were to:

> "translate the various reports. . ., the needs of the Division, and other developments on the campus into specific projects which will guide our computing efforts in the immediate future and provide the framework for changing the way we work in the division."

Basically, I wanted divisional staff to be better prepared to provide quality service to students in an increasingly technological world and to work smarter, better and faster.

Tim Heidinger:
I accepted the assignment as Chair of the Computing Implementation Group with great anticipation. However, because all my previous computing experience centered around meeting the needs of a single office, I made a few erroneous assumptions. First, I assumed the Vice Chancellor for Undergraduate Affairs, who after all was my boss's boss's boss, would have much more authority over the Student Information Systems, the department which was synonymous with computing for student affairs units. The second assumption I made was I understood the nature of the assignment. In fact, the reconciliation of the Vice Chancellor's vision for technology with the operational realities of providing service to students is something that challenges me to this day.

On the Berkeley campus the Office of the Registrar, the Financial Aid Office, and the Office Undergraduate Admission rely on centralized computing support for their functionality. Student Information Systems (SIS) provides this support with a combination of mainframe systems development, training, consultation and standard and ad hoc reporting. The offices of the Registrar, Financial Aid and Undergraduate Admission report to the Associate Vice Chancellor for Admission and Enrollment, who in turn reports to the Vice Chancellor for Undergraduate Affairs. SIS on the other hand, reports to the Vice Provost for Systems and Technology under the Provost for Research. As a result, the application of technology to the delivery of service to students has always meant collaboration and dependence between people who do not share a common boss, who may not have the same priorities and who face different organizational cultures and pressures.

The relationship between UGA and SIS is not unlike the relationship between a popular restaurant and its customers. When customers in the Division have computing needs they look to SIS to fulfill the needs. The menu and the number of tables that SIS has to offer however is not limitless and much of the time there is a wait for a table. The relationship works most effectively with advance planning, either in terms of making a reservation or anticipating how long the wait usually is.

I have never liked the idea of waiting for tables at restaurants, even really good restaurants, so early in my life I resolved to learn to how to cook. Not unexpectedly then, when I arrived at Berkeley I quickly became very uncomfortable with how computing support was structured, especially given the volatile nature of the admission process at the time. I started looking for ways to gain more control over my dining options.

I reported to the Director of Undergraduate Admission whose main concern was the timely delivery of management and operational information, not the method by which they were delivered. At the time however, SIS was making preparations to replace our out dated Tandem admission system with a new system that was part of an integrated student database on an IBM mainframe.

Naturally during this transition, resources for new development on the old platform were scarce. In the true spirit of collaboration and while SIS was looking the other way, I began to implement new functionality on the Tandem mainframe. The mainframe functionality that was added, however, was only the routine delivery of raw data, local desktop machines did all the necessary manipulation. With direct access to the kitchen we now had the option to wait in line and be serviced or do our own cooking. In addition, we were much better able to satisfy our craving for between meal snacks. and dishes which were not on the regular menu.

The idea of using desktop machines to manipulate student data was not unique to the admission office or new to SIS. In fact, SIS encouraged the use of extracts and was providing them upon request. In addition, SIS was making plans to further exploit this trend by making all student data available with client/server technology. Not withstanding the technological issues of this new client/server environment, the Division was ill prepared to benefit from it. Never the less, the model was successful in the admission office and I assumed that it was that success which lead to my assignment as the chair the Computing Implementation Group.

In preparation for my first meeting with the Vice Chancellor, I envisioned a discussion about the delivery of a system. A system to provide all the offices in the division with the reports, lists, and labels they needed to provide more efficient and accurate student services. Much to my surprise, the Vice Chancellor was not interested. His concerns were electronic communication, positioning for the future and implementing the recommendations of the Divisional Computing Committee. While I understood what the Vice Chancellor wanted, I could not see how it would help the division provide better service to students.

In hindsight, I was expecting the Vice Chancellor to embrace the idea of opening a fast food restaurant. A different type of restaurant from the one provided by SIS, one which delivered meals much faster and cheaper, but a restaurant never the less. Vice Chancellor, on the other had, did not want his staff to remain customers. He wanted a staff of cooks, believing this to be the best solution to the problem of satisfying their hunger. "Teachers perform the strange magic of doing something important while doing nothing tangible." (Stuart Serman, "Time and teaching, teaching in Time," The University of Chicago Magazine, October 1994: 31)

Indeed, given the direction of technology to a client/server orientation, a new partnership needed to be formed between SIS and UGA. In this new client/server world SIS would no longer be the restaurant, it would be a grocery store. SIS would not be providing meals but the food stuffs necessary to create the meals. It was imperative then, that UGA follow the vision of the Vice Chancellor and learn how to become cooks.

Over the last almost two years now, the Implementation Group has struggled with ways to prepare the division for its new partnership with SIS. Two constraints we had to work under were:

- We had responsibility but no authority. We could recommend, we could discuss, we could train, we could set standards, but no one had to do any of the things suggested.
- We had some money but no staff

Given these constraints, here is a brief summary of the types of activities the Computing Implementation Group has pursued:

- Make recommendations about hardware and software standards as well as providing a central point for questions, referrals and review of departmental technology proposals.
- Implement policy to fund network access for all offices
- Implement policy to fund software training courses for all staff.
- Foster communications by maintaining division wide and specific e-mail reflectors.
- Identify and coordinate the usage of all new types of computing resources available on campus.
  Coordinated specialized training session with the office responsible for computer training.
  Coordinated implementation of divisional usage of e-mail and gopher serviced offered by new central UNIX computer.
- Occasionally, develop something which does not/cannot exist elsewhere on campus. For example, a way to update our gopher server with email.
- Investigate the application of new technology. For example, we have been fostering the development of World Wide Web servers within the Division.
- Explore the security and confidentiality issued involved with the new client/server access method.
- Foster collaboration between the computing staff within the division.

As a result of these activities, the Division hopes to foster an environment where effective conversations about computing can occur, collaborative decisionmaking and sharing of information about computers can be promoted, and the Division can become an effective lobbying group for campus computing. Additionally, with a competent staff who know how to be cooks as well as customers, we look forward to a new partnership with SIS. - each partner accepting responsibility for their part in the world where computing will be delivered within a client/server architecture.

Director Bjorn Solberg

POISED FOR THE FUTURE: Technological advances in central systems

While Undergraduate Affairs was undergoing change in the computing area, SIS was also in the middle of a major shifting in frames of reference and our relationship to the campus. And, although one of SIS' biggest clients, Undergraduate Affairs was only one of several constituents which we were trying to serve.

Currently, at the University of California at Berkeley central student systems are well positioned to meet current and future campus computing needs. Student data are consolidated in an integrated IDMS Student Database. All systems reside on a single hardware platform. Central student systems are interactive and widely used on campus. All central student data are stored in the IDMS Student Database, and most central student systems use this database. From a user perspective, we have a single image system, with data being sharing between systems and virtual elimination of system interfaces. This was not always so. Dramatic advances in upgrading and improving campus student systems has occurred in the last seven or eight years.

HOW THINGS WERE

Central student systems used to be fragmented, reflecting a lack of overall planning. Systems were developed in response to the needs of individual central student service offices. Systems didn't interact effectively, because interfaces were not emphasized in the original designs. The systems were essentially stand-alone systems that were meant to serve a narrow function. Each system had its own files, and there were inconsistencies and redundancy in data between systems. Data were collected by individual systems, requiring students and staff to enter the same data multiple times. At least four different student identifiers were used, complicating interfaces between systems. Systems operated on more than one hardware platform, making it necessary to ship data back and forth between different computers to synchronize data in different systems.

There was disagreement about the future direction of student systems. Proponents of the Tandem minicomputer wanted student systems to operate on the Tandem, and others argued for consolidating student systems on the campus IBM mainframe computer. Student systems operated on both machines, making it necessary to establish a two-way communication between the two machines in order to try to synchronize student data. There were numerous problems associated with this arrangement, including data inconsistencies, confusion about where the most accurate and up-to-data was stored, and the need to do a lot of processing that was aimed strictly at trying to synchronize the data on the two machines. The feelings on both sides were intense, culminating in the equivalent of a religious war on campus about computing. The dispute interfered with planning and was an impediment to progress.

Two different committees reviewed campus administrative computing and issued critical reports. There was dissatisfaction with central administrative systems. The Student Information Systems (SIS) Department was created as a result of a reorganization of campus administrative computing. When SIS was formed in 1987, we recognized that things had to change in order for the organization to be viable. We attempted to learn from the past mistakes of the central administrative systems department and made the following changes:

- -Encouraged collaboration with users
- -Emphasized the service role of our department
- -Improved productivity by emphasizing development and shifting resources from maintenance
- -Initiated a long range planning effort in partnership with users
- -Changed the governance structure for student systems giving users the authority to set work priorities for SIS projects

SIS management devoted much time and effort consulting with users about student systems planning and attempted to build a consensus for student system projects.

EFFORTS TO ACHIEVE CONSENSUS

A needs assessment conducted by SIS and representatives of user offices in 1987 concluded that current systems reflected a lack of overall planning. In order to remedy this problem, SIS and Undergraduate Affairs began to do long range planning for student systems. As a result, in 1990 the Student Information Systems model was published, in 1991 the Five Year Systems Plan was issued, and in 1993 the Five Year Systems Plan was updated (available from the CAUSE Information Resources Library-CSD0924). We are working on the 1994 version of the Five Year Systems Plan, which will be published in December.

SIS's strategy for getting agreement on a long range plan consisted of documenting current problems, preparing an objective assessment of current systems, and preparing a plan that was realistic and would solve major system problems. Our plan called for developing an integrated IDMS Student Database, consolidating all central student systems on a single hardware platform (IBM 3090 mainframe computer), and converting to a single student identifier.

NEW GOVERNANCE FOR STUDENT SYSTEMS

In 1989, while working on the development of a new on-line add/drop enrollment system, we started using a new governance structure. A project steering committee chaired by a faculty member (Dean of the College of Letters

& Science Advising) and comprised of representatives from affected offices, faculty, and students was established. The committee was large and had broad campus representation. The steering committee was responsible for determining system requirements and setting work priorities for the SIS project team. This model was very effective and has been used on subsequent system projects. This approach is now always used on systems that have campus-wide application. SIS has benefited from this governance structure, because we are getting clear directions about what is wanted by the campus.

COLLABORATION OF SIS AND USERS

One major reason for our success and progress with student systems is the strong support we have received from users. Early on, the Associate Vice Chancellor for Admissions and Enrollment offered encouragement and support for our planning activities and system proposals. He recognized that a partnership between his units and central MIS had the potential of benefiting the campus. He encouraged other units on campus to participate, leading to the involvement of the College of Letters & Science. We have learned that the combination of the central computing organization and the major student service organizations on campus has been effective in getting campus support for new student service initiatives. The combination of different offices has been more effective than individual offices acting alone. Evidence of this is provided by the fact that the campus approved this fiscal year approximately $612 K in funding for three campus student service initiatives: Tele-BEARS (the touch-tone telephone based enrollment system), DARS (a new degree audit reporting system), and Bear Facts (Berkeley's version of the Mandarin technology based system developed by Cornell University). New funding is hard to get when the campus is facing overall budget cuts.

NEW DIRECTIONS FOR CAMPUS STUDENT SYSTEMS

DARS is a new system that SIS is in the process of implementing. This system is based on a application system package purchased from the University of Miami at Ohio. We are working on integrating the Miami package into the Berkeley student systems environment. For example, we are creating an interface to the IDMS Student Database to obtain student transcript, profile, and enrollment data for the audit report. Degree audit reports will be available on-line as well as in printed form. Since degree audit reports are now prepared manually, the implementation of this system will save much staff work and improve service to students. We are aiming to go into pilot production with this system next summer.

Bear Facts, Berkeley's newest student system, is being developed using the Mandarin technology created at Cornell University with funding from Apple Computer and IBM. In our version of the system, student data will be extracted and downloaded from the IDMS Student Database to a server machine running

ORACLE. The downloaded data will be stored in a relational database using ORACLE, and this database will shadow the IDMS Student Database. The server database will be refreshed on a nightly basis. Students will be able to access their data on the server database using Macintoshes or PC's. Screens providing information about various deadlines, locations of student service offices, transcripts, final grades, billing status, financial aid applications, and current enrollments will be offered to students. Initially, limited updating (e.g., student addresses) will be supported. Most activity will be to display data, with an option to print on a connected printer.

Bear Facts will provide a new way for students to access central student data and will supplement the access to central student data provided by our touch-tone telephone system. It will also provide SIS with a new alternative for future systems development. As we gain experience with the client/server environment, we will assess whether we want to add functionality to the server-based system or shift functions from the IDMS system to the server. We are seriously thinking about the possibility of migrating some services from IDMS to the server machine. We are excited about the prospect of experimenting with different options. This offers us the opportunity to try out a client/server architecture in a situation where risk can be minimized.

Computing technology is developing at a rapid pace. Distributed computing is growing, and this is reflected by the increasing numbers of programmers in user offices. A campus survey completed last year indicated that only about 43% of the staff holding programmer classifications work in the central computing organization. Most programmers are now working in departments. Much of the departmental activity is dependent on using centrally stored data.

SIS encourages user offices to extract and download centrally stored student data, minimizing duplication of work that already has been done. For example, departments do not have to collect data from students since it is already stored in the central database. The central IDMS Student Database continues to be the official student record for the campus, containing the most up-to-date and accurate information. The new ORACLE database will provide a new and more convenient way for users to access central data.

We plan for users to access the ORACLE server database to generate their own reports. Point and click types of front-end tools that generate SQL queries to generate reports will be used by our customers. A convenient means of generating ad hoc reports has been missing in the IDMS mainframe environment, so we are excited about the prospect of being able to offer this new service to our users.

What did We Learn?

- Technology in and of itself cannot resolve "computing" problems; communication and dealing with people effectively are the key to managing this area
- Ask users to help define the problem, issues and solutions
- Working in collaborative partnership can be very effective
- New environments require new adaptations
- In order to move forward, we need both tangible and intangible goals
- By achieving the goal of serving students well, we eventually also serve ourselves

Decision Support at Stanford: Partnering with Users

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Abstract

Stanford University has been developing its Decision Support System (DSS) and associated Data Warehouse since the summer of 1992. The primary mission of the team is to significantly improve the University's data-based decision-making capability. We've taken an opportunistic approach to developing a decision support system by focusing on high-value, high-profile problem areas. After a brief context and history of the University Data Warehouse, this paper describes a major partnering project between the University's Budget Office and the DSS team, and ends with a discussion of the lessons we are learning from the project.

Decision Support at Stanford: Partnering with Users

I. Context and History

The Changing Nature of Managing University Business

Schools are businesses. They have revenues and expenses, assets and liabilities, products and consumers. For example, the "market" for research, one of Stanford's major product lines, has been declining in recent years. As a result of this and other factors (such as the Loma Prieta earthquake), Stanford is in the middle of the same kinds of cost cutting efforts that many major enterprises are facing. As resources become scarce, decisions on how to allocate them become more difficult to make. Management at Stanford is inspired to take a new approach and require quantitative as well as qualitative decision making. The following excerpt from a 1993 Board of Trustees presentation sums up the urgency of improving decision making capability:

> "In today's unforgiving economic and regulatory environment, Stanford cannot afford to base decisions on guesswork or partial information. We have immediate needs for reliable, integrated management information to support critical decisions being made right now. At the same time, Stanford must not become so preoccupied with today's pressing demands that we neglect to plan for the future; solutions for today's information needs must be flexible enough to meet tomorrow's needs as well."

Stanford is a major enterprise by all measures (except profit, of course). Our total expenditures across all business units is closing in on $1.5 billion annually. The University has close to 14,000 students and 1,380 full time faculty in 7 schools including a major teaching hospital. We also manage 8,180 acres of campus, retail and office park real estate and a $2.5 billion endowment.

As one would expect, Stanford generates a lot of operational data and is typical in its systems evolution. Many of our legacy systems are "stovepipe" in nature. Although they do a fine job collecting the data needed for their function, maintaining that data and reporting on it, it is very difficult for a business user to combine data from two or more different systems. Stanford's legacy systems use at least five different identifiers for people and three different identifiers for organizations. A report on faculty activity should draw data from the faculty, student, finance and sponsored research systems, but these systems do not communicate with each other. As a result, many major decisions have been made without the help of complete information.

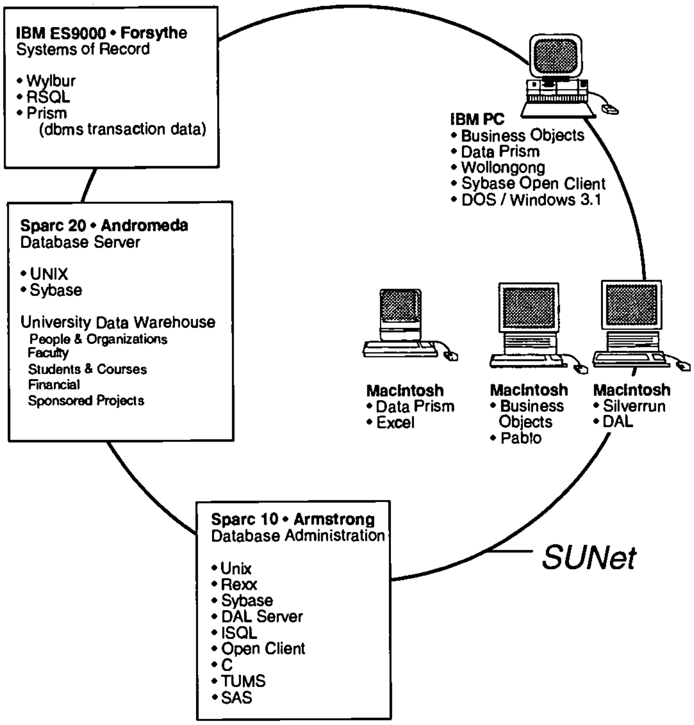
The DSS Project

Two years ago, the Director of the Data Center proposed to the Provost and the Board of Trustees that the University create a Decision Support Systems (DSS) team. Motivated by a history of success with DSS in the Medical School and an understanding of the need for analysis, the Provost's Task Force for Information Systems funded a pilot project to demonstrate the feasibility and value of a

University DSS. This successful pilot project resulted in a charter DSS group charged with the following mission:

> Significantly improve the University's data-based decision making capability by
>
> - providing tools for end users and IS to support ad hoc data access and DSS applications development,
> - providing a single, integrated authoritative source for university decision-making data, and
> - providing examples, expertise and training to help build the University's analytical capability.

DSS Hardware / Software Platforms



The Warehouse Foundation

The Initial Base

Given the emphasis on value, the DSS project has taken an opportunistic (almost mercenary) approach to implementing the Warehouse. Our focus has been on high value problems. We designed an initial framework for the warehouse, then prioritized its development based on the requirements and interest level of several key clients, mostly in the Provost's office.

The initial development of the warehouse's foundation was driven by client requirements, so each new application meant a large behind the scenes effort to create the data structures needed to solve the problem. We relied on business analytical expertise in our group to work with the client in defining the problem. This person would then work with the data team to ensure the available data met the need, or to specify any additional data required. As the base grows larger, the incremental effort for each new use has decreased significantly – in some cases from weeks to minutes.

The Platform

Part of the original charter of the DSS team was to help pioneer the University's use of open, client/server based technology. The Warehouse is Sybase based, running under UNIX on a SPARC 20 (see figure 1). This open client/server systems approach offers the advantages of:

- *mixing and matching off-the-shelf, industry standard, commercial products*—allowing the University to respond more quickly and economically to changes in information technology and allowing users to have more choices in selecting the software tools they prefer.

- *separating data capture needs from data access needs*—systems can be optimized for transaction processing at the data capture end and for decision support and analysis at the data access end, without either end needing to compromise.

The desktop platform mix in our user base is about 60% Macintosh and 40% PC compatibles.

The Data

Before we could answer any significant questions, we had to build a database. Drawing from the Medical School's experience, we extracted a core set of data from the University operational systems. A significant amount of data work took place during the extract process: person identifiers were mapped to a unified set, data was aligned by time and organization, history was kept, and certain calculations, aggregations and filters were applied to give the data a business orientation. (See figure 2.)

Operational Systems vs Data Warehouse

Operational Systems
(Transaction Systems, Legacy Systems)

- Designed for transaction processing, data entry
- Allows data entry and data retrieval
- Separate databases on one large mainframe
- Data oriented around forms, procedures
- Emphasis on detailed, current data

Decision Support System

- Designed for reporting, data analysis
- Allows data retrieval only
- One integrated database, on one or more servers
- Data oriented around subject/business problem
- Emphasis on summarized, historical data

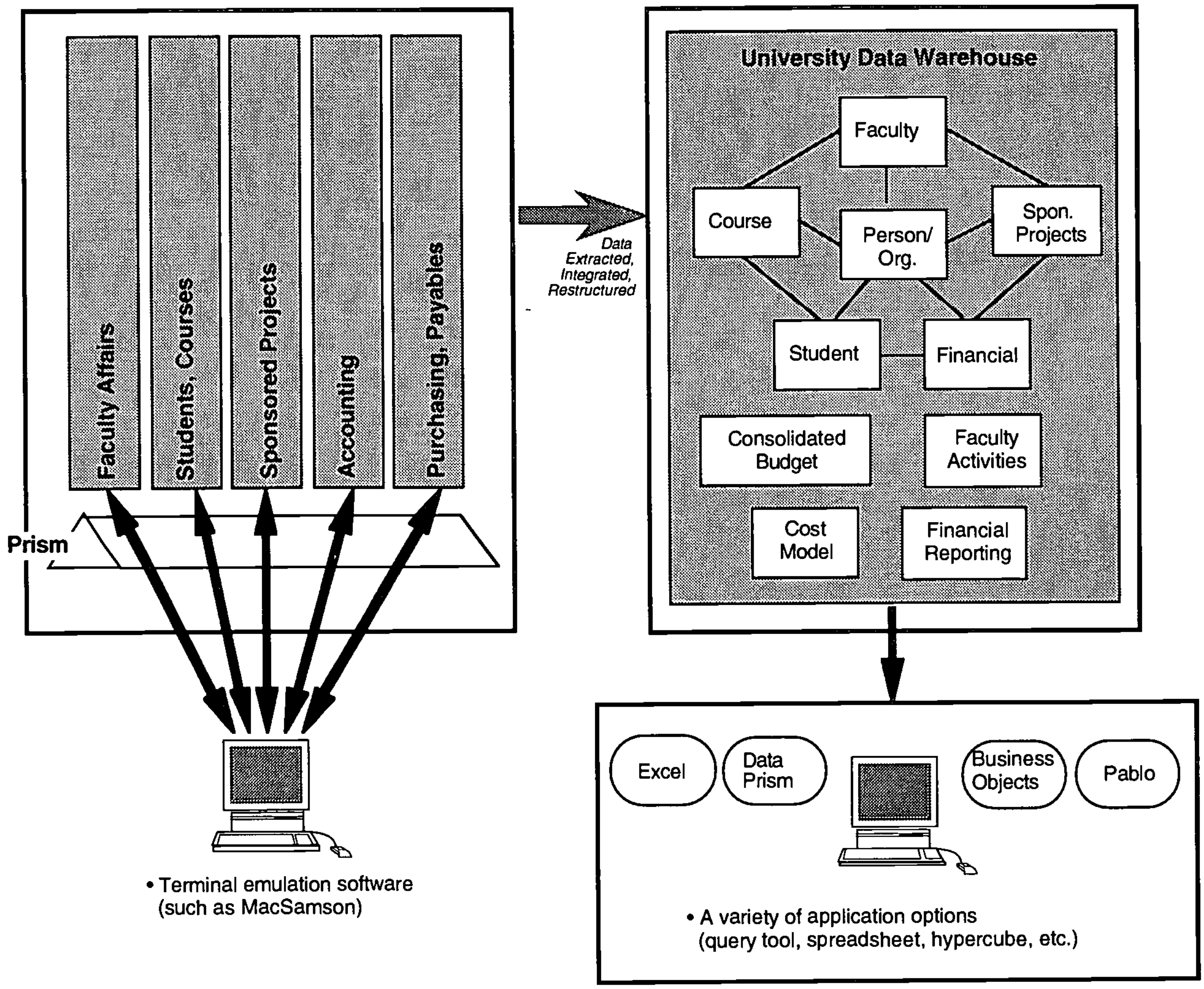


Figure 2

The DSS team built and populated databases containing information about student status and activities, faculty status and activities, sponsored projects, courses and instructors, fund balances, budgets and expenses. In addition, and more importantly the team developed and verified the logical links between these disparate clusters of data. The University Data Warehouse is now the only place at Stanford where there is a generalized way to link information about the same person in different systems. (See figure 3).

University Data Warehouse Contents (as of 8/94)

This diagram includes base tables only, and it does not include decode tables. There are many possible linkages across sectors which are not shown here; e.g. Faculty could be linked to Course Instructor or Major Advisor.

Years Included: FY91..FY94

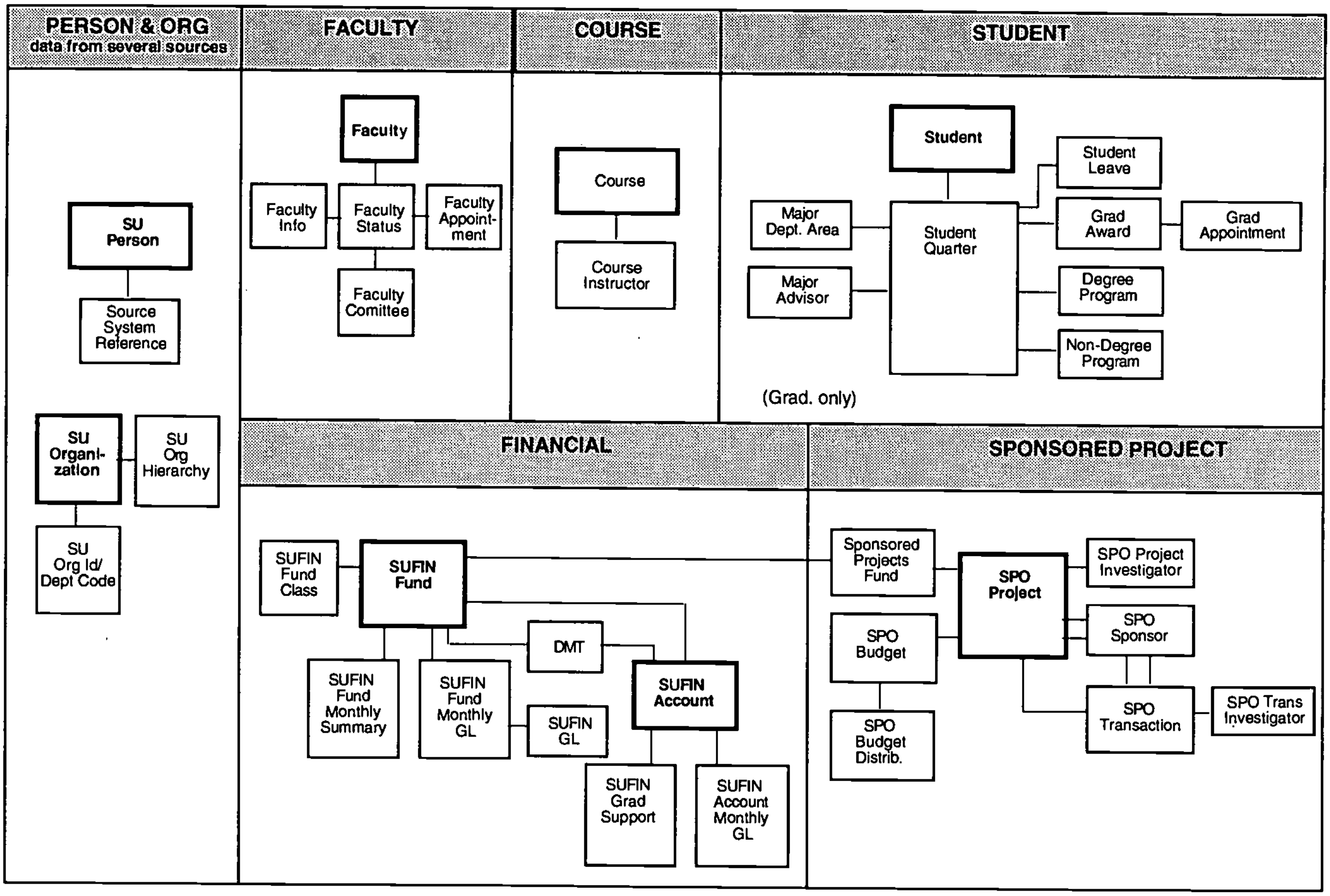


Figure 3

Data Access

Once the University Data Warehouse was populated with tables and data, we tested data access tools for users. We are currently supporting three data access tools: BusinessObjects, DataPrism, and Pablo. The first two tools are supported for both the Macintosh and Windows platforms.

User community

We are in the midst of launching the Warehouse to an initial user community, targeting users in Central Administration, the Controller's Office, the Budget Office, and School and departmental administration. We hope to convince users that new tools will:

- help them to explore the data,
- remove some data "drudgery" from their current reporting requirements,
- encourage creative thinking, and
- be easier to use than legacy systems.

To succeed we must develop extensive training and documentation, simplify the database, educate users about the data, and make sure the users and database have adequate computing power. The database simplification and data education pieces are much more difficult than one might expect. Simplifying the database reduces the range of questions it can answer, and the search for the 20% of complexity that answers 80% of the general questions is a difficult one. The University is a complex place, and the data it generates matches that complexity. Stanford's academic environment seems to be more prone to complexity than a for-profit institution, and the distributed business environment has led to systems that accommodate many different modes of management. We are still trying to determine if our DSS can be a true end-user environment, or if the complexities of our business, the state of our tools, and the multiple roles that our users play will require us to rely on technically skilled users who act as intermediaries.

The University has invested significantly in the systems that create the source data for the DSS. This source data is essentially a fixed asset and the marginal cost of using that data to enhance the decision making process is relatively small. As we cautiously enter the roll-out phase of the Data Warehouse, we are working with small groups of users who share an interest in a specific subject area, such as sponsored research or graduate student data. Wherever possible, we will capitalize on this interest to motivate users to climb the learning curve associated with querying a complex database.

In many ways, the Consolidated Budget project described in the next section is just this kind of starting point. It is a critical project, so people are motivated to learn; it is similar to existing activities, so the logical leap is not too great; and it is small enough to manage.

II. The Partnering Project: the Consolidated Budget

The projects that the DSS team has undertaken in the past two years span a wide range of analytical complexity and breadth of access. The projects most visible to senior management have required complex transformations of University-wide data, yet the deliverable may be simply a report. We have found that projects at the other end of the spectrum, which deliver flexible access to base data for a broad set of users, are a greater challenge. The project that we will discuss in detail here—the Consolidated Budget project—requires that we work closely with business analysts to provide flexible, accessible data and analysis tools.

Statement of business problem

Stanford has centrally budgeted and controlled only a subset of its activities. The "Operating Budget" of about $450 million covers only 40% of the University's expenses, and encompasses what is generally thought of as the general instruction and operation of the University. Senior management has set out the charge that the University develop a process to forecast, plan, and budget the entire activities of the enterprise, which includes $500 million in sponsored research, and $150 million of expenditures from gifts and endowment that are managed locally.

The analytical problem is that both sponsored research and management of restricted funds are extremely decentralized at the University, as individual faculty members conduct research and control many gift funds. Forecasts and plans, by contrast, must be developed at the Decanal level, with input from departments who in turn communicate with their faculty. The key ingredients of a good forecast are a clear understanding of past activities, and a reasonable guess about how those activities will change in the future. No application or data can answer the "future directions" question, but helping Deans' and Vice Provosts' administrative staffs better understand their organizations' current and past operations is the DSS team's charter for the Consolidated Budget project.

The data problem has been that the source financial systems were built to manage the University's day-to-day operations, and are designed to report on a relatively narrow set of activities at a time. There is no *technical* reason that the needed reports and analyses could not be generated directly from the source system. Rather, the problems are related to flexibility, ease of use, and scalability, as the Deans' administrative staff explore the financial data, develop ad hoc reports, and run those reports for each department in their School. For example, one of the Consolidated Budget reports would require users to run 6 reports in the existing systems and combine the results.

The DSS and Consolidated Budget support

The DSS team is supporting the Consolidated Budget project for 1994-95 by providing School and VP area administrative staff with data, tools, and training. The base data are five years of detailed yearend financials for each area, and are largely unchanged from the systems of record. We have developed data collections especially for the project, that rationalize, transform, and pre-aggregate some slices of the data. We have developed flexible structures to easily aggregate up and drill down through the different dimensions of the data.

The Consolidated Budget users access the data through an off-the-shelf query and reporting product. Their view of the DSS database is limited by this product to the data collections that were designed specifically for the project. Our users are finding this view of the data useful for a broader range of questions than just the Consolidated Budget.

DSS team members developed a formal training program on the tools, techniques, and data for the users, and we spend a lot of time in ongoing consulting and support. Helping our users understand the tools and data, and to use them effectively, is the team's greatest challenge.

III. The Partnering Process: Working with Clients

Unlike most operational systems, DSS is a service that users may choose to use or not use. As a result, it is particularly important to work directly with the users in all phases of a DSS project, including the fundamental decisions about what data elements and periodicity of data to warehouse. Although it is necessary to receive input, and get buy-in, from a wide range of users, it has been critical to the success of the Consolidated Budget project to work closely with a high-level project owner: the University Budget Office which staffs the Provost. The DSS team relied heavily on analysts in the Budget Office during the design and development phases of the project, and they are lending their expertise during the delivery phase as well.

Application design: Help clients think outside current boundaries

One of the first lessons that the DSS team learned is that users' views of what they want are strongly coloured by what they have. A user who is adept at extracting data from the source systems and who is reasonably facile with desktop spreadsheets, will ask that DSS simply provide an easier way to download 10,000 rows into Excel. Others request that we replicate the standard reports, but make them faster and easier to run. The DSS tools and data can easily accomplish both tasks, but we would be squandering resources if DSS were merely a big database.

Because users are not familiar with the technology, they must rely on Information Systems (IS) staff to propose specific plans for transforming general requests—"I want to explore my financial data"—into an application. The key implication of *users'* lack of familiarity with the technology is that the IS staff in DSS must be hybrids; they must have skills in both business analysis and systems analysis. During the Consolidated Budget project, a DSS analyst met weekly with the Budget Office and target users for two years, in order to learn the details of the business problem that DSS was committed to help solve.

Another lesson we've learned is that in order to provide analytical flexibility, IS staff must develop a toolkit of standard enhancements to base data: standard approaches to slicing, dicing, rolling up and drilling down through the data. Further, this toolkit must be customizable, if not by the users themselves then quickly and easily on their behalf by IS staff. This point follows directly from the earlier statement that users tend to want different instances of something they have already. As soon as you give them a new way navigate through their data, they'll want a slightly different version of the same thing.

The Stanford DSS team developed a generalized approach to building hierarchies atop atomic data as the center post of its data enhancement toolkit. Hierarchies help users to navigate through data, they provide natural paths of aggregation and drill down, and they become subtotal lines in canned reports. The DSS team has developed tools that make it quite easy to develop new hierarchies, and we have even had some success in having users design their own hierarchical structures.

The design phase of the DSS Consolidated Budget project consisted largely of determining upon which atomic elements in the financial data to build hierarchies, and choosing the tools with which to deliver the data.

Application development: Prototyping is the key

Once you've chosen information delivery tools and developed your data enhancement toolkit, prototyping is not just key; it's most of the work. In our experience, DSS tools are well suited to prototyping, and the iterative cycle is easy to manage. Rapid prototyping and development reaps the investment in infrastructure and data alignment that underlies a production Data Warehouse.

The Consolidated Budget project supported the development of many important pieces of the DSS infrastructure, especially the development of the hierarchy tools. Once those pieces were installed, the user access applications were developed over the course of six weeks. We anticipate that future application areas can be developed even more quickly.

A DSS application must balance the need to simplify users' views of complex data and minimize the chances and negative outcomes from "bad queries" with the requirement that the system support ad hoc querying. User tools provide some assistance here, although there's always a tradeoff. We've found that users have difficulty with (1) navigating through the tables and columns of the database; (2) joining tables correctly; and (3) remembering to aggregate when requesting a sum or count. Our choice and use of data access and analysis tools has been driven by our commitment to help users avoid these pitfalls.

Application delivery: Training, documentation and rollout

Training and documentation are absolutely vital, and involve more than just "how to use the system." The training program must educate users about the tools, the data, ad hoc querying and reporting. Users who previously have accessed information only through canned searches and reports may not be familiar with all the dimensions of their data. We have learned that the "value added" information such as our DSS hierarchies were initially confusing to many users.

The DSS team has not been impressed with the quality of documentation that arrives with data access products purchased off the shelf. We have found it necessary to expand upon, or even rewrite, that documentation. As wasteful as such an endeavor sounds, it pales in comparison with the waste of resources that would result if users avoid DSS because they can't drive the tools.

Rollout is considerably more challenging than in the mainframe environment, as anyone who has dabbled in client/server architecture will attest. As a vanguard client/server application at Stanford, we have tackled more than our share of general connectivity and distribution problems. We have found that choosing an access tool that keep most or all of its knowledge about the application (its metadata) on the database server itself is extraordinarily valuable.

IV. Critical Success Factors

The work of the Stanford DSS team over the past two years has led us suggest the following critical success factors to colleagues who are considering building a Decision Support System of their own.

Project value Developing a Decision Support system is expensive; the projects that provide the initial impetus for the system must provide significant value.

Client involvement

- Partnering is mandatory, since DSS is optional.
- Identify a business partner to be the project owner. The person must be engaged and excited about the project, and ideally cannot do her or his job without this application.
- Clients know what they need and how it should look.
- IS staff must work with users to deliver a flexible product in the best way possible.

Client analytical ability The business partner, and other future users of the application or system, must recognize that ad hoc querying to perform "decision support" is not easy, even under the best of circumstances. If the clients do not have the analytical skills and knowledge to use data that are raw enough still to be flexible, then IS will have to deliver a less flexible and more costly product.

Trustworthy data The data upon which DSS applications are built must be

- available within a single system,
- clean (error-free, with referential integrity), and
- aligned across the various sectors.

Technology DSS applications should use off-the-shelf products that adhere to industry standards. The technology in the user access area is changing rapidly, and everything you design and build should be modular and reusable.

V. Next Steps and Challenges

Users

Our biggest challenge is user acceptance (another phrase for organizational change). Downsizing over the last few years has hit the administrative community hard. Fewer people are trying to do the same amount of work, and any new tool with a learning curve must have a major obvious payback in terms of time savings in the long run. With DSS, this payback is not always obvious (or it would have been seized by now). The real return comes in making decisions or finding problems that are not even on the table today.

Education is a big part of gaining acceptance. Documentation on the data and use of the tools is weak. We are working hard to fill it in, but the task is massive. We also need to investigate alternative delivery vehicles for this information. The World Wide Web has several advantages, like a single set of source documents, and multi-platform readers developed by third parties. It also means converting our documentation into HTML.

Data

As we expand our user base, we will continue to expand the contents of the Warehouse. We are in the process of reverse engineering a user-driven logical model for the DSS database that we'll use as our guide to filling out the database contents.

Infrastructure

Early on, we built a metadata driven utility called Table Update and Maintenance System (TUMS) on the UNIX side which drives our current loading process. Over the next 12 months, our challenge is to automate the full data load process, combining the mainframe piece and the UNIX/Sybase piece into a single job stream.

We have been disappointed with the immaturity of current job control products that bridge the two environments.

In general, we need better tools, both for the data access side, and the data management side. There are literally dozens of data access tools available. Many of them have useful features. Most of them are in the process of growing up from desktop roots—they do not handle many of the enterprise issues well. Capabilities like distribution and management of reports, security, version control and so on are difficult or impossible with most of today's data access tools.

Data Administration

The need for a Data Administration function became clear when we began to develop a data warehouse. Many of the source systems collect information without proper data edits in place. In many cases, these were actually removed to improve the transaction time because they were not critical to the system's function. Many others are free-form data entry, and need to be manually aligned with other data sources. Stanford has recently adopted a set of Information Systems Principles which call for operational systems to recognize their requirement to meet broader University data needs as well as the specific needs of the business function. Some day, our source systems will generate data with the same codes and references. Meanwhile, we continue to clean up after ourselves.

Security

The warehouse faces the same general security issues as all client/server applications. The data has to be secure both at the source, and across the network. The warehouse also has the added complexity of protecting confidential data from a broad range of users at all levels in the University. Stanford is very careful about who can see what data. Implementing security in the warehouse has not been easy. At this point, we are confident about our security set up, but its administration will become an increasing burden as more users come on-line.

Part VI. Conclusions

In the initial phases of our project, our group provided extensive analytical expertise so that we could understand problems from both a business and technical point of view. We must continue to be responsive to the requirements and capabilities of our user community or we will fail. We know the textbook formulas —that is, we are familiar with the checklists and guides and seminars on how to build a data warehouse. These are helpful, but success will ultimately depend on organizational culture and individual attitudes. In our case, economic realities are forcing a cultural change. If we can help people handle that change better, we will be successful.

Partnering is critical to the success of any DSS/data warehouse effort. If users are not brought into the process, they will not use the product and they will not be able to articulate the value of the system. Without an understanding of the value, one of the University's largest assets will "rust" away unused in the back rooms of the computer center's disk farm.

Implementing a Kiosk-based Campus Information System at Community Colleges: Three Case Studies

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This paper presents case studies of three community colleges that implemented a campus wide information systems (CWIS) using touchscreen kiosks. The three colleges cumulatively offer students approximately 20 kiosk encasements on campus for access to the CWIS. Although the three college executives who participated in the development of this paper have differing responsibilities, each assumed an important role in the CWIS's implementation. Because each institution had a distinct rationale for implementing the system, each college's CIS has unique features. This paper will describe the complete implementation project, from involving various administrative departments to define the CIS's functionality, to reporting on its effectiveness. The paper also includes the featured institutions future plans for the system.

Introduction

I. Purpose

We experience changes in our environment on a daily basis. As the warm sunlight fades each day, we adapt to the coolness of dusk. As the seasons evolve throughout the year, we find pleasure in each period's renewal. We welcome the brisk days of Fall, the serenity of a light snowfall, and the renewal of a colorful Spring. Because we have experienced these environmental transformations, we are able to prepare for and adjust to them. Our preparation enables us to experience the changes without feeling disrupted by them.

However, when we sense impending changes in our professional lives, our anticipation is sometimes embedded with anxiety. Is our anxiety the result of not having yet experienced what the change will bring? Could it be that because we are not certain how the change will affect our lives, we are reluctant and sometimes resistant to the change? Is it because we do not know how to prepare for what we have not yet experienced? All of us can acknowledge that, just as the time of day and the seasons change, the institutions at which we work change. Because our work environments change, our professional lives change. To decrease the stress related to the changing seasons in the workplace, we need to gather information and knowledge regarding what the change will be. By preparing for our professional changes, we may even welcome the evolving season.

The colleges and universities that have emulated many of the characteristics of the industrial model of organization are beginning to adapt to a different season. Some of the more important change catalysts are as follows: (1) the emergence of "consumer diversity and sovereignty," (2) the dwindling and shifting portfolio of financial resources, (3) the exponential expansion of information, (4) the imperative to achieve a higher quality quotient, and (5) the insatiable appetite for more and better technology.

It is not the purpose of this paper to determine which of these change catalysts was first and/or is more significant. What is relevant is that these factors interactively result in a barometric change that signals a new season for colleges and universities. The purpose of this paper is to share information that illustrates how three institutions -- College of DuPage in Glen Ellyn, Illinois; Brevard Community College, in Cocoa Florida; and Sinclair Community College in Dayton, Ohio -- are anticipating and adapting to this changing season. In particular, the paper will describe how the community colleges have employed the strategy of optimizing the use of information and technology-based tools as one of the ways in which to prepare for the new environment.

II. Rationale

The authors prepared this paper based on the premise that the more information that is shared among higher education institutions, the better we can envision the new environment and anticipate the next season. The featured institutions share many common characteristics with other institutions that have implemented similar systems. However, their efforts and results differ because of the unique combination of a set of characteristics that are described as follows:

A. Common Mission: The mission of higher education institutions is focused upon instruction, community service, and research. Within higher education, community colleges' focus their mission on instruction and community service, and are particularly concerned about student development and retention. Accordingly, the featured institutions employed technology to focus primarily upon service to students. In some cases, the institutions also involved students in the design and testing of the system.

B. Collaboration: The featured institutions employed a collaborative methodology both internally and externally. The institutions planned and executed the projects internally through a collaborative effort that joined employees from multiple departments who had not previously worked together, and at some institutions, students. They also planned and executed the projects with two external business partners: TRG, Inc. and IBM. They acquired *TRG-Intouch*, TRG's campus-wide information system, and services. Some also implemented IBM's kiosks and RS/6000s.

C. Technology Integration: The featured colleges based the project on the integration of technology with many different capabilities. These include communication between PCs, servers, and hosts over the network; access to student information systems on a variety of hosts; and the ability to access Gopher servers. The technology also varied in the presentation of information with formats such as textual, graphic, animated, and multimedia. The integration of technology also featured the inclusion of capabilities such as printers and touch screens. Some of the featured institutions also plan to integrate card readers to increase the number of business transactions that students and other users can conduct.

D. New Uses of Information: The taxonomy of capabilities resulting from the information contained in the system is broad, encompassing for example: the passive viewing of information regarding programs, personnel, facilities and services; interactive searching and matching of personal characteristics to resources such as scholarships; and iterative answering to adaptive questioning to provide a customized recommendation regarding a course of action. One of the featured institutions pioneered the design and integration of an expert system for advising. Representatives of this institution collaboratively worked with counselors, advisors, and students for a two-year period to identify the numerous factors that they needed to consider when advising students. They focused on areas in which students frequently request assistance such as how many credit hours to take and which major to select.

E. New Information: The featured institutions are utilizing a component of the *Intouch* software that records utilization statistics and generates reports. Using this information, the institutions can collect information about their students. For example, the institutions can better understand the types of information that students most want to access, and the frequency, dates, and locations at which they access the information. One institution also has done a demographic analysis of the students who access information using the kiosk. Thus, while providing a service to students, the institutions are able to collect information about their students. Institutions can use the reports to continuously plan what information should be available to students and in which locations. The information also has assisted one of the institutions to develop a cost justification for the system. For example, they can compare the number of hours that the kiosk provides information compared to the number of hours that staff can provide services and information. They also can then equate the cost of staff providing information versus a kiosk providing information.

F. Enhanced Professional Roles: The featured institutions also were concerned with limiting the number of routine tasks required of their staffs to serve the institutions' increasing student bodies. Their intent was to "free-up" staff from providing access to routine information so that they can focus upon the specialized needs of students in a "consultant" role rather than an "information intermediary" role. Some counselors suggest to students that they first visit the kiosk and use the counseling module before scheduling a formal meeting. Because the system provides preliminary information, it frees counselors and other staff to meet with students who really need or want human interaction.

G. Student-Enabling: The final characteristic shared by all three colleges was their interest to provide a solution that enhanced service to students. The institutions also found that the kiosks enabled students to become as pro-active as they needed and/or wanted when accessing information about themselves, their courses, and other institutional categories. The colleges recognize that many of their students may enroll in classes at their institutions and have very little interaction with counselors and other staff. The reasons may be that the students have busy schedules with work and home responsibilities; that the students might have had an unpleasant prior experience; or that they are uncomfortable meeting with "strangers." The institutions wanted to use technology to provide students with another option for accessing information.

III. Featured Case Studies

Although the community colleges featured in this paper vary in size and location, all share the mission *to effectively employ technology to address issues affecting higher education*. Each institution has uniquely introduced a campus wide information system (CWIS) using touchscreen kiosks. They represent three different stages along a continuum from planning to fully implementing and evaluating.

The College of DuPage acquired the *Intouch* software in February, 1994. Since that time, they have used a committee approach to plan and implement the project. The authors will describe DuPage's current status to illustrate to other institutions how one methodology is working to begin the continuum. Brevard Community College (BCC) purchased *Intouch* in June, 1992 and is in the piloting phase of implementation. BCC will share their results to this point in time as well as how they plan to move to full implementation. Sinclair Community College (SCC) began a unique project in 1990 which resulted in acquiring *Intouch* in December, 1992. SCC has implemented the software, expanded the number of kiosks, and has robust plans for additional enhancements. The authors will concentrate on SCC's success with the project which has provided new insights to other institutions into the changes that may occur when implementing a CWIS.

Case Studies: College of DuPage

I. Rationale

Located in Glen Ellyn, Illinois, the College of DuPage (DuPage) acquired *TRG-Intouch* software and IBM hardware in 1994. There were a number of factors that contributed to DuPage's interest in implementing a campus wide information system (CWIS). First, with five regional centers, DuPage needed to provide convenient access to information from multiple locations. Second, recognizing the capabilities of a CWIS, DuPage determined that they could integrate information from a variety of sources and make it accessible through kiosks. Third, with a relatively small staff to serve DuPage's large student body of approximately 36,000 students, DuPage wanted to find other ways for students to directly access routine information. To address these identified factors, DuPage organized an Information Distribution Task Force (the task force) with the following mission: *"To develop a plan for information distribution on and off campus to provide easy access to information for faculty, staff, and students."* The task force reviewed all forms of information distribution, both on and off campus. To help determine the information needs of faculty, staff, and students when arriving on campus, the task force distributed a campus survey.

The results of the survey defined a lack the following information tools: an appropriate campus maps and signage, a campus directory of staff and departments, and a single point of information for campus events and activities. These results provided a focal point for the task force to address the needs of DuPage's student and community residents with the following recommendations: signage on all campus buildings; campus maps at high traffic entrances; information kiosks at all entrances; and computer-based kiosk in high traffic areas. In addition, the task force recommended a five level kiosk design for the various entrances at the college. The levels range from level one that features a floor plan of building to level five that features a floor plan, a wall directory with campus brochures, a computer-based kiosk, and a staffed information booth. Through the recommendations of the task force the college included the computer-based kiosks in the Information Technology Plan. DuPage budgeted for four kiosks in the high traffic areas of the campus in the first year and plans to evaluate the kiosks' effectiveness to determine future needs.

To initiate the task force recommendation of implementing a computer-based kiosk, the MIS department evaluated commercially available CWIS based on design, architecture, functionality, vendor support, and costs. The department also investigated the option of internally developing a system. When they evaluated TRG, Inc.'s solution, they found that they were able to combine the strengths of commercially maintained and enhanced software with the internal creativity and expertise of DuPage's Information Systems staff. DuPage purchased a single license of *Intouch* in February 1994 as a model to prepare various application examples to determine the campus "fit" for the system. DuPage's intent was that their staff would continue to develop the applications using the same development environment and architecture as *Intouch*. Two information systems staff were selected to receive training in ToolBook, the base language for *Intouch*. After training they assembled a team to work with TRG to install and develop the model applications which included access to the IBM mainframe student system, human resource system staff directory on a LAN, and campus maps with graphics. This provided the information systems staff a base to develop additional applications. In June 1994, the system was demonstrated to the Information Distribution Task Force.

II. Implementation

Following the successful demonstration to the initial Information Distribution Task Force, DuPage employed the implementation model of collaboration by establishing another task force to focus on the implementation of *Intouch*. This committee is composed of thirteen members that include all the key institutional support areas. They first met in July 1994 to receive a demonstration of *Intouch* and to determine the project activities and time frame. The activities included the definition of a menu structure and the type of information to offer students. In addition the group determined the kiosk locations and the design of the kiosk enclosure. They also prioritized the tasks and assigned responsibilities for each of the major activities. The committee reached a consensus built at each critical milestone.

Over the next several months, the committee then engaged in the process of identifying the type of information to make available to a maximum of four levels on the kiosk. The first level included the following: Academic Information; Admissions, Registration, and Records; Advising, Counseling, and Testing; Calendar and Events; Campus Maps and Directories; Community Services; Employment; Financial Aid; Health and Special Services; and Student Activities. The committee currently is prioritizing these ten menu items to determine the order and time frames to implement this information. The committee next defined the next three levels of each menu of the CWIS. They currently are defining the type of application information to include behind each menu selection.

III. Future Plans

DuPage plans to make *Intouch* available to students and community residents by Summer, 1995. Later this Fall, students will have the opportunity to enter a contest to name the new system. DuPage will install four kiosks, located in the following settings: the entrance of a new addition to the Student Resource Center that is currently under construction; the existing Student Resource Center; and the Open Campus Center which is used for community and business events. The committee is confirming the location for the fourth kiosk and is considering either the Instructional or Art Center.

DuPage also has planned for completion of an enterprise network by the Summer of 1995. This network will tie together DuPage's five regional sites and central facility. DuPage is building the infrastructure to provide easy access by high schools and public organizations within the district. DuPage selected this type of design to permit the placement of kiosks at the various locations. Since the college has upgraded its initial purchase of one *Intouch* license to a full site license, DuPage will be able to provide campus wide access from all faculty and staff offices, and student labs. DuPage also plans to take advantage of the system's capabilities to provide generalized access to many different types of information to improve campus communications. DuPage plans to install four kiosks per year. Ultimately, DuPage will make *Intouch* available at locations throughout the whole county that it serves. DuPage plans to provide information on these kiosks that expand beyond their current CWIS to include all relevant student-related information that the committee determines is appropriate.

Case Study: Brevard Community College

I. Rationale

Brevard Community College (BCC), serves more than 14,000 students at four campuses located in Cocoa, Melbourne, Titusville, and Palm Bay, Florida. The driving imperative to acquire a campus-wide information system (CWIS) was to support the recruiting process. To do so, BCC will make the software available at numerous convenient locations, including employer sites, shopping malls, and surrounding high school guidance counselor offices. By providing comprehensive information about BCC in an appealing and convenient manner, BCC anticipates that they will be able to attract many additional students.

II. Implementation

BCC used a prototype model for initial test implementation. Using TRG's *Intouch* software as a base, a talented programmer developed a prototype customized to BCC. Various college departments reviewed the prototype. BCC incorporated the suggestions from the college, as well as new ideas gleaned from other external sources into the software. BCC completed the initial phase of the project and installed the prototype kiosk at the Student Center of the Cocoa Campus in the Spring of 1994.

III. Results

Once the prototype was in place, BCC asked kiosk users for input and reviewed screen utilization statistics. BCC's executive staff found the feedback to be very valuable because it provided specific suggestions for enhancing the way students and other users accessed information from the kiosk. For example, the college learned that a bigger touch screen was needed, that the processor needed to be faster, and that the kiosk itself needed to be more attractive. Subsequently, the college upgraded to more powerful PCs with a larger touchscreen and purchased attractive kiosk cabinets. Shortly after the start of the Fall 1994 semester, the college installed the enhanced personal computers in the new kiosk cabinets at the Student Center of all four college campuses.

IV. Future Plans

BCC's next milestone for its project is to install kiosks at the local public school system. BCC's executive staff are currently in discussion with a local high school and anticipate that the first BCC kiosk will be in place at this local high school within the next 60 to 90 days. When this installation is complete, BCC will have realized its initial goal of providing convenient access to comprehensive information in an appealing manner to attract additional students to the institution.

BCC's plans expand beyond its initial goals. BCC is confident that the *Intouch* system has the potential to open up a new era of information dissemination at the college. For example, BCC has stored over 8,000 lines of information in the system that students are able to access. BCC will add five to ten kiosks per year to increase the number of locations where students can access *Intouch*. Another dynamic new capability that BCC plans to add to its CWIS is to incorporate video disk capability and feature short clips of the various performers appearing at BCC's performing arts center. BCC's next release will build upon the presentation of video clips by interacting with card reader technology. This will enable students and others to use their credit cards to buy tickets for the performances that they had just previewed. Since *Intouch* can interact with printers, the kiosk will then instantly print the purchased tickets.

Case Study: Sinclair Community College

I. Rationale and Implementation

Of the three featured institutions, Sinclair Community College (SCC) is at the most advanced stage of the continuum. SCC's initial goal for its campus-wide information system was to augment the college's ability to advise its diverse and growing body of 20,000 students. Its student-to-counselor ratio of 1000 to 1 motivated one counselor to investigate other options. His investigations resulted in a project referred to as CWEST (Counseling with Expert System Technology) that eventually became integrated within TRG's *Intouch*.

During the first few years of the CWEST project, a group of volunteers led by artificial intelligence specialist, Dr. Kathryn Neff, and counselor, Mr. Gordon Robinson, developed a prototype of the system. Taking the information that counselors consider when advising students and how counselors weigh the different factors during the session, the team reformatted that information into an expert advising system featuring two advising modules. As the team progressed, they recognized that other modules could enhance the services offered by the advising modules. Since SCC's policy is to not write its own software, the team decided to find an external partner that marketed a system that would complement their counseling modules. In December, 1992, SCC formed a partnership with TRG, Inc. TRG's team worked with SCC to integrate the functionality of *Intouch*. SCC launched the new system during the late Summer of 1993. An imperative of SCC's executive staff was to have a sufficient number of kiosks so that students would be able to find them anywhere on campus. SCC initially acquired six IBM kiosks and now has 13 kiosks located throughout the campus. In summarizing the project, SCC notes that it was driven by users, not information systems staff, to ensure that "need," not technology, was the focus.

II. Results

Quantitative data show that SCC averages over 1,500 users per month per kiosk. According to the observations of SCC staff, it appears that most people will select two or three main menu items in one session. SCC's utilization statistics and transactions counts measured from April 1994 through October 1994 are featured in the **Appendix**.

SCC conducted a demographic analysis of SCC's kiosk users during the Spring 1994 term. The study concluded that *Intouch* kiosk system is reaching a broad spectrum of students: men and women of all ages, ethnic backgrounds, majors, and academic disciplines. The report titled, "Who's Using the Kiosks?" notes that 6,480 different students, representing 35% of the institution's total Spring enrollment, accessed their personal records (from SCC's student information system) at least once during the term. The utilization statistics revealed that the kiosk users were slightly younger (age 28.4 compared to 32.8 for all SCC) and more likely to be male than the average student, although the system has been accessed by students ranging from age 13 to 83 with 36% of the kiosk users over age 30. The report demonstrated that all ethnic groups are well represented and, in particular, SCC's African-American population. Additionally, the statistics showed that kiosks seem to attract students who are somewhat more dedicated and academically successful than the overall student population, as indicated by kiosk users having slightly higher grade point averages and higher credit hours loads than the general student population. An actual kiosk user distribution breakdown by major closely parallels that of SCC's overall breakdown by major.

To provide a basis for judging the cost effectiveness of *Intouch*, SCC has attempted to compare kiosk costs with human academic advisors and with printed items such as catalogs and brochures. SCC determined that a kiosk costs approximately $600 per month: about one third the cost for people to do the same tasks. Also, each kiosk is available for use about 390 hours per month (15 hours per day, 26 days per month).The annual cost of the kiosk system can be broken down to $2.16 per student or just $.30 per interactive session. Compared with the costs of delivering information and advisement through more traditional channels, for example, catalogs ($1.58 each); brochures ($1.00 each) or 30 minute sessions with an academic counselor ($11.75 each), kiosks are proving to be very cost effective.

During the nearly one and a half years that the kiosks have been used on campus, student usage has increased dramatically More than 6,400 students requested information via *Intouch* in the spring quarter, 1994. SCC is observing other positive results that that are not directly cost-related. These include the convenience for students since no appointment is needed to use the kiosks and they are available at all hours and at multiple locations. SCC also had found that there is a consistency in the information provided that is more up to date than printed materials. Also, the information is provided in a manner that is unbiased with respect to race and gender. Additionally, SCC officials believe that the frustration students can feel when they are caught in administrative red tape is reduced when they get assistance immediately from a kiosk. By SCC's being more responsive to student needs, the College feels that it has made the campus a better learning environment.

III. Future Plans

SCC recently has expanded the applications available from *Intouch* to include textbook listings and an interactive quiz regarding distance education/independent learning. SCC's plans to add the following additional functionality to the system: online registration, credit card fee payment, course recommendations, degree audit program requirements, transfer information, course planning guide, financial aid status, textbook ordering system, and campus ID card applications. SCC also plans to incorporate the State of Ohio Bureau of Employment Services job opportunity database, JobNet. To increase feedback from students, SCC plans to incorporate functionality for students to complete mini surveys, "opinionnaires," and log complaints. SCC also wants to serve students and other users by adding the ability to access employee applications and personnel-related documents. Longer term, SCC plans to incorporate access to a Gopher server, voice recognition, desktop conferencing, and the presentation of information in multimedia formats. SCC plans to reach new students and community members with its enhanced *Intouch* system at off campus sites including malls, Wright Patterson Air Force Base, high schools, and neighborhood centers.

Summary

The three institutions featured in this paper represent how colleges can collaboratively use information technology to anticipate and prepare for change. Equally important, the College of DuPage, Brevard Community College, and Sinclair Community College are helping to create the new season. Although representatives from the institutions experienced challenges throughout the processes, they are making important advances in creating a student-centered environment. The following is a sample of benefits that they have noted to date and anticipate experiencing in the future.

A. Student Success: By installing a CWIS on their campuses, the featured colleges have provided students with access to a large volume of information in a convenient manner that adapts to the students' schedules. By reducing students' frustration over standing in long lines to conduct transactions and overall administrative "red tape", the colleges are using CWIS's to help create an environment for their students to succeed. By using kiosks, the colleges are able to expand the "points of service" for their students. Because the colleges want to decrease the potential of drop-out due to financial reasons, the colleges are providing students with access to information regarding college costs, financial aid, and scholarships. The featured colleges also are interested in assisting students to navigate effectively through institutional processes, such as registration, add/drop, and graduation. To accomplish this goal, the colleges are providing information regarding campus events and institutional policies and procedures. To help new students better assimilate to the college experience, the colleges are providing them with easy access to locations of classes, faculty offices, and services. This information is being made accessible in a manner that is both consistent and unbiased with respect to ethnicity and gender.

B. Employee Professional Development: The featured colleges also are striving to create a work environment that enhances their employees' professional development. For example, representatives from their technical staffs became trained in new tools and the latest technology to creatively design and develop unique applications and additional *Intouch* applications. They also are gaining experience in the RISC technology with IBM's RS/6000 servers, in card readers, in multimedia, and in ToolBook. In addition, staff who are not directly related to the implementation project are also experiencing a positive change in their work environment. Since the kiosks are able to address many of the routine requests that staff who provide student-related services formerly answered, these staff members are able to reallocate more of their time from information access and dissemination to student consultation activities.

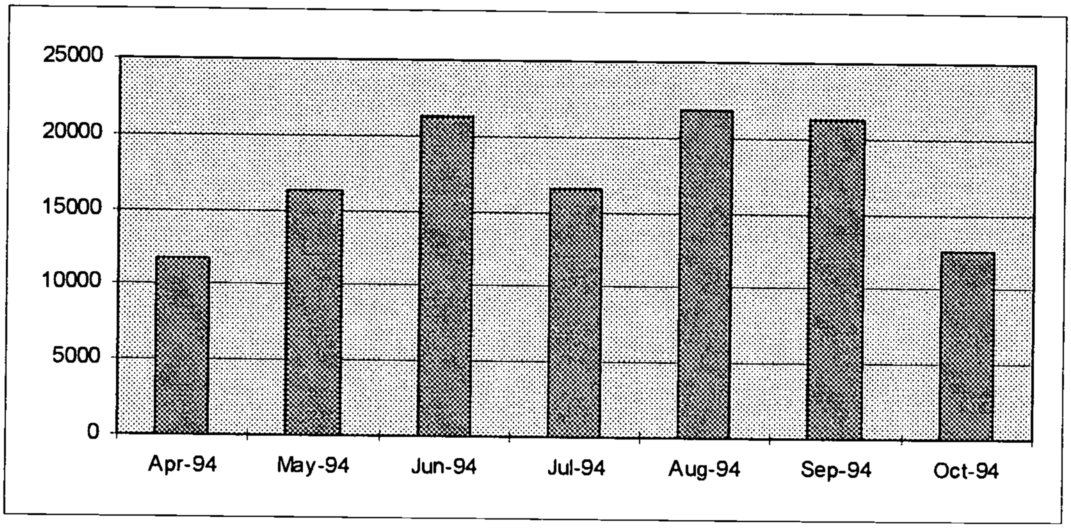
C. Institutional Competitiveness: Another benefit that the featured institutions are realizing is in the area of institutional competitiveness. Because the colleges are striving to quickly and conveniently serve all of its student body, they hope to use their CWIS to enhance their ability to attract and retain students. When new students visit their campuses, the colleges are able to reflect a progressive image with touchscreen kiosks. The featured colleges also are investigating additional off campus sites to install kiosks for access to *Intouch*. Shopping malls, local high schools, major employers, military bases, and city libraries are just some of the locations that the featured colleges are investigating to attract students and increase awareness about their offerings. Since the colleges are generating utilization reports, they can use the reports to tailor the CWIS features to best serve the various target audiences. The colleges also are using these reports to provide more informative documentation to the administration regarding how the institutions are expending their funds to serve their students and communities.

Although the College of DuPage, Brevard Community College, and Sinclair Community College are pleased with the outcomes to date, they recognize that the continuum is infinite and that there are many significant steps ahead. The colleges plan to create further changes when they use the technology for additional purposes. They plan to conduct even more business transactions through *Intouch* such as registering students; paying for tuition and fees; ordering and paying for textbooks; selecting, paying, and obtaining tickets; inputting applications; and initiating transcript transfers. When the colleges use voice and multimedia technology more extensively and interactively, institutions also will gain additional new insights. As the featured colleges join with some of TRG's other *Intouch* partners who are providing their users with access to information from Gopher servers and in the future from World Wide Web servers, the students at the featured colleges will have universal access to the Internet and their available information resources will exponentially change. In conclusion, the environment serves as a catalyst; information is the resource; technology is the tool; new processes are facilitators, and people are the creators.

Special recognition is extended to TRG, Inc.'s Maureen Tuskai, Manager of Corporate Communications for her editorial assistance.

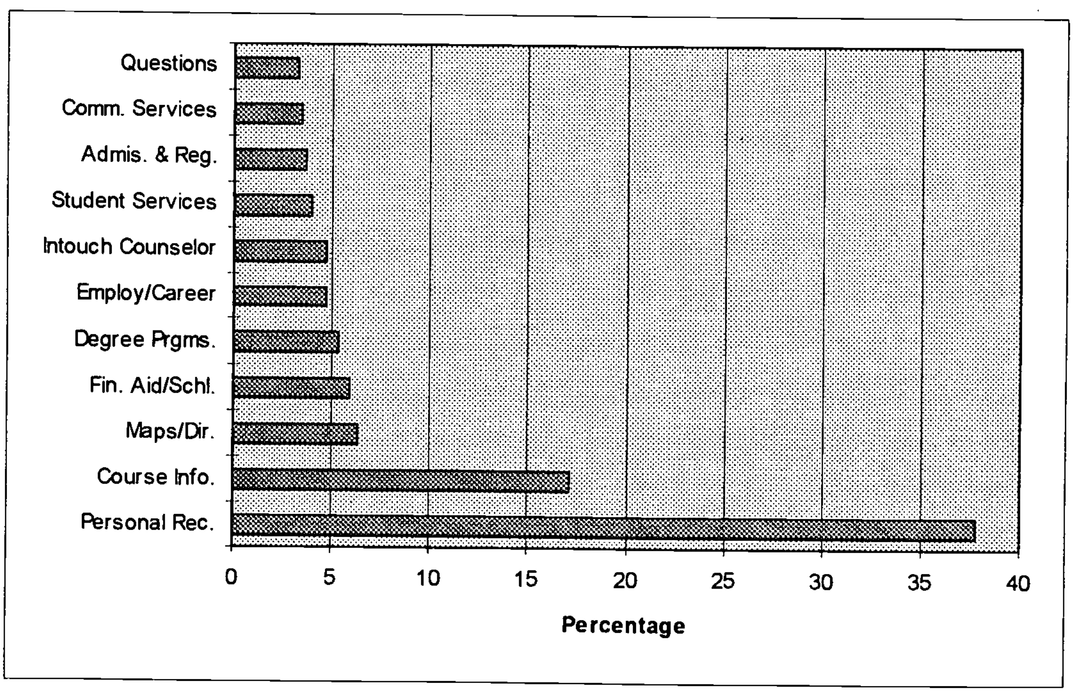
Appendix

Sinclair Community College's Kiosk Utilization Statistics - Total Transaction Counts from April through October 1994



note: April - 10 kiosks on campus; May - 11 kiosks on campus; June to October - 12 kiosks on campus

SCC's Kiosk Utilization Statistics: Average Percentage of Menu Items Selected from April through October, 1994



CAUSE

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Track IV
Networking

Coordinator: Douglas S. Gale

Integrated Statewide Infrastructure of Learning Technologies

Lee Alley, Ph.D.
Associate Vice President for Learning and Information Technology
University of Wisconsin System Administration

The University of Wisconsin System includes all public higher education in the state, excluding local technical colleges. The UW System has about 120,000 students on 26 campuses. There are two doctoral degree granting institutions and ten comprehensive universities, each headed by a Chancellor. An additional institution, whose chief executive is also a Chancellor, is UWExtension. Finally, the UW-Centers is a single institution, also under a Chancellor, with 13 two-year academic campuses throughout the state. These Centers campuses feed into the other UW institutions.

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Foundation: Why are we doing this?

Consider the case of Chris, a student of the University, and an employee of one of the state's leading firms. Her employer gives her one afternoon off each week to drive to the nearest campus of the university system, to take a course in Japanese language.

Let's trace a recent afternoon at the campus for Chris. Each Wednesday afternoon she first attends the one hour lecture on Japanese. Afterword, she goes to the library to copy information needed for a student team project for the course. Then she stops by the language lab for an hour to use some special software packages that help practice Japanese reading and writing skills. From there she hurries to the Student Services Center for an appointment with an advisor who will help her go over her overall degree plan and progress toward graduation. Then it's off to the campus computer lab, to work on her part of the term paper for the student team project. As the last on-campus task of the day, she walks over to the student union to meet with her fellow students on the project team.

From our "customer's" point of view, we have been in the distance education business all along, with students leaving family, work and home behind to go off to college in some distant place. But things are changing. Growing numbers of our citizens now expect, and need us to deliver a full-spectrum educational experience closer to home, job and family.

This market demand, or at least anticipation of it, is spawning increasing numbers of ventures to sell education delivered over networks. But there is a difference between "education," "knowledge," and "information." Selling Internet access to databases and other recorded information can be just that, information. Use of live or recorded video of lectures might offer a higher level of information, along the lines of what we might call packaged knowledge. But what Chris is doing in her several separate visits to class lecture, library, student advising, laboratory, computer lab, and a meeting with fellow students, more closely resembles our *traditional* sense of a rich educational experience.

That is all well and good, as far as it goes. It recognizes what we have all come to realize, that a university is an information system. But the traditional university campus is not an "integrated information system." As we look to the future, for both on-campus and off-campus, what we look for in our learning technologies is an integration of the diverse traditional elements of the university information system (libraries, computer labs, etc.).

Our objective is:

Better access to higher quality learning for all our students, both on and off campus.

Our vision on how to accomplish that is:

Integration of digital versions of the full spectrum of traditional instruments of education, delivered to the student's multimedia desktop computer.
This includes concurrent multimedia access to:
- *digital libraries;*
- *automated and simulated laboratories;*
- *online classroom instructional media;*
- *telecommunications for team work;*
- *high level interaction with professors; and*
- *student support services.*

But not all entrants into the higher education business share these objectives and visions. The historical national infrastructure of universities has been tied together by their cross-cutting academic disciplines, professional membership societies, and institutional consortia. This is now joined by an interstate commerce in higher education. Venture capital now hungrily stalks new markets for digital delivery of a wide definition of "information", including Hulk Hogan reruns on demand, home shopping, and "education sound-bytes" via pay-per-view.

Meanwhile, American industry has finally discovered the commercial value of education as a method to leverage existing "human capital" in the work force. In the "information age" education will certainly not provide the basics of food, clothing, etc. However, it will provide an essential boost to an economic system which depends increasingly upon a more highly educated workforce. Industry does not often wait for the pace of innovation in Universities. They want it just in time, just in that place, and just that way. There appears to be an emerging trend toward large employers, especially high tech firms, going out and buying up universities. This "vertical integration" of education into the corporate structure will measure the true valuation industry places upon higher education. Both in terms of amount of value, and in what type of education is valued.

Universities, especially public institutions, are not in the business of distributing information as a simple one time product. Our students are our customers, not just a product. Universities are not simply value-added resellers of high school graduates. Our "ace in the hole," our strong suit in dealing with those who would offer simply video taped "freeze-dried education," is that we are uniquely able to offer a fully rounded educational environment. An integrated educational environment that coordinates all facets of a systematic education: lectures; library and computing services; student services; lab access; etc.

The components of this full-spectrum educational environment being developed by the University of Wisconsin System are described in the following section. These components are more "programmatic" in the sense that they focus on end-user service applications. We will describe a number of projects for building the information technology infrastructure needed to support this systematic approach to education. In aggregate, about $20,000,000 is being spent on this coordinated program of upgrades to the information technology infrastructure.

Building Blocks: What are the usage components being integrated?

The primary end-user component applications that drive the information technology infrastructure are described below. These component applications are all considered essential parts of the overall educational environment, and therefore, strategic plans for any one application component are interdependent with the plans for all the other components. The spectrum of "educational environment applications" is made up of:

1. Classroom instructional technology and media
2. Library automation and access
3. Automated student support services
4. Automated and virtual laboratories
5. Distance education
6. Business support services

An important factor in all these application areas is Systemwide sharing and coordination. The key to such a statewide collaboration is the availability of inter-campus networking facilities. At present these facilities vary by application, with some provided over the Internet, and others via dialup or leased telephone lines. The University System Administration, and the individual institutions, have invested substantially in a number of inter-campus networking arrangements. These include: WiscNet, the state's primary Internet service; WisLine, a permanent-line audio conferencing system used extensively for business meetings and instructional support; WisView, a sophisticated audiographics system for instruction; a number of emerging regional video conferencing systems; and statewide coordinated public TV and public radio educational programming.

At the (last mile) campus level, the UW System is completing two major projects to place a fiber backbone network on each campus. These interconnect campus buildings. In addition, the UW System is in the process of major upgrades to intra-building wiring in the highest priority buildings. A Systemwide wiring standard has been developed to provide for the uniformity and minimum performance of these wiring projects.

Classroom instructional technology and media includes the electronic systems used directly in, or in direct support of, classrooms. This includes items such as networked classroom computers, display equipment, connections to the campus network, instructor podium system, as well as the pre-developed digital courseware that "runs on" those systems. This courseware includes both software and stored information or instructional modules.

At the core of the overall strategy, UW System has been fortunate to establish an important ongoing funding stream of about $5 million per year for classroom modernization. Most of these modernization projects involve substantial upgrade of the classroom instructional technology and media.

All the chief librarians of the UW System institutions, and the UW System Administration's Office of Learning and Information Technology work in close collaboration. The UW System succeeded in obtaining a major legislative appropriation for a Systemwide upgrade of the institutions' library automation systems. As part of this project, the librarians have committed to working closely together toward using the same library automation system (NOTIS). The UW System libraries have begun implementing a shared, distributed library for all students and faculty at all the campuses to have equal access to. In addition, this has allowed coordinated selectivity of individual institutions to decide which subscribed digital holdings (such as periodicals indexes) to mount locally, which to leave to another campus to mount, and which to access from commercial providers and peer institutions in other states.

The UW Office of Learning and Information Technology has recently arranged for several campuses to proceed with a pilot project for statewide full-text/full-image document retrieval. This project will examine usage behaviors, service quality and user satisfaction, network capacity requirements, costs, etc.

The UW System takes extraordinary pride in reflecting the culture of the state in providing the highest quality support services to its students. An important aspect of the UW System has been a concern for the needs of students transferring between institutions within the UW System. For this reason, the UW System has established a uniform Systemwide Transfer Information System. A host Gopher machine has been placed at each UW institution, and standardized Gopher-based reference information is being established at each site for students to access remotely. At the end of Phase I, the TIS provides simple transferability and equivalence cross references between UW institutions. Subsequent phases will bring added user-customized intelligence to the system.

A companion to the Transfer Information System includes the Degree Audit System being installed at a number of institutions. This helps students evaluate their progress toward degree at their home institution, in addition to how they would fare if transferring to another UW institution.

The UW System has recently given formal commitment to standardizing on the SPEEDE national standard for electronic student transcripts and associated inter-campus processing transactions. This will help Wisconsin citizens with inter-campus transfers between UW institutions, as well as aiding in the students' holistic educational experience, by inter-connecting the student records at K-12 and technical college campuses.

An important basis for these consistent UW Systemwide student support services is the ongoing program for stewardship of "common systems." A common systems committee was established recently, to help identify and recommend those learning and information technology systems which should be established for uniform Systemwide usage.

More and more of the laboratory experiences of students is computer based. This lends itself to increased use of "virtual electronic laboratories" for some student instruction. As these labs become more automated, or simulated, it becomes more and more realistic to provide student access from off campus, from other campuses, and Systemwide. There is often a blurred boundary separating "instructional classroom system" from "virtual electronic laboratory systems." Some examples of these remotely accessible electronic laboratory experiences include: physiology of the ear and computer simulation of hearing losses; on-screen dissection of laboratory animals, with real time feedback on technique and student observations; experiments in musical composition; and language practice and style analysis.

However, while there is considerable progress being made in isolated, anecdotal cases of remotely accessible automated laboratory systems, there has not yet matured a critical mass of these systems to constitute a major percentage of such laboratory experiences required for the typical undergraduate. This is an area we are watching closely, and expect to see much progress in the future. While the advent of low cost live interactive video does offer some prospect of added remote access to (especially hostile environments) lab practices, the availability of truly unmediated remote access to automated lab experiences is still quite far off in many areas. Meanwhile, we will continue to pursue those areas of progress as they come into existence.

As in most other states, Wisconsin's leaders in government, business, and higher education have begun to expect significant improvements to equal access to education "any time, any place, in any form." However, it is likely that no state has a deeper, longer term tradition of commitment to support of the individual citizen. Wisconsin had the first public radio station. The first Public Service Commission in the nation was established in Wisconsin, reflecting the state's commitment to the social agenda of making public services equally available to each citizen. Few statewide multi-campus university systems have a separate institution, headed by a chancellor, dedicated to extension and statewide outreach.

This attitude of statewide equal service to all is reflected in "the Wisconsin Idea." This ideal holds that "the only boundaries of the University are the boundaries of the state." As such, the recent advances in telecommunications technology engineering, costs, regulation, and public expectation have found an extraordinarily fertile ground in Wisconsin. The primary budget initiative for the UW System in the current legislative appropriation cycle was for distance education, with aggregate funding requests totalling about $30 million. This initiative includes new building facilities, electronic systems for distance education, faculty support staff, course redevelopment funds, and funds for faculty development.

Meanwhile, a number of distance education telecommunications facility development efforts have already been organized and underway. Several UW institutions have joined or helped form regional distance education consortia with nearby K-12 and technical college campuses. The UW-Extension organization has re-allocated a major portion of ongoing funding to help establish a Systemwide distance education "common ground" network.

Finally, the UW System has begun to consolidate a number of the most consistent and uniform "backroom" administrative systems operations. The University of Wisconsin Processing Center was established recently, to provide Systemwide payroll, accounting, personnel and other automated services. This UWPC is governed by a board consisting of institutional business officers and also the UW System Office of Learning and Information Technology. It is expected that additional administrative operations which are done at the UW System Administration will be migrated to this consolidated processing center.

The Players: Who is doing this, and how?

How does all this tie together? First and foremost, we must recognize that the student's view of the university is one of the few which spans the holistic collection of our various components. While we staff and faculty inside the structure tend to see the institution in limited slices, fragmented by the organizational hierarchy, the student comes into direct contact with every major component of the university.

Therefore, one of the best ways to integrate the whole of our various information technology activities is to see the university through the eyes of our students ("customers").

However, besides this conceptual discipline, a more concrete forum is needed for stewardship of the whole of information technology. The UW Learning and Information Technology Executive Council was recently established. This LITEC's role is three fold: Systemwide plans, policies, and standards for information technology. LITEC was carefully designed to be program-driven, with cognizance of technological considerations. Therefore, LITEC membership includes users of information technology, in student services areas, business services, and libraries, as well as chief academic officers. In addition, membership includes information technology experts in computing, educational media, distance education, and library automation. Because of the close cooperation with other state agencies related to K-12, technical colleges, etc., those non-UW agencies are represented as well.

The nature of things in Wisconsin is such that the University acts in closer collaboration with peer state agencies than in most states. In addition, the telecom providers have taken a very proactive role in the state.

Wisconsin's Education Communications Board is charged with coordinating statewide telecommunications for all public education. Although the ECB's prime early mission focused on public broadcasting, recent expansion of the role of "telecommunications" in our public affairs has brought the ECB into even greater prominence.

In Wisconsin, the Department of Administration plays a very central role in procurement, contracting and aggregation of statewide telecommunications arrangements for education and other state agencies. The UW System is cooperating with the Department of Administration on a statewide project to redesign and recontract for most of the telecommunications in the state from roughly 1997 through 2005. This "Bignet" project is expected to consolidate a number of previously separate network arrangements, for which their respective technologies have begun to converge. This major statewide networking initiative is expected to involve about $150,000 over a five year period.

Wisconsin is served by about 150 telecommunications companies. Of these, Ameritech provides roughly 87% of the phone lines in the state, in 17% of the state's land area. GTE is second largest provider. The Wisconsin Independent Telecommunications Systems is an alliance of these numerous providers. Both WITS and Ameritech have begun to play a substantial role in the state, by virtue of a number of very progressive partnership initiatives, as well as in their interactions with State government in redrafting telecommunications regulations.

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Designing and Implementing a Network Architecture Before it Becomes Obsolete

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With the rapid advances in networking technology and the exploding demand for network access, resources, and services, Penn finds itself needing a new network architecture as it works to complete its present one! Through the work of a small but dedicated group, the campus is following a careful, structured methodology to develop its next-generation network. A partnership was forged among individuals responsible for major campus-wide client/server initiatives, representatives of the major schools, and the separate organizations responsible for telephony and data/video communications. To keep the campus community informed, World-Wide Web is used to publish not only finished products of the project, but work-in-process as well.

Introduction

Networking has changed significantly at Penn since the early days of Gandalf boxes and IBM 3270 terminals. It took decades for the telephone to be considered an essential instrument appropriate for ubiquitous deployment. In a mere twenty years, data networking has evolved to become as mission critical to the academic enterprise as any core piece of Penn's infrastructure. Consider:

> *Virtually every school at Penn uses the campus network, PennNet, in its teaching, from simple electronic messaging and conferencing to promote student-faculty and peer interaction, to entire electronic courses taught for credit. Faculty, however, often will not use the network during class presentations until it is as reliably as their overhead transparencies.*
>
> *Data communications are now essential to research in many, if not all, academic disciplines as a means to quickly exchange data or ideas, submit proposals to sponsors, or harness the appropriate resources for experimentation and inquiry. And research continues to push the envelope of technology every day.*
>
> *Telecommuting and mobility will become increasingly important to students, faculty and staff as the University seeks ways to become more energy-, environment-, and efficiency-conscious. Robust data communications, integrated with better telephony and video, will enable this location independence.*

But also consider that PennNet was never architected to provide services as reliably, quickly, or broadly as users have come to expect. To meet this challenge, the Network Architecture Task Force was charged in March, 1994 to assess the current state of data, voice, and video networking at Penn, and to make recommendations for changes to these architectures during a three to five year planning cycle.

Membership and Organization of Task Force

The Task Force is made up of individuals from across the University. One of its two chairpersons comes from the central computing group, the other is the computing director at one of Penn's major schools. This sense of partnership is critical to the success of the project, since PennNet is a campus-wide asset. The other members of the committee, while not selected for strict purposes of representation, represent a broad set of individuals from around the University with differing technical backgrounds. Two important criteria guided the selection: individuals either needed to have something concrete to contribute, or had something they needed to learn.

For perhaps the first time, the Office of Telecommunications, which is responsible for telephony at Penn and reports through a different Vice President than data communications, is a full participant in this planning process. The University's contract with Bell Atlantic for Centrex services expires during the course of the planning period, so the Task Force is examining options for its replacement. Other members of the committee include additional networking directors from other schools (Arts and Sciences, Wharton School), computing directors from other units (like the Library), as well as other individuals from various central computing departments (networking, academic computing services, central MIS group).

The Task Force was charged by Penn's Network Policy Committee, a subcommittee to the campus' computing advisory board. This committee not only receives regular updates, but is available to grapple with policy questions that have the potential to slow the Task Force's progress.

A small sub-committee of the Task Force was formed to craft the architectural alternatives (see methodology section below), since this step is best performed by a relatively small group initially with its work exposed over time to more and more individuals. The two co-chairpersons, along with the Manager of Network Operations and Manager of Network Engineering in the central networking department formed this sub-committee.

It is important to recognize the overlap with other efforts at Penn, and the coordination that is constantly required of the Task Force chairpersons. At Penn, the network architecture is seen as just one piece of a larger, inter-related architectural puzzle. Similarly, some sections of the network architecture are being developed primarily by other Task Forces and groups. Some relevant efforts include a recently-started DCE Task Force; our ongoing Project Cornerstone, which focuses on administrative systems and processes; Access 2000, our initiative in the area of library systems; and our E-mail Task Force, which focuses on a number of electronic mail, netnews, and office automation issues.

Technical Architecture Methodology

Network planners often believe they "know what is best" for the campus without bothering to ask. Many, in fact, have turned as conservative as the data center manager of the 1980's who safely bought "whatever IBM had to offer." In the 1990's, the once-"maverick" network manager is playing it "safe" by buying whatever CISCO and Cabletron have to offer.

Definition

A technical architecture is a blueprint for making technology choices. In the words of the GartnerGroup, it is a process and not a product. The crucial objective is to improve the performance of the enterprise. A technical architecture is *not* a platform from which to preach a certain methodology or justify a predetermined technical direction.

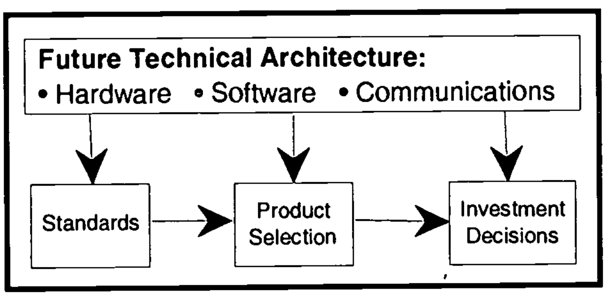

Figure 1 - **Components of a Technical Architecture**

Generally speaking, a technical architecture consists of the hardware, software, and communications components of an organization. From the architecture flows the standards (including policies and procedures), product selections, and ultimately the investment decisions of the enterprise.

Developing a Technical Architecture

According to the methodology being followed at Penn, four major factors are considered when developing a technical architecture:

- University Direction and Business Requirements - First and foremost, the technical architecture must satisfy the University's needs. It must support the University's academic and administrative objectives. Care needs to be taken not to deploy technology simply for technology's sake.

- Principles - The University has developed a set of principles, or beliefs, that together provide direction for information systems and technology. Project Cornerstone, Penn's multi-year effort to improve administrative information and systems, developed principles in the administrative domain. A set of principles which apply to academic information technologies is currently being developed. Generally, principles are meant to remain relatively stable, unless major changes in University philosophy or direction occur.

- Current, or *de facto* Architecture - Regardless of how it came to de deployed, the current, or *de facto* architecture is nonetheless the major starting point for any new architectural initiative. The existing architecture must be documented and understood, for both its strengths and weaknesses, before work on a new architecture can begin. The current architecture of PennNet , the University's telephony network, and the University's video network have been documented.

- Industry and Technology Trends - To assist in identifying the new architecture it is necessary to have a base of information about the technologies and industry trends that are both popular and emerging in the marketplace. Vendors, as well as experts and consultants, have been invited to supply this information via briefings and reports. The Task Force has been collecting and synthesizing this material from a number of sources:

    - Regular review of material from the GartnerGroup, the Internet and other sources.
    - Briefings from major network technology vendors, with an engineering rather than marketing focus, during the summer/fall of 1994, including Fore Systems, Cabletron, DEC, and AT&T.
    - Formal and informal exchange of information with experts and our counterparts at other institutions.

This set of data assists the team in developing a set of architectural alternatives which are presented to University management with a cost/benefit analysis and recommendations for implementation.

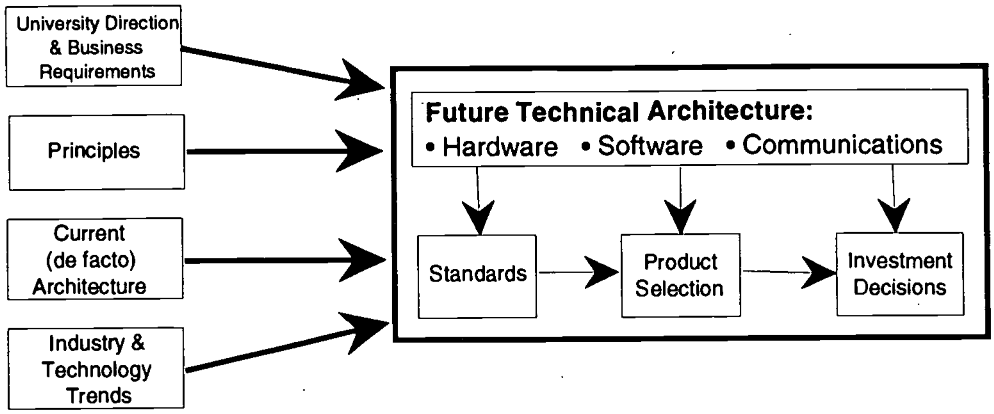

Figure 2 - **Developing a Technical Architecture**

<u>Scope of the Architecture</u>

The technical architecture is made up of a number of components. At Penn, the network architecture will not define every component at the same level of detail. It is expected for the current effort that data networking will be more developed than either voice or video. Other efforts will have to follow in these two areas to define their architectures in more detail.

Data networking will include models for both the physical networking topology (from Internet gateway to the desktop device) and the services that use that physical network (e.g., protocol stacks, LAN strategy, DCE, end-user networking products). From these models will flow the standards and supported product lists to be adopted campus-wide.

It is important to provide an architecture that enables access to the network and its services to as close to 100% of the University community as possible, while recognizing that a small percentage of aggressive users will likely require more sophisticated connectivity or services than the mainstream, and a percentage of less sophisticated users will be satisfied with substandard facilities.

The potential convergence of video, voice and data technologies is high on the minds of task force members. Relevant factors include:

- Increased digitization of services (versus more traditional analog implementations) leading to increasingly common media and wiring standards
- Arrival of multimedia technologies that will synchronize data, audio and video in a single application
- Increased interest in and use of video conferencing
- Increased potential and use for voice-response system integrated into traditional business applications
- Crossover in offerings beginning in the commercial marketplace among traditional data, voice and video providers

The Task Force is monitoring these developments and assessing their impact on the architecture.

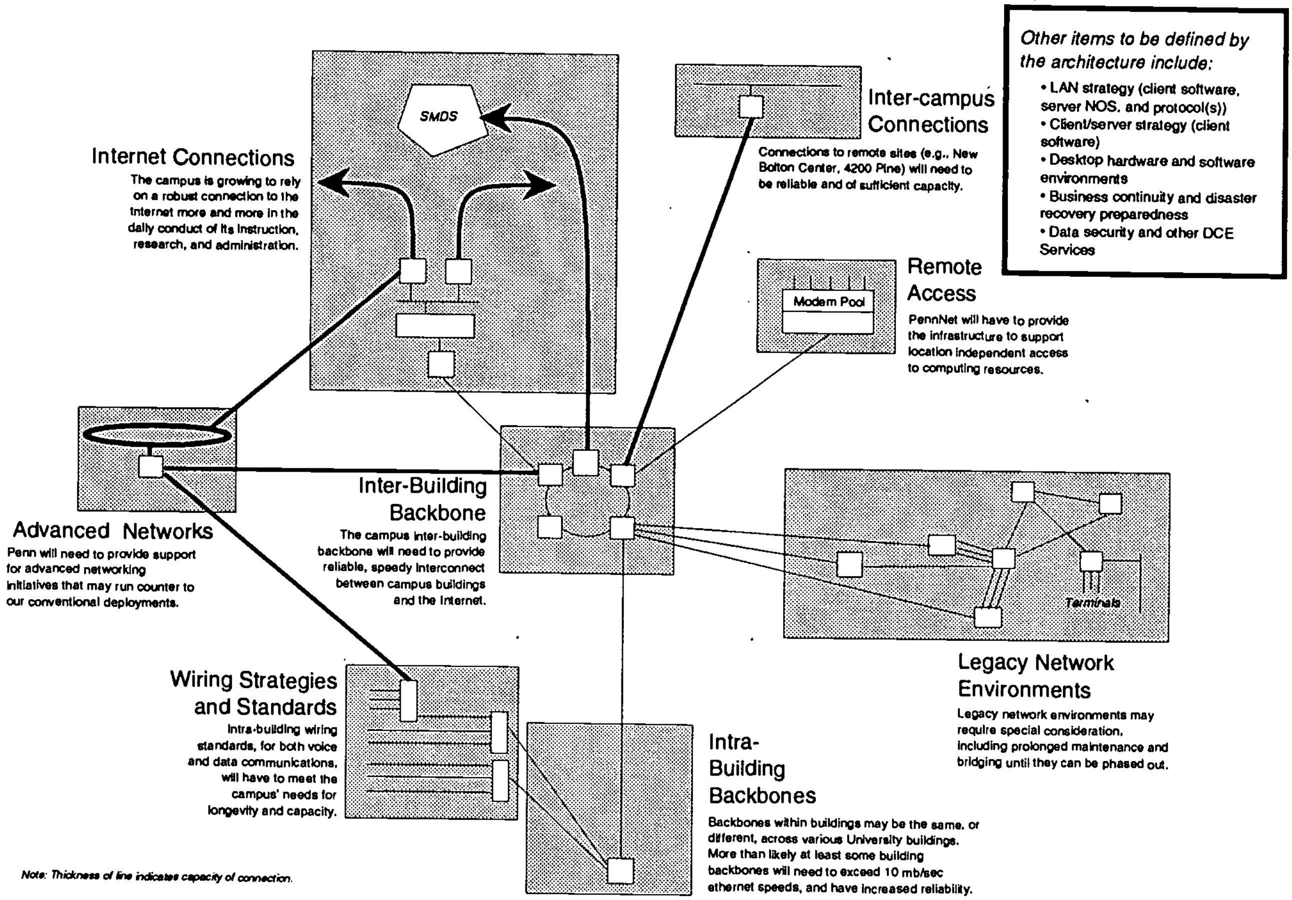

Figure 3 - **Network Architecture Template**

A template for the network architecture is found in Figure 3. The goal of the architecture effort is to define alternative strategies for each of these areas. Major components of the architecture include:

- Connection to the Internet and other wide-area networks
- Inter-campus backbone (e.g., New Bolton Center, Center for Judaic Studies)
- Inter-building backbone
- Intra-building backbone
- Wiring and media standards (e.g., wireless)
- Workgroup computing strategy, including appropriate client and server software, Network Operating Systems (NOS), and protocols
- Enterprise computing and communications strategy, including appropriate desktop software to be compatible with various enterprise-wide initiatives
- Institutional file system that might be required by workgroup or enterprise computing strategies
- Remote access strategy, for home and "on the road"
- Desktop hardware and software environments for networking
- Business continuity planning and disaster recovery preparedness
- Network information security, including network-wide authentication services
- Role of legacy network environments (e.g., ISN, terminal servers)

Developing and Articulating Needs

The Task Force spent considerable energy in an initial analysis of the campus' needs for networking technology and services. Wider discussion of these points is now required. While it is tempting to simply say "more *whatever* is better," the Task Force has attempted to be more precise in anticipating the campus' needs and describing those needs relative to each other. Two important points need to be made:

Elements out of Penn's Control	Elements, like the reliability and capacity of the Internet beyond the campus' boundary, that are out of Penn's control can have a substantial impact on users. Steps can be taken in some cases to either minimize Penn's reliance on these resources, or provide redundant or back-door methods of securing reliable service.
Test Bed for Experimentation	Given the rapid changes in information technology, and the rapid expansion of our collective knowledge base, Penn must be positioned to use new technology in an appropriate and timely manner for the greatest pay-back from the most prudent investment. Penn must have a formal mechanism for testing new technology for potential production use or campus-wide deployment

Figure 4 below displays a framework for understanding these desired network functions which are described below. The four core needs -- accessibility, reliability, capacity, and capability -- appear close to the center of the diagram. Their supporting needs appear around them. The main categories are defined as follows:

1. **Accessibility**: The ability to access network resources whenever and wherever desired. To use a metaphor from another utility, electrical power is available and accessible by-and-large whenever and wherever it is needed, and both the power companies and builders accordingly work together to anticipate and meet needs.

2. **Reliability**: The consistency and quality with which the network performs its tasks and provides its services. An important component of Reliability is the set of services that allow the network to be managed and that allow for prompt trouble-shooting and maintenance. We currently lack clear language that allows customers and service providers to even consistently understand what constitutes a network "outage" or "failure." We also lack clear measures that allow us to determine whether the network is living up to its expected or planned targets of operation, while recognizing that individual services provided by departments may become unavailable regardless of the state of the network.

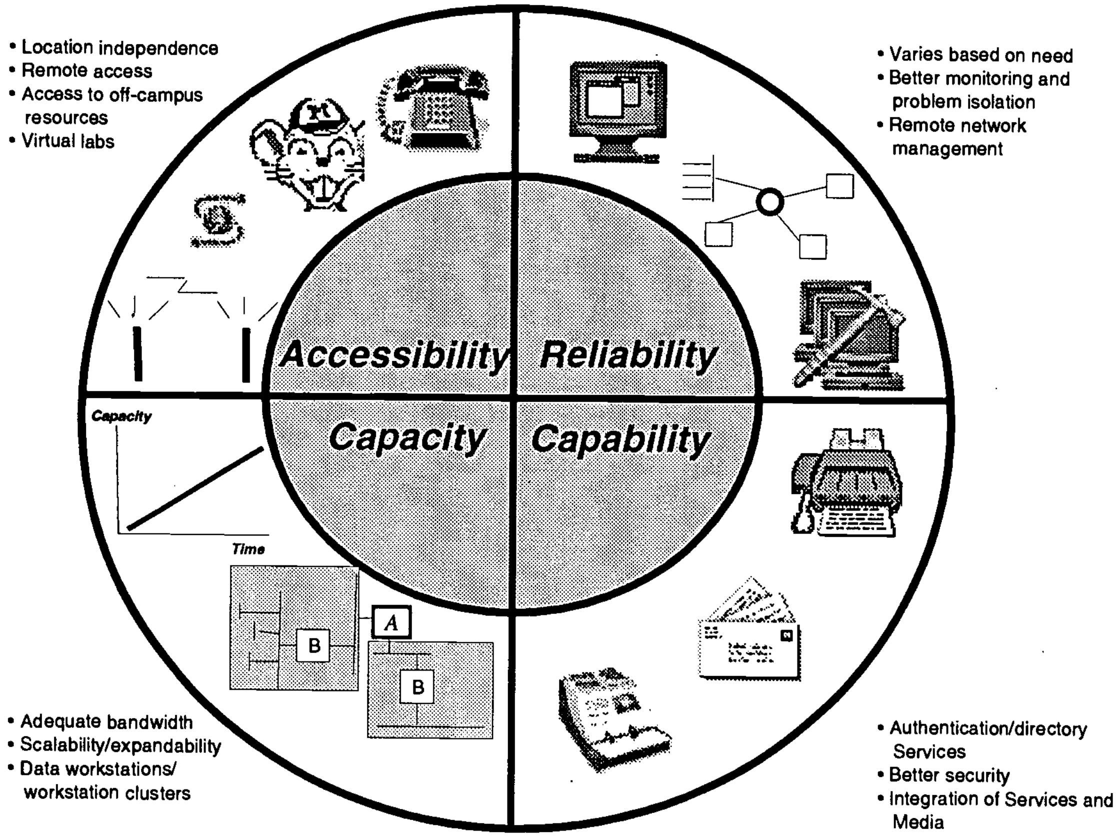

Figure 4 - **Desired Network Functions**

3. **Capacity**: If the network is thought of as a highway (or pipe), and bandwidth as its capacity for travel or use, the goal is to ensure sufficient ability to travel on or use this highway with an acceptable level of performance to complete a given operation. The new architecture must be sufficiently scalable to accommodate a connection for *everyone* while recognizing that new users will phase in over time.

4. **Capability**: Given sufficient capacity, the network must have the capability to support the necessary services. Authentication/directory services control access to network resources, and inform users about where to find those resources and other users. In an evolving multi-media world, PennNet must provide services using less traditional media, and recognize the convergence of traditional data, audio and video services.

Assumptions help to bound the set of possible architectures to a more reasonable set, and help focus the search for solutions. The Task Force developed a set of working assumptions that continue to evolve as the project evolves. Some examples include:

TCP/IP	TCP/IP will continue to be the enterprise-wide networking protocol. OSI protocol is not, and will not, become significant.

Higher Bandwidth to Homes	The choice of offerings of infrastructure to provide higher bandwidth to homes will become increasingly available during the planning period.
Dorm Connectivity	All dorms will be wired by the end of the planning period.
Bandwidth Demand	Demands for network capacity and services will continue to increase at a dramatic rate (estimated to be at least 50% per year) for the foreseeable future. Sudden increases in demand due to discrete events or new capabilities will require a quick response in added capacity to meet demand.
"Killer Apps"	"Killer Apps" (perhaps desktop video-conferencing?) will change network usage patterns in ways we cannot predict.
Inter-building Communication	The campus per-building subnet model still seems valid.

Developing Alternatives: "Myths" of Network Planning

Penn has found that a small group of individuals must work closely to develop alternative architectures. Using the template (Figure 3 above), a sub-set of the Task Force worked on brainstorming different levels of the architecture: inter-building communications, intra-building communications, migration strategies, etc. The vendor presentations helped to inspire critical thinking and visioning. Interestingly, these discussions highlighted a number of common misconceptions, or myths, about network planning in the 1990's:

Myth 1: Ethernet is Obsolete

It appears that ethernet has life in it yet, evidenced by the movement toward switched (versus shared) ethernet, and the likely dominance of greater-than-10MB ethernet over the next several years.

Myth 2: Network Electronics can "Trickle Down"

The market for network electronics is changing rapidly. It is common today to assume that these components have a useful life of three to five years, and that they can be migrated from sites requiring more aggressive solutions to sites requiring less aggressive solutions to prolong their life. Product lifecycles are shrinking quickly, and it appears that old network electronics, especially electronics that cannot be remotely managed, have no place in the infrastructure.

Myth 3: When in doubt, always lay fiber

The jury is still out on whether fiber to the desktop is necessary or even wise. The market seems to have embraced category 5 twisted pair copper wire as the standard, with potential for transmission speeds exceeding 100MB/sec on this wire.

Myth 4: ATM will dominate in the next few years

It is not clear how soon virtual circuit networks (like ATM) will become the new paradigm in networking. While virtual circuit networks support real-time services better than packet switching networks, they fail to run today's protocols robustly enough to support the large installed base of applications.

Myth 5: An Architecture can last for five years

Various components have very divergent lifecycles making network planning increasingly challenging. Product lifecycles are now measured in weeks and months instead of years. An architecture that takes too long to implement is destined to become obsolete before its time. It is useful to plot a technology migration path within which one is able to skip steps in order to minimize obsolescence.

These are just some of the issues the Task Force has struggled with, and about which, in some cases, has not yet reached a conclusion.

Building Consensus and Marketing the Architecture

A critical piece of the architecture process is building consensus as recommendations develop. Penn is an especially decentralized campus with strong, independent schools who will build their own infrastructures if they do not feel well-served by the central computing group. Additionally, the central computing group is ultimately dependent on the schools to fund its activities.

Technical architecture efforts face the double problem of needing to keep technical managers around the campus informed and up-to-date, while figuring out how to market the ideas to the financial and business managers who ultimately need to be "sold" on the need for the investments. It is common for managers, especially when the investments are big, to consider the problem "taken care of" after a one-time purchase. At Penn, the original network infrastructure was funded through a bond purchase whose repayment extends until 1999, though the equipment purchased is already obsolete. Managers must be educated to view investments in technical infrastructure as ongoing, evolving purchases.

The Task Force chairpersons decided to use the World-Wide Web as a vehicle for documenting the process and outcome of Task Force activities. Works in process as well as draft and final "products"of the task force are maintained in a WWW server available for wide viewing on campus and across the Internet. This goal of "full disclosure" removes any fear that a given constituency may have about not being included in the process - all they have to do is consult the on-line documentation and comment as appropriate. All meetings are announced in the Web. Agendas are made available before meetings, and notes are made available after meetings. All products of the task force are immediately available for comment, and are likewise accessible by vendors to assist them in preparing for technical sessions on campus.

The project became amazingly self-documenting. When it became clear that a traditional needs document was necessary to effectively explain the objectives and interim conclusions of the Task Force to the various advisory boards and business managers, it became very easy to make the leap from notes to a formal document since all the important information had already been electronically "published" via WWW. This step of marketing early to financial decision makers is critically important: first it is necessary to explain the project, then prepare cost estimates in ways they can understand.

Conclusion

Developing a network architecture is an ongoing process. Market pressures and short lifecycles make decisions about directions, standards, and products increasingly difficult. The key to avoiding obsolescence is to plan continuously, keep abreast of technology developments, and engage the campus whenever possible.

Penn is currently developing its architectural alternatives, building its cost model, and developing the necessary recommendations to present to the campus early in 1995. Progress can be monitored in the World-Wide Web with the URL **http://www.upenn.edu/ITI/it-initiatives.html**, Information Technology Architecture branch.

"Future-Proofing" Your Campus Network

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Skokie
Illinois

Brevard Community College has completed the installation of a structured cabling system that will meet the institution's voice, data, and video communications requirements through 2010.

By adopting the ANSI/TIA/EIA-568A structured cabling standard, institutions can maintain maximum reliability for the present and flexibility for the future, making the cabling system an asset that will outlive several generations of computing and data communications equipment.

This paper discusses:

- the benefits of a star topology structured cabling system.
- how the college developed its plan for using legacy coax, UTP, and multimode fiber media.
- the administrative issues surrounding installation of the system.
- communicating video over coax, STP, UTP, multimode and single-mode fiber.

STRUCTURED CABLING: A STRATEGIC ASSET

Development of a strategy for moving voice, video and data around campus is an important part of any institution's over all plan for information technology. Selection of the right strategy is not a trivial task to be relegated to the lowest bidder; this is the legacy one leaves to ones successor.

Spending time and other resources on selection of a structured cabling system makes sense because

- cabling is a long-lived asset that will out last several generations of software and electronics.
- cabling will facilitate or impede adoption of new high bandwidth communications services (whatever they may be).
- according to a Frost and Sullivan, 70% of on-premises networking problems are attributed to the physical layer (even though it accounts for just 5% of networking costs).
- cabling is geographically distributed around campus, making it difficult to troubleshoot and expensive to replace.
- schools rarely abandon facilities so they can derive full benefit from a long-lived investment.

The IT administrator's challenge is to handle many issues under uncertainty and under budget. These include the selection of media and access method and choice of a strategy to handle video, wide area network connection, and bandwidth crunches.

CABLING SYSTEM DESIGN SHOULD SUPPORT THE INSTITUTION'S MISSION

If money were no object, the obvious data network media choice for educational institutions would be fiber-to-the-desk. However, most educational institutions need to identify the least costly system that will support their mission.

For example, a research university or medical school would need hundred megabit bandwidth sooner than a community college. In contrast, students, faculty, and staff in the humanities are heavy users of productivity software that runs well at 10 Megabit per second (Mbps) Ethernet speeds. Distance education does not tax the capacity of the on-premises cabling system because the video teleconferencing system performance is constrained in the near-term by the wide area network links.

It makes sense to meet early with the facility planning administrators to identify buildings that need better than

Ethernet data speeds today or will be migrating to Asynchronous Transfer Mode (ATM) speeds in 3 or 4 years. ATM service will support voice, video, and data at rates of 25 to 622 (but principally 155) Mbps.

BREVARD COMMUNITY COLLEGE

Brevard Community College (BCC) serves approximately 15,000 students in degree programs on four campuses in central Florida. From term to term, 10,000 to 20,000 other people will take courses for enrichment and skills improvement. The college also The college provides affordable freshman and sophomore education and has certificate programs in the allied health professions and computer science and technology. Brevard County is the home of Cape Kennedy, so students and citizens expect ubiquitous access to technology.

DETERMINATION OF SYSTEM NEEDS

One recent project is the construction of a new library. In order to stretch its resources, Brevard Community College shares its library with the University of Central Florida and the Solar Energy project. The library is multimedia capable to permit use of all its resources by students on campus and in the community. Video materials are being encoded in MPEG files and moved onto a RAID storage. Work stations play back the video through Mosaic running under Windows NT version 3.5.

The library also offers Internet connections to the college community. Finally, students on and off campus can take courses through the college's educational TV station, which is transmitted among the four campuses over microwave.

Across much of the campus, computer applications, both current or anticipated in the next two years, are text-based productivity applications, so the campus is Ethernet now. In the library, however, the system needs to support video/media teleconferencing for remote reference assistance. Brevard is installing switched 100 Mbps Ethernet in 1995 to support the video/media teleconferencing under TCP/IP.

DESIGNING STRUCTURED CABLING SYSTEM

The cabling system design for the library was started after the architect had the building design well underway. The designer, a consultant with Florida's College Center for Library Automation (CCLA), which is networking Florida's 60 community college libraries, was forced to take some relief do to the placement of the wiring closet. The college had decided in 1990 that all new communications networks must conform to a structured cabling standard.

ANSI/TIA/EIA-568A, THE STRUCTURED CABLING STANDARD

The Electronic Industries Association (EIA), its affiliate, the Telecommunications Industry Association (TIA), and the American National Standards Institute (ANSI) have developed standards for structured cabling systems for use in commercial and other enterprises. The standard, known as ANSI/TIA/EIA-568A[1], is recognized as the specification upon which cabling systems and components are designed[2].

The standard dissects the cabling system down into six distinct subsystems:

Entrance facilities	Equipment room
Backbone cabling	Telecommunications closet
Horizontal cabling	Work area

Three cabling system choices for building premises media in both the backbone and horizontal subsystems are: unshielded twisted pair (UTP); 150 ohm shielded twisted pair (STP), commonly known as the IBM Cabling System; and optical fiber[3].

Each structured cabling system possesses particular bandwidth capability. The committees responsible for developing application standards, generally the Institute of Electrical and Electronic Engineers (IEEE) and ANSI, work within these bandwidth limitations when designing their applications and encoding schemes.

New applications are designed based on the standards for the physical layer. This provides benefits for both the developer and the user. The developer knows that a large installed base can economically purchase his or her products; the user knows that new products will run on the cabling system in place.

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[1] The current (December 1994) standard is actually ANSI/EIA/TIA-568. In very early 1995, this standard will be replaced by ANSI/TIA/EIA-568A, so this designation is used here.

[2] John Crandell, "Built for Speed and Built to Last" (LAN Computing, June 1994).

[3] EIA/TIA-568 Standard: A Reference Guide to the Commercial Building Telecommunications Cabling Standard (Skokie: 1994), p. 8.

Star Topology and System Components

The physical layout of the system can also impact its long-term utility. A star cabling topology can be used in both the backbone and horizontal subsystems. This topology is quite common in the horizontal cabling but not necessarily in the backbone.

The star topology in the horizontal simplifies moves, adds, and changes, trouble shooting, and management. The benefit of star topology in the backbone is that, through the use of network segmenting equipment like routers, the network can be more easily controlled and administered from one central point.

This is key especially as schools move from Ethernet to switched Ethernet and ATM, which are based on a switching hub concept.

ANSI/TIA/EIA-568 is an Evolving Standard

In 1991, the EIA/TIA-568 standard described UTP (for data use up to 16 MHz, called Category 3) , STP, and multimode optical fiber (commonly known as FDDI grade fiber). Later in 1991, Category 4 and Category 5 UTP (for data use up to 100 MHZ) were described in Technical System Bulletin (TSB) 36. In 1992 and 1994, Category 4 and 5 connecting hardware and patch cabling standards were described.

In early 1995, expected changes include introduction of higher performance STP-A and single-mode fiber. Legacy 50 ohm thinnet and thicknet coaxial cabling for horizontal and backbone cabling for Ethernet will be "grandfathered in" in the 1995 standard.

BENEFITS OF STRUCTURED CABLING

Structured cabling saves money and increases system performance. The cabling system is independent of communications services (listed below), thus allowing an institution to migrate from AppleTalk to Ethernet to ATM as applications demand, without changing the cabling.

Voice	SNA
Ethernet	100 Mbps Ethernet
Token Ring	FDDI
AppleTalk	ATM

SELECTION OF MEDIA: UTP, STP, OR FIBER

Media selection involves a high degree of uncertainty because replacement of cabling in place is expensive and disruptive. How is one to make a reasoned choice when ten years equals two technical generations? Although we cannot see over the technical horizon, we know that certain laws won't be repealed. Some are laws of physics, and some are laws of economics.

The laws of physics show that although fiber is technically superior to UTP in almost every way, UTP supports ATM, the next major networking scheme.

UTP is currently the most popular media used in business. The developers of software and hardware will make products for the information superhighway aimed at large, profitable markets like business. If an educational institution's cabling system is similar to a business's, equipment will be available to the institution at competitive prices.

UTP: Supporting Services From Voice to ATM

The acceptance of UTP cabling for Local Area Networking (LAN) was a watershed event. Ethernet running over coaxial cable was victim to installation, maintenance, and management problems, and Ethernet was losing ground to Token Ring as the access method of choice. The adoption of the 10Base-T Ethernet standard helped give Ethernet new popularity.

The telephone world has used UTP since the turn of the century, so telecommunications administrators are familiar with its design and installation. The 10Base-T standard nurtured the move to wiring concentrators or hubs, with all the performance, cost, and management benefits they bring.

The ANSI/TIA/EIA-568A standard categorizes UTP by its electrical properties and applications.

Category	Test Frequency	Application
3	16 MHz	Voice and data applications to 10 Mbps (Ethernet; Manchester encoding)
4	20 MHz	Data applications to 16 Mbps (Token Ring; Manchester encoding)
5	100 MHz	Data applications to at least 155 Mbps (ATM; multilevel encoding)

Categories 1 and 2 are not recognized by ANSI/TIA/EIA-568A and are used for plain old telephone service (POTS) and for low speed data communications, respectively.

New data encoding schemes allow unshielded cable that has been tested to only 100 MHz to support ATM at 155 Mbps. Whereas Ethernet and Token Ring use an encoding method that communicates one bit per hertz, ATM uses encoding schemes that communicate multiple bits per hertz. Therefore, ATM will be able to communicate 155 Mbps at working frequencies of 32 or 78 MHz over category 5 UTP.

It is important that the cabling and associated components all provide equivalent performance. A structured cabling system is like a chain, and overall system performance is limited to that of the weakest link. In order to have the system perform at the desired level, connecting hardware that meets TSB 40 specification must be used and installed per instruction. Sloppy installation causes a Category 5 system to perform at Category 3 level.

UTP cabling is a natural for horizontal cabling with its ability to support voice as well as data. Its use in the backbone is permitted, but electrical properties limit its distance to 90 meters and its bandwidth is much narrower than fiber, coax, or STP. You can buy Category 5 twenty-five-pair backbone UTP, but Category 5 high density connectors are not yet available.

STP-A: The Best Copper Cable and Proof that Structured Cabling Works

The 150 ohm STP-A has superb electrical properties due to its heavier wire gauge size (22 AWG vs. 24 AWG for UTP) and its shielding. Both the cabling and its connectors are tested to 300 MHz.

Although it is not reflected in the standard, STP can support Ethernet and Token Ring at distances up to 150 meters. In addition, with the correct video baluns, STP-A can carry 550 MHz of broadband video concurrently with data on 16 Mbps Token Ring.

Because of its cost, size and rigidity, STP-A is not common in educational institutions outside of the mainframe computing environment or where the institution was an early adopter of Token Ring.

STP does, however, prove the efficacy of structured cabling. An IBM Cabling System (tested to 20 MHz) installed by the far-sighted ten long years ago in 1984, will probably support tomorrow's 100 Mbps Twisted Pair-Physical Media Dependent, or Twisted Pair Distributed Data Interface (TP-PMD or TPDDI) and ATM. One manufacturer warrants their earlier design product to carry ATM.

Fiber: In the Backbone and Riser and for Near-term Highest Speed Data

The rapid growth of fiber optic cabling installations on campus is due to fiber's technical superiority over copper cable in almost every aspect. The obstacles to a fiber installation used to be the craft sensitivity of the connections and the cost of the electronic components. Thanks to training and better component design, fiber is now in many ways easier to install than twisted pair cabling, and small projects are undertaken by college personnel. And electronic component prices are falling. Fiber makes both economic and technical sense in the campus environment for backbone and riser applications.

Fiber is vastly superior to copper cabling in terms of bandwidth, attenuation (distance), immunity to electromagnetic and radio interference, security, strength, and weight. Because two of the four campuses are spread over large sites, and because Florida has truly spectacular lightning displays, fiber was indicated for all inter-building communications.

Multimode fiber's bandwidth is 500 MHz-km, which provides the advantage of hundreds of megabits of data over several kilometers. Although its laser-based electronics are more expensive than those for UTP or multimode fiber, single-mode fiber has a bandwidth of hundreds of gigahertz-km, giving it capacity to do both high speed data and broadband video over long distances. The telephone companies use single-mode fiber to achieve data transmissions rates up to 2.48 gigabits per second.

Although the ANSI/TIA/EIA-568A standard limits multimode fiber to horizontal cabling distances of 90 meters, this is under review as electronics vendors' specifications indicate fiber will actually perform at distances of two or three kilometers.

It is good practice to include single-mode fiber when multimode fiber is being installed as a backbone especially between buildings. The marginal costs for adding single-mode fiber in a composite cable, adding many gigahertz of capacity, are very small.

Coax: For Broadband Video This Year

Video can be carried baseband (one channel's worth of video on one cable) or broadband (multiple channels on a single cable). At this time, while baseband can be carried over UTP, STP, coax, and fiber; full broadband video is limited to STP, coax, or single-mode fiber.

If you have a need for channel switching in the dorm room, classroom or office, enhanced performance Category 5 UTP, with appropriate baluns, can carry up to 26 channels of video over short distances of 100 meters or less. STP with special baluns or coax will carry 80 or more channels. Although single-mode fiber has the bandwidth to carry hundreds of channels, the sending and receiving electronics are still prohibitively expensive.

Multimode fiber carries just four channels before compression. Category 5 UTP carries one channel up to 400 meters with special baluns. These alternatives make sense if one does channel switching remotely.

SELECTION OF SPECIFIC CABLING FOR SPECIFIC AREAS

Fiber's advantages offer the greatest payoff in the backbone and the riser, but UTP's flexibility, low cost, and ability to handle voice indicate its use in the horizontal.

Application standards for UTP cabling systems usually express performance requirements in terms of a minimum Signal-to-Crosstalk Margin (SCM) requirement, also called Attenuation to Crosstalk (ACR), which takes into account signal loss and interference (near-end crosstalk or NEXT). The minimum SCM requirements are set based on the needs of sending and receiving electronics for signal strength and clarity.

There are Category 5 UTP cables available from several vendors that significantly exceed the NEXT requirements of ANSI/TIA/EIA-568A. The allowable values in Annex E of the standard call for a difference of greater than 10 dB between the attenuated signal and the interference caused by NEXT talk. These enhanced Category 5 cables provide an additional 12 dB of margin. The additional "headroom" insures that the system will perform even if real world considerations impinge on the installation.

IMPLEMENTATION ISSUES

EIA/TIA-569: Some Place for the Cabling

The structured cabling standard assumes that the buildings meet the requirements of EIA/TIA-569, the architectural standard for spaces, raceways, and wiring closets. Older buildings force compromise, but all new construction and renovation should adhere to the EIA/TIA-569 standard.

There is room to take relief in some parts of ANSI/TIA/EIA-568A, and there are no TIA/EIA police, but variances increase the probability that the system will not be able to accommodate some new communications technology in the future.

The consulting engineer should specify that the TIA/EIA-607 standard for grounding be closely observed. Grounding problems may cause the communications system to no work at all, or worse yet, may cause intermittent failures or safety problems for people and equipment.

Installation

One reason that businesses and institutions have adopted UTP is its ease of installation. A contractor must observe UTP's 25 pound tension limit, minimum bend radius, and termination instructions. Failure to do so increases NEXT and attenuation and reduces available bandwidth.

Fiber cable is more forgiving during pulling, supporting 200 pounds in tension and being easier to terminate than it used to be. However, care is still required to keep connections within their 3/4 dB loss budget.

Testing: Getting Your Money's Worth

Since potential sources of problems are spread across campus, hidden in conduits and behind faceplates, testing each end of each link or segment ensures you get what you paid for.

The testing standards for Category 5 UTP have not been finalized, so institutions depend on tester manufacturers to have the latest values from Annex E of ANSI/TIA/EIA-568A, which will be released as a TSB in 1995, programmed into the test device. So long as the principal performance parameters of continuity, NEXT (from both ends), attenuation, and return loss are tested and recorded, the institution can reasonably assess the quality of the installation and will have a baseline for future maintenance[4].

As current uses like Ethernet and voice communications use only a fraction of the cabling's capacity, testing and warranties protect the school through the delay between cable installation and the initiation of ATM service.

EIA/TIA-606: System Administration

Once the cabling infrastructure is installed, the system will become disorganized unless energy is expended on its maintenance. Label all terminations (both in the closet and at the information outlet) and document all runs and subsequent moves, adds, and changes.

The EIA/TIA-606 Administration standard describes a color coding scheme for the cross connect field labels and guidelines for record keeping. In addition to the EIA/TIA-606 color scheme, manufacturers offer cables and components in many colors. Unless there is consistency across the campus installation, all this color will lead to confusion instead of reducing it.

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[4] Mike Longo, "Practical Considerations of Structured Cabling Installation" (Un-published paper).

BUYING THE STRUCTURED CABLING SYSTEM

Getting Technical Assistance

While the ANSI/TIA/EIA-568A has gone a long way toward simplifying the area of structured cabling systems, it does not take into account additional considerations such as structured cabling system choices, network applications, configuration issues and financial considerations involved with selecting a system. Design can be done in-house as it was at BCC, by a consultant, by the integrator, or a structured cabling vendor.

Long-term Warranties

After the general design was complete and specific products chosen, Brevard sought a vendor and a contractor who could offer installation with a 15-year warrantee. Given the service life needed from the system and the fact that capital funding is sporadic and maintenance funds are tight, the college elected to reduce risks wherever possible and to cable just once. Several vendors offer long-term performance warranties. Even with the time value of money over 15 years, the college decided to take the warranty.

RECOMMENDATIONS: WHAT WE LEARNED.

1. Bring decision makers and stakeholders into the planning process early.
2. Spend sufficient management attention and resources on the structured cabling system.
3. Adopt the ANSI/TIA/EIA-568A series of standards to reduce the chance of obsolescence.
4. Unless distances or near-term applications require the bandwidth of ATM before ATM is available at popular prices, use UTP in the horizontal.
5. Use multimode and single-mode fiber in the backbone and riser for distance and bandwidth, especially between buildings.
6. Get a warranted installation.
7. Test each circuit from both ends and document the results.
8. Adopt an automated process for administering the cable network.

MULTI-NETWORK COLLABORATIONS EXTENDING THE INTERNET TO RURAL AND DIFFICULT TO SERVE COMMUNITIES

Dr. E. Michael Staman, President
CICNet, Inc.
Ann Arbor, Michigan

PREFACE:

The Rural Datafication presentation was based in large part on Dr. Staman's recent testimony before the US House Committee on Science, Space, and Technology. The following is the written text of the testimony.

Committee on Science, Space and Technology
U.S. House of Representatives
Washington, DC
Hearing on The Technological Transformation of Rural America
July 12, 1994

Testimony of:
Dr. E. Michael Staman, President
CICNet, Inc.
Ann Arbor, Michigan

Mister Chairman and members of the Subcommittee:

Your invitation to participate in today's hearing came during a time when we at CICNet have increasingly found ourselves engaged in a number of forums discussing rural America's access to the National Information Infrastructure (the NII). Thank you for the opportunity to discuss theseissues in with you.

The growth of both the number of users and the applications of the Internet (that element of the NII which is available and working effectively today) has astounded even those of us who have been its most optimistic proponents for many years. It has grown from a resource used primarily by the research and education sector as recently as five years ago to a significant force within the nation's business sector today. It will become a major element of our global competitive posture within the decade.

Perhaps the best way to clarify its status at present is to quote directly from the July 7th, 1994 issue of *USA TODAY*:

"Across the USA, thousands of companies are tapping into the mother of all computer networks -- the Internet -- to find job candidates, communicate with customers, work out technical problems and peddle their wares. ... Having an Internet address is rapidly becoming a requirement for doing business, ..."

As with the deployment of all national infrastructures in the history of this nation, we need to insure that all citizens participate fully in both the evolution and the promise of this new resource. Its potential to transform the way we work, communicate with each other, and even enjoy portions of our leisure parallels the potential of virtually every other massive infrastructural change, whether it was the development of the railroads in the early 1800's, the electrification of urban areas in the late 1800's and rural areas in the mid-1930s, the establishment of telecommunications connections in the late 1800s, or the development of urban and interstate transportation in the early to mid-1990s.

My comments today will focus on barriers to access to the NII that exist within rural America, and on several key initiatives needed to further encourage and enhance rural acceptance and use of the NII. For the record, I have submitted several additional documents which might be of interest to the committee. Specifically:

1. A paper discussing CICNet's Rural Datafication Project. This project has been funded by the National Science Foundation.

2. A report on CICNet's second annual conference on Rural Datafication. These conferences, the most recent of which involved approximately 350 people, literally from around the globe, has become one of the key forums at which people gather to discuss problems related to extending and using the National Information Infrastructure in rural America.

3. A working paper discussing several of the issues which we believe to be of critical importance as the nation continues its evolution to a National Information Infrastructure.

4. A document containing the full text of my report in response to your invitation to present testimony, from which my comments today will be drawn.

So that my comments might be presented in the correct context, I need to begin with a description of my organization, CICNet, and CICNet's owners, the major research universities throughout a portion of the midwestern United States.

THE COMMITTEE ON INSTITUTIONAL COOPERATION

The "CIC" in CICNet stands for "the Committee on Institutional Cooperation," a thirty- five year-old collaboration among the following universities: the University of Chicago, the University of Illinois at Urbana-Champaign, the University of Illinois at Chicago, Indiana University, the University of Iowa, the University of Michigan, Michigan State University, the University of Minnesota, the Pennsylvania State University (the most recent member), Purdue University, the Ohio State University, Northwestern University, and the University of Wisconsin-Madison. There are over 75 separate and unique collaborations currently operating under the aegis of the CIC.

These institutions serve the region and the nation on a truly impressive scale. Collectively they account for more than 17% of the Ph.D.'s awarded annually, approximately 20% of all science and engineering Ph.D.'s, in excess of $2.5 billion in externally funded research annually, and over 17% of the holdings of the Association for Research Libraries. With an aggregate total in excess of 500,000 students, 33,000 faculty, and 57 million volumes within their libraries, these institutions are truly a resource which consistently enhances both the quality of life and the global competitiveness of both their region and the nation.

In 1988, CICNet was founded as a CIC not-for-profit corporation to provide inter-institutional CIC-university network infrastructure and network access to the National Science Foundation Network (NSFNET). Today, in addition to all of the CIC universities, both Argonne National Labs and Notre Dame University participate in CICNet Board of Director activities. As part of the CIC community of activities, CICNet is now part of the infrastructure providing NSFNET connectivity to over 400 colleges and universities, commercial or other organizations throughout its seven-state region of operations. A recent study indicated that approximately 20% of the traffic on the United States Internet backbone (NSFNET) came from throughout the CIC region. Given the above, and the rural community and economic development activities that are part of the mission of many of the CIC-universities, it should be of little surprise that these universities would encourage CICNet to move in directions designed to increase both NII access and services for rural areas.

RURAL DATAFICATION IN AMERICA

Several years ago CICNet, in collaboration with NSF-sponsored networks in eight states ranging from New York to Iowa, was awarded $1.3 million by the National Science Foundation to conduct a project that we entitled "Rural Datafication." The intent of the project is to find ways to create Internet infrastructure and services in difficult-to-reach and difficult-to-serve user communities. It was, and is today, the only project of its kind in the nation -- focusing on strengthening the ability of state networks to deliver services to rural communities while simultaneously attempting to develop workable solutions which scale to vast geographic regions and huge user populations. The state networking organizations now participating with CICNet in rural datafication activities include INDnet (Indiana), IREN (Iowa), MICHNet (Michigan), MRnet (Minnesota), netILLINOIS (Illinois), NYSERNet (New York), PREPnet (Pennsylvania), WISCnet (Wisconsisn), and WVnet (West Virginia).

During the course of the project we have been in contact with citizens from throughout the nation, held several national and regional conferences focused on rural access and services to the NII, and participated in forums on the topic in Minnesota, Oregon, West Virginia, and Iowa. We have learned a great deal during this process. I would like to discuss four of the most important topics with you today.

I have entitled the first topic "common themes." There are common themes which occur whenever the topic of access in rural America is discussed. They focus on the need for equal and affordable access for all citizens, the need for pro-active community and economic development strategies based on telecommunications technologies, the creation of enhanced training and support for the large percentage of the population which has yet to understand the potential of an NII, the development of improved information services which both serve and stimulate communities as they contemplate the promise of the NII, and the need to insure that somehow rural America participates fully in the services which will be made available via the NII.

This last "theme" is particularly critical, and is not well understood either in rural America or in Washington. As the "superhighway" increases in capacity, steps must be taken to insure that same capacity is available throughout the land. Polices or practices which create high performance, robust infrastructure in urban areas or within selected segments of our nation while simultaneously creating low-speed, low-performance infrastructure in the remainder will actually serve to exacerbate an existing problem of "information haves and have nots."

It is becoming clear that, marketing and public posturing to the contrary, depending only upon market forces to deliver high-quality, supported, information infrastructure and services to rural America will result in both a long period of time for such services to become available and a further exacerbation of the problem. The worst thing that we can do is "wire 'em for dial access" and proceed to install fiber-based infrastructure only in locations where market forces (read, return on investment) would normally justify such investments. We are not yet at a point where market forces will best serve our national agenda of equal access for all citizens.

The second topic that I would like to discuss with you is best described as "the uniqueness of unique-user communities." While somewhat obvious if one were to think about it for only a moment, this topic is of interest to rural America because there is little in our public policy which seems to recognize its existence and importance. Actual uses of the information and services which are available even today via the network turn out to be different for different communities. That is, like all infrastructure and all communities of users, the needs, goals, and uses to which the NII will be put by groups such as the native American community are vastly different from those of, say, the agricultural community, public libraries, K-12 education, youth groups, small businesses and the like.

Understanding these differences and developing strategies accordingly will accelerate the time when the promise of the NII becomes real for these communities. Such an effort will require the involvement of our universities, the communities involved, and the government. A critical element of any initiative in this area is the support and services that can be provided by the nations NSF-sponsored mid-level networks.

The third topic is "local ownership." Ownership of the problem by those most directly affected -- the nation's towns, communities, and their concomitant citizens' groups -- combined with the now rapidly evolving groups of "virtual communities" -- is critical to the success of the NII. There is probably not, nor should there be, sufficient discretionary revenues within the coffers of either our states or the federal government to meet the needs for the kinds of high-performance infrastructure that will ultimately be required by every city and town in America, and the absence of such infrastructure to the edge of any community will inhibit the development of appropriate infrastructure within.

By creating strategies which cause local ownership we will enhance local investment, creating a dynamic which will hasten the day when the NII is truly part of the fabric of the nation. There is little doubt that such local ownership will result in better and more appropriate solutions at the local level, and that solutions developed and funded locally will be more effectively used than something developed without local involvement or investment.

We should be careful not to confuse the messages of affordable access and suitable capacity in Topic #1, "common themes", and the "local ownership" theme of Topic # 3. To accelerate the evolution of an NII which extends not only to every city and town, but also to individual homes and businesses, we must BOTH insure that our telecommunications carriers deploy adequate infrastructure to support NII applications AND create strategies which cause communities, their citizens, and local businesses to experiment with and understand the power and potential of an NII. While seemingly a delicate balance, accomplishing both goals will accelerate the immediate uses of existing infrastructures and community interest in investing as new infrastructure becomes available.

The final topic involves "building on existing efforts." We should not forget or ignore the fact that there are already, and in some cases have been for many years, ongoing efforts at community development using whatever technologies are available. For instruction in the problems and successes related to these initiatives one need only contact individuals at places such as Eastern Oregon State College, which is attempting to serve citizens resident in some 42,000 square miles, West Virginia University, which contemplates training some 2000 teachers in the use of the Internet during the next three years, or Virginia Polytechnic and State University, which is using its "Blacksburg Electronic Village" project as an endeavor to bring the entire citizenry of a single town into the NII movement. At CICNet, a "Building Electronic Communities" project is attracting inquiries from around the world, and one can now find initiatives similar to those above in many pockets throughout the land. Their hallmarks are the involvement of volunteers, universities, usually some state or federal involvement, and sometimes (but, unfortunately with increasingly less frequency) mid-level networks.

We have examples and models upon which we can build, and whatever polices are developed should encourage and enhance initiatives such as those cited above.

POLICY IMPLICATIONS

Both he NII goals of the current administration and NII services to rural America can be accelerated by several important policy initiatives. Initiatives are required which guarantee affordable access, stimulate the expansion of capacity at the local level, and create local leadership and ownership of this new and unique resource. In the process, market forces need to continue to evolve naturally while, simultaneously, initiatives are developed which stimulate enhanced volunteerism, the continued role of our universities, and the contributions of the not-for-profit mid-level computer networks. I have recommendations in three areas: pricing, infrastructure, and services. Specifically, the following should be created:

1. An environment in which access will be affordable for all citizens. In the process of creating such an environment, avoid usage sensitive or time-based pricing. Citizens will, I believe, pay a fair price for volume (flat rate proportional to available capacity), but experimentation and innovation, two critical elements in creating an environment

in which we can realize the promise of the net, will experience a premature and tragic demise if discouraged by the burden of usage-sensitive pricing.

I would like to carefully place this recommendation in context. The NII will grow to encompass the cables coming into people's homes, and they will want to buy movies and other services across the NII. It is only reasonable that they pay the going rate for each of these services. But what is most critical is that the following three elements are maintained: flat-rate charging for basic access to all network services, such as those now on the Internet that are free; freedom from any bundled extra services included by the carrier in the price; and freedom to pick and choose services offered by vendors across the network, and to pay for them directly to the vendor, with no involvement by the carrier.

2. An infrastructural environment in which communities can and will assume ownership of their elements of an NII fabric. This is important because there are clearly insufficient financial resources to develop federally funded infrastructure to every city and town in America. Modest community and economic development programs which have as their foundation the same imagination and leadership shown by the National Science Foundation when it created the "Connections Program," however, will stimulate significantly community involvement and the investment required to make a full NII a reality. At the individual community level the initial investments necessary for proof-of- concept and demonstration activities are not large, and I believe that modest stimulation via federal programs will both create the initial investment and ownership, and larger local investments as local leadership and citizenry begin to realize both the promise and potential of the NII.

3. A services environment in which those organizations which choose to continue to foster and develop community and economic development can do so with renewed vigor and strength. Volunteerism, the role of not-for-profit organizations, the very special activities of organizations such as Eastern Oregon State College and the CIC universities, and the unique contributions that can continue to be provided by many of the nation's mid-level networks must be preserved if rural America is to realize the promise of a national information infrastructure.

Finally, and perhaps most important, we need to create an environment in which local communities can and will create services of their own. Services such as community information servers, structure providing access to health care information, activities to create virtual electronic communities of interest which encompass and then extend beyond local communities to a global environment, and initiatives which bring the digital library and other globally-based information resources to the desktops of individual citizens represent the promise of the National Information Infrastructure. We should never lose sight of these goals as we work very hard to make the NII a reality and a sustainable resource for the nation.

I believe that our government has an opportunity transform America in ways which parallel the transformations resulting from the Rural Electrification Act of 1936. I would like to close with a quote which I have used in other publications. It describes that impact much more eloquently than any which I could develop on my own.

"As late as 1935 ... decades after electric power had become a part of urban life, the wood range, the washtub, the sad iron and the dim kerosene lamp were still the way of life for almost 90 percent of the 30 million Americans who lived in the country-side. All across the United States, wrote a public-power advocate, "Every city 'white way' ends abruptly at the city limits. Beyond lies darkness." The lack of electric power, wrote the historian William E. Luechtenberg, had divided the United States into two nations: "the city dwellers and the country folks"; farmers, he wrote, "toiled in a nineteenth-century world; farm wives, who enviously eyed pictures in the Saturday Evening Post of city women with washing machines, refrigerators, and vacuum cleaners, performed their backbreaking chores like peasant women in a pre industrial age."
... from a description of the US before the Rural Electrification Act of 1936. (Robert A. Caro: The Years of Lyndon Johnson: Path to Power, Vintage Books, 1981, p. 516.)

Our opportunity and our responsibility are both clear. Thank you, again, for the opportunity to participate in this forum. I stand ready to provide additional information today and, of course, will respond to similar requests in the future.

E. Michael Staman

July 12, 1994

ATM: Reality or Pipe Dream

Douglas Gale
Guy Jones
University of Nebraska-Lincoln
Lincoln, Nebraska

Martin Dubetz
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St. Louis, Missouri

Abstract

Since the early 1980s, campus networks have generally been based upon shared backbones. In this paradigm, traffic from individual users is aggregated on backbone networks and each user gets a share of the backbone bandwidth. That paradigm is rapidly becoming inadequate to meet growing user demands.

This paper describes the strategies developed at Washington University and the University of Nebraska-Lincoln to transition our campus networks to Asynchronous Transfer Mode or ATM technology.

Paradigm Shift

Since the early 1980s, campus networks have generally been based upon shared backbones. In this paradigm, traffic from individual users is aggregated on backbone networks and each user gets a share of the backbone bandwidth. That paradigm is rapidly becoming inadequate to meet growing user demands.

While the original motivation to move towards higher speed "broadband" networks was new applications such as multimedia and client server, those applications have happened more slowly than anticipated and the current motivation for broadband networks is traffic aggregation and LAN interconnections.

While it is difficult to quantify the growth in peak bandwidth demand or even average bandwidth utilization on a campus network or local area network, there exists good data on the growth of average bandwidth utilization on the NSFNET, the primary component of the Internet backbone. That growth is shown in Fig. 1.

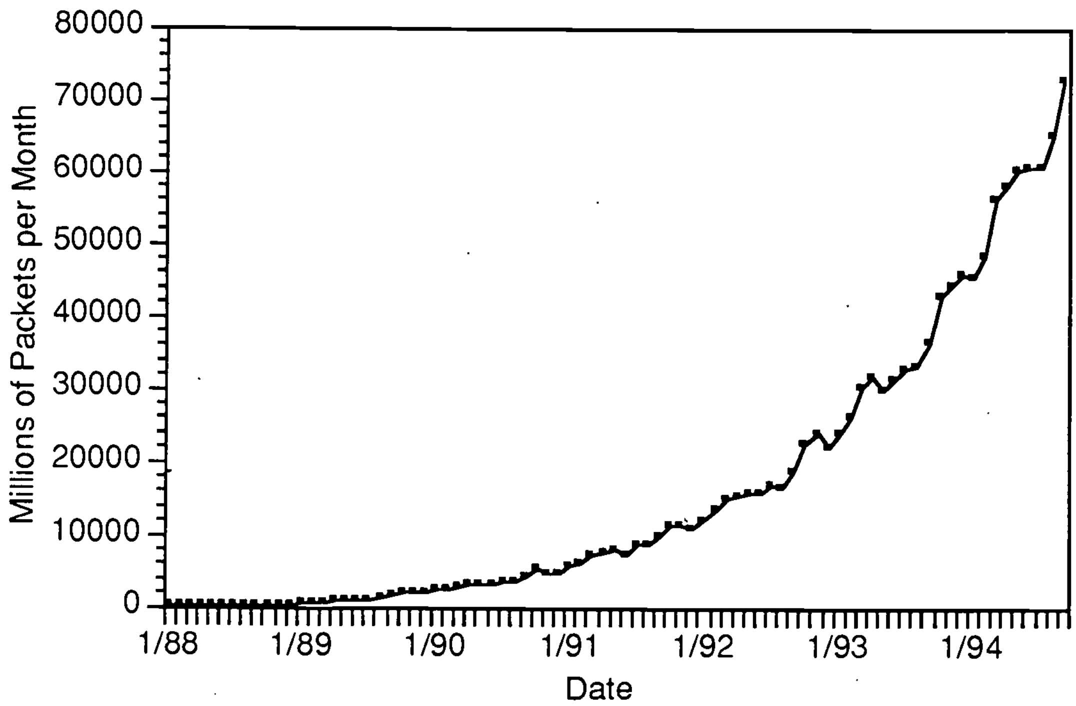


Fig. 1. Packets per Month on the NSFNET

It is reasonable to assume that the grown of campus network traffic parallels the growth of the NSFNET since the NSFNET is the composite of the intercampus Internet traffic.

The composition of that traffic is changing. In addition to the growth that is resulting from a larger user base, the network is being increasingly used to transfer multimedia information using software such as "Mosaic." This shift is illustrated in Fig. 2.

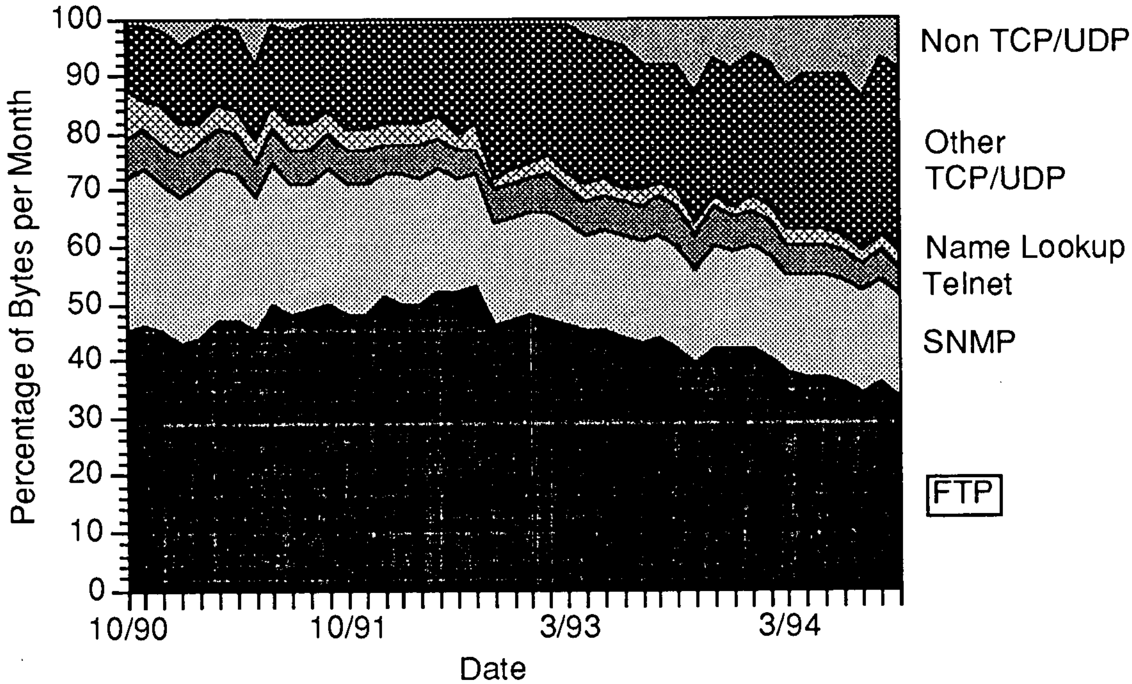


Fig. 2. Percentage Utilization of Bytes on the NSFNET.

It is clear from the data that the traditional uses of the Internet, file transfer (FTP), electronic mail (SNMP) and interactive logons (Telnet) are a decreasing portion of the utilization of the Internet. The growth in "Other TCP/UDP Services" can be attributed to multimedia applications such as "Gopher" and "Mosiac." Separate data indicates that Mosaic has been growing at 61% monthly since its inception.

Not only do we feel that bandwidth requirements will continue to increase at their historical rate, we are also concerned that historical growth patterns may not adequately reflect the bandwidth requirements of interactive multimedia. In other words, the projections that follow may be far too conservative! Our campus experiences have indicated that multimedia creates a quantum jump in bandwidth requirements.

In an attempt to project the future bandwidth requirements of campus networks, we have extrapolated the historical growth of the NSFNET through the remainder of this century. Our assumption will be that the growth of campus peak and average bandwidth requirements will parallel or exceed the historical growth of the NSFNET. That extrapolation is shown in Fig. 3.

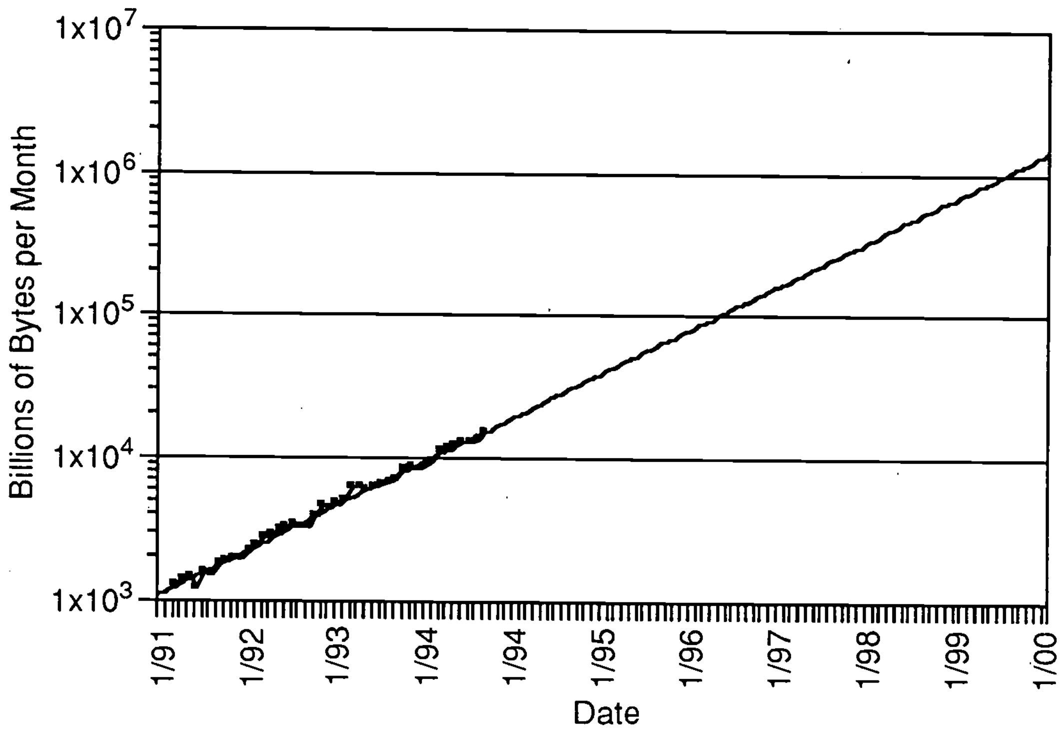


Fig. 3. Extrapolation of historical NSFNET traffic.

The data clearly indicates bandwidth increases of two orders of magnitude (a factor of 100) by the end of the decade. Many campus networks, including the University of Nebraska-Lincoln and Washington University, have already reached the point where shared bandwidth backbone architectures are no longer capable of meeting user demands. Bandwidth increases of two orders of magnitude cannot be accommodated with current architectures. Many campus networks will reach this point within the next few years.

The most obvious solution is to increase the speed of the shared backbone. Unfortunately, the cost of increasing the speed of a network that spans hundreds of kilometers is not easily accomplished. Using current technology it is very expensive to increase the speed of shared backbone networks one order of magnitude. There are no technologies available or proposed that provide two orders of magnitude increase for wide-area shared backbones.

Current technical solutions to this bandwidth problem all involve reducing the dependence on "shared backbones" and a migration towards dedicated bandwidth.

Alternatives to the Current Paradigm

There are a number of alternatives to the current shared backbone paradigm. By segmenting current routed backbone networks, we can effectively reduce the traffic on the shared backbone component. Ultimately, however, such techniques reach a point where more fundamental changes are necessary.

Switched Ethernet. Switched ethernet utilizes a star wiring configuration to extend 10 Mbs links from a high speed central switch (several hundred Mbs) to distributed equipment. In a typical campus environment, these distributed units might be distributed routers and strategic computing resources. This strategy suffers from two limitations. The first is that it is not scalable. Ultimately the 10 Mbs (or 100 Mbs fast ethernet) link to the distributed units will be overwhelmed. The second is that ethernet is not isochronous. That limits the use of the technology to data and low grade video or voice. In our opinion, switched ethernet should be regarded as a transition strategy.

Switched FDDI. Switched ethernet utilizes a star wiring configuration to extend 100 Mbs FDDI links from a high speed central switch to distributed equipment. In a typical campus environment, these distributed units might be distributed routers and strategic computing resources. This strategy suffers from two limitations. The first is that it is not scalable. Ultimately the 100 Mbs link to the distributed units will be overwhelmed. The second is that FDDI is not isochronous. Again, that limits the use of the technology to data and low grade video or voice. In our opinion, switched FDDI should be regarded as a transition strategy.

Asynchronous Transfer Mode. Asynchronous Transfer Mode or ATM is a fundamentally different technology. It is connection oriented, whereas ethernet and token ring are connectionless. It is scalable in multiples of 51 Mbs through several Gigabits per second. It was designed to carry voice, video, and data traffic. It represents a unifying force in that it provides services to workstations, computers, networks, homes, video stations, and telephones and is supported by both the computer and telecommunications industry.

Problems Associated With ATM

If ATM is so great, why isn't it being adopted everywhere? First, it isn't ready yet. There are no large ATM networks in operation.

Second, the standards for ATM are still evolving. In particular, the standards for LAN emulation have yet to be finalized. Institutions have a substantial investment in current LAN's. Any successful transition strategy must provide for operating existing networks over ATM.

Third, standards for quality of service (QOS), which is necessary for providing video and voice services is still evolving.

Fourth, standards are not yet in place for linking equipment from different vendors.

Fifth, video and voice may not use ATM technology. Video and voice are both very mature technologies and are very cost effective. The cost savings offered by an integrated technology may not be sufficient to offset the efficiencies already developed in specialized voice and video transmission systems.

Sixth, LANs may not convert to ATM. The availability of inexpensive higher speed LANs, such as 100 Mbs ethernet, will reduce the demand for a transition to ATM. Standards have been developed for isochronous ethernet (IEEE 802.9). Multicasting bandwidth reservation will be available through enhancements of traditional TCP/IP.

Transition Strategies

The fact remains that there are no alternative to ATM that will meet the projected bandwidth requirements by the end of the decade. Both Washington University and the University of Nebraska-Lincoln began a transition to ATM technology several years ago. The transition strategies developed at both institutions have three components. The first is to deploy a wiring plant capable of supporting both future ATM technology current non-ATM technology. The second is to deploy transition architectures that will meet current campus needs while ATM technology is maturing. The third is to deploy ATM test bed networks to develop expertise and experience.

Wiring Plant

Given unlimited resources every location would have available STP, UTP, Coax, single-mode fiber optics, and multi-mode fiber optics. Cost and physical constraints imposed by retro-fitting existing buildings requires a more modest approach. At Washington University the following set of guidelines have been adopted.

UTP: Level 5 UTP is installed at all locations. Where possible, multiple sets of two pair cables are installed but 4 and 8 pairs cables are also used. All cables are terminated at level 5 using punch down blocks in the wiring closets. Level 3 punch downs can be used for phones. When practical, the enhanced level 5 cable is used (sometimes called 5+ or level 6).

Cable Runs: A 90 meter rule is used from the punch down block to the jack on the wall. This leaves 10 meters of cabling for connections to the host and the hub. Multiple punch downs on a cable run are avoided requiring some home running of cable.

Wiring Closets: Wiring closets now contain hubs and required ventilation and power. Sufficient space in required for the equipment and maintenance access.

Additional Station Cabling: Coax (CATV) is installed in residence halls, lounges, conference rooms and classrooms. Mutli-mode fiber is also installed in classrooms and conference rooms. Where possible, the fiber is left unterminated to reduce costs, but in many cases the difficulty of post termination (short leads) requires the fiber be terminated during installation. If open conduits are available for future installation only the copper is installed.

Vertical Wiring: Both multimode and single mode fiber are installed to every wiring closet. In some cases two or three floors will share a closet. Level 3 trunk cable is pulled between floors for telephone. A common fiber de-mark consist of 18 multimode and 6 single mode fibers.

Campus Wiring: The campus is divided into sectors each with a major fiber hub and several minor fiber hubs. Sectors are interconnected with 96 multi-mode fibers and 48 single mode fibers. The resulting topology is a inter-connected multiple star network. From this topology rings and buses can be created if needed. The major hub room will contain substantial equipment and additional attention is given to space and environmental considerations.

Development and Training: Installation of ATM capable networks requires close attention to level 5 installation standards. Early training of engineers and technicians is critical for a successful installation.

Legacy Systems Support: In nearly all cases, existing asynchronous lines (terminals) and ethernet connections are re-established using the new stations wire. Telephone trunks were installed at level 3 to provide connectivity to centralized building hubs or traditional asynchronous data circuits including fire alarms, security, and physical plant controls.

Existing fiber rings and ethernet circuits are re-established by appropriate jumpering of the fibers at the major and minor hubs. If possible baseband ethernet cabling is left installed, if not ethernet is moved to fiber in a star configuration.

Transition Architectures

The second component of our transition strategy is to deploy a transition network architecture appropriate to the demands from users for more bandwidth and greater network capabilities. Differences between campuses will result in different architectures. Washington University has deployed switched FDDI, switched ethernet, and collapsed backbones. The topology of this deployment, shown Fig. 4 on the next page. The network consists of inter-connected stars; the same topology will be used for ATM. Networking privacy, a feature of ATM technology, is currently provided to the user by deploying secure hubs. The new generation of these hubs simplify the management of a privacy enhanced network.

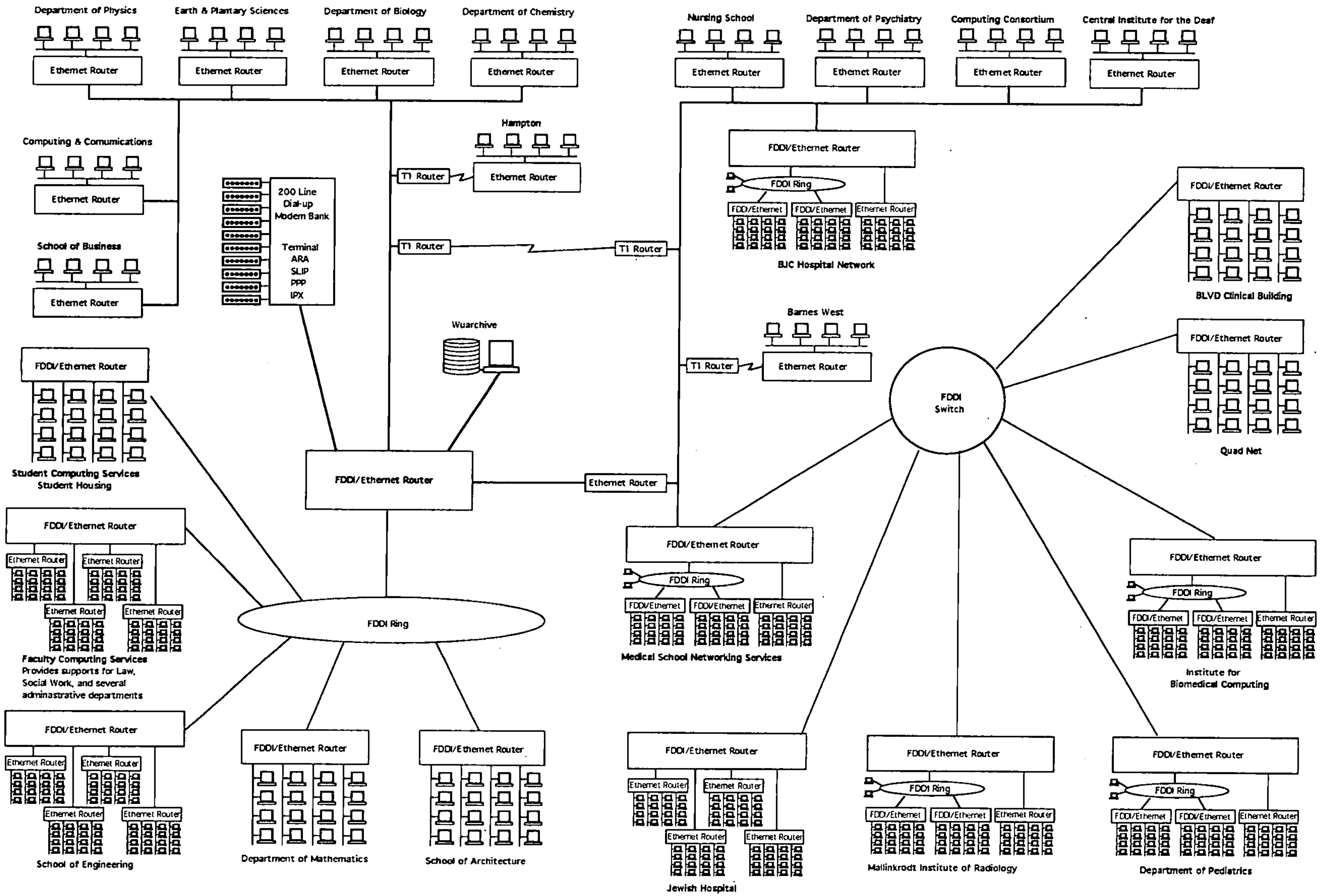


Fig. 4. Washington University Campus Network - Nov 1994

At the University of Nebraska-Lincoln, bandwidth requirements track several years behind those at Washington University and allow a different transition strategy. UNL plans to by-pass both switched ethernet and switched FDDI and deploy ATM switching technology; Washington University has used FDDI switching as an interim step. UNL feels that enhancements and further segmentation of its current network will allow the campus to "get by" until ATM technology matures sufficiently for its adoption in a production environment.

ATM Test Beds

ATM technology is new and both campuses have deployed ATM testbed networks to gain experience.

UNL ATM Testbed: The UNL testbed is a joint project of the Computing Resource Center, the Department of Computer Science, and the University Library. The testbed is shown in Fig. 5.

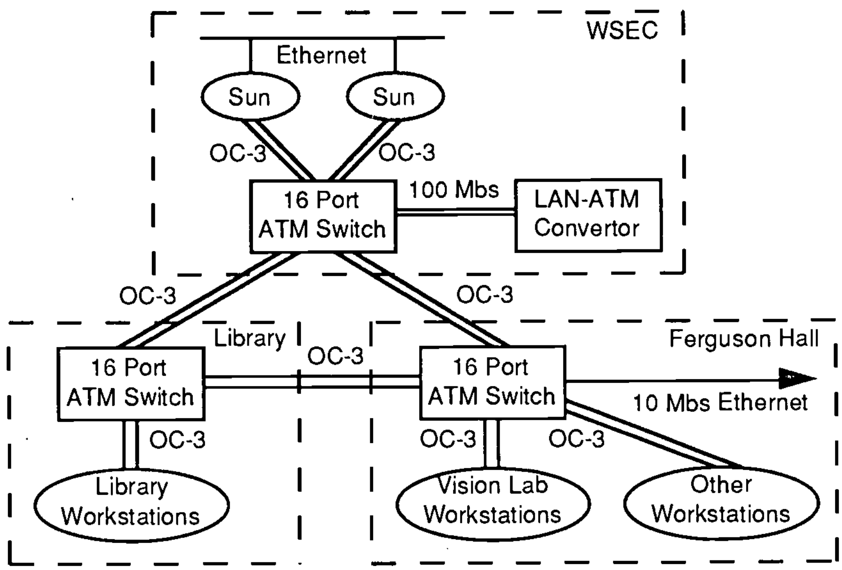


Fig. 5. UNL's ATM testbed.

Washington University ATM Testbed: The Washington University ATM network is shown in Fig. 6 on the next page. The switch speeds range from OC3 (155Mb/s) to OC192 (10Gb/s). Most of the OC3 switches are deployed, others will be added as they become available. The network is designed to bring ATM to the desktop. The figure shows a variety of hosts that contain commercial ATM SONET interface cards and other hosts utilizing a device called a multimedia explorer. This device supports bi-directional broadcast quality NTSC video and CD quality stereo sound through external ports. There is also an ATM host interface. The multimedia explorer is used for multimedia applications development on the ATM network.

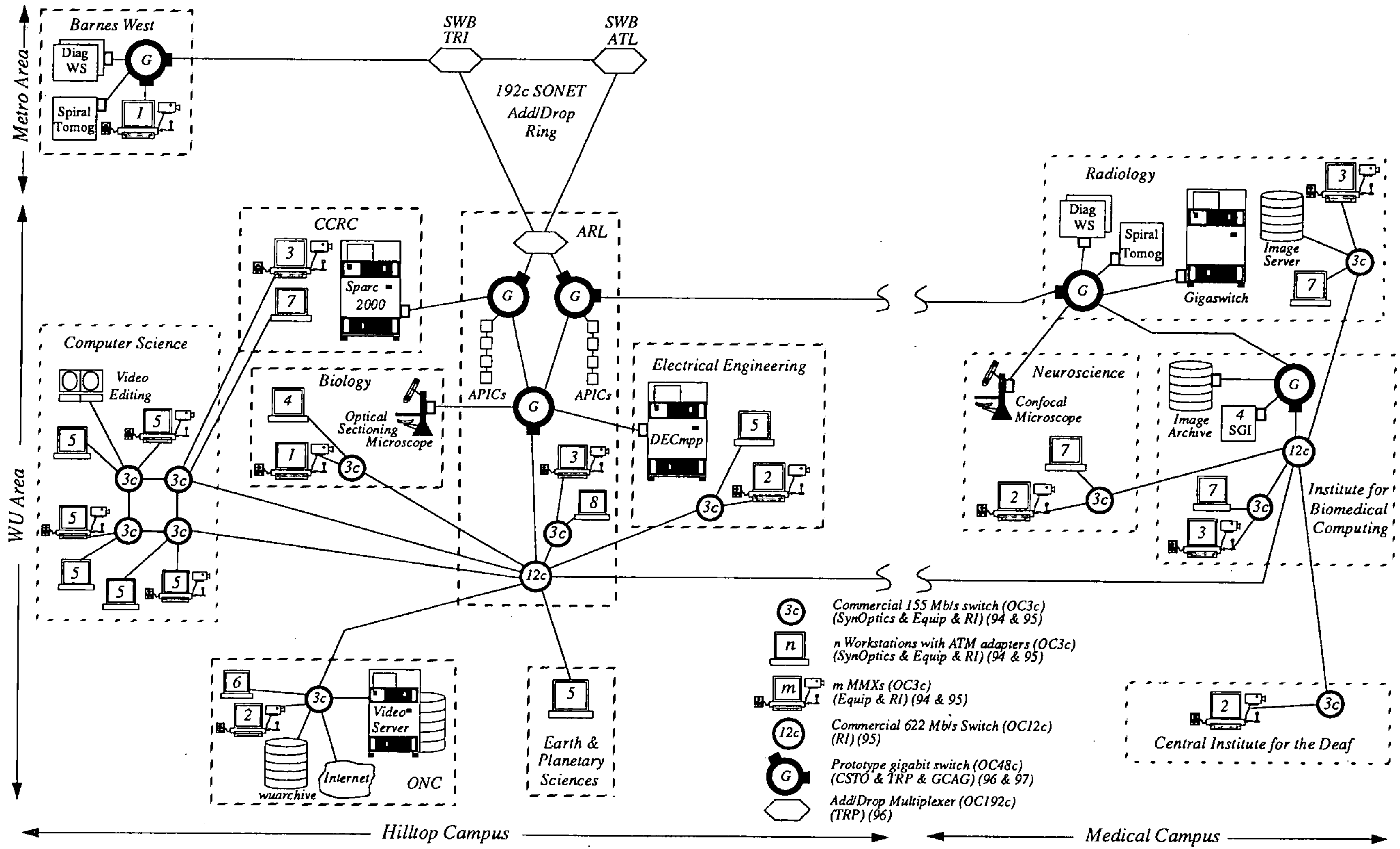


Fig. 6. Washington University ATM Testbed

292 293

BEST COPY AVAILABLE

Selling ATM - The End Users View

As a scalable and secure technology, ATM solves many network engineering and management problems. End users, however, will be reluctant to pay more money to adopt this technology if they do not perceive that they are receiving new and innovative services. The argument that "we need to do this to keep your email running the way it always has" is not likely to generate support for additional network expenditures.

At both Washington University and the University of Nebraska-Lincoln, we feel that the development of new applications such as multimedia and remote collaboration (teleconferencing, telemedicine, distance learning, etc.) is an essential part of any ATM networking plan.

To complement ATM technology Washington University has identified applications in Neuroscience, Radiology, Biology and Hearing where the strength of the ATM technology can make a solid contribution. The networking research group in the Applied Research Laboratory in the School of Engineering is working with these researchers and several prototype applications are operational.

At the University of Nebraska-Lincoln we have created "New Media Center" dedicated to supporting the development of multimedia applications in instruction. That facility includes two completely equipted classrooms as well as a staffed media development area.

Personal Data Delivery on Campus Networks

David L. Rotman
Cedarville College
Cedarville, OH

Abstract

This session is designed to share some techniques being used at Cedarville College for the delivery of information to individuals. Our customers (students, faculty, and staff) have an expectation of convenient and rapid access to information. Providing non-confidential information via CWIS systems mets part of this customer expectation. This session will explore means of delivering confidential information and some basic transaction processing over the campus network.

Pesonal Data Delivery on Campus Networks

As computer networks become more pervasive on campus and the various campus constituencies become more accustomed to using those networks, expectations grow regarding the use of computers to access information. In fact, the development of some campus networks is the result of an emphasis on delivery of information. Cedarville College's campuswide network was designed on the basis of such a vision [Cedarville College, 1991]:

> Cedarville College is committed to providing its faculty, staff, and students with an integrated, broadly-accessible information, voice, and video communications technology infrastructure.
>
> To this end, the College should:
>
> 1. Assure that its personnel and students can access and maintain, through appropriate technology, the information necessary to fulfill their roles;
>
> 2. Continually assess information technologies and seek to implement appropriate hardware and software that enhances individual and organizational effectiveness;
>
> 3. Make available to personnel and students instruction and reinforcement in the use and application of information technologies; and
>
> 4. Foster an environment that encourages responsible use of technology, yet maintains a sensitivity to technology's effects on its users and their environment.

Goals for Information Delivery

As suggested in the vision statement above, two primary goals for information delivery have been identified: ready access to information and providing information which meets the needs of individuals within the college. *Ready access* means that individuals will be able to obtain information they need when they need it and where they need it. In an ideal world, students should not have to leave their residence hall room to obtain reference materials, prepare assignments, or conduct business transactions. Faculty members should be able to prepare teaching materials, do subject-area research, and develop service opportunities from their offices. Similarly, staff members should have access to institutional information from their own work areas.

Providing information meeting the needs of the individuals means that adedquate information should be provided and that tools should be available for screening and manipulating that information according to the needs of the user. Sufficient information must be provided. As delivery of information increases, more attention must be given to making that information relevant to the individuals receiving it. Individuals need to have enough information to do their work, without being overwhelmed by information which is unrelated to their work.

Constraints

There are both legal and practical constraints on the delivery of information. While finances can be a very real limiting factor, there are other factors which may limit delivery of information or affect the form in which that information is delivered. *General security* is a major factor in designing information systems. Some applications need to be restricted to selected groups of individuals so as to ensure the integrity of transactions. For example, certain individuals should be able to initiate general ledger transactions easily while other members of the general college community should not have this capability. Enforcement of general security is both a quality-control issue (limiting access to those persons who are qualified to use the access) and a fraud-avoidance issue (limiting access to minimize the risk of falsified records).

Besides general security issues, there are *privacy issues* which are particularly relevant to the college environment. Privacy issues can be specifically mandated or a matter of insitutional policy. The Family Educational Rights and Privacy Act (FERPA) limits what portions of student's records may be made available to various constituencies. Directory types of student information can be made available to the general public. An employee may obtain any and all student information, provided the information is based on a "need to know." Parents of an adult child may not have access to their child's records without written authorization or written proof of their child's IRS dependency status. Data which fall outside the purview of FERPA may still be restricted due to institutional policy. For example, general ledger information may be considered confidential in many private colleges.

A third constraint on the delivery of information is the institutional approach to *accessibility*. Some data must be made available to certain classes of individuals (e.g., federal crime statistics), but there are no clear requirements for how this access is to be provided. The institution has some latitude in deciding how easy to make the access. Having a document available in a central campus location may suffice in some situations, whereas some institutions will choose to make the access even easier by making this information available over the Internet. For security and public relations reasons, an institution might provide easy access to persons on campus, but block access to that information from off campus.

Another constraint in the design of information delivery is the desire to *preserve human contact and dignity*. The information system designer must continually weigh the impact of the technology on the users: Will this system increase or decrease person-to-person contact? Will this system make people feel like they are being treated as machines? Will this system improve the quality of the work environment (e.g., reduce monotony) for the people who use the system?

Cedarville Environment

Cedarville College has implemented a campus-wide network which is based on a philosophy of making information available to people who need it *when* they need it and *where* they need it. The outworking of this philosophy is a design which called for installation of network computing in each office and each residence hall room over a three-year period ending in 1994. The network currently connects all faculty offices, all classrooms, and 95% of the residence hall rooms. The college provides a computer and printer in each residence hall room, so that resident students have immediate access to the network as part of their educational experience. Commuting students gain access in public laboratories or via modem.

Cedarville College Network Environment Fall, 1994	
Student enrollment	2378
Full-time teaching faculty	137
Full-time staff	210
Networked computers	1200
Network configuration	Novell Netware 4.02 12 servers Ethernet in each building Collapsed TokenRing backbone

Cedarville's Information Delivery System

The system design at Cedarville divides information delivery into three categories: public information, confidential information, and transaction processing. Public information is information which is widely accessible (though the access may be limited to on-campus use only). Confidential information is information which is restricted to certain individuals within the college community (e.g., grades may be seen by the student and the student's advisor). Transaction processing involves the updating of databases where the user does not have direct access to those databases.

Data Access Models for Confidential Information and Transaction Processing

Administrative data capability can be provided to the college community in two different ways: by allowing direct access to the system containing the data or providing indirect access to that system. In the Cedarville College situation, a decision was made to provide access indirectly. Provision of direct access was deemed to present a large security risk and unnecessarily increase the workload in the computing center. Providing direct access would have required creating individual login accounts for each person and then establishing rights for those accounts. Through indirect access, authentication is handled on the Novell network rather than on the administrative host system. Using a model with some client/server characteristics, the requested information is passed from the host to the network without the user having to login to the host.

The Cedarville system utilizes a requestor program on the network, a transfer processor on the network, and a server program on the host, as shown in Figure 1 below. The requestor program verifies the identity of the requestor and writes the request to a directory on the network. Users have write privileges to this directory, but do not have file-scan or read privileges. The requests are moved from the network to the host system by the transfer processor. Once on the host system, the requests are processed and the results are returned via electronic mail.

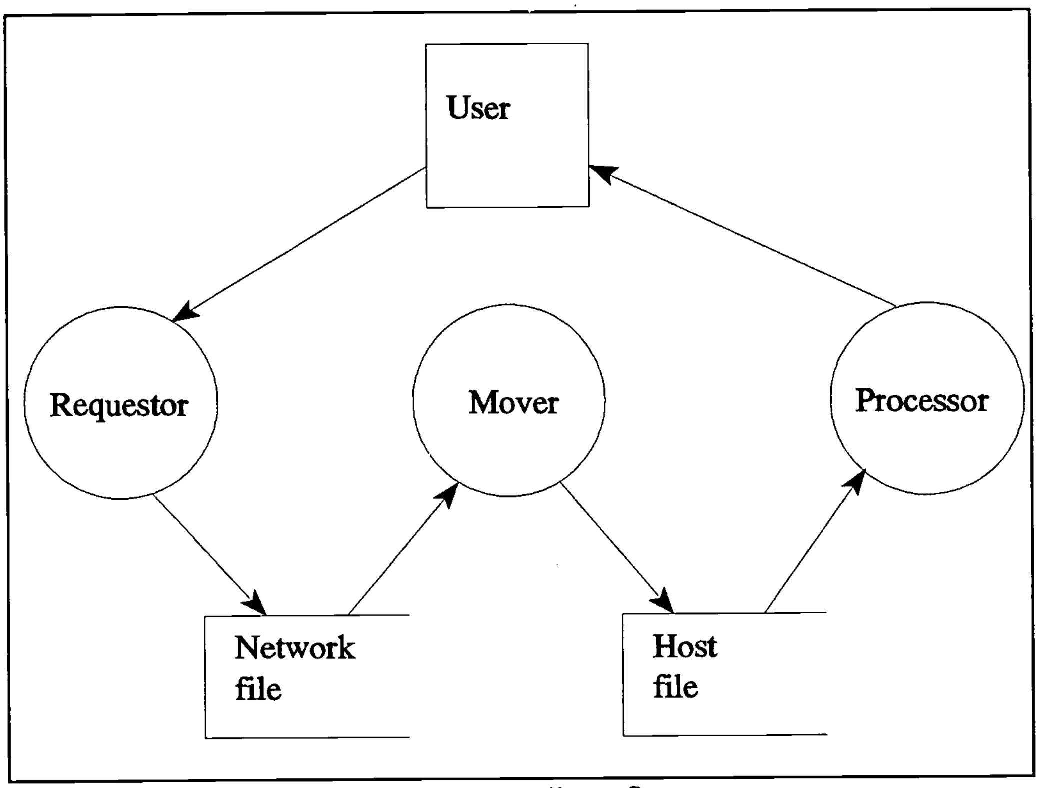
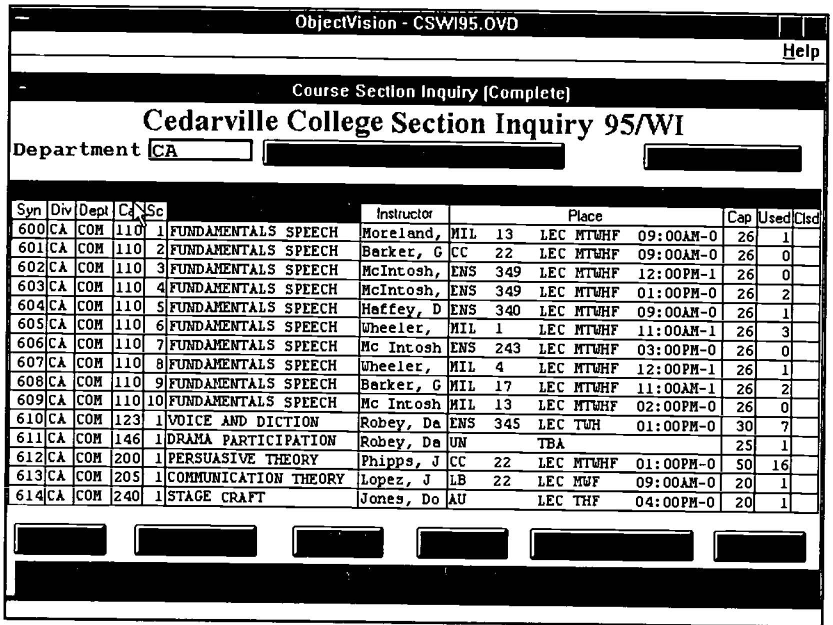


Figure 1 Cedarville College Information Delivery System

Public Information Examples

Two examples of public information delivery are shown below. These items are available to anyone logged into the campus network, merely by clicking on an icon.


ObjectVision - CSWI95.OVD

Help

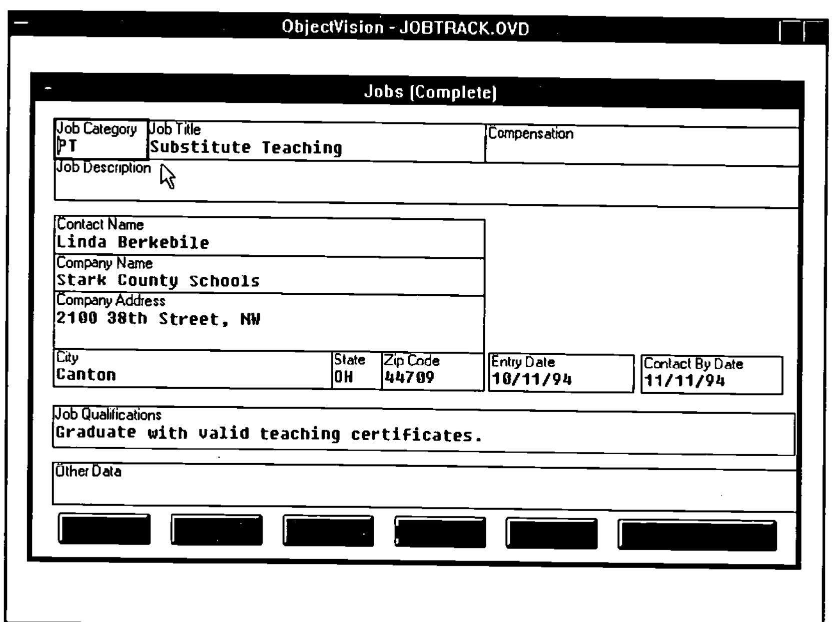
Course Section Inquiry (Complete)

Cedarville College Section Inquiry 95/WI

Department CA

Syn	Div	Dept	Ca	Sc		Instructor	Place					Cap	Used	Clsd
600	CA	COM	110	1	FUNDAMENTALS SPEECH	Moreland,	MIL	13	LEC	MTWHF	09:00AM-0	26	1	
601	CA	COM	110	2	FUNDAMENTALS SPEECH	Barker, G	CC	22	LEC	MTWHF	09:00AM-0	26	0	
602	CA	COM	110	3	FUNDAMENTALS SPEECH	McIntosh,	ENS	349	LEC	MTWHF	12:00PM-1	26	0	
603	CA	COM	110	4	FUNDAMENTALS SPEECH	McIntosh,	ENS	349	LEC	MTWHF	01:00PM-0	26	2	
604	CA	COM	110	5	FUNDAMENTALS SPEECH	Haffey, D	ENS	340	LEC	MTWHF	09:00AM-0	26	1	
605	CA	COM	110	6	FUNDAMENTALS SPEECH	Wheeler,	MIL	1	LEC	MTWHF	11:00AM-1	26	3	
606	CA	COM	110	7	FUNDAMENTALS SPEECH	Mc Intosh	ENS	243	LEC	MTWHF	03:00PM-0	26	0	
607	CA	COM	110	8	FUNDAMENTALS SPEECH	Wheeler,	MIL	4	LEC	MTWHF	12:00PM-1	26	1	
608	CA	COM	110	9	FUNDAMENTALS SPEECH	Barker, G	MIL	17	LEC	MTWHF	11:00AM-1	26	2	
609	CA	COM	110	10	FUNDAMENTALS SPEECH	Mc Intosh	MIL	13	LEC	MTWHF	02:00PM-0	26	0	
610	CA	COM	123	1	VOICE AND DICTION	Robey, Da	ENS	345	LEC	TWH	01:00PM-0	30	7	
611	CA	COM	146	1	DRAMA PARTICIPATION	Robey, Da	UN		TBA			25	1	
612	CA	COM	200	1	PERSUASIVE THEORY	Phipps, J	CC	22	LEC	MTWHF	01:00PM-0	50	16	
613	CA	COM	205	1	COMMUNICATION THEORY	Lopez, J	LB	22	LEC	MWF	09:00AM-0	20	1	
614	CA	COM	240	1	STAGE CRAFT	Jones, Do	AU		LEC	THF	04:00PM-0	20	1	

Figure 2 Public Information, Course Enrollment Inquiry


ObjectVision - JOBTRACK.OVD

Jobs (Complete)

Job Category: PT
Job Title: Substitute Teaching
Compensation:
Job Description:
Contact Name: Linda Berkebile
Company Name: Stark County Schools
Company Address: 2100 38th Street, NW
City: Canton
State: OH
Zip Code: 44709
Entry Date: 10/11/94
Contact By Date: 11/11/94
Job Qualifications: Graduate with valid teaching certificates.
Other Data:

Figure 3 Public Information, Employment Opportunities

Confidential Information Examples

Using the Cedarville information delivery system, students may copies of their class schedules, unofficial transcripts, current account balances, statements of their accounts, and their chapel attendance records. Faculty members may request schedules and transcripts for students. Work is in-progress to provide degree audit capability for both students and faculty. The figures below show the requestor screen for faculty and a sample retrieval of a transcript.

```
Data Requestor

 1. Student Data Sheet
 2. Unofficial academic transcript
 3. Account balance
 4. Student account statement
 5. Chapel attendance record
 6. Academic transcript for a student
 7. Schedule for a student

Enter selection number or ESC to quit:
```

Figure 4 Confidential Information, Requestor Program (Faculty Version)

```
From:       Registrars Office
To:         rotmand@cedarnet.cedarville.edu
Date:       Wednesday, November 9, 1994 6:49 am
Subject:    Data server request: TRANSCRIPT

Cedarville College Data Server           DATA.SERVER.TRANSCRIPT
11/08/1994                                          07:02:34AM

ID: 9999999
Johnson, Henry William
345 South Main Street
Chicago, IL 60601-9999

  TERM  COURSE      TITLE                CREDS GR RP TERM  CUM
- ----- ----------- -------------------- ----- -- -- ----- -----
I 92/FA ENG  110 11 COMPOSITION I         5.00 C+    2.200 2.200
        GSS  100 01 FOUND SOCIAL SCIENCE  5.00 C-
        MATH 171 05 COLLEGE ALGEBRA       4.00 C+
        PEF  199 06 PHYS ACT & CHRIST LI  2.00 B
I 93/WI COM  110 03 FUNDAMENTALS SPEECH   5.00 B-    2.133 2.168
        GSCI 190 01 CALCULUS FOR BUS/SOC  5.00 C
        HUM  140 01 INTRO TO HUMANITIES   5.00 C-
```

Figure 5 Confidential Information, Electronic Mail Response

Transaction Processing Examples

At this point in time, two types of transaction processing are provied on the network. In one type of transaction processing, a particular group has write privileges to a database while another group has only read privileges. In the other type of transaction processing, none of the users has write privilege to the files.

The "faculty schedule" system is an example of transaction updating by a privileged group. Preliminary faculty schedules are built on-line using the registrar's course schedule. Faculty members can then add office hours, committee meetings, and other comments. Students have inquiry-only access to this database.

The "late pass" system is an example of transaction processing where none of the users has write privileges to the database. Prior to leaving campus for a weekend or overnight trip, students enter destination information using a VisualBasic program. Upon their return, the students record their return dates and times. Both the initial entry and the entry upon return from the trip generate transactions for the database. The "data mover" routine detects these transactions and does the updating of the network-based files. Appropriate individuals (head residents, deans) can query these network-based files to determine the students' destinations and expected return times.

```
                         Schedule
   Name/Home address                                          BONENBERGER
  Bonenberger, Omer                           Bldg Room   Phone
  238 Bridge St.                   Office     WI   116    7788
  Cedarville     OH 45314          Home phone 513-766-5466
     Monday      Tuesday      Wednesday      Thursday        Friday
 8             EDUC*393*01                 EDUC*393*01
 9             EDUC*393*01                 EDUC*393*01
10 Chapel      Chapel         Chapel       Chapel          Dept mtgs.
11 Office      EDUC*393*01    Office       EDUC*393*01     Office
12             EDUC*393*01                 EDUC*393*01
 1
 2 EDUC*350*01                EDUC*350*01                  EDUC*350*01
 3 Office      Office         Office       Office          Office
 4
 5
 6
 7
Comments  This schedule is good from Sept. 21 to Nov. 8.
          After that date, I will be in clinical field experience
          until 3:00 pm on most days
```

Figure 6 Transaction Processing, Faculty Schedules

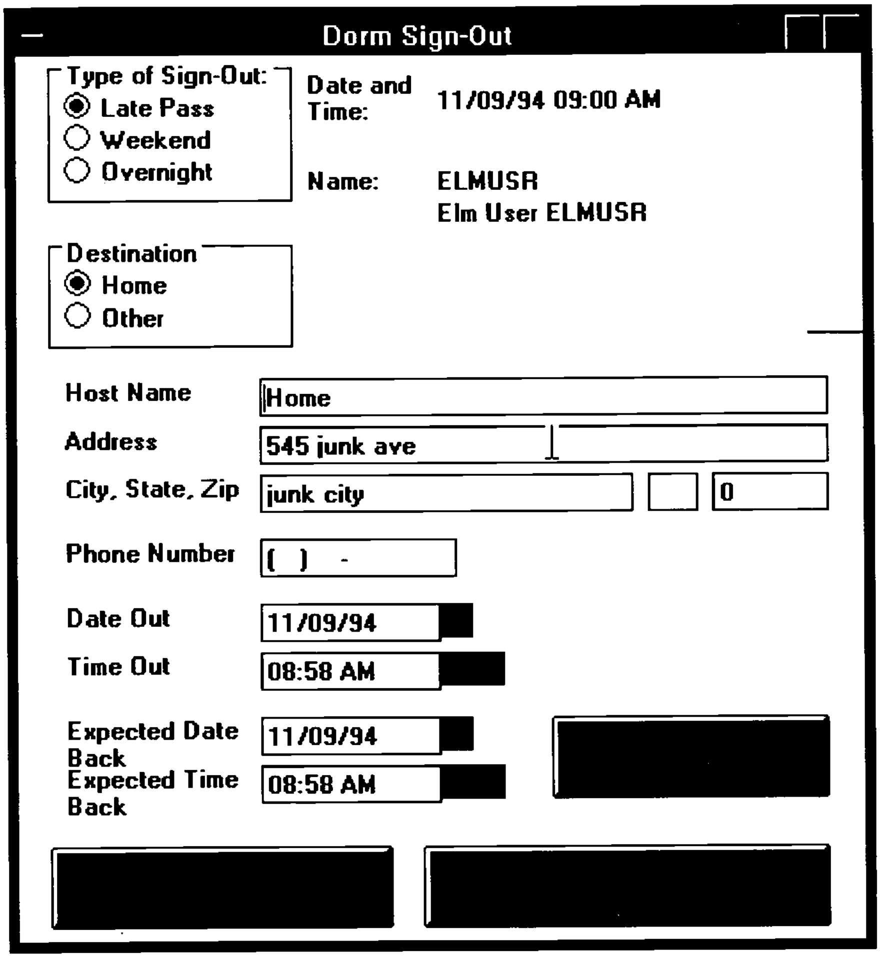


Figure 7 Transaction Processing, Inquiry-only Access

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IMPLEMENTING A CAMPUS NETWORKING INFRASTRUCTURE

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Most higher education institutions have an aging infrastructure that greatly hampers the use of modern computing technologies. This session will discuss the implementation of a campus-wide solution for the networking infrastructure needed for the 1990s at Southern Methodist University, a medium sized, private institution. Topics include evaluating alternatives, selecting a strategy for the environment, and getting the job done successfully--buying and installing a cable plant; constructing closets; dealing with asbestos; transitioning old voice and data switch technologies; installing an integrated telecommunication management system; and, seeking funds, space, and faculty support. The combined management of voice and data communication greatly simplifies the politics and provides economies in allocation of staff. Expansion of the Internet to each desk top and campus-wide client-server applications are now possible.

INTRODUCTION

Many colleges and universities have already implemented a campus networking infrastructure, particularly those that are large research universities. These projects began in the early 1980s when it became clear that communication infrastructure was not going to remain the purview of the telephone companies. But many medium sized and smaller institutions may find that their infrastructure is incomplete and does not cover all their buildings including dormitories. Others may find that they are still dependent upon old telephone wire and modems for most locations excepting island areas that are served by coaxial cable and cluster controllers.

If the goal is to get every desk top on campus connected to the "information superhighway" at 10 to 100 megabits per second, you may find that much work needs to be done on infrastructure before computers can be connected. You may also be interested in replacing legacy administrative applications with modern, client-server applications. Without a means for universal connectivity on the campus, some locations will be unable to participate in the newly designed environment.

This paper and presentation describe how a medium sized, private university was able to accomplish these goals. Southern Methodist University has 7,500 full-time equivalent students, a 160 acre campus four miles north of downtown Dallas, and 60 buildings on the campus proper. Alternatives that were evaluated are identified. Hopefully, you will find some ideas here that you can apply on your campus to improve the communication infrastructure so that it does not hamper computing growth and development.

The orientation of this information is from the point of view of improving management. It is not meant to present technical details of what might be the best information or communications technology, but rather how management can be improved with proper infrastructure and software. Emphasis is placed on the management of the telecommunication and data communication infrastructure with the professional staff using software tools to better serve the needs of the faculty, administration, and students. Integrating traditional telecommunication staff into a computing organization is a management challenge because of the different cultures. Until this is accomplished, voice and data communication are not truly integrated. A telecommunication management system is necessary to preserve and maintain major investments in infrastructure and to minimize the growth in staff that can be required for an expanded cable plant and electronics distributed across campus.

The technology leader has immense problems on a campus if the buildings were built many years ago without infrastructure to support 10 to 100 megabit data communication, funding is quite limited, and the administration has great trouble in understanding your unhappiness with the situation. Modern computing with powerful workstations communicating with remote servers both on and off campus using multimedia technologies was unheard of even ten years ago. Now, the faculty and administration expect that these technologies can be had through some magic on our part and the purchase of some electronics. Access to the "information superhighway" is a right, an academic freedom. Most faculty and administrators do not understand that access from every desk top requires much work and investment of time and financial resources.

BACKGROUND OF THIS CASE STUDY

This story begins more than five years ago. Southern Methodist University is an oasis in the city of Dallas. Even though it is part of a metroplex of four million people, it goes about its business of educating traditional, 18-22 year old students somewhat oblivious to the technological changes in its midst. The situation five years ago is described below.

Cable Plant

Some of the telephones failed when it rained. This failure was due to old copper wire that had been installed when the buildings were built or when telephones were first required for business purposes. Data communication was being accomplished on copper wire that was telephone wire or that two entrepreneurial subcontractors were installing as demand required, charging the university $50 per hour for their time plus materials. These installations were occurring in an ad hoc fashion, not following any design or plan. They did not conform to any standards of either the electrical or communication trades. Any look into a telephone closet in any building on campus caused rational people to shudder. Only long hours of working by trial and error led to any changes in service.

Telephones

The telephone switch was a leased AT&T Dimension 2000 that was nearly out of ports. It continued to operate only because of one employee who juggled its capacity to meet campus needs and worked closely with maintenance staff from AT&T. AT&T charged the University $76 per hour. Many business offices on campus contracted separately with Southwestern Bell for business lines because the University telecommunication office could not meet their needs. The dormitories were served for voice communication by Southwestern Bell Centrex; data communication for these locations was not considered.

Data Communication

An AT&T ISN network owned by the University provided data communication for administrative computing applications. Its major electronics were connected by limited fiber optic cable in the steam tunnels. Additional capacity was not available without purchasing additional hardware from AT&T. This product was no longer being promoted by AT&T. The gerryrigged copper plant of the subcontractors supplied communication within the buildings. Access to administrative computing applications operating on mainframe computer was limited to those locations that had AT&T ISN networking. These were usually the major administrative offices, such as the registrar, finance, development, and so on, and usually only the locations previously designated as doing data entry were connected. Consequently, it was not possible to promote and support ad hoc queries by user locations or other interested administrators. Most faculty communication with computers was through modems that were quickly consuming the limited AT&T Dimension 2000.

Internet Access

Access to the National Science Foundation Network (NSFNet), also later known as the Internet, did not yet exist on campus. Only Bitnet access was available and it was used very little by the academic community and was unknown to the administrators. Only the Engineering School was pressing for NSFNet access. It had installed some fiber for its own use and was successfully experimenting with ethernet. It was clear that this requirement was about to spread to the sciences and elsewhere on campus and the infrastructure did not exist to deal with it.

Asbestos and Space

The steam tunnels that connected all buildings and seemed the likely conduit for a cable plant were filled with asbestos. An initial estimate was $3 million for removing the asbestos from the tunnels. The mechanical equipment rooms where most of the copper plant terminated often had hazardous asbestos. It was suspected that many of the buildings had asbestos in normal surroundings that would endanger workers doing installation as well as the University employees. Strict rules for the appearance of the campus as "Collegiate Georgian" limited what could be visible. The existing telephone switch room was limited in size. The only possibility for expansion was the space occupied by the three telephone operators.

If there is one good view of the situation five years ago, it was that the University was not committed by any prior poor choices in technology. It hadn't made any decisions about computing and communication technology for five years. In that time networked computing and powerful workstations had become accepted and preferred over the centrist mainframe environment. We just had a long way to go to catch up.

ALTERNATIVES AND STRATEGIES

It is easy to conclude that a new cable plant was required in all campus buildings and that it should address both voice and data communication for the next ten to twenty years. A new and larger telephone switch was needed by the administration. The students in the dormitories should be included in the new system. Asynchronous data communication connections needed expansion. Demand for ethernet access was within two years of reaching the state of a "roar" from the faculty. Already the campus computing advisory committee had sent the president a report with the top priority being the installation of more fiber for data communication. But how would a private institution that did not have a balanced budget at this time and was facing constant threats of declining enrollment deal with these problems? How could this work be funded? We left this question for later resolution. First we needed a complete plan and price.

The only alternative for attacking these problems seemed to be to do the project all at once with one prime contractor. The project would have "critical mass" to obtain funding and it could be accomplished within a reasonable time frame. This approach was risky; there were many opportunities for failure. The other alternative of doing this project incrementally, one or a few buildings at a time, seemed endless, and we could never have modern computing. If selling a "critical mass" project failed, we could always return to an incremental approach. About seven campus buildings had been extensively remodeled or newly built in the past three years and had reusable inside cable. The University libraries were attempting some incremental cable plant improvements that could fit into the larger project.

Hiring a Consultant

With all these goals for the project and its high risk, it seemed wise to enlist the services of a telecommunication consultant. Such a person, with the proper credentials, can lend credibility to the selection process, can assure that a contract is negotiated that is favorable to the buyer, and can assure that some details are not overlooked that may jeopardize successful completion. I recommend that you shop carefully for such a consultant, asking colleagues or calling institutions where you know projects have been successful.

You should also evaluate your own skills and those of your staff, and within the university. Do you have people who can serve as experts in data communication? Is the physical plant staff able to assist in cable plant and construction? How capable is the legal staff and do they have any technical expertise? How much problem will it be to get administrative and board approval? Do you need someone to manage this approval process? Do you need someone to manage the acquisition process? Do you need implementation monitoring or supervision? Answering these and similar questions will enable you to assess what consultant can best meet your requirements.

You may need several consultants, each with different skills and purposes--perhaps one for the selection process, another for construction, and another for writing the contract. Depending upon the procedures at your institution, you may need to write a request for proposal or a bid specification to obtain the consultant, or you may be able to search out the best possible person through your personal network.

At another university, I had previously worked with a consulting firm that had the needed skills. I wasn't sure about all skills on campus, but I knew I needed help on the acquisition and selection process. The president needed convincing since he wasn't sure about why I was so intent on this project when he had dial tone. I was sure he had not yet discussed anything with the Board of Trustees. A study done four years earlier by AT&T for the University, though dated, offered some validity for my claims of eminent collapse of the infrastructure. I found money for the consultant by changing the leasing contract on the AT&T Dimension 2000 from monthly to annual. The president approved hiring the consulting firm that I requested, and we began.

Deciding on the Vendor

In a very political environment and with large amounts of money to be spent, a representative committee from across the institution was needed to choose a vendor. Minimally, the committee should include people from finance, housing, deans offices, faculty, physical plant, library, and the best technical people from computing and communication. At SMU, this amounted to 12 people who spent at least 200 hours each spread over one year beginning in the summer of 1989.

The activities included meetings to identify requirements and evaluation criteria, to review written materials, and to contact vendors. We began by visiting all major vendors, telling them what we had in mind, and letting them tell us about their products. We were educating ourselves about the market and possible approaches. The committee discussed our goals with the consultant and what we could reasonably expect from the marketplace. We developed a list of about 25 potential vendors. The consultant took major responsibility for writing the Request for Proposal (RFP) based upon his experience at other universities. However, the committee added its requests and nuances before the RFP was sent out in November 1989. Requested responses were due in February 1990.

Because of the asbestos problems, we could not let groups of vendors into many areas, including the steam tunnels, in order for them to provide accurate pricing. We stated that all vendors were to assume that the asbestos problems would be addressed by the university prior to their work in order to provide a standard environment against which to evaluate their proposals. However, we clearly told them that we had not determined how we would deal with the asbestos and that those costs would be separate from the requested pricing. We showed them a video tape made by University staff in the steam tunnels so that they would know the extent of the problems. Not only was there asbestos, but there were several locations where steam and water pipes constricted passage and possible space for the large copper cables. The Physical Plant Department was very hesitant about having these large copper cables to contend with in doing electrical, heating and cooling maintenance.

The Request for Proposal was very general and solicited creativity on the part of the vendors. It asked for a cable plant and a telephone switch with asynchronous data capability to replace and expand the AT&T ISN network. It definitely encouraged data communication at higher bandwidth but our survey of the market did not support getting anything greater than one megabit per second from any of the vendors who could provide a telephone switch. It requested separate pricing for administrative buildings, dormitories, Greek houses located adjacent to University property, and university owned apartments located somewhat further but still adjacent to the campus proper. The tunnel system only served the administrative buildings and the dormitories. It did not extend to the Greek houses and the apartments. The vendors were to propose how to cable to the more remote locations. Because of the asbestos problems, we also asked for pricing for trenching the campus so that we could compare these prices to the cost of dealing with the asbestos in the tunnels.

Only six vendors submitted responses to our Request for Proposal in February of 1990. All committee members read all proposals and we prepared lists of questions for each vendor. The consultant also had his questions. Five vendors were asked to spend two hours meeting with the committee to answer questions. The sixth vendor's proposal was quite inadequate compared to the others so we chose not to waste his time. In April 1990, we met and democratically voted based upon an agreed set of criteria as to the first and second choice. The committee's vote was nearly unanimous on the first choice vendor and we received a majority vote on the second.

The Technical Services Agreement for Design

Once the committee had selected the first and second choice vendors, the University approached the first choice vendor in the fall of 1990 asking if he would enter into a Technical Services Agreement in order to do the detailed system design and to work with the University in planning how to deal with the asbestos problems. The consultant recommended this procedure so that the University would have a complete picture of the situation before making a commitment by signing a contract. The Board of Trustees and the President backed this cautious strategy. There was no guarantee to the vendor that the University would proceed with the full project, both because of the unknowns in dealing with the asbestos and also because the University had not yet determined how it would pay for the project. The first choice vendor, who was the manufacturer of the voice and data communication switch, agreed to enter into the Technical Services Agreement for $200,000, and we proceeded in good faith that we could solve the problems.

Vendors must design systems as part of the process of responding to RFPs to provide pricing. However, since only one of them gets the work, this design is not necessarily detailed enough for the customer to review and for the vendor to do the work. Usually the detailed design is done after the contract is signed. The vendor then argues with the customer over what is included and excluded, thus requiring contract amendments and escalation of price. The process of paying the selected vendor before contract signing for the detailed design work assured us that we could review and question all aspects of the design before implementation, that we could jointly address the asbestos issues and find solutions, that we would get experience working with these people to assess how they might perform, and that the University could fully assess the products and apply them in the best way.

The detailed design and asbestos issues took about one year from the date of signing the Technical Services Agreement. The University contracted with an engineering firm to survey all campus buildings to locate asbestos. After about four months, the University had drawings of all buildings that identified asbestos in floors, ceilings, and walls, including window chalk and paint. The vendor hired a consultant who identified procedures to meet federal and state regulations that needed to be followed to work in the tunnels and mechanical equipment rooms. The University's Health and Safety Officer was very much involved in approving these procedures. In order to minimize cost, we jointly decided that it would be less expensive to exit the tunnels adjacent to the mechanical equipment rooms by digging new entrance facilities to most buildings. The cost of building communication closets was far less than the cost of precautions required in the mechanical equipment rooms. There was also great fear that dislodging asbestos in these rooms would cause it to get into the air handler systems and thus become distributed throughout the buildings endangering faculty, staff, and students. To minimize costs, the motto became to avoid the asbestos rather than to deal with it directly.

The vendor provided pricing and drawings for ten scenarios in response to a detailed Request for Quote (RFQ) that was part of the Technical Services Agreement. The RFQ refined the specifications of the earlier Request for Proposal but held the vendor to his pricing of the RFP. The University eliminated putting the communication system in the apartments and doing any trenching on campus after the RFP process. We determined that the scope would minimally be all 60 administrative and dormitory buildings but we were still interested in further pricing for the Greek houses. The ten scenarios combined administrative and dormitory buildings using various combinations of copper and fiber optic cable with and without the Greek houses. We added options for data communication at both one megabit per second and ten megabits per second with the fiber cable plant that this vendor was now able to provide for selected scientific and engineering locations. These combinations of data communication and cable plant options resulted in ten scenarios.

Defining the Scope of the Project

In March of 1992, the vendor submitted ten designs with drawings and complete pricing that included:

- installing all copper and fiber optic cable outside buildings terminating in the building distribution frame closets (outside plant),
- installing all cable inside buildings from the building distribution frame closets to intermediate distribution frame closets through risers and then to the wall jack (inside plant),
- constructing building distribution frame closets and intermediate distribution frame closets within 90 meters of all wall jacks,
- digging new entrance facilities to buildings where required,
- dealing with all asbestos issues,
- remodeling the switch room including all electrical and air conditioning and installing a new main distribution frame for cable with new entrance facilities provided by the local Bell operating company,
- providing a digital voice and data switch and all related electronics,
- providing a voice mail system from a third party vendor, and
- providing a telecommunication management system from a third party vendor.

This pricing was firm enough that we felt we could confidently ask for these moneys and deliver the project within budget. We now built a budget for the entire project and estimated operational costs with a model over a ten year life cycle.

The Greek houses were not uniformly on University property, the relationship with each varied greatly, and for 850 students the approximate cost would have been $1.2 million, a cost that could not be recouped except over about 25 years. We discarded the idea of including the Greek houses. Installing the copper cable plant in the steam tunnels would be very difficult and consequently very expensive. The physical plant staff were very happy to see a fiber optic cable alternative. When we reviewed the pricing, the fiber optic cable plant in the steam tunnels was about $800,000 less expensive than the copper, even accounting for the construction of the larger closets, and electrical, and environmental work to house the distributed line modules. The fiber optic cable plant in the steam tunnels also better positioned the university for future technological developments.

A communication switch has line cards that service groups of ports. These are generally resident within the cabinetry of the switch. With the fiber distributed line modules, these cards are located remotely in each building. Communication to these modules is over fiber optic cable since it needs to be at high speed. Having some of the switch electronics in every building complicates the management of the infrastructure. Each line module is connected to two fibers and provides 32 voice and data ports. Buildings on campus do not require more than 250 ports with most requiring considerably less, so these modules provide great flexibility in configuration for our circumstances. However, if power fails in a building, the telephone system fails unless power is supplied to the modules by battery backup in every building. We reasoned that because of the climate and other reliance on electrical service, a power failure would cause people to abandon a building in a short time. We decided to provide one hour batteries on the distributed line modules in administrative buildings and two hour batteries in the dormitories.

This distributed infrastructure requires larger building distribution frame closets and space is always at a premium on college campuses. Because of the elapsed time, space was often reallocated and we needed to renegotiate. At SMU, central control over space allocation does not exist, so discussions and compromises ensued, many after the contract was signed thereby requiring contract modification. Some building administrators wanted access to building distribution frame closets. We were resolute that we could not be responsible for voice and data communication in buildings when access to these closets was not controlled. We reached agreement in all cases, but this issue continues to surface as units want to "control" their data communication or local area networks.

We recommended the fiber optic cable plant in the steam tunnels and fiber risers in the science and engineering buildings. It was difficult to justify taking the fiber further toward the desk top since departments did not have any computers that could connect to it. For the copper cable plant within the buildings, we considered both level three and level five unshielded twisted pair copper. Level three was rated for 10 megabit per second data communication with intermediate distribution frame closets located within 90 meters. Level five was rated for 100 megabits under the same conditions. The cost was 15 cents per foot more for level five, so we decided to recommend level three. Today, these prices have changed and level five should be less expensive. However, today level three is being rated at 51 megabits per second with ATM (asynchronous transfer mode) technology. Of course, if you can afford it, level five should probably be used today.

Once the fiber optic cable plant was selected, the price for options for data communication became insignificant compared to the system price. Therefore, we opted to try the vendor's new product for 100 megabit per second data communication between selected administration buildings. We chose to implement the highest technology option that was not the most expensive.

Drafting the Contract

The University's legal department had never written a contract for this kind of construction, so the assistance of the consultant was essential. Occasionally, the legal department would contact outside legal sources for advice and consultation. Another consultant from the same firm took major responsibility for drafting the language with the legal department critiquing and adding their flavor and style. Much of the discussion occurred though conference telephone calls with each party having a draft copy. The contract was drafted with concurrence from all parties in three to four months.

The contract focused only on implementation and possible problems that might arise. Since all detailed design work was complete, it could be very specific about what were the deliverables and the timetable. It incorporated all necessary language about dealing with asbestos; the contractor agreed to follow all applicable laws and the buyer was not liable. Liability insurance and performance bonds were established. Some of the contract features included incorporation of all previous proposals and responses from the vendor, nine milestone payments tied to work completion, acceptance test procedures, system performance criteria linked to milestone payments, and definitions of warranties and training programs for University staff.

Gaining Consensus

Now that we had a detailed plan and a draft contract, we needed to sell it to the President and the Board of Trustees. The recommended financing was to sell bonds in conjunction with refinancing some existing bonds. The financial people were able to build their plan based upon our budget projections and a ten year life cycle model for expenses and revenue from selling long distance service to students. However, we had selected a small vendor and the Board was worried about placing so much reliance on them. Board members were quite concerned that we did not get a response to our Request for Proposal from a particular large company, that the local Bell operating company had not responded, and that another local company had not submitted a response. So we needed to either get additional responses from them or find out why not.

We had been concerned earlier about getting a response from the large company that would only deal with us through distributors. In fact, at one time we had expected five different distributors to submit a proposal using this vendor's equipment. We had delayed the date for submission of responses to the RFP until this vendor's new product was announced. However, in following up later, we discovered that their switch would not fit into the limited space we had for a switch room. Consequently, we had not received any proposal using their equipment.

The local Bell operating company relished the opportunity to be invited to submit another proposal. They had led us to believe that they were going to submit a proposal in February 1990 but declined to do so one day before the due date. However, we stipulated this time that they must provide a fiber optic cable plant in the steam tunnels; they could not use copper cable. After three months, they returned with a proposal that cost $3 million more than the price from the first choice vendor.

The other local company had not responded because the asbestos scared them and they didn't want to deal with it. So after a delay of some six months, the University signed the contract in December 1991. One lesson to be learned here is that even if you think you have covered all bases in getting vendor responses, your Board of Trustees may require additional measures at the last minute, thus delaying your best efforts.

One of the inadequacies with the above process of getting the contract signed was the lack of involvement of the faculty. Articles appeared in the computing center newsletter to keep them updated, but the day to day design work, contract negotiation, building financial models, and convincing the administration and Board of the value and need for infrastructure somehow did not interest the faculty. Updated information was provided regularly to the campus computing advisory committee. The process of getting commitment for the project dragged on for two years, and as a result, no one thought anything would happen. The student newspaper occasionally picked up some tidbit and went into attack mode. The project would produce an invisible product with the exception of a new telephone on each desk. It was not even possible at this time to reconvene the selection committee that had been educated about the products and issues. The faculty representative was on sabbatical, the deans representative had left the University, and the staff from finance and housing had retired. Somehow, the faculty did not remember that their highest priority for the University articulated in their 1989 report to the president was more fiber optic cable in the steam tunnels. The faculty and deans continue to grumble about the cost of this project even as they use its products. A project can be a thankless job particularly if it takes a long time and is largely invisible.

GETTING THE JOB DONE

The Timetable

Beginning in 1992, implementation commenced in earnest, 2.5 years after project inception. The cutover date for phase one, the administrative buildings, was Thanksgiving weekend of 1992. The dormitories were phase two and needed two summers of scheduling for installing building wire with cutover scheduled for mid-August of 1993. Most of the outside plant work needed to be completed before phase one cutover because administrative offices existed in some of the dormitories and the buildings were not in clearly separate areas on campus. The fiber optic cable and 50 strands of copper per building for alarm and security circuits were installed without incident. New entrance facilities were dug with major disruptive activity occurring at night. Construction of building and intermediate distribution frame closets proceeded in parallel. The major issues here were renegotiating space for the closets and changing the construction plans accordingly. Never count on space until you have occupied it.

Refining the Counts

Even though we thought we had excellent counts for stations and equipment in the contract, it had been nearly two years since the preliminary survey had been done as part of the design work of the Technical Services Agreement. Another survey was needed and this time, since the contract was signed and it was apparent that work was really going to happen, everyone asked for a great deal more than in the original design. We ended up with approximately 1,000 additional jack locations and 100 additional telephones. These were easily incorporated into the schedule and the contract and costs fit within the allowable contingency.

Gaining Cooperation

Enlisting the cooperation of the many diverse groups on a campus is one of the biggest problems in attempting a campus-wide project. We did not have anyone with central control over space so we needed to create a group of building and departmental representatives who would deal with the contractor. We needed another group that could speak for how voice and data communication would be used for various groups. These tended to be the lead secretaries and administrative assistants. We had another group that met regularly called the College Computing Coordinators who represented technology interests and provided support services within the academic units.

Each college has a financial officer who was very concerned about what these new services would cost. Telephone and data communication services are cross-charged to the units, so if their costs were going to increase, they needed to have the additional funds. The controller dealt with this group of financial officers. He was also in charge of the bond sales, and he had closely scrutinized the projected budgets and models. He was very important in assuring everyone that their financial status would not be jeopardized. You need a financial partner in the institution who can work with you when you undertake these large projects.

You also need many people across the campus who will come to meetings, undertake information gathering on where jacks are needed and who needs what kind of telephone and data communication equipment, and generally spread the word about what is going on. The staff are your best allies. Work with everyone of them who will talk to you or your staff. Alienate no one. The faculty are generally too busy to pay attention except to criticize if they are inconvenienced.

Performance of the Prime Contractor

We were very fortunate that our prime contractor was local and was heavily motivated to do an excellent job for us. They were anticipating the University to be a reference site for future marketing and we were quite agreeable. However, we faced some very vocal criticism for our selection. Dallas seemed to be a very small town when everyone voiced an opinion of this contractor and one came to wish that the contractor was from Tokyo. It appeared easier to buy from the Japanese in Dallas than to buy Dallas.

We had biweekly status meetings with the prime contractor with the consultant available on a conference telephone call. The prime contractor's program manager took responsibility for the agenda with the University writing the minutes. The University's representatives to these meetings included the physical plant, the construction supervisor, voice and data communication staff, and University management. The contractor always included the program manager, staff that supervised the sub-contractors, the lead data base designer early in the project, and the lead person for the telecommunication management system later in the project. Usually the local Bell operating company sent a representative to the first part of the meeting to assure coordination with them. Others were invited as appropriate.

Our only criticism of the prime contractor's work was the oversight of their subcontractors, who sometimes did an inadequate job. The contractor, however, always remedied the situation in a timely fashion. We let them handle these situations and by withholding payments for milestones, we eventually had satisfactory resolution of all issues.

THE TELECOMMUNICATION MANAGEMENT SYSTEM

The most difficult issue was the telecommunication management system. We knew we were in uncharted waters with our desires for software to accomplish this objective. A private university that is not large does not want to hire many specialized technical people for which it cannot have full-time work. Neither does it want to rely on contractors who can bill for many hours for trivial work. Staff who can do many jobs with the support of software would be ideal. Another view of the telecommunication management is that it is a large management information system. The cable plant, the station locations, the equipment, the people and their billing are all interrelated data bases that communicate in order to run the system. In addition, a telephone switch processes the calls and must report what it does to these data bases. Moves, adds, and changes are made in the field and must be reported in these data bases. Most telecommunication staff do not have this view or the background to assess the problem in this manner. If you view the problem in this way, what you want is software that is called a telecommunication management system. With such in place, you can use more generalized staff who will use the management system.

Selection

The telecommunication management system was part of the contract with the prime contractor. During the Technical Services Agreement period we had jointly viewed many vendors' products. Unfortunately, many were mainly billing packages or mainframe products that reflected telecommunication operations of the 1970s. We were looking for something different and were, therefore, prepared to take some risks. We wrote the contract incorporating the best package that we had found. However, we had great misgivings about it since when the third party vendor arranged a demonstration in Florida, the customer had never put any data into the system. Indeed, all fields were empty of information so it was difficult to judge its operation. One of our criteria for a telecommunication management system was that it should communicate with the switch. The switch sends it records of calls in real time that are rated and stored for monthly billing. Moves, adds, and changes are made through the telecommunication management system software and the switch is automatically updated in its information and function. The prime contractor assured us that this functionality would be provided by their staff working in conjunction with the third party vendor.

Shortly after the contract had been signed with the prime contractor, their relationship with the third party telecommunication management system vendor disintegrated. The prime contractor suggested another package that was under development, would operate on an IBM RS6000, and would fully communicate with their switch. They wanted to work with this company, wanted us to work with them, and were willing to risk their milestone payments to assure us of their good faith. The software was not yet developed enough to view it. The company doing the development was very small and owned by one person. Under normal circumstances, these were reasons to reject the substitution but we agreed to change the contract with some price concession and the contractor's risk of milestone payments.

The Telecommunication Management System as a Tool

From the University's viewpoint, the telecommunication management software should be used from the onset of the implementation process. Data should be collected, wires and cables should be laid, telephone numbers assigned, and all should be documented through the telecommunication management system. Ideally, it could load its data into the switch just before cutover. However, as implementation proceeded, so did software development. By the time of the administrative cutover on Thanksgiving weekend of 1992, an early copy of the telecommunication management system had been loaded on the IBM RS6000 and the telephone operators could look up telephone numbers on it and use this information to transfer calls. However, all data had been separately loaded into the switch and the management system so there were often errors and discrepancies.

Communication With the Switch

The telecommunication management system became the single biggest problem for the project, but, of course, it was not unforeseen either by the prime contractor or the University. The prime contractor had several problems with the switch software communicating with the management system software. When we thought these were solved, we needed to work on getting the data coordinated between the two. Then another software bug arose and we worried about diverging data bases, later followed by more coordination. Sometimes we needed to stop using the management system for certain functions. Sometimes the switch couldn't provide certain information. It took about nine months, a normal gestation period, to get these communication problems resolved. As time moved on we needed to involve the third party vendor more and more as the debugging became more their problem and appeared more subtle to the prime contractor.

Billing

Our second most visible and critical need from the management system was billing. The third party vendor claimed that was his "bread and butter" and he really could do this. Since we had cutover the administrative area first, billing at this time was only processing internal cross charges for equipment and long distance. After several fits and starts at processing bills, we managed to get December through May processed by the University's fiscal year end on May 31, 1993. We believed this billing was largely correct. But we needed to process student bills by September 30, 1993 and we could not tolerate any errors or problems. We also needed the switch and management system to communicate so that a student's long distance service would be terminated if his monthly billing exceeded $200. The third party vendor, the prime contractor, and the University worked feverishly over this summer to assure that all went smoothly in the fall, and it did.

Work Order and Trouble Ticket

The work order and trouble ticket part of the telecommunication management system was the last part implemented. Its features were based upon having a complete cable plant data base that the prime contractor assured us had been entered as the plant was installed. We hadn't used it nor had the prime contractor maintained some of it for nearly a year. The longer data are unused, the less usable they are. The staff seemed to hate this part of the software, continually claiming it was unusable and didn't work. Management was skeptical because the prime and third party contractors said it worked and it could be demonstrated. They ran extensive training classes and you could see the software work. Here is where we get into cultural and perceptual issues.

The third party vendor insisted his software worked fine and the University staff claimed it didn't. Some of the prime contractor's staff that worked at the University were skeptical. The prime contractor sent in a supposed impartial staff person from their organization to investigate why this software was so difficult to use. After three days on site and the preparation of a report, everyone sat down to analyze the situation. The University could do several things to better utilize the software and over time the third party vendor could improve the software functionality of the screens, the data on them, and how they interacted. But the fundamental data and functionality were there. The University had organized work in the traditional fashion of having individuals perform some tasks and then handing off the work to others for additional tasks. The system was not designed for this hand off--one staff person could see the work through from placing the work order to closure. However, the staff person had to understand all the processes that were taking place. Some of our staff did not have this conceptual skill level. The University needed to reorganize some jobs and define tasks differently.

The University had hired two cable plant people during this project who were traditional telecommunication workers. We needed to reorient their thinking into being data base maintainers rather than people who tinkered in wiring closets. The cable plant data base must reflect what exists on campus or the work order software cannot operate properly in assigning cable pairs, and so on. The software tells the workers what needs to be physically done, rather than having the workers make those decisions. This is a big change.

Staffing Requirements

By summer 1994, we believed that we had accomplished the goal of having a telecommunication management system working in conjunction with a few good people to operate a 7,000 port voice and data communication system. The organization for this size system is: an associate director who is in charge of all voice and data communication for the campus, including the ethernet network that does not use the switch; an assistant administrator who is largely responsible for all billing; two cable technicians; two switch technicians; 2.5 telephone operators (0.5 less than three years ago when we had 2,300 ports); three clerks with one primarily handling student service and long distance, one for administrative moves, adds, and changes, and one for voice mail with all cross trained to cover for each other. All of these staff intensively use the telecommunication management system. They cannot do their jobs without it now. We do fill in with some additional support from the Help Desk that takes requests for services and answers basic operational questions. This can be quite hectic in the fall when the students first come to campus and do not understand the telephone and voice mail systems, but usually these activities calm after two to three weeks.

Staff Integration

The telecommunication staff are fully integrated with the computing staff and work together not only because their responsibilities overlap for data communication but also because the computing staff are primarily in charge of the hardware and software of the telecommunication management system. It was our first production system operating on a UNIX-based platform. It has real time and batch production requirements. The telecommunication people are learning about these aspects of computing systems and the management information system people are learning about the data bases that drive a campus infrastructure and functions that make a telephone call--very small, high volume transactions with high dollar volume cost to the University. In general, the management information system people think the design and implementation of the telecommunication management system to be primitive by their standards. The telecommunication staff don't really think they are doing their work by sitting at a computer entering and changing data. But they have worked well as a team and have made this project very successful for Southern Methodist University, for the prime contractor, and for the vendor of the telecommunication management system.

WHAT NEXT?

Voice Mail and Culture

What are some other worthwhile ideas to be passed on from this project? The cultural changes to a campus from the installation of voice mail should be noted. Many offices on our campus had secretaries that answered telephones and wrote little pink slips. Just because technology enables another mode of operation does not mean that the old disappears. One faculty person objected to having a light on his telephone to let him know he had a message. He wanted it removed! Others flatly refused to use voice mail. However, some jumped on board and loved it from day one. Within the computing center alone, an organization of about 60 people, we freed up 0.5 full-time equivalent staff from answering the telephone for people. We all used voice mail with an option for a human. Quickly most chose to leave a message and we all worked to positively reinforce this behavior by calling back. After six months, I believe a vote would have been overwhelmingly positive. When the students got into voice mail in the fall of 1993, there was no turning back. They loved it and used most features.

Data Communication Escalation

With a universal cable plant, the demands for data communication increased more quickly than anticipated. Ethernet had existed in the engineering school for many years. A 56 kilobit per second link to Internet was installed in 1989 and upgraded to 1.54 megabits per second in 1991. Several academic buildings had some fiber that had been installed with the AT&T ISN system. Some of these academic locations outside of engineering were connected and as the cable plant was installed in 1992, we began connecting a few more academic locations. By the time of cutover at Thanksgiving of 1992, many faculty and staff preferred ethernet to asynchronous data communication. We tried to limit the scope of the ethernet installations for a while so that we could complete the project that was underway. The clamor for ethernet continues today even though we already have about 1500 ethernet ports with many of these serving multiple connections. The continual change in technology means that new requirements will be generated even as the old are being implemented. The next technology will probably be ATM (asynchronous transfer mode) with some universities already involved in pilot tests. This technology will enable the multimedia communication that all will expect shortly.

Beginning in the late 1980s and continuing through the time of this project, many departments installed Novell networks that could not be connected campus wide without an outside cable plant. With the completion of the infrastructure, these networks can now be connected to the campus backbone network and to the Internet. These networks and their management that have operated autonomously must now cooperate and interoperate with some central coordination. This integration process in physical and software connectivity and in management is underway, often with some stress to the units and to the central organization.

Scholarship

The most significant change to the campus was the possibility for the faculty to participate in the scholarly activities of the day. The on-line library catalog could be accessed from their desk tops. Faculty do not need to walk to the library and they have access through the Internet to scholarly materials worldwide. They can use electronic mail as easily as voice mail. They can collaborate with colleagues worldwide from their desk tops. They can easily reach campus communication systems and computers from home through the new modem pool. Asynchronous communication will be with us for a long time, especially when we must rely upon the local Bell operating company, despite preference for ethernet. Faculty can be continuously available to students through electronic communication and the use of bulletin boards as part of their teaching techniques. A new interest developed on campus for improving instruction through the use of technology. The University library took over much of the instruction for the faculty on the use of Internet as a means of promoting the use of information resources worldwide. Many changes have occurred on the campus in the past two years, and none of these would have been possible without the new infrastructure.

Replacing Administrative Systems

The University is now able to consider the replacement of its legacy mainframe systems with the possibility of implementing new systems in the "client-server" mode. The mainframe systems were designed in the 1970s and represent the methods of doing business of this period. The University can evaluate new ways of doing business because its communication has changed. The integration of electronic mail, document transfer, voice mail and numerous other technologies with powerful desk top machines means that the way business is conducted can be changed or "re-engineered" to better serve students and faculty. Over the past year, the University has conducted a project with a consulting firm to evaluate how this might be done. Preliminary plans have been developed and are under study. Without a powerful communication infrastructure, none of this would be possible to implement. It did take time and the commitment of many to get here. We are hopeful that these investments in technology will continue in higher education and that we can be helpful in these processes.

CAUSE 94

Track V
New Technology

Coordinator: Daniel J. Oberst

New Tools for Multimedia Development: ScriptX

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Abstract

There are two trends in desktop computing that have become popular: Multimedia and Objects. There has also been one problem that has bedeviled higher education institutions as they create and implement software on desktop computers - the incompatibility between the two dominant standards, Windows and Macintosh. What I propose to present here today is a tool designed to facilitate the implementation of multimedia programs, taking full advantage of object oriented technology, and designed to run on most popular desktop platforms of today, not only Windows and Macintosh, but also OS/2 and UNIX.

ScriptX is a product of Kaleida Labs, a company formed and jointly owned by IBM and Apple Computer. Before delving into ScriptX, let me take a few minutes to justify the use of multimedia in higher education. If multimedia is just a fad without real educational benefit, we are wasting our time and our investment.

New Tools for Multimedia Development: ScriptX

Introduction

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ScriptX is a product of Kaleida Labs, a company formed and jointly owned by IBM and Apple Computer. Before delving into ScriptX, let me take a few minutes to justify the use of multimedia in higher education. If multimedia is just a fad without real educational benefit, we are wasting our time and our investment.

Multimedia Effectiveness

We have all heard clichés such as "A picture is worth a thousand words." Intuitively we agree with such clichés. We know that no matter how well someone describes a face to us, we rarely, if ever, can "picture" the face correctly until we see the person, or a photograph or drawing of the person. We assume that multimedia can somehow enhance the teaching and learning process, but are not quite sure why.

The answer lies, as you would imagine, in the way our brains function. Research done at Woods Hole Oceanographic Institute and other centers of learning has shown that learning is enhanced not only by repetition, but also when multiple senses are involved in the process in a short span of time. Thus if we see and hear something we are more apt to remember it than if we only saw it or heard it. If this something is repeated enough times, physical and chemical changes take place at the synapses in the brain, and the memory becomes permanent.

It is also true that memory is diffused. A memory is not stored in a single synapse, or within a single nerve cell, but over large areas of the brain. In retrieving a memory the brain performs a pattern matching function, trying to match the current stimulus to the memories stored in the brain. The match does not have to be complete. The brain retrieves memories based on partial information. This is why we sometimes confuse a stranger with someone we know. A glimpse of the stranger matches enough of the pattern that the brain retrieves the memory. On closer inspection we find out that the patterns are not a complete match, and we apologize to the person we have just mistakenly recognized. This partial pattern matching is an essential feature in our lives. It allows us, for example, to instantly recognize a dog, although dogs come in a wide variety of breeds, sizes and colors. The richer the pattern of the memory, the easier it is to match. This is why we often form memories by association. A certain smell will invoke, perhaps, memories of childhood or of a loved one. A certain song might have the same effect.

How is this related to multimedia, and specifically to multimedia programs implemented on a personal computer? In several ways:

- Multimedia engages more of the senses. A picture provides a richer pattern than words. Pictures plus sound, moving pictures or animation do the same. Multimedia on the personal computer can be interactive, which engages the higher order thinking processes of the brain, thus facilitating learning.

- Multimedia on a personal computer lets the learner learn at his or her own pace.

- Multimedia on a personal computer lets the learner go over the information multiple times, which also enhances learning.

Although the last two points are not restricted to multimedia programs alone, they are an important factor in successful multimedia courseware. Evidence continues to accumulate on the effectiveness of computers in instruction. Dr. G. Philip Cartwright writes in the 1993 EDUTECH Report: "Do Computers Help Students Learn?"

> "There have been literally hundreds of research studies carried out in which computer based instruction was compared with conventional instruction in a controlled research environment. These summaries reveal that CAI is equal or superior to conventional instruction on the following variables: student achievement, covering both immediate and long term retention; attitude toward both the subject matter and the instructor; and time to complete the task. The generalization is that CAI students realize higher achievement in significantly less time than the conventionally instructed students."

Recently EDUCOM published a document titled "101 Success Stories" which documents many cases in which computers and multimedia have helped the instructional process.

Programs such as Perseus and the Great American History Machine use multimedia not to entertain or to allow mindless pursuit of facts, but to elucidate, explain, and help students develop theories and test them.

Object Oriented Technology

Lets leave the discussion of multimedia for now and look at another promising technology, the technology of objects. While the technology is not new, its benefits had not touched us until programs, such as HyperCard, used some object oriented technology to make developing software easier. Today there are many more recognizable examples of object technology at work: Authoring programs such as Authorware and ToolBook, drawing programs that treat elements of the drawing as objects such as Corel Draw, and even operating systems incorporating object technology such as NextStep and OS/2 Presentation Manager.

Behind object oriented concepts lie many technical terms such as encapsulation, inheritance, polymorphism and instantiation. However it is not necessary to understand the technology to appreciate its benefits. As we explore ScriptX, we will highlight some of the advantages that object technology provides.

Introducing ScriptX

ScriptX is an expression based, interpreted language, which means that every statement you type returns a result. Thus if I type 3 + 4, ScriptX returns the result of the expression, 7. One of the benefits of ScriptX is its interactive nature. I do not have to write a lot of code before I can test it. I can actually run each statement as I type it. Everything in ScriptX is an object, including the numbers I just typed in, and the returned result. ScriptX comes with a wealth of object classes, so I can create a new window as easily as I added two integers. A window is just another kind of object.

Clocks

A unique feature of ScriptX is that one of the object types (classes) that are implemented is clock. Thus you can create clock objects in your program, and assure that events in your program occur at the times you specify, independent of the speed of the machine running the program. You can also synchronize activities in your program and maintain the synchronization, even on a slower machine. As a matter of fact, all of the multimedia objects in ScriptX are derived from the clock class. This makes it easy to start, stop, synchronize, and control the speed of multimedia.

The Foundation Authoring Model

Another interesting architectural feature of ScriptX is the division of function among what are called models, controllers, and presenters. This is termed the Foundation Authoring Model in ScriptX. A model is an object, or set of objects, that we are interested in. A presenter is an object that provides a view of our object on the screen. A controller is an object which controls the interaction between objects in spaces, as well as the interaction between objects themselves.

For example, consider a Text object. It contains a string of text. To show the text on the screen one needs a TextPresenter object. The TextPresenter object handles such issues such as justification, left to right or right to left text display, etc. Consider also a 3D object (these are not currently implemented in ScriptX, but the foundation is there for them). If you wish to show it in two dimensions (for example, the view of a ball would be a circle) you can use a 2D presenter. If you wish to show it in three dimensions, with shading, hidden line removal, etc., you would use a different presenter. The object itself does not change and does not have to be concerned about how it looks. It is the presenter's job to do that. As a final example consider an object that has a temperature property. One presenter can be written to display the temperature as a number, another to represent the temperature as a thermometer-like display, while a third might represent the temperature as a color, so that red is displayed if the temperature is high, and green if it is low, and shades between the two colors can represent the intermediary temperatures. This division between an object and its properties, and the presenter (how the object is displayed), is very powerful. The objects I construct can be simpler. The presenters can be general purpose. Once I construct a presenter for temperature, I can use that same presenter to display the temperature (or any other linear property) of any object.

The third element of the Foundation Authoring Model is the controller. A controller is an object that controls some aspect of another object's behavior. For example, the Projectile controller gives an object velocity and elasticity properties. The Movement, Bounce and Gravity controllers are able to control one or more projectile objects inside a space. We can, of course, create other controllers as well.

Re-Use of Objects

One of the benefits of object oriented systems is that you can easily re-use objects. Consider the case where there is a portion of a program that performs a function you would like to implement, but is perhaps missing a feature or two you would like, sort of like finding a car on the dealer's lot that is the right make and model, but is missing a desired option or two, or is the wrong color. In traditional programming you muck around with it the code to understand how it works and to incorporate the changes. This has the unpleasant side effect of often introducing bugs in the program, making the code more complicated, and perhaps changing the interface to the code, so that other code that depends on it might have to change as well. You can get rid of some of the problems by copying the code and creating a new piece of code by modifying the copy. Of course, the problem then becomes that your program gets too large, as there are several pieces of near identical code performing separate functions.

On the other hand, in an object oriented program if an object exists that is close in function or appearance to what you desire to implement, you can create a new object that is derived from the original object. You only write code for the new behavior you wish to implement. All of the rest of the object's function is inherited from the original object. There is no danger of adding bugs to the original, working object, there is no duplication of code, and you don't even have to understand how the original object works.

A ScriptX Example

Lets use an example to put it all together. Say we have a number of bitmaps representing the movements of a fish. In order to animate the movement of the fish we need to display the bitmaps in succession at a constant rate. To show a bitmap on the screen I need a presenter, in this case the TwoDShape presenter. To change the bitmaps I will need a clock. Although ScriptX has many object types to support animation, we'll do it the hard way by defining an Animation class (Figure 1). This class will accept a collection of objects, and display them one at a time using the rate of a clock I define. Notice that, in true object oriented fashion, I can pass an Animate object a collection of anything that has a visual representation, not just bitmaps.

I can now run a program and see the fish moving because the animate object is playing the bitmaps in sequence. However, the fish does not move through the water. By creating a new object type, which incorporates the characteristics of the Animation object and the Projectile object (which incorporates the concept of velocity) we can get the fish to move across the window. While I am at it, I would also like to be able to have the fish reappear on one side of the window after it exits the other side, or the animation is going to be short lived. I can create a controller object that will do this. Again, once this object is created, it will take *any* object that falls off the screen on one side and place it on the other side, so this same controller object, which I will call Wrapper, can be used in many other programs.

I would also like to be able to drag the fish in the window and move it to a new position. ScriptX provides a DragController object which works on Dragger type objects. So, somehow, my fish will have to have the characteristics of the Dragger object.

To create my example, then, I define a new class of object called Fish, which inherits the characteristics of:

- Animation (to play each cell in succession).
- Projectile (so it can move in the window), and
- Dragger (so that I can drag it).

I will place this object in the window and activate three controller objects to work on the window:

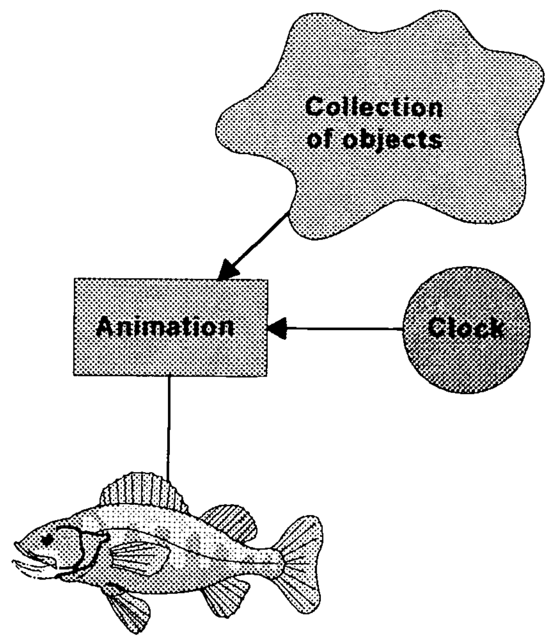

Figure 1: The Animation Object

- Movement (to move the fish across the window).
- DragController (to cause the fish to follow the mouse cursor as a result of a drag operation), and
- Wrapper (to move the fish to the edge of the window when it falls off the other edge).

Figure 2 illustrates the program. A new object type (class), called Fish, inherits from the Animation, Projectile and Drag classes. I gave the Fish object the behavior I desire not by writing more code, but by having it inherit the behavior from the other classes.

I also apply the Movement, DragController and Wrapper controllers to the window, so that these controllers will interact with the Fish object to produce the desired behavior. In other words, the Fish object has characteristics that allow it to be moved, dragged, etc. The controllers utilize these characteristics.

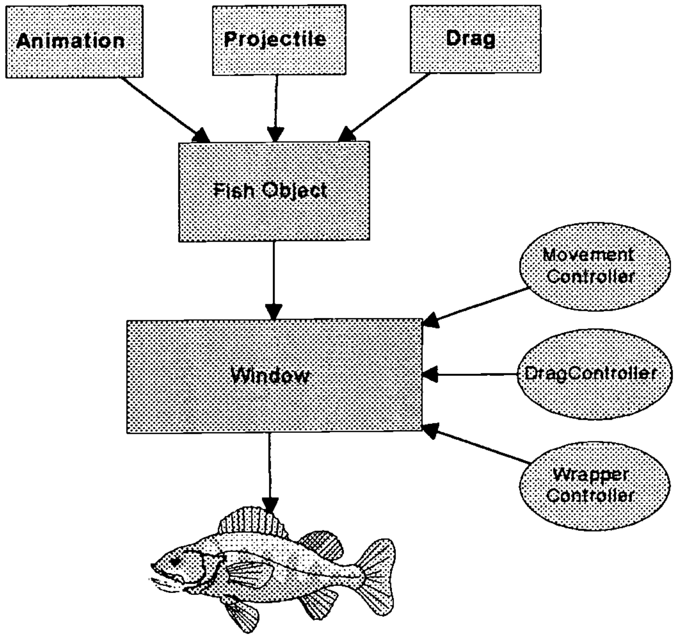

Figure 2: The Complete Program

For example, the Fish object inherits the velocity property from the Projectile class. The Movement controller looks at this property and moves the Fish object by the proper amount at each time interval.

Multimedia

Multimedia is well supported in ScriptX. There is built in support for animation, digital audio, digital video, and MIDI. As previously mentioned, all these object classes are derived from the Clock object, so it is easy to set up and maintain multimedia synchronization. However, multimedia is often file based, and incompatible file formats are a problem for a cross platform product. A PICT file is not the same as a BMP file, a AIFF file is not the same as a WAV file, and a QuickTime movie file is different from an AVI file. ScriptX handles this problem by defining its own internal file formats, and providing importers that will convert the various file types into the internal ScriptX formats. A file may be imported "on the fly," or may be imported ahead of time and saved as an object. Importing a file on the fly can be a time consuming process, so the author of a ScriptX title is likely to do it ahead of time. To handle the situation where a file is not available until run time, such as is the case with a generic media player, ScriptX allows one to invoke an external multimedia player. ScriptX also allows one to manually control multimedia devices via an MCI command interface, and through a similar mechanism on the Macintosh.

Other Features

A vexing problem in object oriented systems is that they normally cannot permanently store the objects they have created. Storing an object is not as simple as writing the object to a file. The object might reference (point to) many other objects. These references, which are usually implemented as internal pointers, are a problem because when the object is read back at another time the objects might not be in the same place anymore. In C++ all of the objects are built when the program starts, from the code in the program. In other words, a C++ program starts with cookie cutters (class definitions) from which the program creates the necessary cookies (objects). However, objects created by the program as it runs cannot be stored. To solve this situation third party object stores are available. ScriptX, on the other hand, implements its own object store. What this means is that a ScriptX program can start out with the cookies - it does not have to make them. It can also store new kinds of cookies it makes while it runs, so they can be used by other programs. ScriptX uses the Bento architecture (also to be used in OpenDoc) as the mechanism for implementing its object store.

One of the facts of life of an object oriented program is that when it runs, objects are created and others, no longer needed, are destroyed. The programmer does not manage memory as is done in C, where to create, say, a new array, the programmer must invoke the Malloc function to grab some memory, and remember to free it later. The cost of running an object oriented program is that it must include what is called a garbage collector, a part of the program that scans memory and finds objects that are no longer in use and removes them from memory. This is not a simple process, as in object oriented programs objects often reference other objects, so it takes some doing to determine whether an object is to be discarded or not. The problem is that when the garbage collector kicks in, the program ceases to run for a few seconds while the garbage collector does its job. This is of necessity, since the state of objects should not change when the garbage collector is examining them. In most programs this is at most an annoyance. In a multimedia program it is not acceptable. For this reason, the garbage collector in ScriptX (patent applied for) runs on a separate thread in the background and does not cause the program to hiccup. Although it has not been mentioned before, ScriptX is a multi-threaded program, which implements its own thread system so that it can run in single thread environments such as Windows 3.1 and Macintosh System 7.5.

ScriptX supports the Unicode standard. In addition it supports the ISO 10646 standard for representing characters as 4 byte quantities. The storage requirements are minimized, as ScriptX automatically recognizes ASCII characters and stores them as one byte values. ScriptX is also architected to represent text from right to left, and from bottom to top, to be able to render text in several foreign languages and scripts.

The Dynamic Nature of ScriptX

Perhaps one of the most interesting features of ScriptX is its dynamic nature. That means that new objects, say, from an object store, can be added to the system while it is running and these objects will be incorporated into the system dynamically. It is not necessary to recompile the program. Of greater importance is the meaning that the author does not have to plan all of the interactions between objects in the program in advance. New objects can be added later, and they will adapt to the program in much the same way that a child adapts to a new neighborhood.

The potential of this feature is that independent parties can create libraries of objects for ScriptX, in the same way that vendors now create and sell libraries of clip art. One can envision Chemistry objects, Biology objects, Psychology objects, and many others. Thus an author can build his or her own ScriptX program, but populate it with existing objects they did not have to create.

ScriptX Today

Where does ScriptX stand? This fall the ScriptX team at Kaleida has been busy working on footprint and performance issues. Any significant new technology such as ScriptX tends to stress the currently available hardware platforms. This was certainly the case when Windows was first released. Given the rapid advances in platform speeds and capacities, this should not be a problem for long. ScriptX is slated for release on December 16 of this year, initially on both Windows and Macintosh platforms, and soon thereafter on OS/2.

Perhaps a more significant concern for faculty authors is the lack of a visual front end for ScriptX. While ScriptX will ship with tools to translate some aspects of Macromedia Director and Asymetrix ToolBook programs, these are stop gap measures at best. Kaleida hopes that third party developers will develop such tools, in the same way that companies such as Watcom developed Visual REXX for the REXX language. Once such tools are available, ScriptX should provide an exciting, powerful and cross platform enabled multimedia authoring tool. It is also a terrific tool on which to learn the ins and outs of object oriented concepts and programming.

The presentation at CAUSE94 will include demonstrations of live ScriptX code and examples.

Providing A Campus-Wide Software Server Or How To Be All Things to All People!

CAUSE94 Presentation

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and
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Abstract:
Distributed computing systems are a reality, but a wealth of computation hardware is useless without software. Managing and funding the software in a distributed environment is a headache! Faculty need access to the instructional software available in the student computing sites to prepare class assignments. Students need access to the same software to complete their class work. The confinement of software to specific devices or locations contradicts the theme of distributed computing. Everyone needs access to current software to ensure compatibility and to reduce the computing support load. Faculty and staff need access to a diverse set of software, but they do not always have the budget to purchase and maintain this software let alone the time to install it and maintain updates. All this argues for the extension of the student site server concept to a campus-wide software server concept. Without something like this, it will be nearly impossible to adequately manage the burgeoning volumes and diversity of software on our campuses. This paper describes the vision, issues, and estimated costs involved in setting up and running such a service.

Background

As the campus computing environment continues to transform itself from centralized to distributed in nature, one of the key leadership challenges that has emerged is determining how to provide software and support in this environment. Traditionally, student computing sites have provided access to computing hardware and software so that students could complete their course work. To make efficient use of the distributed computing resource available to faculty, they need access, either from their offices or from home, to the same software that is installed in the student computing sites. With personal ownership, or distributed computer facilities, students also need access to this software from anywhere on campus or from home. Many of the clientele of the central Information Technology (IT) department have become sophisticated users of technology. They need access to an increasingly diverse array of current software products that are maintained and compatible with one another and with the campus computing environment.

The costs associated with providing access to adequate software and supporting it, are substantial and--while budgets have improved over the drastic cuts experienced a few years ago--it is unlikely our institution will be able to afford continued proliferation of the present highly distributed and individualized software purchase and distribution schemes. Furthermore, there are significant management headaches involved with supporting a distributed server environment, e.g., backups, restores, off-hours support, network management, and systems administration. All this takes time and resources away from mission-critical departmental activities.

A new kind of centralized management and support scheme is in needed. However, our customers will **not** return to the old days of their forced dependence on the central IT department. Thus a new synergistic balance between independence and centralized economy-of-scale is also needed.

The IT department on our campus already has a significant investment in personal workstation software in the student computing sites and the support infrastructure to install and maintain that software. Like most institutions, we have also deployed a campus-wide network. With the right software management and networking products, this investment can be leveraged to provide a campus-wide software server environment that can make software available to anyone associated with the institution. This technology can also be used to restrict access for a particular set of software to a particular community of interest, such as a single college, department, or class.

Components of the Campus-Wide Software Server

At Arizona State University (ASU), we have put a lot of time and resources into establishing the new distributed computing environment for faculty, staff, and students. We are in a position to capitalize on this investment by leveraging a number of inter-related technology components to establish the campus-wide software server. Not all of these components are entirely in place, but most are at least partially deployed at present. The components we expect to use are identified below.

Distributed computing architecture: ASU has established a distributed computing architecture for the campus called ASURITE ("Developing a Distributed Computing Architecture at Arizona State University", CAUSE/EFFECT, V.17, No. 2, Summer 1994). This architecture specifies a coherent technology environment in which all the components are compatible with one another. This architecture allows us to focus on a restricted set of platforms--i.e., Windows, Mac, and UNIX Motif--in order to make the most of our limited resources.

Adequate personal workstations: Part of the ASURITE architectural definition is the general availability of adequate personal workstations on the desktop. A minimum of a 386 PC or a 68030 Mac is required to run the kind of client software needed. At ASU, the Provost, Dr. Milton Glick, has provided significant workstation "infusion" funding over the past couple years which has essentially brought faculty desktop systems up to par; administrative desktops will be a future priority.

Universal network connectivity: These personal workstations must be connected to the campus network. At ASU, we have deployed a campus-wide Ethernet-TCP/IP network with selected links upgraded to the higher speed FDDI as necessary (and affordable). The same "infusion" funding mentioned above has also allowed a substantial portion of the campus to become networked.

Replace LAN 's With a WAN : In order to minimize the support overhead associated the campus-wide software server, we are planning replacement of our existing Banyan and AppleTalk LAN's in the student computing sites with a WAN. The Andrew File System (AFS) is part of the ASURITE architectural definition. AFS can be used to replace our existing LAN's with a WAN thus unifying our networking support strategy and simplifying training, documentation, and support for the campus-wide software server.

"Dial-up Ethernet": The same functions available on campus must also be available off-campus to foster home access and location independent computing. Clearly, dial-up speeds will restrict some applications with high bandwidth requirements, but most functionality can be provided. We are using the Point-to-Point Protocol (PPP) at ASU to provide this service, although it is restricted to faculty and staff at this time.

Software license management: Products are now available that will allow better management of site licenses in order to minimize the number required for any given package; to avoid a one license per computer approach. These products keep track of, and limit, concurrent usage of a particular software package to the licensed quantities. These management tools can span the campus network to keep track of software use throughout the institution.

Software distribution: The old methods of diskette copying and individual computer installation are time consuming and inefficient. We envision hundreds or even thousands of copies of various software products available via the campus-wide software server. To ensure interoperability among software on the same and separate workstations, it is crucial that there be a way to manage versions of software products. There are two software distribution models: the "push" model and the "pull" model. In the push model, software is distributed from the central location through the network as a universal update. Software is "pushed" out to the customer. In the pull model, software is distributed from the central location when requested by the customer. Software is "pulled" out by the customer. ASU is targeting the pull model for our campus-wide software server.

Campus-Wide Software Server Benefits

We anticipate realizing a number of benefits from establishing the campus-wide software server at ASU including:

- Encouraging student micro purchases. We will never be able to afford to centrally fund all the micros in the sites students will need. The campus-wide software server will encourage student purchase of micros because they will have access to the software they need from home or any other campus location without expensive purchases or having to wait in line for access to a computer in the student sites.

- Faculty access to site software. Faculty will be able to gain access to the same software used by their students. They will be able to develop class demonstrations and assignments from their office or home without having to physically go to a computing site.
- Leveraging of software investments. The investment in software by IT or other entities will be better utilized for a greater return on investment for the institution. When software is not in use on one computer it is available to use elsewhere. This network access can be restricted; for example, software purchased by an academic unit can be restricted to members of that unit.
- A greater diversity of software available to the individual. Products will be available that individual faculty, staff, or students would never be able to afford by themselves.
- Lowered overall software costs for the institution. Fewer copies of software products will be required since everyone will have ready access to a wide diversity of products in the campus-wide software server. Also, more copies of products will be purchased "in bulk" realizing greater volume discounts and a lower cost per copy.
- Lowered overall overhead and support costs for the institution. Much time will be saved by individual faculty, staff, and associated clerical support in navigating the purchasing bureaucracy. Plus all the time required to install and maintain those purchased packages will be saved.
- Location independence. Software will now be available from anywhere rather than being restricted to a particular device, room, or LAN. This reduces unnecessary travel, provides personal convenience, and makes better use of hardware. You don't need to go to the location with the "right" software but can work from any location with adequate computation capabilities and network access.
- Improved ability to support the campus computing architecture. Software product and/or version mismatches are a major headache in maintaining a reliable, responsive campus distributed computing environment. The central IT staff can ensure the products and versions available via the campus-wide software server do indeed work together and are ASURITE compatible.

Strategies for the Campus-Wide Software Server

We have been seeking a unified distribution and license management mechanism. Our investigations indicate that we will likely have to settle for a suite of products, as there does not appear to be a "one-size-fits-all" solution for our three platforms (Windows, Mac, and UNIX Motif). Many of the leading contenders address one aspect, distribution or license management, but not both. Our unified file system, AFS, promises to simplify the distribution issue; however, further development is needed.

While we expect greater efficiency of investment for the university as a whole, a unified licensing effort requires concentration of money into a common fund. We are now managing software across several IT computing sites as a single resource. If we are to transition this IT site resource to a campus resource, we estimate that approximately 1000 additional Windows clients and roughly 500 additional Mac clients will be needed. Extrapolating from our site software licenses, the additional costs could be \$250K+ for an initial purchase, with \$65K+/year in additional maintenance and upgrade charges. Additional servers will be needed, with an estimated initial cost of \$100K and an increase of \$10K/year to our maintenance expenses. We have not yet settled on a funding strategy. Will the additional budget be provided centrally or do we need to sell "subscriptions" to the service in order to fund it?

We are planning a two phase pilot. The first phase is already underway and involves opening the software to a relatively small academic unit, the College of Architecture & Environmental Design (CAED). Macintosh products are available (pull model) to all associated with CAED. This first phase is intended to let us discover technical and administrative issues associated with managing a campus-wide software server.

In the second phase, we intend to broaden the scope to include PC products as well as Mac products and involve a broader base of students and faculty. This phase of the pilot is expected to cost ~$25K and is targeted to begin spring semester '95.

We will need to do a Request For Proposal (RFP) for products that can support the software license management and distribution functions. We have identified the following requirements for the RFP:

- support WINDOWS/Mac/UNIX Motif clients;
- support access that is customer location independent;
- provide usage statistics by application and platform to help track usage and predict the need for additional licenses;
- provide the capability to restrict access to software based on rules (e.g., restrict software usage to certain departments or colleges)
- provide the capability for central and distributed management (license administration);
- support the Kerberos standard for authentication;
- be compatible with AFS;
- support version control for software distribution; and
- provide software distribution functions.

Implementation of a Virtual Software Library at ASU

Earlier LAN-based software management included software distribution and license control functions, but only within the LAN. With the interconnection of several student computing site LANs into the campus network, we began looking for management mechanisms that could span the campus network.

The first package we implemented that could do this was KeyServer, from Sassafras Software, which was implemented to provide the license management along with AppleShare file servers that provided software distribution. A KeyAccess client is installed as an extension to the Macintosh operating system. Software is keyed so that it invokes the KeyAccess client during software launch. The KeyAccess agent contacts the KeyServer to register the launch of the software. As implemented, KeyServer uses AppleTalk protocols for communication between client and server. The license limits are coded in the KeyServer. When all licensed copies are in use, a launch attempt is denied and the person is given the option of waiting in a queue for one of the current users to close the application.

With KeyServer controlling simultaneous launches, it is easy to prove license compliance to software vendors. Keyed software is open to copying from the file server to the local hard disk, but the keyed version of the software cannot launch without KeyServer authorization, so the software is useless off the network. Software control is no longer dependent on restricting distribution, but rather on the active monitoring of simultaneous use.

KeyServer has been running as the software control for the Macintosh systems in the IT sites for over a year now. The distribution of software is still through AppleShare file servers, although we are experimenting with AFS. The software is now managed as a single resource independent of specific locations. A limited license can now be served to any Mac participating in the KeyServer/KeyAccess launch control mechanism. A student can compute at whatever location is convenient, with access to the same suite of software.

KeyServer can also use TCP/IP instead of AppleTalk, which is in keeping with our strategic direction as defined in ASURITE; however, we have not yet shifted to TCP/IP. Sassafras Software has just released a DOS client, thus we are planning to implement KeyServer as the launch control for our PC's as well as our Macs.

The Phase One Pilot

The College of Architecture & Environmental Design has about 1000 students total, which constitutes a little over 2% of the total student body of ASU. CAED has a relatively large installed base of Macintosh computers among students, staff and faculty (for its size). Some key pieces of graphical software are licensed by IT in quantities capable of supporting CAED's needs but were previously only available by traveling to one of the IT sites. With the implementation of KeyServer, CAED purchased a license for the KeyAccess client for its Macs, and is now running software on its Macs from the IT licenses within the same launch control that serves the IT sites.

CAED also has an inventory of limited copies of specialized software of particular interest to the design disciplines. This software is also controlled through the central KeyServer. CAED owned software is no longer available on the limited number of machines that have the few copies of specialized software. Rather, it is accessible to all Macs through the network from a file server. Launch denials are tabulated and used as justification for the expense of limited budget resources on expansion of licenses for those software in highest demand.

The additional usage from CAED has stayed within the existing licenses of IT, demonstrating the ability of the campus-wide software server to make fuller use of software within its license limits. The performance of KeyServer has proven adequate for the larger audience in this initial pilot. We have experienced minor problems with launch approval due to network performance caused by systems other than KeyServer, but the network load of KeyServer activity is negligible.

Challenges

There are still some significant hurdles to overcome in providing a fully configured software server to the ASU community. One is the lack of a PC AFS client which will perform adequately. We deployed AFS as a replacement for our Banyan LAN's in the student computing sites at the beginning of fall semester 1994, but had to go back to Banyan because of sever performance problems with the NFS/AFS translators we were using to bridge the NFS clients on the PC's to AFS. We had similar, problems on the Macintosh computers. We attempted to use an AppleTalk/AFS translator in servers so that the Macintosh clients could use the built-in features of the Mac OS to connect to the AFS servers. Performance limitations have put this strategy on hold. Restricted budget flexibility for this fiscal year may delay the second phase of the pilot.

Conclusion

Distributed computing environments have the potential to create provincialism in the management of software, leading to redundancy of effort, duplication of licenses, limited utility of scare resources, and general inefficiencies in the acquisition and management of software. However, the interconnectivity of the distributed environment coupled with network distribution and control of software promises to overcome the downside of the distributed computing environment for software availability.

We are convinced the campus-wide software server is an idea whose time has come. There simply does not appear to be another viable alternative to manage the burgeoning demand for software on campus. With this concept, software will be recognized as a strategic resource in the distributed computing environment of ASU. In a sense, the distributed computing environment coupled with the campus-wide software server gives units the freedom to do their own thing where appropriate, but to rely on the central organization for those needs held in common with the rest of campus. And allow IT to (finally) be all things to all people!

About the Authors

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INTERNET TOOLS ACCESS ADMINISTRATIVE DATA

Carl Jacobson
University of Delaware
Newark, Delaware

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 (Gopher and Mosaic) have been merged with the institution's closed, proprietary administrative systems (student records and human resources).

Private, personal information, including student and personnel records, is integrated with the public, general information of the campus-wide information system. Freely distributed clients for DOS, Windows, MAC and Unix workstations allow access to official, production data from both MVS and Unix platforms.

The methods employed to achieve this success are simple, inexpensive and easily adapted.

ADMINISTRATIVE SYSTEMS AND CUSTOMER SERVICE

While the administrative systems of the University can be characterized as closed, proprietary, private, controlled and secure, the student's view of computing is open, pedestrian, public and wide-reaching.

In keeping pace with trends toward increasingly student-centered service, Delaware's administrative systems have been reworked to place an emphasis on self-service. Self-service technologies have been applied to deliver integrated information services directly to the customers in a timely manner. These technologies empower the customer and provide cost-effective, automated services that know no geographic bounds.

THE ROLE OF THE CLIENT-SERVER MODEL

With a healthy portfolio of existing 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 these 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 can 22,000 students be allowed to log on to the mainframe to review grades on the day they are posted.

Closed, proprietary systems must be opened to allow such "pedestrian" use. Administrative information services must be adapted to behave more along the lines of publicly available campus-wide information systems (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 campus-wide information systems,*
>
> *in order to*
> > *-deliver customer services 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.

At Delaware, official institutional data is maintained using Software AG's ADABAS database management system and processed by programs written in COBOL and Natural (a programming language), while CWIS information is collected, maintained and delivered using Gopher and World-Wide Web (WWW). Gopher and Mosaic use is widespread among our campus customers, while our Natural/ADABAS systems are robust and useful. These resources have been combined in a unique way to quickly deliver improved information services to student, staff and faculty.

Transforming the "host" of a host-terminal system into the "server" of a client-server system allows the application of technologies geared to improving customer service. The host and its associated applications becomes part of a client-server network enabling outreach and supporting diverse data types.

OPENING CLOSED SYSTEMS

The client-server model of computing makes the opening of such closed systems a simple task. The work required focuses on the need to create a "server" that speaks an open protocol on the user side (Gopher protocol in this case) and understands and interprets the proprietary administrative systems on the database side (ADABAS, Natural, and COBOL). Gopher and Mosaic clients recognize such a server as a Gopher service while the ADABAS DBMS speaks to such a server using existing COBOL or Natural programs.

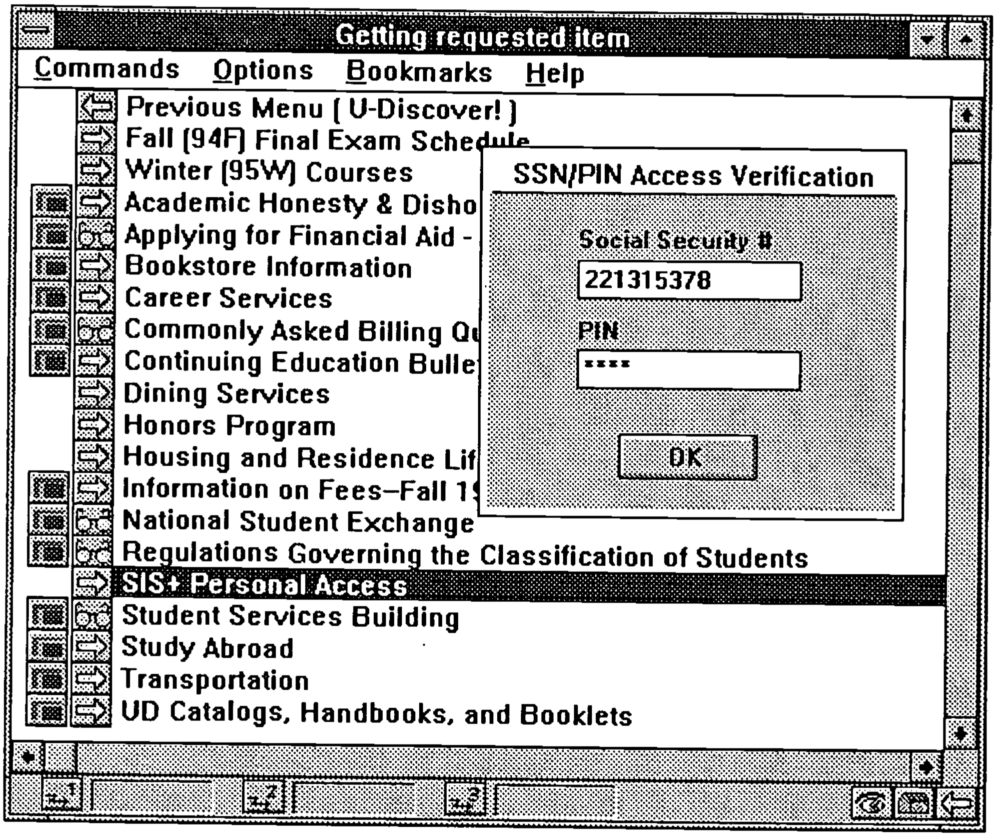
With Gopher and Mosaic clients already in the hands of students, faculty and staff, the issues of training, support and software distribution are minimized. Student grades and transcripts may be accessed in a manner familiar to all existing Gopher and Mosaic users allowing students to use these tools to conduct institutional business as well as to explore academic frontiers.

Since these tools are free and widespread, client-side costs were kept to a minimum. However, in order to provide the levels of security needed in conducting personal business, authentication routines need to be added to these tools. At Delaware, this was first done by adding an encrypted authentication scheme to Gopher clients.

AUTHENTICATION AND AUTHORIZATION

With an overall design goal of "using existing resources whenever possible", SSN/PIN authentication and authorization schemes used for touch-tone registration were enlisted to provide similar security to the Internet clients. PINS (Personal Identification Numbers) were already known and used by students and staff. PIN-based authorization tables were already in place in administrative systems. Therefore, Gopher clients were modified to prompt for SSN and PIN. These values were encrypted and appended to standard Gopher packets to be unpackaged and handled by server-side authorization routines.

Of course, this approach requires that Gopher source code be available. At the time of this phase in development, there were very few Gopher clients, Mosaic was unavailable, and Gopher source code was fairly easy to come by. Since that time, the construction of Internet "browsers" has become a growth industry and there are now many Gopher and Mosaic clients to choose from, and source code has become hard to come by.



SSN/PIN Authentication Added to Gopher Clients

In keeping with the spirit of "doing it the student way", it is important to provide access to users of any Gopher or Mosaic client, on any platform. To meet this goal, a second version of the client was developed with the SSN/PIN authentication and encryption routines "externalized" and packaged as a MIME (Multi-purpose Internet Mail Extensions) viewer. This viewer was written using a cross-platform development tool to allow one piece of source code to be the basis for viewers for DOS, Windows, Mac an Unix users.

In this way, users of any MIME compliant Gopher or Mosaic clients may define the University of Delaware SSN/PIN viewer, called "You-View" to handle any requests requiring University of Delaware authentication. The current authentication scheme uses a single key encryption algorithm and includes the encryption of the Internet station address to guard against the rebroadcast of clandestine packets. With the implementation of a campus-wide Kerberos authentication service, its expected that Kerberos will eventually replace and improve this current scheme.

While the SSN/PIN "key" is protected using encryption, all text is returned in unencrypted format. As the popularity of "You-View" continues to grow, plans are underway to eventually "garble" this text using DES (Data Encryption Security) encryption to add an additional level of security to the entire process.

The use of Gopher ASK blocks and Mosaic forms to prompt for SSN and PIN was considered during development of "You-View". At this writing the results of either method are transported across the network in unencrypted formats and key encryption is required on our campus. However, with the development of secured Mosaic and Gopher clients for business and commerce comes the possibility of using off-the-shelf Gopher and Mosaic clients to provide secure, encrypted authentication. These developments hold great hope for the future, when Internet tools will be routinely applied to deliver campus business services.

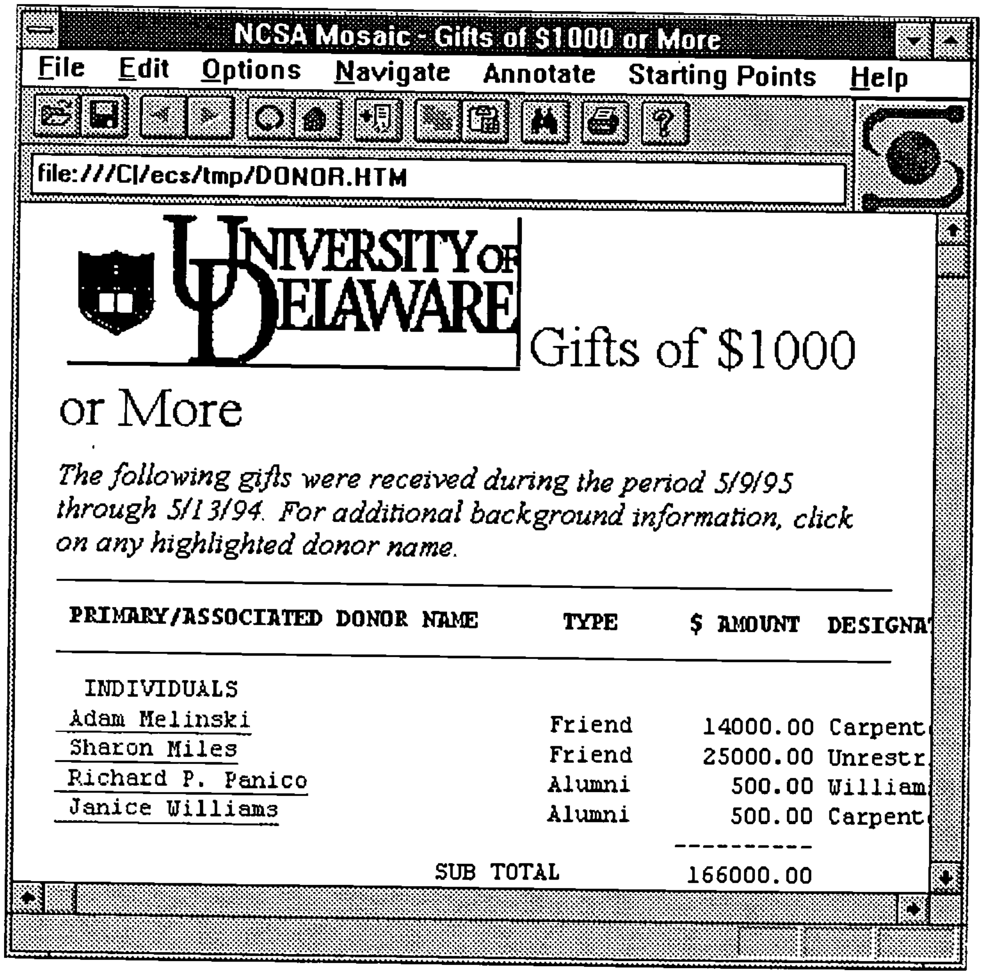
SERVERS PROVIDE SERVICE

On the service side, it is necessary to translate Internet protocols into the languages of our administrative systems and databases... to provide a bridge between the Internet protocols of gopher, WWW and email and the administrative 3GLs, 4GLs and DBMSs.

With administrative systems residing in an MVS mainframe environment, it was necessary to write a "server" to run in this environment, accept IP packets, recognize Gopher protocol, and call administrative application programs based on the content of these Gopher packets. Gopher and Mosaic can routinely display directories and text. Application programs already existed on the mainframe to produce transcripts, grade reports and schedules as text reports. Instead of printing these reports, the server needs only to package them as Gopher replies and send them back out onto the IP network.

Again, this effort was completed before the advent of Mosaic, so that text is packaged in Gopher format. Currently there is no need to hyper-link items in the student or personnel reports, so these documents have not converted to the HTML (HyperText Markup Language) format used by Mosaic. Unlinked documents allow all text to continue to be used by both Gopher and Mosaic clients. However, the generation of HTML documents is appealing and would be useful in developing applications such as Internet-based Executive Information Systems (EIS).

A mainframe-based HTML server has been developed at Delaware as a "proof-of-concept" trial, generating hyperlinked management reports that are delivered via MIME-compliant email. This would allow university management to receive regularly generated summary reports with built-in "drill-down" capabilities and links to official, production data from live administrative databases or links to more diverse data-types such as photographic or document images.

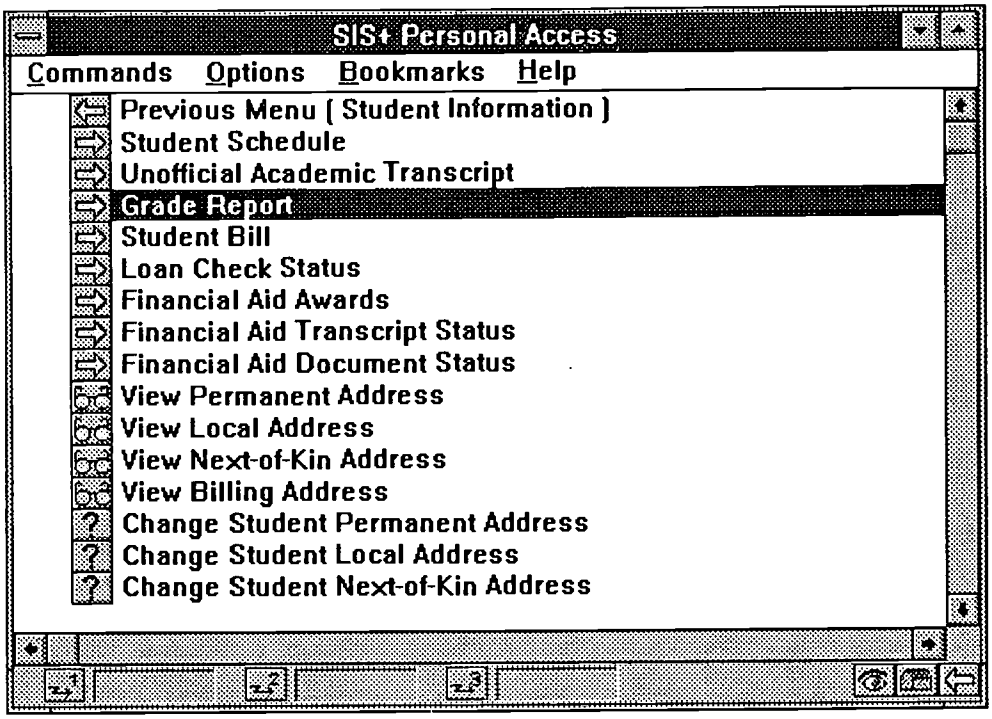


Hyperlinked Executive Summary Report

STATELESS CLIENT-SERVER RELATIONSHIPS

A significant advantage to adopting a Gopher-like server to provide student services lies in the "statelessness" of Gopher and WWW 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 across the network, 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.

Students do not log on to the administrative system, there is no datacommunications overhead. A single started 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.

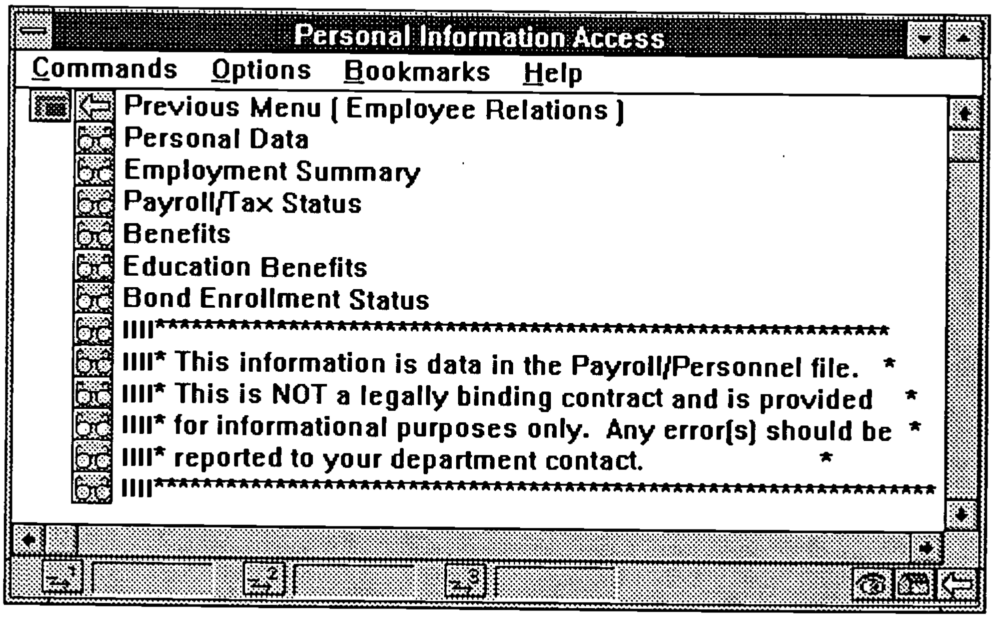


Menu of Student Services

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

Besides the great advantage of using existing programs to produce grades and transcripts and schedules, this "interpretive server" has the advantage of accessing production data directly. It does not rely on data extracts but instead returns timely and accurate information from the official, production records of the institution. 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 the database in real time, it has become necessary to report the changes in real time. "Just-in-time" production of course schedules and transcripts calls for this level of timeliness. The stateless, interpretive server allows this to be accomplished easily and inexpensively.

With interpretive servers speaking to administrative programs, existing tasks, such as transcript production, can be reused rather than re-developed. 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 Gopher packet and sent it out onto the network.



Menu of Personnel Services

Servers have been written to run on both MVS and Unix platforms to allow information to be gleaned from various databases across campus and to take advantage of the relative merits of both operating systems.

THE CUSTOMER IS THE CLIENT

At Delaware the "You-View" client was deployed as a "self-service" technology. It was first made available at character-based, public kiosks, then to public computing sites, labs and libraries. After all residence halls were wired the same client programs used to deliver services to these sites were used to delivery services to individual students in their rooms. For some time only these "stateless", workstation clients could be used for personal access to student and personnel information. The clients running on central time-share systems were not enabled with the SSN/PIN authentication. This was done to allow the stateless clients to gain a foothold in the network and to avoid the possibility of 22,000 students logging onto a timeshare system the day the grades are posted.

Now that the clients have been established, the Unix-version of "You-View" will be placed on a central cluster of time-share machines heavily used by students. This will allow increased access to all "You-View" student services.

TOUCH-SCREEN, MULTI-MEDIA KIOSKS

Public access workstations at many locations across campus, including all public computing labs, computing classrooms, business service centers, libraries and residence hall lounges, provide access for those who do not have their own workstation or network connection.

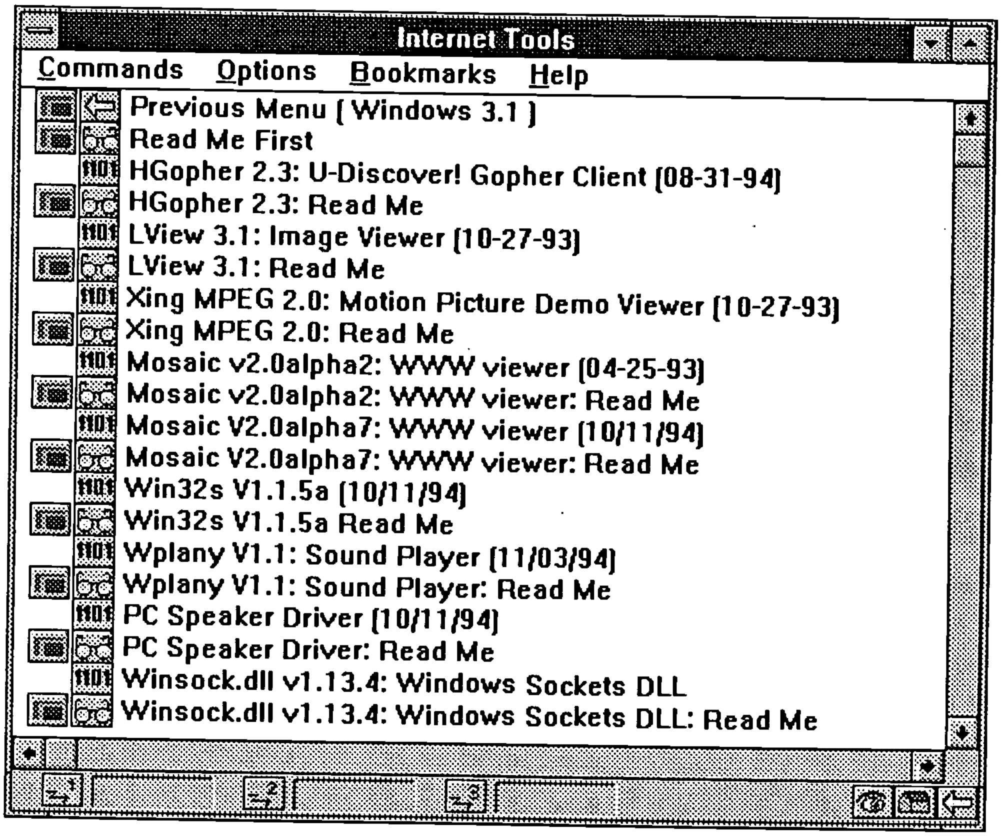
A multi-media authoring tool developed by a University of Delaware professor, has been made "Internet aware" allowing it to speak Gopher protocol. This tool, originally targeted as a classroom technology, is now used to develop compelling, multi-media, touch-screen kiosk applications; merging images, sound and video with administrative information.

This object-oriented toolset allows kiosks to be built quickly and inexpensively using existing Internet resources. Thus, the "dusty old" COBOL transcript program is given new life, delivering up-to-date transcripts to users of DOS, Windows, Mac and Unix workstations, Unix dial-in and network users, as well as to customers of self-service touch-screen kiosks located on campus.

SOFTWARE DISTRIBUTION

One advantage of the client-server model of computing is the increased functionality provided at the desktop. Not only can Internet browsers retrieve 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 Gopher server and made available to anyone in the campus community across the network from Gopher or Mosaic pages. A simple point-and-click causes the newest version of a program to be loaded, across the network, to the user's hard drive.



Software Distribution Menu

UPDATES

Delaware's EZForms electronic forms system is available as a MIME "viewer" enabling protected-field forms to be delivered to Gopher or Mosaic clients. This allows functions such as "change of address" to be performed under the protection of SSN/PIN authentication.

The EZForms application provides automated control of the document routing and approval process and allows users of any campus mail system, on any operating platform to participate as "submitters" or "approvers".

SUMMARY

The interest of the Clinton/Gore administration in a National Information Infrastructure, coupled with the emergence of compelling Internet applications such as Gopher and Mosaic, has contributed to the recent explosive growth of the Internet. Advances in the tools of the national network will impact the processes of teaching, learning and research on our campuses. Many of these same advances will contribute to the way we conduct business and affect daily campus life for students, employees and visitors.

By combining current tools and technologies, existing resources can be re-used effectively to return immediate benefits against small investments. Early adopters of these technologies and methods will gain valuable experience and insight into the issues of delivering networked services and will establish a foundation for controlled growth and change.

As administrators on the Information Super Highway, we will need to move quickly and carry little baggage. From this point on, there will be few rest stops, and little time for planning long journeys. As explorers on the old frontiers of our country had little idea what was in store for them as they journeyed west, we cannot predict the events on the information frontier well enough to lay complex and concrete plans. We cannot contribute to any plan, until we simply begin the journey.

To achieve business and academic advantage, we cannot delay in identifying and applying the emerging technologies of networked information.

-Technologies that recognize the changing nature of proprietary systems, and acknowledge the role of openness in the future success of our networked campuses.

-Technologies that depend on the client-server model of computing to coordinate the deluge of dispersed information events across these networked campuses.

-Technologies that fundamentally change the way we conduct business, our approach to the educational process, and daily campus life.

-Technologies that allow continued improvement of service; enabling the re-engineering of business processes, facilitating client outreach and self-service, advancing teaching and research, and enriching campus life.

Moving Towards the Virtual University: A Vision of Technology in Higher Education

by Warren J. Baker

and Arthur S. Gloster II

Abstract

California Polytechnic State University, San Luis Obispo, is exploring several cost-effective technology solutions aimed at improving learning productivity, reducing labor intensity, and providing new ways to deliver education and better services to students while enhancing the quality of instruction. Strategic planning and partnerships have been key to their progress to date.

Moving Towards the Virtual University: A Vision of Technology in Higher Education

by Warren J. Baker and Arthur S. Gloster II

California Polytechnic State University, San Luis Obispo, is exploring several cost-effective technology solutions aimed at improving learning productivity, reducing labor intensity, and providing new ways to deliver education and better services to students while enhancing the quality of instruction. Strategic planning and partnerships have been key to their progress to date.

After decades of promises based on overhead projectors, video distribution, and other instructional technologies, the ability to improve instruction using information technology has now become a reality. By incorporating a wide range of digitized media into the myriad of curriculum-related activities fundamental to teaching and learning, the quality of both can rise.

A paradigm shift is taking place in higher education instruction, from a mode of faculty–student interaction occurring in fixed locations at specified times to one in which students can access the same instructional resources in a variety of forms, regardless of location, at their convenience. This is possible because several technologies have matured, supporting major changes in how instruction can be delivered to students on the campus, in their homes, or in their work places.

Escalating costs, declining support, increasing demand, and diverse demographics have placed significant pressures on higher education to become more productive. Careful analysis shows that the productivity improvements required cannot be achieved by increasing the workload of the faculty; in fact, any significant movement in this direction will only decrease the quality of instruction. There is simply no room left in the workday of a faculty member to teach more students. Rather, the focus for productivity improvement must be on learning resources that will improve retention and decrease the time needed to earn a degree.[1]

It is this realization that is leading to the paradigm shift towards an instructional model in which students gain access to information resources, faculty lectures and demonstrations, library and research materials, and conferencing and tutorials over networks from digital information organized in servers by the faculty. Students and faculty can "talk" electronically whenever they like. Assignments can be given and received electronically. Faculty can hold "virtual" office hours, freeing them from rigid schedules, and enabling students to obtain information with little waste of time and without sacrificing the fundamental, close-knit quality of the student-mentor relationship. In this developing model, faculty can become facilitators and guides for individual learners rather than simple conduits for transmitting information.[2]

Productivity gains can occur in greater retention, more efficient use of the student's time, easy access to group study over networks, better feedback to faculty, and organized self-assessment and self-pacing. Faculty and traditional classrooms are not replaced, but another dimension is added that greatly improves the efficiency of learning. Studies have shown that students supported by technology-mediated instruction required about one-third less instructional time than students using traditional lecture/textbook methods. Not only did college students using technology learn faster, six months after completing their studies, they tested better on the subject than their peers who had been taught in traditional settings.[3] Other studies have shown that people reluctant to speak in a group are often less inhibited by electronic communications. By increasing opportunities for interaction and participation, electronic scholarship offers a whole new range of pedagogical techniques with which to reach people who have been left out.[4] As this new process of using technology to improve learning develops, more students at every level, from elementary student to adult learner, will be able to take advantage of this type of instruction.

Technological advances to deliver entertainment or "video on demand" are progressing rapidly. The opportunity exists today to take that technology and apply it to education to overcome economic, cultural, and physical barriers to learning facing the nation as a whole, including continuous retraining of the workforce. This will require colleges and universities to mirror business and industry by delivering "just-in-time" rather than "just-in-case" education, and to pursue cooperative efforts with the private sector to achieve this vision.

California Polytechnic State University, San Luis Obispo (Cal Poly) is exploring several cost-effective technology solutions aimed at improving learning productivity, reducing labor intensity, and providing new ways to deliver education and better services to students while enhancing the quality of instruction. This article shares Cal Poly's experiences to date in creating a vision and plan to develop the infrastructure needed to transform the way education is delivered, presents steps that have been taken or are about to be taken to implement that vision, and details some of the many partnerships that have contributed to the plan's success thus far.

Strategic plans, goals, and issues

Since the mid-1980s, when the University decided to upgrade its administrative computing systems, Cal Poly has aggressively pursued the use of information technology to transform educational services. By the early 1990s, strategic plans for an integrated, online administrative system (OASIS), voice-response registration, online library services, improved telephone service, a campus-wide fiber optic data network, and instructional access to UNIX had all been realized.[5]

Two years ago, Cal Poly's computing advisory committees embarked on another strategic planning effort to define the future role of technology in support of the University's instructional program. This effort coincided with a campus-wide reassessment of the University mission and academic calendar, adoption of a new strategic plan for the campus, CSU system-wide initiatives for using technology to support instruction (see Project Delta sidebar), and a decision to upgrade the central mainframe.

This planning effort was led by the University's Information Resource Management Policy and Planning Committee (IRMPPC) and the Instructional Advisory Committee on Computing (IACC). The IACC includes one faculty member from each of the University's six academic colleges, and representatives from the library, student association, and academic computing services. The IACC chair acts as liaison to the Academic Senate on instructional computing issues and also serves on the IRMPPC along with several faculty members and vice presidents, the library dean, an academic dean, a student representative, and the chair of the Administrative Advisory Committee on Computing.

After consulting with their respective college computing committees, academic departments, the Senate, and other constituency groups, the IACC produced a strategic plan outlining four major goals for academic computing:

- a networked instructional environment, based on universal electronic mail, shared information resources, and computerized classrooms;
- easy access to workstations and networked information services;
- institutional support for faculty and student development of computer-based communication skills; and
- simplified interfaces, procedures, and documentation for accessing networked information services.

The vision that emerged recognizes that technology can benefit learning when it (1) allows a student to take a more active role, (2) allows a teacher to express the content of a course in more than one format, (3) broadens the array of resources brought to a classroom or the student's workstation, (4) increases the opportunities for interaction between teacher and student and for interaction among students, (5) reduces barriers to University services, and (6) increases the productivity of those who support the learning environment.

As envisioned by the IACC, this "next revolution" will cross all disciplines, especially those which have not traditionally used computing in the past, and will emphasize content development, easy access, and information sharing, rather than focusing on the technology itself. Beyond the obvious need for technology enhancements, the IACC strongly recommended providing incentives and support to enable the faculty as a whole to develop the necessary skills and methodologies to conduct and publish research, create and deliver lectures, and interact with students in this new environment. Other policy/support issues included:

- considering professional development in the technology area when evaluating faculty for retention, promotion, and tenure purposes;
- supporting faculty with well-defined projects for experimenting with new technologies and innovative ways of employing them in the teaching, learning, and research processes; and
- providing instructional designers and technical support to assist faculty in developing content and integrating technology into the curriculum.

In addition, a number of infrastructure issues were identified:

- adequate network connections to faculty offices and classrooms;
- network ports for students to connect portable computers;
- adequate network access from off-campus sites or residences;
- appropriately configured workstations;
- classrooms equipped with systems for displaying prepared lecture materials and sharing information resources; and
- online search and retrieval tools with graphical user interface.

The IACC plan was generally accepted by the faculty, despite reservations by some as to how it would be achieved technically, and what the impact might be on University resources and faculty workloads.

Implementing the vision: a MegaServer approach

After receiving the plan, the IRM Policy and Planning Committee began an intensive study of how to implement the vision. They spent several months analyzing the capacity of existing resources to support the vision and considering various alternatives before recommending going ahead with a plan to develop a multimedia "MegaServer" as part of the planned mainframe upgrade for the campus.

This MegaServer will provide faculty and students with on- and off-campus access to a full range of information technology resources (voice, data, video) in an integrated, networked educational environment. It will also facilitate local and statewide access to full-text articles and publications, electronic library services, databases, and digitized instructional materials, including slides, graphics, and full-motion video. It will also serve as an important node in a client/server arrangement, supporting campus-wide administrative services and functions.

Cal Poly envisions using this MegaServer approach to support its concept of a "virtual university" (see Figure 1), with many potential applications (see sidebar next page). The benefits for the University include (1) improved access by students enrolled in traditional programs offered by Cal Poly, (2) increased access to academic programs by non-traditional students, (3) better prepared students in K-12 and community college programs, (4) improved effectiveness in uses of limited human, program, and financial resources, (5) new revenue streams to offset infrastructure and operating costs, and (6) incentives for faculty to develop new educational materials.

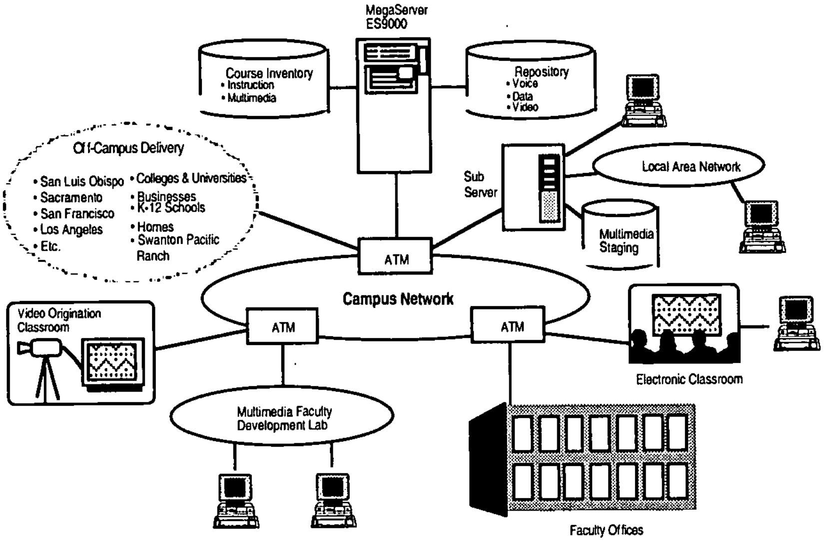


Figure 1: The virtual university

Progress to date

Cal Poly has already taken a number of steps to begin preparing for the virtual university.

In May 1992, the University began using two-way interactive video to deliver courses on campus, between the campus and its satellite agricultural facility 175 miles away, and to the Lucia Mar School District just 20 miles away.

The Faculty Multimedia Development Center (FMDC) was established in March 1993 to provide a variety of hardware, software, and consulting assistance to encourage and support faculty interested in developing and integrating materials into their courses or for delivery over the network. This facility is described in greater detail below in the discussion of support systems.

In September 1993, the University entered into a joint development agreement with IBM to develop and test the MegaServer concept, installing an IBM ES/9000-732 mainframe, LAN File Server/Enterprise System Architecture software, multimedia development workstations, disk storage, and other basic system components. As of spring 1994, the mainframe supported eight concurrent multimedia video streams or sessions to multimedia workstations in the FMDC and a specially equipped classroom. The MegaServer currently supports token ring network access, but most faculty offices and instructional facilities are now or will be equipped with Ethernet connections; extending full-motion video network access to Ethernet connections is a high priority in 1994.

Currently several classrooms are equipped with large-screen video projection systems, Macintosh and IBM-compatible computers or interfaces, and network connections to the mainframe. The University is committed to developing "electronic classrooms" equipped with high-resolution projectors, quality audio systems, and microcomputers with high-speed network access to the MegaServer. With the implementation of network-connected classrooms and the FMDC, faculty can already develop multimedia lectures in the FMDC, store these lectures on the MegaServer, then walk into an electronic classroom, log on to the MegaServer, and retrieve the same lecture for delivery to the students.

Limited resources will make it difficult to equip classrooms quickly enough to meet the anticipated demand for integrating multimedia into the classroom. (Equipping just one such classroom can cost more than $150,000.) To minimize costs and maximize flexibility, the University purchased several laptop computers (at $3,000 –$5,000 each) and portable multimedia-enabled graphics projectors (at $6,000 each) as an interim solution. This equipment can be checked out by faculty to create and deliver multimedia courseware in their office or any classroom. These initial efforts are introducing the campus community to the possibilities of the virtual university by allowing faculty to develop and use multimedia course materials while the MegaServer infrastructure is being more fully developed.

During winter quarter 1994, the University taped its first series of lectures for a course being developed by two faculty members in architecture and construction management.

Lectures were taped in the campus video production studio, then rebroadcast over the campus television distribution system during the day and to campus residence halls at night. Students were able to view the lectures at set times or check out tapes of individual lectures to view at home, and to communicate with the instructors during office and lab hours and through electronic mail.

Cal Poly plans to develop the capacity to videotape and "digitize" entire lectures, which can then be edited, indexed, and stored on the MegaServer along with course materials. Both the lectures and materials can be retrieved later to supplement existing classroom instruction, or delivered as "on demand" courses in non-traditional settings, such as a graduate-level degree program for students who work full-time.

To digitize and store lectures on the MegaServer for "on demand" retrieval will require higher bandwidth than is presently available on the campus network. To provide this bandwidth, this summer the University is beginning to beta test an asynchronous transfer mode (ATM) network. IBM is providing optical storage, telecommunications technology, wireless LAN technology, and other support as needed to fully test delivery of full-motion video over the University's fiber optic backbone network. The FDDI hubs will be replaced by ATM hubs capable of using the existing fiber. The FDDI hubs will be recycled and used as routers on the network. In addition, the delivery of interactive video from the MegaServer to four other remote CSU campuses will be tested later this year.

The University is also experimenting with providing on-campus network ports ("docking stations" and "port replicators"). This will allow students to use their own laptop computers to access the network, high-resolution displays, and specialized resources.

Creating a support system

In conjunction with the Cal Poly/IBM MegaServer joint study project, the University established a new management-level position, director of multimedia development, to facilitate the use of the MegaServer and multimedia technologies to deliver education. Since July 1993, the director has concentrated on training faculty, developing instructional content, and coordinating and facilitating efforts by faculty to integrate information technologies into the curriculum. To date, nearly 100 faculty members have completed training or sought individual consultation, while another twenty have been helped with specific multimedia projects. IBM is also providing support to help faculty develop instructional content under the joint study.

Staffing is required to support the faculty from the inception of an idea, through the many courseware development steps (see Figure 2), to actual delivery in the classroom.[7] At present, Cal Poly's communications services department has (1) two full-time technicians supporting its audio-visual/television production unit and distance learning facility; (2) one full-time technician to install, upgrade, and maintain new hardware and software in the FMDC; and (3) several student assistants to do graphic design, digitization, editing, and authoring tasks. In addition, there is need for one full-time instructional designer to assist the faculty in developing the interactive multimedia courseware appropriate to their curriculum. This need should disappear as more faculty become familiar with the techniques and grow comfortable using the tools. These pioneers will become mentors and valuable campus resources as they begin to share their discoveries with colleagues.

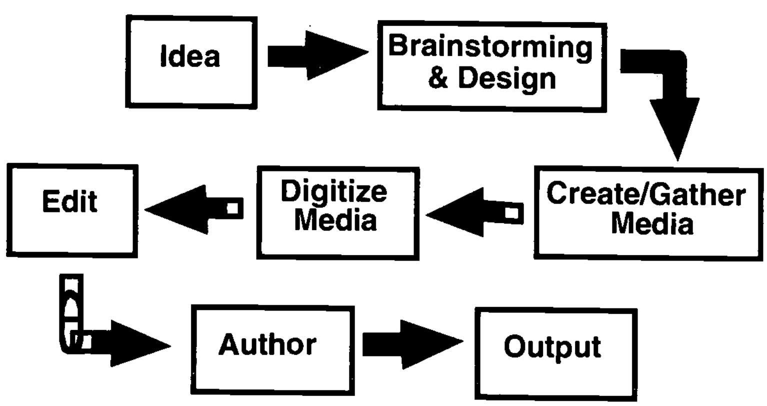


Figure 2: Courseware development

The Faculty Multimedia Development Center mentioned earlier is an important component of the support system. The center is equipped with both IBM and Apple authoring workstations and software tools, including image editors, video editors, and authoring packages. Other resources available to faculty include (1) scanners and digitizing stations to convert source materials from word processing, VHS tape, laserdisc, CD-ROM, illustrations, and artwork; (2) full video production facilities, including a videotaping studio; (3) hand-held video cameras for off-site work; (4) digital, video, and sound editing studios; and (5) in-house support for creating VHS tapes and CD-ROMs. These facilities were developed using existing audio-visual resources, combined with donated and discounted equipment.

The desire to use electronic technology in the classroom must, in the end, come from the faculty itself. To gauge faculty interest in this new technology, Academic Affairs encouraged faculty to submit proposals for release time and offered modest support to develop related projects this year. As it turned out, the campus was able to support only a small fraction of the expressed interest. Currently, faculty in nearly every discipline are involved in creating multimedia presentations for classroom instruction and professional meetings, and interest is steadily increasing. The campus is seeking matching funding, through various sources, to implement a more broad-based faculty training and development program, possibly in cooperation with other CSU campuses.

Reducing costs through partnerships

Cal Poly can only achieve its vision by forming partnerships in which the cost to operate and maintain the information technology infrastructure necessary to deliver education in the future may be partially offset by joint development projects with information technology vendors and other institutions and organizations. These projects must be mutually beneficial for both partners, and involve research, development, and testing of new technologies with potentially wide application to higher education beyond this campus.[8]

Over the years, the University has been successful in developing strong and lasting partnerships with many information technology vendors, including Hewlett-Packard, Pacific Bell, AT&T, SP Telecom, and IBM, to name a few. IBM has been a particularly strong ally in this regard, providing hardware, software, training, and support for key infrastructure projects supporting administrative and instructional computing. With their support, Cal Poly has taken its first steps towards becoming a virtual university. Other corporate partnerships include the following:

- With more than 250 Integrated Services Digital Network (ISDN) lines on campus, providing simultaneous access to telephone and network services, the University is working with Pacific Bell to extend ISDN service to faculty, staff, and student residences, including private residence halls, in the local community in 1994.
- The University is partnering with BellCore to implement SuperBook, an electronic document "browser" that can deliver library materials, journal abstracts, and other documents with text, graphics, and video to the desktop via the network. One major hurdle to address involves licensing and copyright protection of intellectual properties owned by the University, publishers, or faculty. Transactional monitoring and pricing techniques are being explored in a joint study between Cal Poly, Bellcore, Lawrence Livermore Lab, Chevron, and Pacific Bell.
- The University is participating in a joint study with The Robinson Group (TRG) and IBM to test using touch-screen kiosks linked to the University's student information system to allow students to check their own records for information about grades, account balances, current term registration, and other routine requests currently handled in person, by phone, or through the mail. Also under review are methods to allow students to directly update data such as address changes.
- Most University faculty use Macintosh or IBM-compatible computers to develop course content. Since the MegaServer currently supports only IBM-compatibles, Cal Poly and IBM began beta testing Macintosh support earlier this year to extend full-motion network access to Apple computers.
- Another partnership with IBM is enabling testing wireless network access. This technology will permit faculty to access the MegaServer from any classroom, using a transmitter attached

to a laptop computer. If viable, this could eliminate the need for specialized facilities, reduce costs, and greatly expand campus access.

Cal Poly continues to seek private and corporate grants and other external funding for related distance learning, multimedia, and telecommunications projects. A group of faculty has already submitted a proposal to a major national foundation interested in how this technology might be used to deliver a full-degree program to students at home. They are especially interested in the techniques faculty would develop to foster collegiality and shared group interaction between students and instructors and among the students themselves by using communication technology.

The University also recognizes the value of partnerships and collaboration with other education institutions:

- Cal Poly is working toward expanding network capability to other parts of California, through pilot projects with telecommunications vendors to develop and test high-speed, gigabit networks; has established distance learning partnerships with Bakersfield College and Cuesta Community College, to jointly develop and share course materials to facilitate instruction at both levels; is pursuing an ATM test link with CSU Hayward to allow the two campuses to share digitized course materials and interactive instruction; and is expanding access to K-12 schools, to provide college-level courses, including Advanced Placement, to high school students.
- The University's College of Engineering, along with the seven other universities in the National Science Foundation National Synthesis Coalition, are creating a National Engineering Educational Delivery System (NEEDS) that will not only advance the curriculum and enhance the classroom environment, but also promote faculty collaboration and give students direct access to a vast database.
- A major publisher has already shown considerable interest in the work of some Cal Poly faculty who are developing multimedia courseware. If local faculty don't develop their own materials, they can use courseware created by colleagues elsewhere and modified as needed for their classes. For example, Cal Poly and CSU Long Beach are jointly developing a distributed database of digital information (images, audio, full-motion video, and so forth) that will be able to accommodate potential contributions from faculty in any discipline and on any campus. Once developed, faculty on any CSU campus will be able to query the system by data type (audio, graphic) or subject, and retrieve files remotely for inclusion in a classroom presentation or courseware module.
- The CSU is exploring a partnership with the State University of New York (SUNY), the City University of New York (CUNY), and a private academic systems development firm to support faculty in creating mediated learning courseware in courses that specifically create barriers to students who would like to pursue science, mathematics, or engineering programs.

What's next?

Many faculty are burdened with older workstations incapable of supporting the full-motion video and other resources envisioned as part of the "virtual university." Over time these systems will be replaced, but it will take a concerted effort on the part of the colleges to ensure that faculty are equipped with the resources they need.

While almost anyone on campus with a computer and the proper connectivity can now participate in electronic mail and some other resources, the level of service is uneven across campus. With the growing interest in technology-mediated instruction, the IRM Policy and Planning Committee has recommended a new set of communications goals, which will mean much more sophisticated installations to all offices, classrooms, labs, and even the dorms. The network will become simply another campus utility, like the phone system. Higher bandwidth will allow faculty to take full advantage of the information resources.

For off-campus users, private information servers and other public utilities will put these more sophisticated communications tools in the hands of students and members of the public wishing to link up with the University system. Cal Poly is already working with local government and industry leaders to make San Luis Obispo an "electronic village," by extending the network into the community as quickly as possible. Internet access and local network services are already being offered on a limited scale, but to truly bring the benefits of the virtual university to the home will require the support and cooperation of local telecommunications vendors.

We do not expect to achieve these goals all at once. Instead, we intend to proceed deliberately, while keeping abreast of changes in technology that may suggest new directions, and the developments in public and private communications ventures that will provide ubiquitous broadband networks. Still, we feel that we must begin proceeding now toward a networked instructional environment if we are to deliver the sort of education our students will need as we move into the next century.

Footnotes:

[1] For a more extensive discussion on the issue of learner productivity and higher education, see D. Bruce Johnstone, "Learning Productivity: A New Imperative for American Higher Education," *Studies in Public Higher Education* No. 3 (Albany, N.Y.: Office of the Chancellor, State University of New York, 1993), pp. 1-31.

[2] Norman Coombs, "Teaching in the Information Age," *EDUCOM Review*, March/April 1992, p. 30.

[3] Chen-Lin C. Kulik and James A. Kulik, "Effectiveness of Computer-Based Instruction: An Updated Analysis," *Computers in Human Behavior*, Vol. 7, Nos. 1-2 (1991): 75-94. See also W.D. Sawyer, "The Virtual Computer: A New Paradigm for Educational Computing," *Educational Technology*, January 1992, p. 21; and Loretta L. Jones and Stanley G. Smith, "Can Multimedia Instruction Meet Our Expectations?" *EDUCOM Review*, January/February 1992, pp. 39-43.

[4] See Richard Lanham, *The Electronic Word: Democracy, Technology, and the Arts* (University of Chicago Press, 1993) for a discussion on how "digitization of the arts radically democratizes them" (pp. 105-107).

[5] These plans are described in Cal Poly's *Campus Information Resources Plan: 1989-1994* (CSD-0369) and *Campus Information Resources Plan: 1990-1995* (CSD-0918). Both are available from the CAUSE Information Resources Library (orders@cause.colorado.edu or phone 303-939-0310).

[6] *Master Plan for Higher Education, A Dream Deferred: California's Waning Higher Education Opportunities*, California Postsecondary Education Commission Report 93, June 1993, p. 10; see also James Ogilvy, "Three Scenarios for Higher Education: The California Case," *Thought & Action: The National Education Association Higher Education Journal*, Vol. IX, No. 1 (Fall 1993): 25-67.

[7] The importance of centralized support is discussed in Fred Hofstetter, "Institutional Support for Improving Instruction with Multimedia," *EDUCOM Review*, January/February 1992, pp. 27-30.

[8] Arthur S. Gloster II and James L. Strom, "Building Strategic Partnerships with Industry," *Information Technology: Making It All Fit, Proceedings of the 1988 CAUSE National Conference* (Boulder, Colo.: CAUSE, 1989), pp. 263-268.

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Sidebar 1:

Cal Poly: Becoming an Electronic Campus

The University provides access to all major resources through its Fiber Distributed Data Interface (FDDI) backbone network that links thirty-nine core campus buildings and residence halls.

- The network serves more than 2,400 student residents on campus and provides connectivity to most of the University's 900 faculty and 1,200 staff.
- More than 13,000 of Cal Poly's 15,000 students have electronic mail accounts.
- More than one-third of the fall 1994 applications for admission were submitted in electronic form by incoming students.
- Online administrative systems provide timely access to student records, class schedules, financial aid, grades, and other information.
- Increased use of electronic mail, calendaring, online reporting and requisitioning, and tools such as Gopher and other online services has reduced costs and changed the way

departments and individuals communicate and request information.

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Sidebar 2:

The CSU's Project DELTA

The California Master Plan for Higher Education, initiated in 1960, calls for access by all eligible students to the three-tiered higher education system in California. For the California State University, this means that all high school students graduating in the top third of their class are eligible for admission. Given current economic conditions in the state, it is unlikely that the CSU system will be able to expand its physical facilities to meet the increased enrollment demand generated by the master plan. Instead, the system must meet that demand by offering new ways to deliver the required education to students both on- and off-campus.[6]

The CSU Commission on Learning Resources and Instructional Technology (CLRIT) was created to investigate options for using electronic technology in education. Its first major initiative, Project DELTA (Direct Enhancement of Learning Through Technology Assistance and Alternatives), provided seed money for multi-campus projects designed to:

- improve instructional quality and effectiveness;
- increase student access to higher education, by making access more convenient; and
- promote greater productivity and accountability in the use of public funds.

CLRIT is also providing oversight and guidance in the development of systemwide library planning through "Knowledge and Information for the 21st Century," a strategic plan for CSU libraries being prepared by the CSU Council of Library Directors, and in telecommunications planning through "Leveraging the Future: The Telecommunications Plan for CSU," being developed by the CSU Academic Communications Network Committee.

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Sidebar 3:

Virtual University: Potential Applications

Delivery of education to students in classrooms at multiple CSU campuses:

- capturing unique faculty experts and special lecturers on video as a way to augment lectures/courses
- downloading information from multiple sources into a multimedia presentation in the classroom
- teaching low enrollment courses at multiple campuses using two-way video
- evaluating student teachers remotely in the classroom and communicating via electronic mail
- teaching remediation courses at CSU campuses remotely from community colleges
- conducting library/text searches online
- requesting assistance via e-mail with timely responses from faculty
- interaction among students and between students and faculty utilizing bulletin board or conferencing software

Delivery of education to non-traditional, off-campus students in their workplaces or homes:

- specialized training and retraining programs for industry
- professional licensing/certification courses
- adult education/enrichment programs
- continuing education or degree credit programs
- Advanced Placement courses to high school students

Streamlined administrative services to students:

- apply for admission, financial aid, housing, and so forth to one or more campuses using customized electronic forms
- transmit financial aid data to "Sallie Mae" and a third party for more timely evaluation and electronic fund transfers to students and campus
- analyze articulation requirements between schools, community colleges, and universities
- apply AACRAO Electronic Data Interchange (EDI) standards to build databases for capturing transcript/other data
- distribute test scores, grades, transcripts, coded memoranda, and other documents

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Arthur S. Gloster II *has been Vice President for Information Systems at California Polytechnic State University, San Luis Obispo, since 1986, overseeing campuswide academic and administrative computing and communications. With more than twenty-five years experience, he is regularly consulted by the public and private sector on information technology issues and management. He served on the CAUSE Recognition Committee for the past three years, and is a regular presenter at CAUSE and other national forums on using IT to meet higher education goals.*

UNIVERSITY OF
FLORIDA

Productivity Tools: An Executive Insight and Evaluation

Presented by

Mr. John E. Poppell
University of Florida
Gainesville
Florida

How can we develop and deliver increasingly better systems applications at the same time we are experiencing an almost annual reduction in resources? Many institutions--large and small, public and private--are facing this dilemma today. The University of Florida, like most institutions of higher education, depends heavily on its administrative computing group to develop, deliver, and maintain economical and effective applications that enhance processes and optimize resources.

This nontechnical session will deal with the Universities' investment in productivity using Computer Aided Software Engineering (CASE) tools. More importantly, it provides an executive's evaluation of this investment. Can investing in CASE tools provide a return sufficient to warrant the cost? Is CASE the future of application development? This presentation on CASE tools, based on UF's two years of experience, will provide answers to these and other related questions. Productivity tools are not new, but the results they are bringing to the early users are!

Productivity Tools: An Executive Insight and Evaluation

The very mention of the word "productivity" in management circles today seems to invoke apathy and a callous disdain. The word productivity, like the word quality, is often overused, but still recognized as a key to survival in the business of higher education. What is true productivity? Can it be measured? Have real results been realized? Can these results be quantified? The University of Florida can now present a case for investing in productivity and can provide evidence of returns on that investment.

In what specific area within my institution will this investment be made?

The answer to this question is as follows. Information Systems (computer-based applications) is a large and critical component for managing and processing the University of Florida's operational responsibilities. This division handles the accounting system, the payroll system, receivable systems, and inventory systems. Yes, our dependence on computers and the applications developed to operate on those computers is both critical and absolute to our operational survival. Given this, and regardless of your institution's size or mission, there is an excellent chance that an institution that relies heavily upon some form of computer technology can enhance productivity.

How?

To establish a reference point, let's return to the late 1960's and early 1970's. Architectural and engineering professionals had just embarked on something called "CAD/CAM" - Computer Aided Design/Computer Aided Manufacturing. Simply stated, architects and engineers were in need of a systematic and standard approach to design and build aircraft carriers, bridges, skyscrapers, submarines, and other very large and complex structures.

The need for a "recipe" that would standardize each task, beginning to end, was the challenge. The use of CAD/CAM provided that recipe and has withstood the test of time. Essentially, the same process and system are employed today to design and build most structures. Refinements have occurred, but the foundation of a scientific approach to design and construction was forever formed.

So, what does this have to do with higher education and development of "application software"?

Higher education, not unlike the private sector, has traditionally approached software application development with little regard for a standardized approach. Software application development was more artful than scientific, typically representing the systems analyst's style and skill level, both in design and construction. For years, this type of approach has caused systems development to be costly, somewhat unpredictable, and, most times, late into production. This type of approach was often unpleasant and frustrating for the end users and, naturally, to the managers of the operational units who requested the new application. Not only does this artful approach cause frustration towards new application development, it also contributes to very high maintenance demands. It is not uncommon to find 50% of a development department devoted to the maintenance of legacy systems.

Why is there such high maintenance demand?

Given there were few standardized processes from the beginning to the end of both design and construction of programs, software analysts were constantly searching for the secret designs used by their predecessors to develop the software. Given that the employee turnover in this profession is somewhat high, even good systems were found to be mystical after 5 or 6 years in operation.

What, then, has occurred that can now increase productivity in application system development?

The answer is "CASE" technology - Computer Aided System Engineering, the CAD/CAM of software design and construction, and otherwise known as "productivity tools." It is this technology and a systematic approach that can and will provide software application developers new gains and increased productivity. These CASE tools have been around since the late eighties in varying forms, styles, and complexities. Most tools deal specifically with design or program construction, and some even integrate both processes. Today, there are comprehensive tools for all needs, regardless of your institution's size or needs.

So, what's new?

What's new is the results that are coming in from departments that have introduced CASE tools and a systematic approach. Development departments early into this new approach are experiencing the return on this investment in productivity. End users are beginning to benefit from this new approach.

So, let's have it - what are the results?

- Better-designed systems
- Self-documenting systems
- Systems delivered on time
- End-user ownership from the beginning of the project
- Employee morale is up
- Maintenance is cut some 40-50% on new systems
- Productivity is up 10-40% on all projects

These results are real - no sales pitch - no wishful, hopeful theoretical promises. Productivity is up and the investment is now paying returns.

Can the results be quantified?

The answer to this question is, regretfully, yes and no! Yes, later in this paper I have provided some quantified data that depicts documented savings. Ironically, the better answer is no, because we at the University of Florida have essentially discontinued "old" customary practices in favor of the new CASE technology. So, exact comparisons are naturally impossible, but we have keen memories and our very experienced analysts and project managers know how it "used to be." It is from these comparisons that we draw our conclusions.

What are the quantified results?

Conventional vs. CASE Tool Development

	Task Hours Conventional	Task Hours CASE	% Savings
Design			
Data/DB2	180	126	+30%
Applications	384	441	-15%
Construction			
On-Line	1100	594	+46%
Batch	475	200	+58%
Testing			
On-Line	266	186	+30%
Batch	209	135	+35%
Documentation			
Internal	135	95	+30%
User	210	189	+10%
Maintenance			
On-Line	300	120	+60%
Batch	410	254	+38%

It is important to remember the "Conventional Method," given our current, complete use of "CASE," is now an estimate; however, we believe the estimate is very accurate.

What does the investment cost?

Tough question. The answer depends entirely upon the level of CASE technology you wish to employ. The University of Florida undertook a comprehensive project to employ CASE. We installed an IBM OS/2 LAN to develop applications for our campus main frame, an IBM ES 9000. Individual workstations (IBM PS models) were equipped with a complete CASE tool package. All development staff now use these CASE tools. This has become the standard. The average cost, including hardware and software, is approximately $15-20,000 per workstation. This cost is exclusive of training, which is also necessary if the CASE tools are to be effective.

What are some of the tools?

Tools purchased by the University of Florida

Product Name and/or Company	Application Functions Supported	Cost*
Excelerator II for Client/Server V2.0 Intersolv	A planning, analysis, and design toolset for developers of IS applications. Used to create detailed descriptions of applications components, diagrams that show the relationships among these components, and GUI windows or character screens that represent the entry points to the application.	9,500
APS for Client/Server V3.0 Intersolv	A full-function application generator that automates the development and redevelopment of MIS applications to support business. Used to build applications for a variety of production environments using high-level specifications and little or no manual coding.	9,500
Micro Focus COBOL	Software that provides everything needed to develop COBOL applications to run under DOS, Windows, and OS/2 on IBM compatible computers.	
Micro Focus Toolset	An add on product to Micro Focus COBOL development systems to provide a powerful application system.	
Micro Focus COBOL Workbench	A set of software tools to help develop COBOL applications using Micro Focus COBOL for IBM and IBM Compatible computers.	2,250**
Micro Focus CICS	A complete transaction processing development environment targeting development of CICS/ESA COBOL applications. Provides a flexible integrated toolset to enable development of cooperative and distributed processing systems.	1,250
Bachman/DBA	A software tool for building/analyzing, and modifying designs for IBM's DB2. It helps information professional to quickly build and optimize new DB2 designs, and allows them to easily examine and modify existing designs.	10,000
Bachman/Analyst	Provides an integrated set of modeling features that enables developers to build, analyze, and modify models representing complex information systems; and a way to develop and maintain information systems through data, process, and logic modeling.	25,000

* Does not consider educational discounts.
** Cost includes Micro Focus COBOL and Micro Focus Toolset

Other CASE Tools

Product Name and/or Company	Application Functions Supported
IEF for Client Server Texas Instruments	Full Life Cycle Support
AD/Method Structured Solutions	Customizable Automated Methodology
Application Development Workbench (ADW) Knowledge Ware, Inc.	Full Life Cycle Support
Automated Testing Facility (ATF) Softbridge, Inc.	Automated capture, playback, scripting approach to testing
C Softbench Hewlett-Packard	Construction Tool (C development)
CA-Realia Workbench Computer Associates	Construction Environment (COBOL)
Data Dictionary/Solution Brownstone Solutions	Corporate-wide design repository
DB Analyzer Info Systems Group	Relational Database design analyzer
Foundation Anderson Consulting	Methodology and Construction tools for corporate wide systems
Natural & Natural Construct Software AG	Code Generator and 4GL
PowerBuilder Desktop Powersoft Corp.	Construction Environment for OO
System Architect Popkin Software & Systems	Methodology Design Tool and Generators
Visual Age IBM	Object Oriented Development Environment

Can it work for my institution?

The answer is yes. In fact, most experts agree CASE will do to software development what CAD/CAM did for engineering. It will become the accepted standard for development. It can and will work in any software development environment: academic, administrative, etc.

Should you wait?

This answer is easy. There are no short-cuts in the employment of CASE. The training and learning curve is constant. Waiting will only delay the inevitable and prohibit productivity gains.

There are numerous CASE tools available, with many new vendors entering the market place. Selecting the tools for your institution is not much different than most procurement decisions. Seek the advice of your information systems colleagues or visit institutions that have some experience. Private-sector systems departments are likewise entering this new technology. User groups are forming and can help guide your institution. Productivity gains can be achieved. At the University of Florida, the results are in!

What observations have been made?

Overall, all facets of the application development process, except one, have experienced productivity gains. The one exception, as expected, is the JAD, Joint Application Development. It has been our experience that involving the end users early in the planning and design stages was difficult. Users would typically describe a problem and possibly outline a perceived solution, and wait for the analysts to bring structure and organization to the solution. The implementation of JAD has forced users to participate in the design process and to make critical design decisions at the appropriate times. This added time is very well spent, is welcomed by the development staff, and is a significant contribution to the saving of time in the latter stages of the project.

What is our overall assessment?

The use of CASE, or productivity, tools has been good for the University of Florida. We are realizing significant savings. The investment is paying large returns in real time savings, higher employee moral, and better client satisfaction! We believe it was a wise investment, one that will be long lasting; much like CAD/CAM was for architects and engineers.

DESIGNING AND IMPLEMENTING THE CUNY OPEN SYSTEMS CENTER

Richard F. Rothbard
Vice Chancellor for Budget, Finance and Information Services
The City University of New York

Michael Ribaudo
University Dean for Instructional Technology
The City University of New York

Colette Wagner
Director of Education, Training and Staff Development
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I. THE ROLE OF REORGANIZATION

by Richard F. Rothbard

Abstract: The creation of the CUNY Open Systems Center as an outcome of a reorganization of the central computing enterprise of a large urban university system will be introduced.

In July of 1993, the CUNY Office of Budget, Finance, and Computing embarked upon an ambitious reorganization plan. The plan was the result of a thorough examination, conducted by colleges and representatives of the central administration, of the needs of the University and its colleges in the areas of computing, telecommunications, and related technologies, and the resultant call for us to exercise leadership in planning for and implementing technological solutions, where appropriate, for the many academic and administrative challenges facing CUNY.

Far from representing a mere name change to the Office of Budget, Finance and Information Services, CUNY's central computing enterprise has undergone a top to bottom reorientation to serve better the needs of the colleges and to position better the University to make the most effective use of current and emerging technologies in the service of higher education. And the emphasis is very deliberately on Information Services and not Systems, in recognition of the fact that systems are merely tools that may be helpful in achieving an objective, not the objective itself. Rather, our goal is to provide services in the new information age, services that all of us are either required to perform by internal and external mandates, or want to provide by virtue of our shared notions of how to improve life for our students, faculty and staff.

One of the first major outcomes of the reorganization was the Fall 1993 inauguration of the Open Systems Center, a high-end research and training facility located in the Computer Information Services offices at the University's central hub that is designed to serve as a testbed for the application of new technology to problems encountered by the University's professional staff in teaching, research and administration. This morning, Michael Ribaudo, University Dean for Instructional Technology and Industry & Government Partnerships will offer a look at how the creation of the Center emerged from the reorganization and how it took technological shape. Colette Wagner, University Director of Education and Training, will report on the diverse instructional activities currently under development at the Open System Center, Mike Kress, will then speak to you briefly about a number of advanced technology projects that he and his graduate students have been working on and Jim Murtha, University Dean for Comuter Information Services, will address issues regarding sustaining the Open Systems Center effort. Since I'm sure with the diversity of interest represented in this group our prepared remarks might not address every aspect of the project, we'll try to leave ten to fifteen minutes at the end of the session for discussion and questions -- as well as to clear up as much as we can the inevitable confusion that may be plaguing you at the time.

II. BUILDING A PHYSICAL CENTER AND FORMING A VIRTUAL TEAM

by Michael Ribaudo

Abstract: The basic philosophy of the Open Systems Center and a chronicle of its development and operation will be presented. Issues to be covered include: relationship of the initiative to the reorganization of the CUNY Information Services enterprise, installed equipment base and overall strategy.

The Open System Center we are talking to you about here today is actually a small physical embodiment of a larger philosophical construct that has guided the progress of central computing at the City University of New York since the computing and telecommunications area for the Central Office was reorganized into its current structure in July of 1993. Prior to that, much of the thinking which governed the delivery of central computing services could be characterized as largely "Mainframe-Centric". The environment was more like the traditional 'glass house' computer center, with few staff having had any exposure to UNIX based workstations; the orientation of the networking infrastructure being almost totally limited to an IBM/327x/SNA view of the world. In fact, at the time of the reorganization only one or two of the forty or so full-time staff members had anything on their desktops other than a dumb terminal.

In the year and a half or so since the reorganization things have changed considerably. All staff members now have either Intel 486-based or Macintosh machines on their desks, every workstation is connected to a ubiquitously deployed high-speed ethernet network, and we've introduced a suite of servers running almost half a dozen varieties of the UNIX operating system. We haven't as yet thrown away any of our mainframes, but the work those mainframes do now is somewhat different from what they've done in the past. Our central mainframes are now doing what smaller campus based mainframes did for the last twenty or so years at CUNY. By aggressively engaging in a system-wide program of mainframe consolidation, we have been able to afford considerable savings to the CUNY colleges which in increasing number are choosing to run their own locally based administrative mainframe systems on the central processors. By the end of this academic year, over one third of the CUNY colleges will be running their administrative systems"--"for the most part, their student registration systems"--"at the University's central computing facility on West 57th Street in midtown Manhattan.

The shift in central mainframe workload from a primarily academic orientation to a more administrative one provided the initial impetus for creating the Open Systems Center. In order to free up the mainframe cycles and DASD cylinders to accommodate the college administrative systems, we needed to provide alternative and perhaps more appropriate platforms for users looking to port their applications elsewhere. While our utilization studies were telling us that instructional use of the mainframe by students had trailed off considerably over the years, faculty research usage remained high. The time had in fact come for folks like our social science researchers who over the years had become whetted to running SAS or SPSS on the mainframe under MVS to look at the approaching millennium.

Another compelling reason for establishing the Center was our desire to provide faculty interested in developing multimedia courseware applications with a central site where those skills could be developed and nurtured. The university had already obtained site licenses for a number of high end authoring languages and tools and a number of the applications written internally for instructional purposes have won critical national acclaim.

A third rationale was to set up a model site for local area network strategies that the colleges could look to for guidance as they seek more and more to implement campus-based connectivity solutions which include mechanisms for delivering multiple media to the desktop and high speed connections to the Internet.

We wanted a Center that embodied the then emerging philosophy the 'network' was becoming the computer and that in order for that network to accommodate the variety of vendor hardware platforms and operating systems different constituencies would require, we would need to build an open network capable of carrying a variety of network protocols. To that end we have built a heterogeneous and versatile computing environment in a three room 80,000 square foot setting. It currently houses 24 high-end multimedia computer systems and six UNIX work stations and a variety of peripheral devices such as printers and scanners in a state-of-the-art networked environment. The hardware includes Apple Macintosh 840AVs and Power Macs; DEC Alphas; IBM 486-Value Points, Pentiums, and RS-6000's; and Sun Sparcstations all connected in a Novell network capable of carrying Netware, Apple Talk, and TCP/IP over level 5 10-base T unshielded twisted pair wire and gatewayed to the Internet through a Cisco router which is scheduled to be upgraded from T1 to T3 speed within the next few months.

Staffing the Open Systems Center has been a challenge. From the outset, it was clear that no one staff member possesses the full range of skills required for its effective operation. As a consequence, a virtual team has been constructed, pairing staff with requisite skills in project-based activity across traditional organizational boundaries. While successful to some degree, this virtual team approach has created ambiguous situations to which some staff have been unable to adjust. This places divisional leadership in the ironic position of arguing for new staff lines not based on the need for more staff members but based on the argument that existing staff do not possess the requisite skills set to achieve newly promulgated organizational goals. On various projects, campus staff are added to the mix as well. We continue to struggle with this thorny issue through a variety of strategies, not the least of which is our education and training program about which you will hear in a moment.

Finally, a word about start-up funding. Creative partnerships with hardware vendors enabled us to maximize the available budget with the result that a fairly impressive installed equipment base was available from the outset. In our second year of operation, the emphasis is on equipment upgrade and building the software tools available to Open Systems Center users. We are constantly seeking ways in which to finance these activities.

III. TRAINING FOR NEW TECHNOLOGIES
by Colette Wagner

Abstract: The Open Systems Center provides an umbrella structure for training faculty and computing staffs across the University. Its workshop "curriculum" spans interests from introduction to the World Wide Web and HTML document development, to an introduction to Unix for mainframe programmers, to training in the use of Universal Algorithms Schedule 25 (a facilities management program). In addition, the University's Multimedia Courseware Development Initiative is funded under the aegis of the Open Systems Center. The rationale for linking these training experiences under the Open Systems Center banner is explored.

In my capacity as Director of Education and Training for the Office of Instructional Technology, I am the Program Coordinator of the Open Systems Center and it has been my responsibility to develop the activities and agenda of the Center. A key element of that programming activity is the schedule of training workshops for faculty and computing staffs that take place under the umbrella of the Open Systems Center. A key concept in the design of the Open Systems Center's programs is that of the virtual team. From the outset, I have billed all training opportunities provided to CUNY faculty and computing staffs that emanate from the Office of Education, Training and Staff Development as programs of the Open Systems Center, whether they were physically located at the Center or remotely located at campus sites. The method to this particular madness is quite simple. The current space allocated to the Open Systems Center does not include a classroom/conference room environment that will accommodate groups over 25 and I need to locate larger programs at campus sites. In addition, I am slowly starting to build a cooperative network of University-wide training opportunities that will expand based on the deployment of campus-based Open Systems Center facilities at CUNY senior colleges about which Jim Murtha will speak at the end of our session. Finally, with the blurring of distinctions between instructional and administrative computing functions within the overall CUNY computing organization, the Open Systems Center provides a comfortable environment for the collapse of these traditional distinctions in the technology organization.

It might interest you to know that the entire full-time complement of my training staff is myself and an assistant who publicizes workshops and handles registration, etc. In the period July 1993 through Fall 1994, we offered a total of 72 events, representing a total of 1300 participants and 1600 applicants. As you can well imagine from these statistics, the "faculty" of the Open Systems Center's training program are themselves a virtual team representing the best of CUNY's instructional and technology experts. This fall, four CUNY faculty members"--"Michael Fitzgerald (Philosophy, Medgar Evers), Michael Kress (Computer Science, College of Staten Island), Anthony Picciano (Curriculum and Teaching, Hunter College) and Dean Savage (Sociology, Queens College)"--"are serving as Visiting Faculty Fellows. In addition to 18 formal courses for faculty and instructional staff that they are teaching, one of the Open Systems Center's Visiting Faculty, Anthony Picciano, will be serving as a mentor to CUNY colleagues who are novice multimedia developers. This committee of Visiting Faculty Fellows provide the primary input in the design of new course offerings for the Spring 1995 semester and beyond.

Programming for faculty in the Open Systems Center is strongly tied to the University's instructional technology agenda. One of the Center's main objectives is to provide an experimental environment for prototyping instructional software that can be used in the real world of teaching, learning and research at CUNY. In particular, close ties exist between the Office of Instructional Technology's Multimedia Courseware Development Initiative (which has funded the development of approximately 30 multimedia projects by CUNY faculty since its inception in 1990-91) and the faculty workshops that are offered.

In its first year of operation, the Open Systems Center quickly became the locus of the Office of Instructional Technology's Faculty and Staff training workshops. In addition to the scheduling advantage afforded by a training center dedicated to faculty and technical staff, the specialized equipment and high-speed network connections that were designed into the complex enabled cutting edge programming from the outset. In Spring 1994, the Open Systems Center provided the University's first workshops on navigating and authoring documents for the World Wide Web and, as a consequence, this work spurred the development of CUNY's own home page. This semester, campus home pages and individual faculty home pages are all the rage. Additionally, short courses such as *Authorware Professional*, *Introduction to Data Analysis Using SAS for Windows*, *Preparing the Electronic Lecture*, and *QStats and QData* (statistical management programs developed by the Queens College Sociology Department and distributed free under terms of an NSF grant) were featured offerings of the Open Systems Center schedule. Small groups of faculty working on art and technology multimedia projects, and foreign language faculty also used the Open Systems Center to plan events or review new instructional software developments. As the University's videoconferencing/distance learning technology project unfolds over Spring 1995, the Open Systems Center will become a locus for faculty experimentation with the new technology. Finally, as faculty requests for support in identifying appropriate instructional technology materials come into the Office of Education and Training, the Open Systems Center is used as a clearinghouse and a program springboard. Social Science faculty and Foreign Language faculty will be working on conference events in their respective disciplines throughout Spring 1995.

On the front of advancing technical skills of computing staffs across the University, the Open Systems Center strategy has been somewhat different. In start-up mode, training for computing staffs has been offered on a limited basis, with few large scale events, many vendor-sponsored briefings and a number of workshops limited to specifically targeted training audiences. For example, training in CA-IDMS, which is the basis of the University's Student Information Management System, is limited to those schools who are either already participating in the program or are scheduled to migrate to the SIMS systems in the near future. In the area of client/server and Unix training, gradual steps have been taken. Central Office computing staff and users of the *Schedule 25* room scheduling application have been provided with a series of in-house seminars on survival in these environments to enable them to become acclimatized to these new environments and roll-out new applications. At this point, we are in the process of developing more specific training strategies that will identify central office staff for higher level training and that will enable colleges to participate in the same kinds of training at the lowest possible cost. The same approach has been taken in the area of Novell Netware administration. With the installation of a large number of local area networks in the Central Office, we have had the opportunity to assess various Novell training providers while addressing immediate organizational needs. Our long-term goal is to use this information to enable the successful negotiation of a University-wide training contract that will again provide colleges with lowest possible costs for upgrading staff skills in this crucial area.

Finally, on the issue of long-range planning for the training programs that are offered under the umbrella of the Open Systems Center. As a result of the reorganization of Computer Information Services, all CUNY colleges are currently engaged in the process of articulating their own technology mission and program statements. This process involves consultation with the Central Office and one of the areas covered by the activity is technology training needs. It is anticipated that the long-term agenda of our Open Systems Center training program will be forged by this activity and that it will be further affected by alliances with faculty, with students, with CUNY computing staffs, and with the strategic partners identified by Dean Murtha in his presentation.

IV. PARTNERING FOR INSTRUCTIONAL ADVANCEMENT
by Professor Michael Kress

Abstract: The relationship between a large urban University's centrally located, high-end R&D technology center and a Computer Science department at one of its remote senior colleges will be explored. Student and faculty projects in multimedia development, video-editing and scientific visualization conducted using the Open Systems Center facilities will be discussed. Results of a student-taught video-editing workshop for CUNY faculty will be reported.

There were several important features to consider in developing a mutually beneficial relationship between the Open System Center facilities and a CUNY senior college, located a two hour commute away. It was important that they be able to provide each other with valuable resources and that they develop effective communications. This meant using appropriate file transfer techniques to share interesting applications and to disseminate information. It was also necessary to have a strong commitment to success on the part of both parties.

The Open System Center provided the state-of-the-art computer environment (hardware, software, and network) and funds for the students. Both the Staten Island students and faculty, aggressive in their use of new technologies, provided expertise in using and testing the equipment, selecting appropriate software, testing file transfer techniques and network performance, developing applications, and teaching workshops at the Center. The collective expertise and knowledge of evolving technologies contributed by the students was drawn from a wide network of users located throughout the World via bulletin board postings and user group events and meetings in the New York metropolitan area. The faculty expertise in research and development was essential to identifying critical issues and the detailed focus areas pertinent to cutting edge technologies.

Effective communication throughout the project was accomplished through e-mail, fax machines, telephone, voice mail, and CU-SeeMe video conferencing software augmented with conferencing speaker phones. The use of the videoconferencing facility significantly increased the quality of interaction, especially for groups, but it required a scheduling and set-up component to insure that the teleconferencing studios were available at each site and the technical links for the connection established in advance. Concise, brief meetings were held as part of bi-weekly testing and software installation and upgrade sessions at the Center. The daily activity of evaluating and using evolving software and hardware was done at the remote site where one computer station of each of the three platforms supported in the Center was available.

Overcoming the distance constraint between the College of Staten Island and the Open System Center presented a special challenge for file transfer. One of the essential aspects of developing multimedia software effectively is transporting large digital video files from site to site. Various methods of file transfer were considered and tested. At first, we thought that FTP file transfer over the CUNYNet wide area network, would fill our needs. However, after hours of waiting for the transfer of a test file, we realized that a careful evaluation of the network performance at various times of the day was required to understand the feasibility of this method.

After empirical tests of network performance and time calculations based on observed transfer rates, it became clear that even unattended overnight transfers were not always practical. Other methods considered included: portable PC hard disk and Lap-Link computer to computer transfer, 150 MegaByte (MB) transportable removable hard disks, One GigaByte (GB) external SCSI hard disk, read/write optical drives, and write once/read many (WORM) CD's.

Ultimately, we concluded that there was no single way best suited to all circumstances. Network transfer could provide overnight delivery of files but was risky given the possibility of network failure. The use of 150 MB removable disks offered a number of significant advantages. It involved mature, standard technology at a low cost; it was easy to use on all platforms and featured archival backup. It was easy for the user to transport or could be sent by "sneaker net" or "snail mail". However, the transfer rate was limiting for motion video playback directly from the drive. The One GigaByte external drive offered speed and large capacity storage but at a higher cost. It also required (for the most part) that the user him or herself carry the 8 to 10 pound drive from site to site. The optical and WORM technologies as advertised offered cost-effective price per megabyte of storage. However, the startup cost and rapidly changing proprietary formats caused a "let's wait and see" opinion on their use in practice, especially since 20 different Colleges would ultimately be using the Open System Center.

The challenge presented in developing and testing software and hardware integration in the Center typically becomes clear immediately after the first interaction with technical support as the features and behavior of the technology is advertised but rarely known by the software support group or developers themselves. The result is the need for a methodical step-by-step, hands-on testing and evaluation of each component in the system to identify the "features", limitations, and "work arounds" required to harness its power. Bulletin board listings and user group support are invaluable in this phase of the development.

The applications developed by the CSI group used multimedia technology for a variety of teaching applications from Scientific Visualization to American Sign Language. The common component of the applications was the use of "home grown" digital video in a highly interactive multimedia program. The activities of each project included shooting video footage, digitizing and editing motion video, writing digital video playback scripts, and developing and testing programs with content experts. Many digital video-capture and playback-boards as well as editing software packages and configurations were evaluated. They ranged in price from $400 to $2700. For our purposes, the inexpensive consumer boards ranked highest in overall value. Three presentation software packages -- *ToolBook, Authorware Professional*, and *Visual Basic* -- were used for different projects. The following Staten Island projects were initiated as part of the Center's development effort: *Applications and Techniques of Scientific Visualization* -- a multimedia program for teaching and learning visualization techniques in science and engineering; *Bon Jour* -- a multimedia program for learning conversational French; *The Magic Rabbit* -- a computer aided educational (CAE) program for teaching English tenses, aimed at children whose first language is American Sign Language (ASL); *ASL Dictionary and Tutorial Program* -- a multimedia program for learning ASL; *Colors and Shapes* -- a CAE program for teaching autistic children; *What Is Multimedia* -- a descriptive program for demonstrating multimedia techniques for CAE programs; *A Multisensory Calculus Program for Visually Impaired Students* -- a student controlled program using audio-tactile material for learning Calculus for blind and visually impaired students.

One of the exciting aspects of learning and using cutting-edge multimedia hardware and software is ascertaining and disseminating information. The classical sources of information, including library references materials, are of limited value. By the time printed paper makes its way to the library shelf, the hardware and software discussed are often obsolete and the information of little use. Magazines, trade shows, bulletin boards, and user group networks are the essential sources of information. The classical professor with years of theory and a firm mathematical foundation is no longer the renowned expert in solving the details of contemporary development and integration. The students are the experts and become the teachers in the use of the technology! Fortunately for me, professors retain a role as content specialists. Some are also helpful in presenting the student's material to workshop participants. Following the clear gradient of contemporary information flow, a series of faculty and staff workshops taught by students and faculty were held at the Center. The workshops were: Digital Video Editing, Survival in a UNIX Environment, UNIX Script Programming, Graphical User Interface (GUI) Programming, Client/Server Computing, Performance Evaluation and Optimization in A Client/Server Environment. All but the last two were taught by a student-faculty team. Each contained a significant hands-on component with more than 85% of the workshop spent using computers. For the most part, the workshops were at least 1/2 day in length. The projects and handouts provided the workshop participants with practical applications for developing operational skills. Participant surveys indicated an overall favorable evaluation.

V. STRATEGIES FOR CONTINUED DEVELOPMENT

by James Murtha

Abstract: The continued development of the CUNY Open Systems Center and the special projects and strategic alliances that will drive its future agenda are explored.

Now that my colleagues have described how the CUNY Open Systems Center was initiated and have detailed the range of its current activities, I'd like to give some idea of how we intend to sustain the development of the Open Systems Center. Special projects and strategic alliances will be the key to the future of the Open Systems Center.

Building the University's technical infrastructure is an announced goal of the Office of Budget, Finance and Information Systems. With a $3 million capital allocation for an Educational Technology Initiative from New York State in fiscal 1995, CUNY has been able to offer one of two possible technology programs to each of its nine senior colleges. The University's Open Systems Center will figure heavily in the development of both program options. The first option is the establishment of a campus-based Open Systems Center facility which will emulate the design and philosophy of its central parent. The campus-based center will support instructional and research development and testing and will maintain close connections to the central facility. Cooperative projects between and among the various Open Systems Centers will emerge as the centers are installed and program activities are initiated.

The second option available to senior colleges under the Educational Technology Initiative is the choice of becoming a remote site in the University's emerging videoconferencing network. Videoconferencing/distance learning technology has been a research pursuit at CUNY for some time. Switched wideband trials with NYNEX and Ameritech on instructional projects, use of the University's proprietary T1 network to sustain PictureTell installations for administrative purposes, and monitoring the progress of desktop videoconferencing programs such as CU-SeeMe are examples of the range of activities in this field. At present, we are anticipating creation of a University hub at 57th Street that will be connected via a video-enhanced CUNYNet (i.e., the University's proprietary T1 network) and that will be linked initially to five similarly equipped remote senior college sites. The Open Systems Center will play a formative role in the development of this project as it is slated to be the site of the first connection in the network between 57th Street and City College.

In addition to the videoconferencing effort, the future of Open Systems Center will continue to be formed by the technology agenda of the University. For example, research initiated at the Open Systems Center on the development of the World Wide Web and subsequent training in navigation of the Web and authoring HTML documents lead to creative thinking about the ways in which CUNY could participate in the burgeoning international development of digital resource collections on the Internet. A strategic alliance among the CUNY Office of Library Systems, The New York Academy of Medicine, the New York Metropolitan Reference and Research Library Agency (METRO) and the New York Public Library has resulted in a $275,000 award from the U.S. Department of Commerce's National Telecommunications and Information Administration to support the design, construction and demonstration of an electronic Consumer Health Information Network. The project will establish user-friendly microcomputer access at libraries, colleges and hospitals, allowing users to navigate among a wide range of databases, including the Breast Cancer Information Clearinghouse, AIDS Treatment News, Cancernet, Oncolink, Lymenet and the New York State Department of Health's gopher service, among others. Several services will be available in Spanish as well. The network will build on the existing infrastructure available at CUNY, and in order to ensure capacity for growth and interconnectivity, it will employ standard Internet protocols, hardware and software. As the Consumer Health Information Network progresses, the Open Systems Center will continue to play a role its development -- as a training and testing site.

Faculty activity and research interest will also drive the agenda of the Open Systems Center. Recently, CUNY received a grant of approximately $25,000 from the United States Information Agency to maintain and help develop a new gopher specifically tailored to teachers and teacher trainers in

English as a Second or Foreign Language working at locations worldwide due primarily to the activity of CUNY Basic Skills faculty who pioneered listservs on this subject using the CUNY mainframe as a resource over the years. Through the USIA gopher, which is called TES/FL, they will be able to obtain, at no cost, a wide range of pedagogical documents, many produced by the English Language Programs Division of the USIA, as well as lists of Binational Centers, and announcements of international conferences, fellowships, and employment opportunities. A specific reason for USIA's support for CUNY as the TES/FL gopher site is the University's prior creation of TESL-L, the listserv list, or electronic mail discussion group, for teachers of English as a second language. The TESL-L listserv membership includes more than four thousand teachers in 73 countries, making it one of the largest interactive listserve forums on the Internet. The Open Systems Center will continue to play a role in the development of this resource as we explore alternatives to mainframe-based listservices, etc.

We are also pursuing strategic partnerships that will further the development of the Open Systems Center. These partnerships can take various cooperative forms. Our latest venture is the establishment of a CUNY/New York Software Industry Association Internship Program under the aegis of the Open Systems Center. With economic development funding from New York State, this spring will see the placement of 50 funded interns in software companies in the greater metropolitan area. One of the anticipated outcomes of this university-industry partnership is the development of specialized training workshops to be housed at the Open Systems Center that will forge greater cooperation between education and industry to the benefit of both parties.

As a symbol of our reorganization and the reinvigoration of computing and technology at CUNY, we see the continued development of the Open Systems Center as paramount. Under its aegis, we will aggressively pursue all opportunities to research and evaluate the ways in which technology can improve teaching and support learning and research at CUNY, and afford us the ability to provide student services more effectively and efficiently.

Taking the Mystery Out of Document Imaging
Metropolitan State College of Denver

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Associate Vice President for Information Technology

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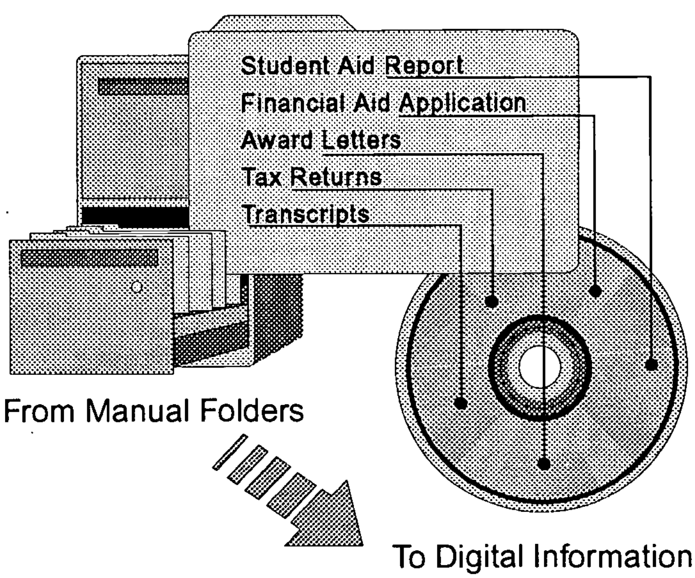
Abstract

This past year, Metropolitan State College of Denver implemented a Windows based archival document imaging system for the Financial Aid Office. The environment consists of twenty-eight IBM 486 image viewing stations (17" monitors), two Pentax 10 page/minute scanners, and a single HP LaserJet IIIsi printer. The system is designed to manage an unlimited number of student documents, and has an average image retrieval time of under 4 seconds to the workstation.

This application was developed over a six month period by a team of four individuals, using PowerSoft's PowerBuilder client/server development tool, in conjunction with Microsoft SQL Server. Developing the system internally provided a system that is closely integrated into the existing Banyan Vines network, and resulted in a cost savings of $140,000, as compared to the proposed vendor solution.

This presentation addresses many of the issues MSCD faced in making the decision to build the system as opposed to purchasing a package. In particular, issues relating to the use of new Windows based imaging technologies and application development tools will be presented.



Taking the Mystery Out of Document Imaging

Introduction

Each year the Office of Financial Aid at Metropolitan State College of Denver (MSCD) processes over 12,000 student applications for financial aid. This amounts to approximately 150,000 pieces of paper requiring extensive manual processing and filing. Rummaging through the reams of file folders to retrieve a student's document was time consuming and very inefficient, not to mention the space needed for storage. No doubt a tremendous amount of staff time is consumed in the never ending quagmire of paper, paper, paper. In an effort to address the document management and processing problems, the Director of Financial Aid sought Information Technology's help in assisting them to find an automated solution.

A systems analyst was assigned the tasks of evaluating Financial Aid's workflow and defining system requirements. The original project objective was to develop a Request for Proposal in order to procure a vendor package solution. This process took 6 months to complete and resulted in a detailed document of system requirements and a RFP. In parallel with this process, numerous vendor systems where evaluated and priced, so as to understand their computing platforms and potential costs. Imaging systems from IBM, DEC, Canon, and other vendors were considered.

As we learned, architectures for imaging systems fall into primarily three categories; 1) host or mainframe based, 2) networked (client/server), or 3) stand alone systems. Having recently completed the implementation of a campus-wide Banyan Vines network, a client/server solution was preferred. Exploiting the desktop had been an objective of MSCD's Information Technology strategic plan for the campus. The Financial Aid office was already targeted to receive new 486 PCs to replace their old 286 & 386 systems. These systems provided the hardware necessary to drive an imaging system. In addition, the existing fiber optic backbone provided enough bandwidth to transport images through the network.

After reviewing the major offerings, only one vendor met the bulk of our requirements. The cost of this solution was approximately $240,000 excluding the cost of user workstations, which exceeded available funding and forced us to reconsider other options. With the existing hardware and network infrastructure already in place we turned our attention to the possibility of developing the application in-house. Not having experience with imaging technologies, the development staff had numerous questions.

> How do we capture, display, and store document images?
> How do we tie the images to database information?
> Must we retain the original documents or can they be destroyed?
> What considerations are there to image compression and decompression?
> How do we integrate optical disk technologies into our network environment?
> How do we interface to the scanners from our application programs?
> What database should we use?

How do we structure document profiles and catalog indexes?
Should we incorporate workflow capabilities?
How do we transport and view images through the mail system?
We've had no Windows development experience, what's the learning curve?

These questions and other concerns needed to be resolved before any decision could be made. One by one each issue was evaluated and technical concerns resolved. It soon became clear that it was indeed possible to undertake the development of the project. The decision to proceed with an in-house solution was made by the Associate Vice President for Information Technology and supported by the Vice President for Administration and Finance.

The Solution

Once the decision was made to develop an imaging based application, a focus group of four individuals was formed. The project team consisted of a Project Manager, Lead Analyst, and two Programmers. This group was relieved of day to day production responsibilities to focus on the project. Work requests from other areas were reprioritized to lessen the impact on remaining staff. The project was initiated in May of 1993 and the application was completed by the end of August 1993. The system was implemented in September 1993.

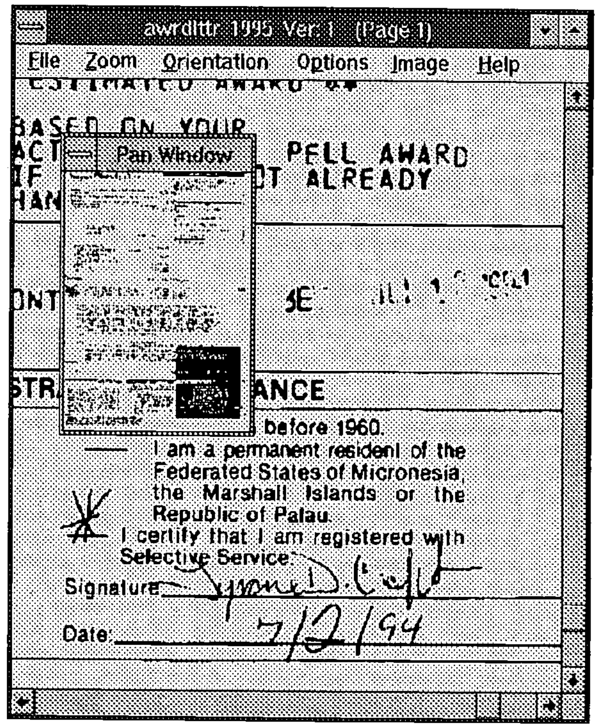
Project Time Frames

Develop RFP & System Specifications	6 Months
Analysis & Design	3 Months
Programming & Testing	2.5 Months
Installation	1 Month

Working with the Financial Aid department, the team finalized the application design and developed program specifications. The following list serves as an example of the types of requirements that were identified, and are in no particular order of importance or priority. A detailed listing of the requirements document and RFP can be obtained through the CAUSE document library.

- Must be a Microsoft Windows's compliant application.
- Retain catalog and images for at least 7 years (current Federal regulations).
- Volumes: Cumulative catalog and images up to 50,000 students over 7 years; up to 1.5 million images over 7 years.
- Image size: Accommodate sizes from 4" x 6" to 8.5" x 14"
- Scan process capable of accommodating 2000 scanned images in an 8 hour day, including scanning, cataloging, and dump to storage media. Complete Scan/Catalog time for 1 image needs to be less than 60 seconds (30 or less is preferred).

- Storage: Write an image file to Permanent or temporary storage in less than 15 seconds (10 or less preferred). Retrieve an image file from permanent storage in less than 15 seconds (10 or less preferred).
- Catalog/Index: Store images with retrieval capability by either: SSN or Name (Last, First). Must have logical folders to store documents by financial aid year.
- Image Manipulation: Ability to rotate an image, zoom in on part of an image to 300% or higher, ability to zoom out to 25%, and have 2 images in separate windows open at same time.

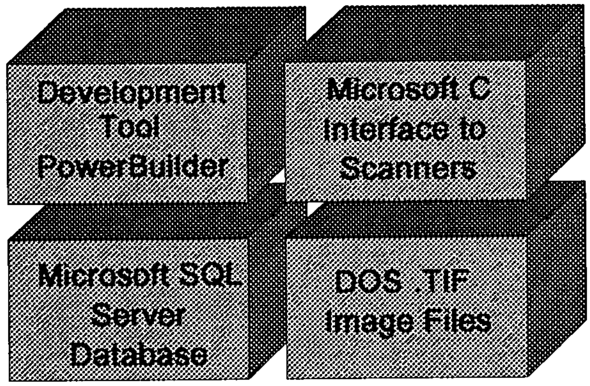


- Verify entries to FAMS records: Download list of all student SSNs, names, and birthdates to SQL tables. Keep file up-to-date with new additions to the Financial Aid system. Provide an optional way to build a student's folder not currently on the mainframe file .
- Multiple page document images must be linked together.
- Accommodate SSN changes automatically through a common SSN change file or have the capability to manually move all documents from one SSN to another.
- Ability to correct cataloging errors after-the-fact.
- Must have easy database indicator to denote when it will be OK to purge or archive a student and all their images (after the 7 year period).
- Ability to print an image in less than 30 seconds.
- Document profile must contain the following attributes: SSN, name (Last First), status of student's FAMS file, date of birth, document title, Image page location(s), DRIVE(Optical Disk#), DIRECTORY, FILE NAME(S), # of pages in document, date/time scanned, financial aid year, scan/cataloging person.

An extensive evaluation was done in determining what Windows-based GUI tool to use in developing the application. PowerBuilder was chosen for its strength in 4GL scripting language, building Windows, linking to SQL databases, efficient use of Windows resources, and team development program check-in check-out capabilities. Microsoft SQL Server was selected as the database engine to drive cataloging, indexing, and image tracking. Each team member was given PowerBuilder training.

Interacting with the scanners and image manipulation required doing some programming in C. One individual was dedicated to integrating the C components into the PowerBuilder application. Dynamic Link Libraries (DLL) were created in C to provide the scanner interface. Image compression, display manipulation, and storage were also developed in C and integrated into the PowerBuilder scripts using external calls to DLLs.

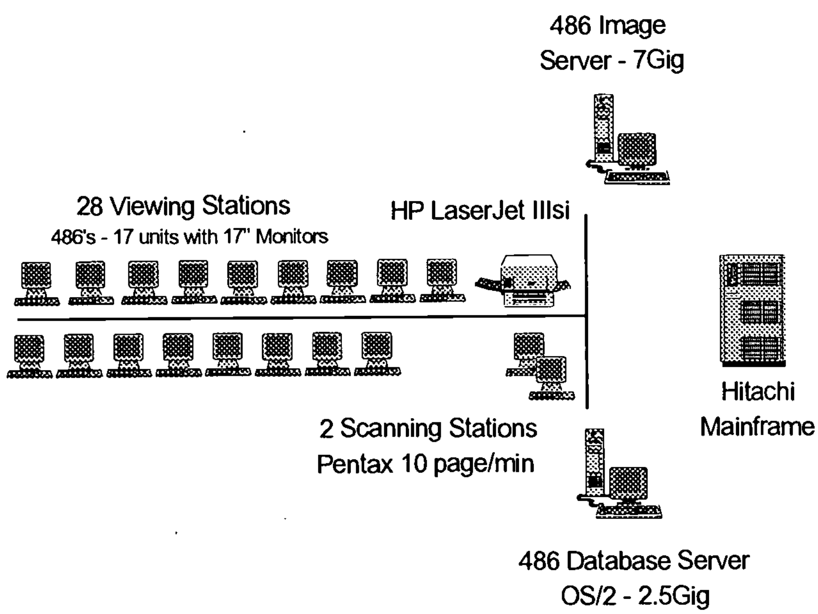
Cataloging and indexing of student documents resides in a SQL Server database on a Banyan OS/2 server. A limited amount of student data is kept on the network SQL Server. Student production data resides on the mainframe in VSAM & ADABAS tables. The system is designed to synchronize new and updated information ported down from the mainframe.



Storing the images posed an interesting challenge. However, the solution was fairly simple. Images are stored in a standard Tag Information Format (TIF) on a DOS drive and are archived in Directories by date. The PowerBuilder application assigns the location and stores that information within the database. The requirements called for fast access and retrieval for documents 2 years old or less. This equated to having approximately 6 to 7 gigabytes of disk on-line. Older documents are to be archived to CD ROM jukebox storage.

Hardware Architecture

The hardware platform consists of 28 IBM 486 viewing stations. Of those 28 viewing stations 17 are equipped with high quality 17" monitors. Each of the desktop units is equipped with 8mb of RAM and 110mb of disk. Two Pentax 10 page per minute scanners are used for all image processing. Printing is done on a HP IIIsi laser printer. A Dell 486 PC is used as the OS/2 database server and contains 2.5 gigabytes of disk. An additional Dell 486 PC is used for storing images and is currently equipped with over 6 gigabytes of disk. The system is to be expanded



to 10 or 11 gigabytes of disk within the current year. CD ROM jukebox technology has been chosen for longer term storage. CD ROM offers one of the more cost effective solutions available today. The network topology is Ethernet running Banyan Vines as the Network Operating System connecting to a Hitachi EX27 mainframe system.

Scanning Hardware & Software Costs
Figures do not include existing 28 486 Workstations

Item	Qty	Vendor Cost	Qty	MSCD Costs
Hardware				
Scanning Stations	**1**	3,100	2	6,200
Print Station Board	**1**	1,049		N/A
Jukebox or CD ROM cabinet	**1**	22,932	1	12,969
Image Server	**1**	N/A	1	7,000
Database Server	**1**	24,370	1	7,000
Scanners + Kofax card	**2**	7,410	2	2,886
17" Monitors - Upgrades	**17**	11,900	17	11,900
Software				
Base Application		14,000		N/A
Customization		14,000		N/A
Workstation View Software	**28**	49,000	28	1,680
Scan Station Software	**1**	3,500	2	20
Print Station Software	**1**	3,500		N/A
Database License	**1**	7,000	1	5,195
Installation & Training		10,000		N/A
Jukebox/CD-ROM support software		7,000		2,000
TCP/IP Software for the Mainframe		60,000		N/A
Development Tools	**1**	N/A		7,495
Development Staff				30,000
Total Start up Costs		**238,761**		**94,345**
Savings				**144,416**
Software Cost/additional user		**1,750**		**60**
Yearly Maintenance		**24,024**		**995**

The Financial Aid department implemented the system in the Fall of 1993 and began full scale scanning of student 1995 year financial aid documents in February 1994. Current year document volumes are estimated to be approximately 150,000 single images. The following table indicates scanning progress and documents to date.

Taking the Mystery Out of Document Imaging

Financial Aid - Current Work Status - Through October '94

	Current	Projected
Documents scanned	36081	
Images	70884	150,000/yr
Days images scanned	174	
Average Images per day	407	
Smallest Image size	514 bytes	
Largest Image size	263000 bytes	
Average FTE Required	.5	
Average Image size	42470 bytes	
Total disk usage	3 Gigabytes	7 Gigabytes/yr

The Financial Aid department has already determined they are saving an equivalent of 4.0 FTE normally dedicated to document filing. These FTE, while not eliminated, have been reallocated to other work within the department. Counselors are beginning to use the on-line documents when working with students. This is resulting in improved service to the students and greater individual productivity. Space once filled with boxes of paper has been reclaimed for new offices.

By developing the system internally, the applications development staff gained valuable experience and knowledge in document management, imaging, and workflow applications. This is expertise that would not have been acquired if a vendor solution were procured. The real value of this knowledge will be realized as imaging technologies are extended out to other areas of the College, such as Admissions, Registration, and Transfer Evaluations.

For those considering implementing imaging technologies the following recommendations may be of help.

- **Start small:** Attempting to do too much increases the risk of failure. Keeping the project scope narrow helps focus the project.
- **Don't buy long time storage today:** Disk, Optical, and CD ROM storage costs are dropping fast. It will be cheaper to buy it when you need it.
- **Plan for enough bandwidth in the network:** Providing you select a network solution, be sure the network will handle your projected volume and traffic of documents.
- **Understand how often documents need to be retrieved:** In Financial Aid's case, once a student's loan has been processed, the need to retrieve those documents is rare - keep the documents that have a higher frequency of access on electronic disk.
- **OCR is much better than it has been in the past, however, don't build your system around it yet:** Greater control on the development of outgoing documents

must begin now if OCR is to work for automatic processing of incoming documents.

- **If you go with a vendor package, make sure that it is an Open System:** Some systems use proprietary image compression, databases, and hardware. You may lock yourself into a situation where you can not expand or migrate to another imaging environment. Be leery of proprietary image compression algorithms. It is possible that other packages may not ever be able to read your stored images.
- **If your user does not know how they want to use imaging, do not try to implement workflow on the first try:** One way to tell if they are not ready is by getting conflicting stories on what the current flow of paper is through the office. Introducing workflow into a business environment that is not ready for the changes it brings can be disastrous.
- **Get IS personnel involved early in the process of dealing with vendors, especially if hooks will be needed into existing systems:** Vendors don't know your systems or environment - don't let them tell your users differently.
- **Do a sample shelf-count to get more accurate volume predictions:** Find out if all pages in a document need to be scanned. Determine the volume of two-sided documents.
- **Look closely at your long-term storage needs:** CD-ROM cabinets and cutters may be cheaper and more practical in the long run than Optical Jukeboxes or Magneto-Optical disk.

Conclusion

It has been said that with every significant success there is a significant vision. Undoubtedly the vision for this project was set by the management of Information Technology and supported by the end users. As a result MSCD was successful in developing a document imaging system based upon the existing networked computing environment.

The initial cost savings of $140,000 for the initial system over the proposed vendor solution will be even more dramatic as MSCD deploys imaging to other areas. The incremental cost to extend imaging is approximately $60/workstation compared to $1,750/workstation for the vendor's solution. In addition, recurring maintenance costs of $24,000 were not incurred. The resulting cost savings are greater than originally anticipated. The Financial Aid office has also realized increased productivity and automated efficiencies beyond original expectations. This has all translated to improved service to our students.

The Delphi Consulting Group has estimated an imaging system similar in size and scope to cost approximately $350,000 and take 19 months from RFP to implementation. MSCD's investment of 12 to 13 months in time and $94,000 in costs has shown it is possible to do document imaging cost effectively, without compromising system capabilities or quality.

SIS 2000
The University of Arizona's Team Approach to Client/Server Migration: Strengthening Old Partnerships and Forging New Ones

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Abstract

At the University of Arizona, we have reached an impasse with our administrative systems. Our mainframe based systems do not adequately support business processes or quality decision making. This paper will outline the approach we, the SIS2000 team, have adopted in launching the University's Student Information System (SIS) into the enabling environment of client/server computing and reengineered processes. Our approach includes marketing our vision, forming and strengthening strategic partnerships, prototyping and implementing new technology, and setting the stage for business process improvement. The campus' positive response to our vision and prototype provides the reengineering effort with the support and political capital it requires to succeed.

VISION

Students

Have you ever...

Applied for admission, completed ALL of your registration tasks, viewed your grades and transcript, communicated with your instructors, checked your financial aid status... using your computer at home, or a computer on campus, at a time that is convenient to you?

Staff

Have you ever...

Had the time to provide quality service to students, instead of having to perform the same repetitive tasks, been able to communicate with colleagues across the campus, the state, and the country, to become more informed and knowledgeable... using a computer system at the office that's as easy to use as the family computer at home?

Faculty

Have you ever...

Managed course offerings, course loads, and course enrollments, assigned final grades, held 'electronic office hours,' communicated with colleagues across campus, the country, and the world... from your computer at the office, at home, or on the road, at convenient times to you?

Administrators

Have you ever...

Viewed accurate, up-to-date teaching load reports, viewed accurate, up-to-date enrollment reports, viewed accurate, up-to-date admissions reports, been able to perform 'what if' simulations using management databases... using your computer at the office, at home, or on the road, at times convenient to you?

You Will!

SIS 2000, helping to launch The University of Arizona into the 21st century!

Borrowed partially from a popular AT&T commercial, the above depicts our vision for transforming the University of Arizona's (UofA) administrative student information system (SIS). We attempted to articulate this vision into a concise, usable statement as follows:

> To achieve a first rate student service and enrollment support system that is easy to use, flexible, and dependable; and is accessible by students, faculty, staff, administrators, and the community, from any place, at any time.

MISSION

We, the SIS2000 team, developed this vision based on a project initiative formulated by Jerry Lucido, assistant vice-president, enrollment services and academic support and

Larry Rapagnani, then the associate vice-president, computing and information technology. SIS applications reside on an IBM 3090 mainframe that is saturated, leading to critical process slowdowns and occasional failures. Upgrades to the system are prohibitively expensive in what continues to be an extremely tight budgetary period. The technology has become dated and no longer adequately supports required enhancements. Jerry Lucido and Larry Rapagnani had the insight to realize that extensive changes were required and initiated the project with the following mission:

> To replace all student system processes that currently reside on the University's 3090 mainframe computer with equivalent, improved and/or reengineered processes, which will reside in a new technological environment utilizing relational database and client/server technologies, and allowing for integration of other related University processes.

With this high-level directive and vision of a new environment in place, we then considered what we needed to do to share and implement our vision. An understanding of the current environment would provide us with information on what needed to be transformed and how that transformation could best take place.

BACKGROUND

The state of affairs at the UofA is not that different than from that at most institutions. We are faced with the challenge of dramatically improving our level of service while facing annual budget cuts of unprecedented amounts. We have business applications based on technologies developed in the 1970's that require major efforts to enhance, if enhancements are possible at all. We have out of date procedures that do not effectively or efficiently support our business that are tied to this technology. And access to information contained in these systems to make quality decisions is, at best, difficult.

Many factors are influencing the demand for improvement. Most of our students are from the "point-n-click" generation. More and more they are expecting the same rapid response from administrative service that they receive from their personal computers. Faculty, staff and administrators are becoming increasingly sophisticated with computer technology and are demanding access to information to effectively perform their duties. Employees that once operated within a strict functional area focus now need to integrate information from many traditional systems.

We identified two concerns that may hinder improvement initiatives. First there is an increasing disparity between those people on campus that have access to, and knowledge of, information resources and those that do not. It is difficult for service providers to improve their business processes when either the technology is not available to them or they are not aware of what it improvements it can provide.

The second concern was that the Center for Computing and Information Technology (CCIT) was often viewed as a provider of specific enhancements to functional area systems and not as a partner in dramatically improving the overall business.

IMPLEMENTING THE VISION

The background analysis emphasized the point that if we wanted to implement our vision, we not only needed to change the technology, but also the organizational culture. We needed to market our vision, educate customers, form strategic partnerships, and successfully demonstrate what level of improvements new technology could support.

The Team

The first step toward implementing the project directive was the formation of the project team. Mike Torregrossa, SIS manager, was chosen as the team leader and determined that to be effective the team needed to contain well-rounded individuals with enthusiasm for implementing improvements. He set the criteria that members have the 'Just Do It!' attitude. Five of us, including Mike, were assigned full-time to the effort. This was a major dedication of resources in an organization already lacking sufficient staffing levels. We believe this demonstrates the seriousness of management toward the reengineering effort.

We chose the name SIS2000 to emphasize that we are looking to the future in solutions to current problems. It is expected that additional team members will join and leave the team as needed, depending on current projects and priorities.

Each team member transferred his or her current duties to other CCIT staff members, whose efforts made the full-time commitment possible. Also, current customers had to agree to lower levels of service. This is certainly a joint effort which requires the cooperation and coordination of many more than just the five of us.

Our first priority was training on becoming an effective team. The training consisted of sessions on Total Quality Management (TQM) concepts such as effective meetings, data gathering, and process analysis as well as learn sessions where individual members shared information on technologies and systems on which they had expertise.

The most important attributes of each team member are his or her communication skills and high level of respect for each other. Each individual brought to the team unique talents ranging from highly technical to process and procedural knowledge. These individual attributes are funneled into group power by using the newly acquired techniques:

- How to hold effective meetings
- How to use group memory systems
- How to use agendas for meetings
- How to use data to make decisions
- How to treat each other as equals and with respect
- How to build consensus about the next steps and future directions
- How to work in very close proximity

During our initial meetings, the team determined that think-tank environment was a criteria for success. We needed an area that would allow us to communicate frequently, learn from each other, brainstorm on possible solutions and separate us from our traditional duties.

Space is a limited commodity on campus and the only area that met our needs was out of the computer center building. There was some animosity from other employees and at least part of it has been attributed to the separation. We still feel however, that the think-tank environment facilitated much of our success and was a necessity. We are attempting to address the animosity by involving others and communicating more effectively.

We defined the following objectives for the project.

- To improve student and enrollment-related services by providing an information structure supporting the University's Mission and Objectives
- To facilitate an environment where decisions are based on data.
- To create the best higher education administrative information system, where administrators, faculty and staff can concentrate on providing quality service.
- To take advantage of skills and talent, wherever they reside, in an effort to launch the University into the future as the leading land grant institution.

Prototype

After team formation, training and relocation, we began the process of implementing the technical infrastructure to support the reengineering effort. We knew that we had to deliver some quick visible wins to demonstrate our vision and garner the support we needed to implement the levels of change we envisioned.

The University joined in partnership with the Mandarin consortium to take advantage of the infrastructure that was first developed at Cornell University. The University of Arizona aligned with Cornell and 15 other schools to continue the development of Mandarin. This technology helps to maintain the usefulness of legacy data, while easing the transition from mainframe computing to distributed, friendlier technologies. The SIS2000 team enhanced the technology by developing software to operate in the unique environment at the University of Arizona.

We originally estimated that it would take at least six months to implement the infrastructure and provide a proof-of-concept prototype. It was a surprise to everyone, including the team, that this step was accomplished in less than 1 month. Much of the credit for this accelerated time frame was given to the "think tank" environment. The environment provided for instant results that would normally take meetings and scheduling to work out. In addition to the environment, the partnerships with the Mandarin Consortium schools, particularly Cornell University, proved to be invaluable in the implementation phase.

The prototype application's objective was to provide students with access to their own data via an interface that was easy and clear to understand. Initially named UA

Access/Student Access, the prototype system gives students an opportunity to see their addresses, grades, class schedules, financial aid awards, class availability, bills, and other campus information. Through communication and feedback from students the team learned that the students were excited and eagerly awaited this type of technology.

An open house had been planned to introduce the campus community to the new team, their mission, and their new space. When the open house was scheduled, there was not even the dream of being able to show the campus a deliverable product. As mentioned previously, everyone was surprised that on March 17, the day of the open house, four weeks from the date that the team had moved into their new space, a prototype of the technology was available for the campus community to examine and test.

Many people attended the open house: faculty, staff, students and high-level administrators. They saw the potential for new technology and the access it would provide to students. The feedback to the team made it clear that the UA Access prototype should be made available to the students as soon as possible.

The following are examples of UA Access Student menu and the most popular service, class availability: (See figures A and B).

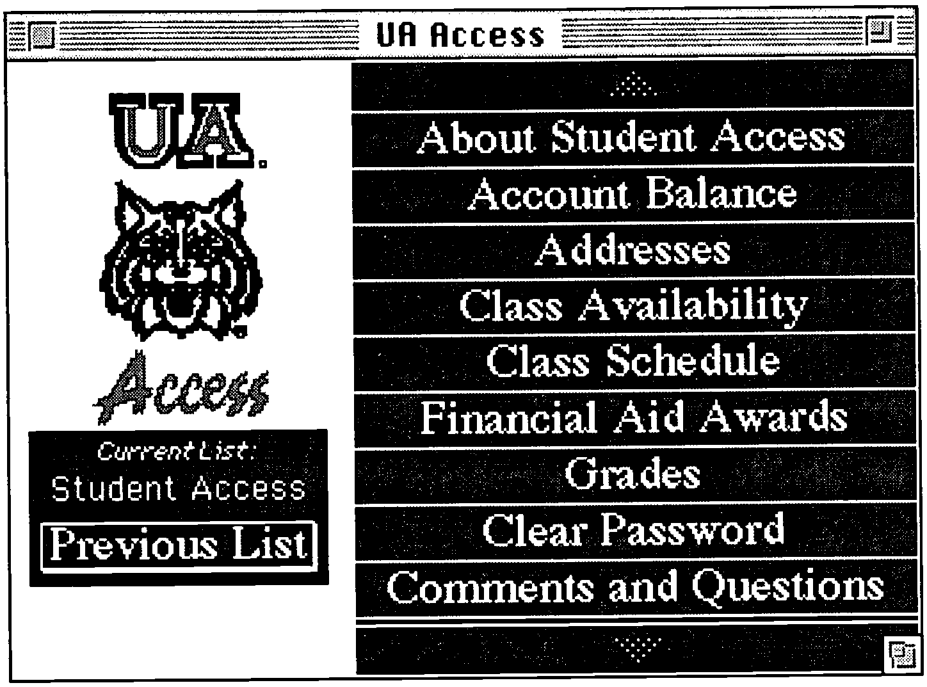

Figure A - Student Access Sub-Menu

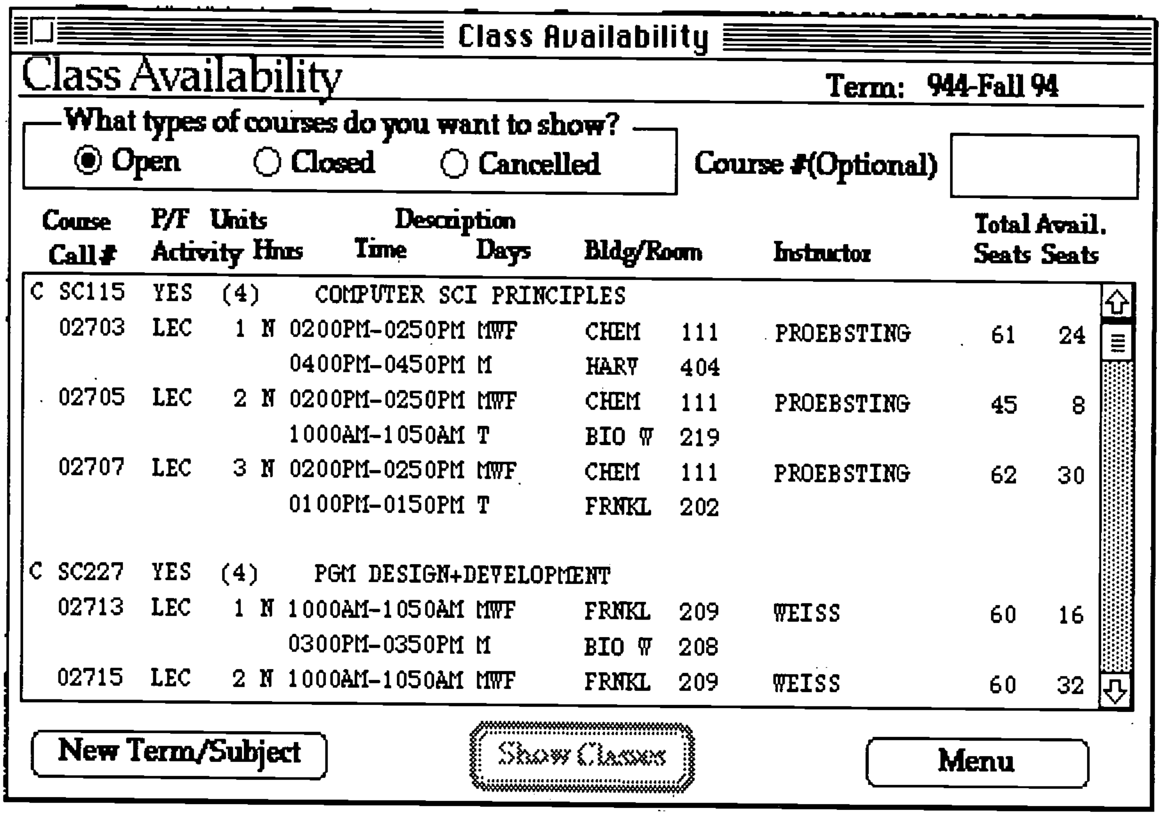

Figure B - Class Availability Service

The following describes services that are currently available to students:

Class Availability - Students can find out which classes are open, closed or canceled. Traditionally, obtaining this information required much time dialing the telephone or waiting in long lines. This is the most popular service for students and parents. The team actually witnessed parents "battling" each other to use UA Access during freshmen orientation!

Grades - Students can look at their own grades for any semester that they had attended classes. This meant that they did not have to wait for the grade cards to come in the mail, or go to the Registrar to find out what grades they received in prior semesters.

Class Schedules - Students can look at their schedules for any semester they have attended the University. This helps them avoid waiting in long lines at registration time, and helps them confirm that they are registered for the correct classes. At the Student Registration Center students may print their schedules, a task traditionally performed by a clerk from the Registrars office.

Financial Aid - Students can see the financial aid they have been awarded. There is no more waiting on award letters, or waiting in line at the Financial Aid office.

Addresses - Students can confirm that they have the correct addresses on file with the University. This ensures the student will get University mailings and reduces return mail costs.

Account Balance- Students can find out how much money they owe or just verify that their balance is zero. They have the option to display billing detail.

Comments and Questions - Students can provide feedback to student service offices. Comments, questions and suggestions can be given anonymously, or they can provide their name, phone number and e-mail address if they request a response.

UAInfo - The new system opened access to the UAInfo system. Students, faculty, and staff can access general campus information on-line. Examples of information include calendars of athletic events, critical deadlines for payments and information about events at the Student Union. UAInfo also provides a direct link to the "information super highway".

Feedback is gathered at the access point as students are using services. A button on the menu labeled "Comments and Questions" allows students, faculty, and staff to type in anything they want. This feedback is electronically mailed directly to members of student service offices and the SIS2000 team where it is categorized and responded to immediately if necessary. This information has been important in mapping the future direction of UA Access and SIS2000. (See figure C for graph of feedback suggestions)

(Figure C - Feedback Suggestions Not Available)

In addition to the feedback data, statistics have been gathered regarding use of UA Access. The following chart shows the usage of each of the student related UA Access services. These usage statistics have helped the team to determine future projects. (See figure D for usage statistics).

(Figure D - Usage Statistics Not Available)

Every student that uses these new services means one less person in line at a student service office. As access to the system grows, employees will be able to utilize their time more effectively by focusing on quality service rather than handling repetitive requests for information.

Marketing

While UA Access was being deployed, our team was busy demonstrating it to administrators, staff, students, and virtually anyone who would take an hour to listen and give feedback. The purpose of the mass marketing process was to gain acceptance and support, and gather feedback for the SIS2000 project.

The biggest, most positive marketing tool was the placement of a kiosk in a visible area within the Student Union. We were stationed at the kiosk during the first week to help market and receive feedback on the product. We received some positive suggestions and implemented some of those quickly. The quick response was another way to show students that this was their service and that we were responsive to their needs.

During this time more than 50 presentations were made to various groups on campus including individual students, student groups, staff, and administrative personnel. One example of how departments became excited by the prototype is after the Financial Aid office saw the demonstration they offered $1000.00 in discretionary scholarship money to involve students in the project. Five hundred dollars was to be awarded for naming the system and five hundred for designing a logo.

When various upper level people saw the demonstrations and the possibilities for improved service, they told us it was time to present our accomplishments to Presidents Cabinet. We shared our vision with and demonstrated our prototype to the cabinet members. The response, from what can be a stoic group, was enthusiastic. Two vice-presidents stood up and volunteered to champion the project. The prototype and marketing had paid off. We now had the political capital and support that we needed to begin the implementation of our vision.

Partnerships

The prototype gave us the support that we needed to proceed, but this project is more than putting another face on legacy systems, it is about dramatically improving service at the University of Arizona. To make the level of improvements that we wanted to make, we needed to define and strengthen many strategic partnerships.

Our partnership with the Mandarin consortium gave us a great lead in providing quick wins, but it also provided us with the opportunity to lay the technical foundation for reengineering student systems. We have adopted Mandarin technology as a fundamental, strategic factor in our reengineering effort. With the Mandarin partnership, we are able to make use of expertise outside of our organization. Many of the consortium members are trying to solve the same problems that we are.

Partnerships with traditional departmental analysts are strengthening and transforming. Seven analysts from student service offices were added to the initial planning team. The members of this team are: Bill Fee, Curriculum Office, Julie Gardner, Bursar's Office, Lori Goldman, Office of Admissions and New Student Enrollment, Judith Mobasseri, Registrar's Office, Mary Salgado, Registrar's Office, David Soroka, Graduate College, Judy Tran, Office of Student Financial Aid

These team members have been instrumental in developing plans and determining the next steps in the larger re-engineering project. A weekly scheduled meeting with this group has helped to keep the communication lines open and broaden the vision of the team. This group of individuals has the knowledge and experience required to make informed decisions regarding improvement efforts. The relationship with this team is transforming from requesters of specific functional enhancements to full partners in reengineering the business of student service.

Along with cross-departmental partners, "project champions" have volunteered. The role of the project champion includes helping to clear barriers to progress, communicating the project objectives, soliciting funding when needed, and generally becoming involved whenever necessary to keep the momentum going. These individuals have been instrumental in supporting the implementation of the vision. The project champions are: Arlene Becella, registrar, Martha Gilliland, vice provost for academic affairs, Jerry Lucido, assistant vice president for enrollment services, Saundra Taylor, vice president for student affairs

The prototype was implemented in a unique environment with much of the work done outside of the traditional management structure. The success and expansion of the reengineering effort required that a new structure be put in place to guide the project. The new structure, the project management team, was announced by Jerry Lucido and includes representation from campus including students, faculty, staff and administrators. The role of the team is to identify projects, set priorities, and allocate resources for SIS reengineering.

A high-level information plan study was conducted at the University in late summer 1994. The study pointed to the need for the University to rapidly move to a new information environment. The study recommended that administrative systems reengineering be a top priority, with the student system to be addressed first. The study recommended that the University release a Request For Information (RFI), to find out what type of resources a vendor could provide in a potential partnership with the University. Another recommendation of the study was that network connectivity for campus be made a top priority. Implementing the connectivity will help to address the disparity in technical capabilities between campus units and allow departments to partner with the SIS2000 initiative.

The project management team is currently conducting interviews with departments as an extension to the information planning study. These interviews are geared specifically toward student systems. The desired result of the interviews is a definition of customer requirements. The team will also determine if potential vendor partnerships exist for specific projects and they may release an RFI or RFP.

UA Access, originally a prototype, has been put into production and a new team has been formed to expand and improve the service. This team has partnered with another campus group, the UAInfo team. The UAInfo project is responsible for deploying a campus information system that provides on-line access to information such as calendars, phone books, catalogs, etc. The two services are somewhat similar in nature and a partnership would allow them to share limited personnel resources and perhaps make the interfaces of the systems more transparent to campus customers.

In addition to the official supporters, CCIT administrative customers agreed to the lowered service levels that would be provided on the current systems, while team members focused on the new project. This meant understanding that some things would not happen and others would be slower. The removal of five people, three of which worked on the Student Information System, meant many people had to commit to have less service in exchange for future potential and growth.

Technical Architecture

Our team has made extensive use of what was developed at Cornell with the Mandarin consortium. We have enhanced Mandarin to work in the CICS/VSAM environment and are using the technology as a means to begin the SIS migration. We feel that Mandarin is a strategic tool that aids us in laying the technical foundation for reengineering, while providing quick wins to customers. Mandarin technology also allows us to make use of the expertise of existing application developers.

Mandarin is best described in the consortium newsletter as follows: "Project Mandarin is an integrated set of applications, tools, protocols, and procedures that facilitate the development of distributed software systems. The focus is on providing end-user access to data stored in enterprise database systems. The suite of products ranges from stand-alone applications to object-oriented building blocks used for creating custom applications. The suite includes tools used for the creation of graphically oriented client applications, desktop integration of third party applications, and integration of system infrastructure services such as version control, authentication, and authorization. Tools are provided to monitor and maintain the system infrastructure services. There are other tools that provide security, data extraction, and communication with various database systems. Although the products are integrated, they have been developed as modular entities. It is not necessary to implement the entire Project Mandarin suite to benefit from the technology."

We are continuing to expand the Mandarin architecture to provide access to other university data. We are developing both client and server API's so that developers can make use of the technology with minimum knowledge requirements of the Mandarin implementation.

Authentication of people requesting service is a priority for the project. In keeping with the University's standards, we identified DCE Kerberos as a requirement in implementing services. However, Kerberos is still some time away from being fully implemented on campus and we decided not to let it hold up providing some services.

ATTAINING THE VISION

Our team has successfully demonstrated that we can dramatically improve student service. We believe that technology is not the only factor that presents a challenge in improving service, but that the existing organizational culture does as well. With the commitment from individuals within many levels of the organization, the culture is changing as well. Individuals and departments are beginning to recognize each other as strategic partners in improving the business of student service. Increasingly, CCIT is viewed as a critical partner in this improvement effort and not just as a entity for making incremental enhancements to resolve immediate needs.

The prototype defined a vision for campus and garnered the support of students, faculty, administrators, and staff. This support has allowed the SIS2000 team and the University to take progressive steps to the future. As we continue on our path, we intend to remain active in the Mandarin consortium, expand the technology to other administrative systems, and continue to develop strategic partnerships, wherever they exist..

The success of the SIS2000 project continues to require people with initiative, vision and excitement about making a difference.

CAUSE

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Track VI

Information Technology Architectures

Coordinator: Jacobus T. Meij

Reshaping the Enterprise: Building the Next Generation of Information Systems through Information Architecture and Process Reengineering

Nicholas C. Laudato
Dennis J. DeSantis

University of Pittsburgh
Pittsburgh
Pennsylvania

A team of faculty and staff at the University of Pittsburgh has completed the design of an enterprise-wide information architecture and a framework for engaging the University community in business process reengineering. The architecture provides the blueprint for developing an integrated set of information services, processes, and technologies, enabling significant efficiencies in business and service processes, and facilitating informed decisions concerning information technology expenditures and acquisitions. Revolutionary in design, the architecture supports evolutionary implementation and intelligent use of legacy systems. The implementation does not adhere to a traditional master plan, but rather adapts principles taken from the Oregon Experiment, to grow the envisioned information system from the ground up. This paper reviews a unique approach to creating the architecture and initiating its implementation. The approach included building consensus on a general philosophy for information systems, utilizing pattern-based abstraction techniques, applying data modeling and application prototyping, and tightly coupling the information architecture with efforts to reengineer the workplace.

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Background

The University of Pittsburgh is an independent, nonsectarian, coeducational, public research institution. Founded in 1787, it is a state-related member of the Commonwealth of Pennsylvania System of Higher Education. In addition to the main campus in Pittsburgh, the University operates four regional campuses. The Johnstown, Greensburg, and Bradford campuses offer four-year baccalaureate programs, and the Titusville campus offers lower-division programs and two-year degrees. Among its five campuses, the University offers over 400 degree programs, and for fiscal year 1994, conferred 7,079 undergraduate, graduate, and professional degrees. The University enrolled 33,756 students (headcount) at its five campuses during the Fall Term, 1993.

The University of Pittsburgh has a central-site information system configuration. Like most systems, it was not specifically architected as it is currently configured, but rather has evolved over the years to meet specialized functional needs. This central site system relies primarily on a mainframe environment using an IBM 3090-500E computer system dedicated to administrative computing applications.

The Administrative Information Systems (AIS) group within the Computing and Information Services responsibility center is charged with supporting the administrative computing needs of the University. AIS is staffed by approximately 75 personnel skilled in creating and supporting batch and character-based interactive systems. This environment encompasses the MVS (Multiprogramming Virtual Storage) operating system, the CICS (Customer Information Control System) telecommunications monitor, file systems, database management systems (Cincom's Supra and Supra II), and the COBOL and MANTIS (4GL) programming languages.

Most of the University's financial, student, library, and personnel systems run in this environment. Some exceptions include the central purchasing system, running on a departmental minicomputer, and an institutional reporting system, running on a VAX/VMS system. For the latter system, data is extracted from the MVS mainframe, and loaded into an Oracle database.

Most of the current administrative systems rely upon batch processing and paper reporting on a scheduled basis, but ISIS (Integrated Student Information System) also provides on-line data entry and inquiry. The majority of mainframe applications utilize proprietary files and databases, making access to the data extremely difficult, requiring significant manual intervention.

As in most other large institutions, there are islands of automation throughout the University in the form of thousands of microcomputers and hundreds of LAN's. The desktop devices are 67% PC's, 30% Macintoshes and 3% Unix workstations. Some of the LAN's are quite large with over 100 desktop devices connected. These types of information processing platforms are found in business units, administrative offices, and most of the schools and departments throughout the University. In addition, there are stand-alone PC's and Macintoshes used for personal productivity applications. These LAN's and stand-alone units are considered by the owning units to be an integral part of information services provided to end-users. Many of them support business applications that duplicate or complement some of the functionality of the central systems.

Some of the data used by these local applications are duplicates of the data maintained on the AIS mainframe with some local enhancements. This data is either entered from the same forms that are sent to the central business units for entry, entered from reports generated by the central system, or downloaded from the mainframe system for use by the local applications. This duplication is quite costly in terms of personnel, hardware and software. But a more critical issue is the timeliness and accuracy of the information on these local systems as compared to the central site systems, and the difficulty of integrating data from multiple systems and platforms. Since there are inconsistencies between multiple sources of data, a major effort involves reconciliation between the data on the local systems and the data on the mainframe.

Project Mission and Goals

Like many institutions of its type, the University finds itself in an economic, social, and political climate that demands the ability to respond to local, regional, national, and international changes in a timely and relevant manner. To accomplish this, University leaders must be able to access and utilize information about all aspects of the enterprise and must change the way its people plan, make decisions, and perform work. In short, the University must transform itself into a modern organization where information is viewed as an asset and used to strategic advantage.

As an initial step in this transformation, the Senior Vice Chancellor for Business and Finance conceived an approach in August, 1992, and initiated the Information Architecture and Process Innovation Project in February, 1993. The project was headed by a senior faculty member and staffed by an advanced graduate student and three staff members taken from their normal responsibilities for the duration of the project. The team distributed its final report to the University community in June, 1994. The project staff defined the following mission:

- Design an architecture for the University Information System (UIS) that will provide a framework for making decisions about information systems and for improving the UIS in the future;
- Establish a methodology for business process reengineering using the UIS; and
- Develop a plan for migrating from the current systems to the envisioned UIS.

The architecture will provide an overall, high level design for the UIS, identifying scope, direction, components, relationships, and behaviors. Understanding and intelligently deploying information technology in compliance with the architecture will, in turn, play a crucial role in successfully reengineering the University's business processes.

Key Elements of the Project's Approach

The Information Architecture and Process Innovation Project employed a methodology that combined information engineering with business process reengineering. These two components have a symbiotic relationship - the information processing technology empowers users and customers to reengineer business processes, and the reengineered processes determine the need for the information technology.

The project began with the articulation of a philosophy and set of architectural principles. The creation of the University Information Systems Philosophy Statement directly involved over 100 faculty and staff. The statement was debated in three formal focus groups that were specifically configured to represent all constituencies in the University. It was also published in the *University Times* and in several electronic bulletin boards. Through this process, the philosophy statement was refined to reflect the desired goals and directions of the entire University community.

Because of the broad scope of the envisioned University Information System, it became clear that its implementation would have to be phased in over several years. Consequently, when choosing an implementation strategy, the project team eschewed the traditional master plan in favor of a pattern-based approach to building the information architecture. This methodology was inspired by the Oregon Experiment[1], a highly successful approach used over the past 20 years in designing the University of Oregon campus. The methodology recognized many parallels between the architecture of towns and buildings and that of information systems.

In a pattern-based approach, the architecture is documented in a set of patterns, or information processing principles. Decisions about developing, modifying, or acquiring components of the architecture are made by evaluating proposals based on their adherence to the specified patterns. The patterns are subject to on-going review and refinement to ensure that they incorporate advancing technology and continue to meet the needs for which they were designed. The information architecture will evolve as more and more projects are implemented that comply with its specifications.

The patterns must be communally designed and adopted, and will guide the design of everything in the University Information System. Patterns can be both very large and general, as well as very small and specific. Some general patterns deal with the behavior of computer interfaces, some with the distribution of data, some with hardware configurations, some with network protocols, and others with data access methods. More specific patterns deal with report formats, application-specific functions, ordering of data on displays, etc.

The use of a pattern-based approach prevented the project staff from being overwhelmed by the volume of small details necessary to implement a specific task for a specific function for a specific application. Such details are better addressed using prototyping techniques at design time, not at the architectural phase of an information system. The project staff therefore developed a set of common information processing tasks based upon a series of interviews and an analysis of user requirements. The architecture is a response to these patterns of information use across all University activities and related processes which are found in every application.

The architecture project staff preferred to recommend guidelines that could be implemented using state-of-the-practice technology and reasonably cost efficient methods. For this reason, many of the principles espoused in the architecture statement were illustrated through a set of prototype applications that would serve as "proof of concept" and validate the premises put forth in the philosophy statement.

The architecture staff completed four major prototypes during the life of the project. The prototypes illustrated several information processing tasks (patterns) that had been articulated in the architecture statement. For example, a ***finder***, is used to identify an object in the database that the user wishes to view. A finder prompts the user for information that could either uniquely identify the desired object, or identify a list of objects. If the search results in more than one object, the prototype would generate a ***browser***. A browser provides a list of objects, with enough information to allow the user to select the exact object to be viewed. Finally, a ***viewer***, displays the object. The viewer is typically segmented into pages or scrolling sections to allow all attributes associated with the object to be viewed without invoking additional transactions. Viewers also provide "hot button" links to other associated viewers and functions.

One of the premises of the architecture is that these three patterns, among many others, would repeat over and over again in different applications, with only the specific data elements changing from application to application. For example, a student finder would prompt for an ID number, but also allow a search on name; a purchase order finder would prompt for PO number, but allow a search by account number, user, vendor, and commodity; and a course section finder would prompt for term and course reference number, but allow a search by subject, number, and campus. If all of the University's business applications were constructed from such recurring patterns, it would be easier for users to master the interface and seamlessly move from one application to another.

In addition to creating prototype applications to illustrate architectural principles, the project staff completed a pilot business process reengineering effort to test the process innovation methodology they had developed. After identifying all business processes in the enterprise, the project staff selected the procurement process. A reengineering team, composed of a representative cross section of faculty, staff, and others, redesigned the procurement process in six months.

Information Architecture Philosophy

The philosophy and related principles provide a framework for the information architecture by articulating the objectives and quality characteristics that the architecture should follow. These, in turn, are intended to guide the analysis, design, and decisions made relative to all aspects of information systems and processes at the University. They determine the technological approach taken in defining components of the architecture and how they must operate, and are meant to provide a set of patterns by which information system design decisions can be made. Some of the key components of the UIS philosophy include:

- Regard and manage information, information technology, and infrastructure as University assets.
- Capture data one time, at its source.
- Enable organizational units and individuals to share information by making data and documents visible via seamless interconnections and adherence to database standards.

- Assure the quality of information (timeliness, reliability, and accuracy) via a centralized data and document administration function with established data ownership and stewardship policies.
- Reduce the manual effort and paper required to perform information processing activities.
- Facilitate flexibility and ease of adapting to changes in policy, to incremental improvements in processes, to specific needs of local units, and to advances in technology.
- Guarantee choice via a systems environment that is open technologically, operationally, and commercially.
- Utilize the client/server model as the basic paradigm for applications in the UIS.
- Implement a common graphical user interface (GUI) for all business applications. The common GUI will provide a consistent look and feel across all applications, be easy to learn and use, be intuitive and consistent with the standards relative to its particular platform, and enable easy transferability of skill from one application to the next, facilitating substitutability of personnel across applications.
- Ensure effective use of information technology via education and training.

Architectural View

To its users, the UIS will appear as a single set of applications automating the information processing activities the user performs. All activities will involve a familiar set of information processing tasks, each with a standard interface. The system will create the illusion that all data is stored and processed at the user's location.

The UIS architecture will be distributed and layered. Eventually, all applications will be constructed and integrated using foundation software, including a data management system, common utilities, a user interface library, and network services. Each will conform with emerging industry standards for distributed information systems. Such standards facilitate the use of common tools such as spreadsheets and statistical packages, facilitate electronic data interchange with organizations outside the University, and promote independence from individual vendors.

Architectural Layers

Philosophy and Principles	Desktop/Client Interface Layer	Organizational Structure and Responsibility Model
	Application Layer	
	Data and Document Management Layer	
	System and Network Management	
	Platform Layer Hardware, System Software and Networks	

The ***desktop/client interface layer*** addresses the end user's window to the world of information and information technology. An interface library will allow an application to interact with a variety of interface devices. Applications will obtain interactive input and present interactive output through routines in the user-interface library. Consistent use of library routines will standardize the look and feel across UIS applications.

The ***application layer*** addresses the software used to support processes within the University. A set of common utilities will provide applications with consistent services common to most UIS applications. Use of the common utilities by all UIS applications will help standardize the way users perceive and perform activities, and will reduce the effort required to create and integrate applications.

The ***data and document management layer*** will standardize the description, storage, and retrieval of all UIS data. All applications will access data through services provided by the UIS data management system. Furthermore, applications will use the data management system to determine whether a user has privileges to perform activities.

The ***system and network management layer*** will facilitate the management of the configuration of computer processors, networks, software, access devices, data storage devices, and other devices, like any other assets within the University. This layer addresses the functions of monitoring, scheduling, controlling, configuring, licensing, upgrading, problem solving, and recovering from abnormal conditions or failure.

The ***platform layer*** addresses the hardware, system software, and networking components of the architecture that support applications and user access to information system resources. This view of the information architecture provides an overall framework for the infrastructure necessary to accomplish the objectives of the other architectural components and provides a basis for determining hardware and system software acquisitions.

Until the architecture is fully implemented, existing systems and commercial packages will be evaluated on their ability to meet functional needs, their compatibility with UIS data management and network standards, and the ease of integrating them with the UIS interface library and common utilities.

Process View

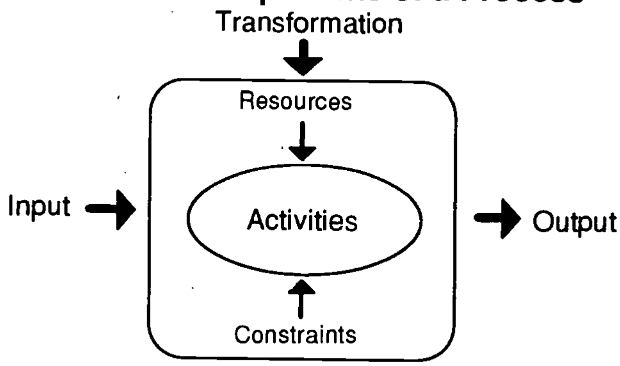
The University's work activities are currently organized around functional units, and the organization can be viewed as a series of vertical organizational structures. All activities are based upon this set of vertical compartments. The current information systems are also organized in this manner, as is all the information technology used to support the work of the University. This traditional organizational structure is not unlike organizational structures found in other industries. Work activities organized around such functional organizational structures are commonly characterized by inflexibility, unresponsiveness, the absence of customer focus, an obsession with activity rather than result, bureaucratic paralysis, lack of innovation, and high overhead.

Current processes, such as the procurement process, are long, convoluted assembly lines that are plagued by inefficiencies, delays, excessive paper, multiple levels of authorizations, errors, lack of access to information and customer dissatisfaction. Personnel are specialized, lack adequate access to electronic information and spend too much of their time on work flow and paper flow issues. Processes are badly in need of significant reductions to the costs of delivering services and radical improvements to the quality of the services delivered.

One of the ways to begin addressing these characteristics is by viewing the organization as a set of processes instead of individual functions. Once natural processes are identified, we can then focus on how well all activities in the process support the process outcome and how well the process outcome helps the University to achieve its goals and objectives. Morris and Brandon[2] state that process can be viewed as the essence of business. Not only is most work accomplished through processes, but a great deal of what differentiates organizations from each other is inherent in their individual work processes. This seems perfectly reasonable, since the same raw materials and human capital are available to every organization. Process is therefore one of the most important factors contributing to competitive advantage. However, despite the importance of process, it seems to have been largely ignored by management theorists and managers themselves.

A process is a logical and finite set of observable, interrelated (or hierarchical), work activities utilizing *input*, that when performed in a pre-defined series, produces *output(s)*. Processes have internal and external customers, and are independent of an organization's functional boundaries. Output is generated by a *transformation* of the input(s). As displayed in the figure below, activities are limited by the resources available to work activities, and the constraints imposed by mandates (policy, laws, and regulations).

General Components of a Process



The Information Architecture and Process Innovation Project identified four general clusters of processes (shown below) and defined the processes and components related to each cluster. The flow through a process represents the data and documents that enter into and exit from the activities for a process. Each of the processes have a set of sub-processes which act as threads of inter-related activities. These process clusters represent the workflow of the University and the services provided by administrative systems to support the mission of the University. The focal point of these processes is the set of customers that the process is intended to support. The data and document processing required to provide service to customers must be supported by the information architecture.

Process Clusters

Educational Support	Research Support	Patron Support	Administrative Support
Processes	Flows Events	Activities	Outcomes
	Customers		
Constraints	Resources	Transactions	Triggers

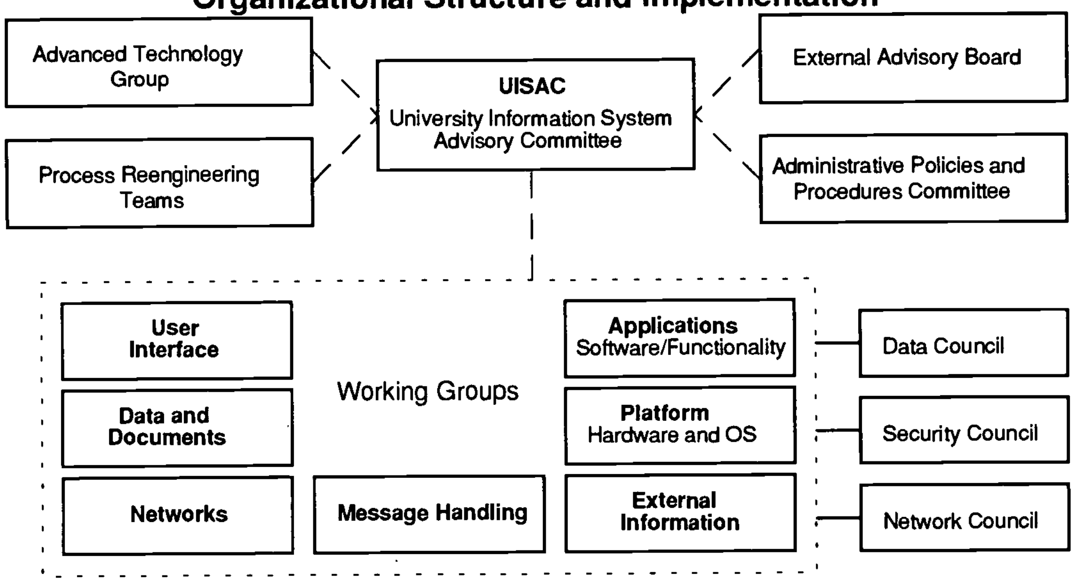
In their seminal work, Hammer and Champy[3] define reengineering as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed." In order to make dramatic and meaningful improvements, an organization must identify and take a fresh look at natural "beginning-to-end" processes. Reengineering means starting over and asking why we do what we do. The purpose of process reengineering is to make the processes as streamlined as possible and provide a high level of service to customers. Part of the streamlining requires the use of information technology to permit sharing of data, parallel activities, increased responsiveness and improved quality.

Transforming the University

Three organizational units will play a prominent role in the implementation of the proposed architecture and process innovation initiatives. The first, an advisory committee, will be formed to provide overall guidance, direction, and priority setting. The second, an Advanced Technology Group, will be formed to investigate and implement emerging technologies, as well as to develop the technical capabilities for staff in AIS. Finally, AIS will assume the ongoing responsibilities of the Information Architecture and Process Innovation Project, ensuring that the architecture evolves and grows with changing technology and that the process reengineering efforts are related and refined.

The basic organizational structure proposed for policy formation and implementation of the information architecture centers around the creation of the University Information System Advisory Committee (UISAC). The UISAC will be composed of representatives from the University community, including academic units, administrative units, regional campuses, AIS, the Board of Trustees, and one outsider. The UISAC will report to the Senior Vice Chancellor for Business and Finance.

Organizational Structure and Implementation



The UISAC will be given responsibility for creating an enterprise-wide business and information system strategy, and for making policy and funding recommendations for information system and reengineering projects proposed by academic and administrative unit design teams and by AIS. The rationale behind the formation of the UISAC is the strongly felt need for a consistent and coordinated approach to the University's administrative information systems and information technology infrastructure, and the policies, tools and techniques required for their development as well as the coordinated implementation of the information architecture and business process reengineering initiatives. The focus must be on technology supporting business and its customers. The UISAC will be a major agent of change and, as such, needs to create an environment of trust, and demonstrate effective planning and committed leadership.

One of the critical elements for any information systems organization in this age of rapid technological development is to develop and retain a staff trained in the use of new and productive technologies and techniques. The recommended approach to this issue is to form an

Advanced Technology Group whose function is to develop applications using the newest technologies and techniques available on a prototype scale. This group could attract faculty and advanced students to work with AIS personnel on projects that are developmental in nature but have a potential payoff for the University. Such a group could also begin to attract external funding as well as become a beta site for hardware and software vendors.

The information architecture will be implemented through a project approach. Projects will be proposed by project design teams that are formed within the administrative and educational units of the University. The design teams for projects may be reengineering teams, or they may be smaller incremental improvement project teams. The teams will propose projects in accordance with detailed guidelines that ensure they will be aligned with the information architecture. This project approach is preferred over a master plan approach in order to avoid the problem of plan obsolescence typically associated with large master plan implementations.

The project design teams will present their project proposals to the UISAC, which will review the proposed projects and recommend revisions as necessary. Project proposals submitted for funding will be described using a pattern language and will contain an environment section, a functional section, a performance section and a budgetary section. The decision to fund projects should be based largely on their adherence to the architectural patterns.

This approach is similar to that taken at the University of Oregon and found to be quite successful in designing and building the campus over the last 20 years[4]. The following set of principles is modeled after the Oregon Experiment:

- Organic order: The planning and implementation of the information architecture will be guided by a process that allows the whole to emerge gradually from local implementations, guided by the proposed information system philosophy and structure.
- Participation: All decisions about what will be built, and how it should behave will be in the hands of the users at various levels. This is based on the assumption that users help shape the environment, know their needs best, and can define the qualities of the information system required to satisfy their needs.
- Piecemeal growth: Piecemeal growth hinges on dynamic and continuous growth. Therefore, the UISAC will distribute funds for small, intermediate and large projects equally. Funds must be made available without an overwhelming amount of specific, low level details, since resources consumed attempting to determine low level details could be better spent on implementation.
- Patterns: All design and implementation will be guided by a collection of communally adopted design principles, called information processing patterns, that will guide the design of everything.
- Diagnosis/Evaluation: The well being of the architecture and the envisioned information system will be protected by an annual diagnosis/evaluation system that will explain, in detail, which information system activities are alive and which are dead, at any given moment in the history of the system.
- Coordination: The slow emergence of organic order in the whole will be assured by a funding process that regulates the stream of individual projects put forth by users. The use of a standard template to fund projects, describe projects, describe patterns of information processing, perform diagnosis and estimate costs will aid in prioritizing projects.

The design team concept takes advantage of the expertise available across the University and permits multiple views of the information system project, consistent with the notion that partnerships produce a better design in a more cost effective manner than if any one of the team components attempted to implement the project alone. It also leverages the knowledge of the unit's needs, the specific knowledge of the local unit's information system and the knowledge that AIS personnel has of the University's central systems.

There is a need to define the roles and responsibilities of AIS personnel, Information Systems (IS) owners and IS coordinators, local unit technical personnel, end-users and management. One scenario for this definition of roles and responsibilities is:

- Managers have the responsibility to assemble design teams for projects and to provide release time for design team members to work on the information system projects being proposed.
- End users have the responsibility to identify requirements for information system services, products and features known to the design team in a timely manner and in a form and format that is understandable to them.
- Local unit technical personnel, IS owners, and IS coordinators act as information system design team members, local system implementors, local system managers, local application developers, and local end user consultants and trainers.
- AIS personnel act as technical consultants and design team members for implementing information system projects. AIS may also act as application developers for both the client and server sides, as well as act as IS suppliers and IS operators.

All proposals must indicate what University and other standards are being utilized as part of the project. If proprietary products are being used which do not adhere to an open systems architecture as proposed by the IA, then a rationale must be provided as to why a closed system product or approach is being used.

Summary

The Information Architecture and Process Innovation Project determined that the current University administrative process environment can benefit from drastic improvements in quality and efficiency by employing the methods available through process reengineering. The project also determined that modern information processing technologies and systems are required to support the flexibility, rapid response time and information access requirements needed by end users to perform their work, deliver quality services and make informed decisions.

The implementation strategy is driven by business process reengineering projects, but, at the same time, these new system implementation projects must be balanced with projects to improve access to information using the current systems. The implementation strategy is based upon process owners, system owners and end user initiatives for projects that follow the architectural principles and the natural relationships between activities of a process and the inter-relationships between and among processes.

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[1] Christopher Alexander, The Oregon Experiment (New York: Oxford University Press, 1975

[2] Daniel Morris and Joel Brandon, Re-engineering Your Business (New York: McGraw-Hill, Inc., 1993) p. 38

[3] Michael Hammer and James Champy, Reengineering the Corporation: A Manifesto for Business Revolution (New York: Harper Business, 1993) p. 32

[4] Christopher Alexander, The Oregon Experiment (New York: Oxford University Press, 1975)

A Distributed Computing Architecture and Transition Strategy

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The UC Davis Information Technology Strategic Plan acknowledges the value of a distributed client/server computing environment to the campus and the need to provide a supporting infrastructure. However, the decentralization of computing also requires a complimentary level of campuswide standards, centralized services and support infrastructure to ensure a reliable, coordinated and interoperable campuswide computing environment in which institutional information is readily accessible as well as secure and well managed.

The UC Davis Information Technology Division demonstrated its commitment to open distributed systems by creating a new department to serve as a campus resource and to provide the staff to develop new infrastructure services. As its first order of business, the Distributed Computing Analysis & Support Department spearheaded efforts to transition existing IT systems to open systems in the Summer of 1993. An open invitation was sent to the campus to attend a two day seminar on Project Athena given by Jeff Schiller from MIT. This conference provided a practical overview of the issues of distributed computing in an academic setting and provided a forum for discussing the key issues associated with implementation, operations and maintenance of systems in this environment. It also served as a way to coalesce a broad based group of technical staff from many departments to work on a campuswide statement of the distributed computing architecture.

This paper provides an account of the U.C. Davis experiences in defining the distributed architecture at U.C. Davis, developing a transition plan for existing systems and the results of the first year of implementing new infrastructure systems as part of the transition.

The University of California, Davis (UCD) has established a new department and distributed computing architecture statement to begin creating the infrastructure and support needed for a fully distributed computing environment. The new department, Distributed Computing Analysis and Support (DCAS), is part of Information Technology and is the result of a campuswide strategic planning process and reorganization to meet the changing needs of the campus community. This article describes the role of the new department, the distributed computing architecture that has emerged and the first year of experience implementing new systems within this framework.

Strategic Planning and Reorganization

The U. C. Davis strategic plan, completed in December 1992, "Creating a New Information Technology Reality: Strategic Directions for the Campus," defines new directions for computing which we expected to affect our strategy for the deployment of technology, but which also included several tasks related to funding models that, as we found out later, had a significant impact on the way we would approach the development of our distributed computing architecture. The components of the plan that affect our decisions the most are:

- Establish a dynamically-responsive structure to support a distributed information technology environment, blending centralization and decentralization in an effective manner. Strengthen the Information Technology (IT) organization's role in centralized coordination of decentralized resources. Provide centralized leadership and support for campuswide activities which are common to multiple units or constituencies.
- Assist units in the development of technology plans, and develop campuswide plans to complement and enhance unit plans.
- Advance the use of collaborative information technologies, including electronic mail, telecommunications, bulletin boards, conferencing systems, and public information networks.
- Provide a base level of service, funded centrally by a campus allocation "off the top," at no visible cost to the individual user or department, including support for student instruction and access to administrative systems and databases required to perform one's assigned duties, e.g., student, financial, payroll, personnel systems.

The tasks listed in a strategic plan should not dictate any particular organizational structure and this was the case at UC Davis. Initially we envisioned these tasks being handled within existing organizational units charged with academic or administrative support. However as tactical plans were developed, it was decided that a dedicated unit was needed to provide the level of service and attention this new infrastructure requires. A small unit was created to focus on these issues.

Distributed Computing Analysis and Support

The new group, Distributed Computing Analysis and Support, is staffed by experienced programmers and analysts from many areas of Information Technology. This group can be described as a combination of two categories of advanced technology groups described by Gartner Group's Bill Caffery and summarized by Megan Santosus in a 1994 CIO article[1], "The Guerrillas" and The Navigators". Their role is to identify technologies that can be leveraged throughout the University, but they focus on serving departments with solutions that work immediately. Initially, the staffing of DCAS was based upon the interest of the staff members to work in the area of distributed computing infrastructure. When creating the group, we placed the highest value on experience in creating campuswide solutions and less on the specific area of expertise, such as academic or administrative information systems. In retrospect, we've found that the range of experience found in the DCAS team is important to creating these services and their rapid deployment.

The mission of DCAS includes the following:

The Distributed Computing Analysis and Support group surveys technologies relevant to mission critical information systems in the context of the Information Technology Strategic Plan, designs new systems of widespread campus use and assists in their transition to fully operational support systems. Major areas of activity include:

- Coordinate the implementation and interoperability of campuswide distributed computing infrastructure and support systems.
- Identify the critical components of networked systems and their relationships and develop reporting, management and problem resolution systems to ensure an optimum balance between reliability, performance and cost.
- Design, plan and support networked systems architectures and applications.
- Research and report on advances in technology that will have a substantial effect on campus computing services in the next three to five years.
- Research key computing developments and chart strategic directions for network systems architectures.
- Design, test and implement new systems in established and newly identified strategic areas as appropriate.
- Coordinate the technical strategic planning process for the Campus with full participation by broad-based campus constituencies.

It is important to note that the DCAS mission specifically refers to implementation , not just design and planning. From the beginning, members of the team have taken responsibility for the smooth operation of production systems through first hand

[1]Megan Santosus, "Down to Earth," CIO, April 15, 1994, p 54.

experience, no matter which department might ultimately manage the services. The group feels that this experience is important to the creation of robust services that are easy to manage.

DCAS also strives to obtain full participation by broad-based campus constituencies in the technical strategic planning process to ensure technical directions identified through this process are relevant to the computing needs of the campus and adopted campuswide. This was the approach that was taken when DCAS initiated the strategic and tactical planning for the campuswide distributed computing architecture.

A New Direction

The strategic value of open systems to Universities has been clearly demonstrated in the use of open internetworking protocols and this concept now generally extends to all aspects of computing. The commitment to open systems within a University is not a difficult decision to make. Deciding how to make the transition is much less clear.

As its first order of business, the Distributed Computing Analysis & Support department spearheaded efforts to transition existing IT systems to open systems in the Summer of 1993. An invitation was sent to the campus to attend a two day seminar on Project Athena given by Jeff Schiller from MIT. This conference provided a practical overview of the issues of distributed computing in an academic setting and provided a forum for discussing the key issues associated with implementation, operations and maintenance of systems in this environment. It also served as a way to coalesce a broad based group of technical staff from many departments to work on a campuswide statement of the distributed computing architecture. This resulted in a working document, "The UC Davis Distributed Computing Environment 1994 - 1995" which provides an overview of the existing computing environment and charts the course for then next two to three years.

The architecture chosen by UC Davis is very similar to that reported by Arizona State University in the Summer 1994, CAUSE/EFFECT.[2] The architecture is summarized in the following table.

[2]Neil Armann, L. Dean Conrad, Darrel Huish, and Bruce Millard, "Developing a Distributed Computing Architecture at Arizona State University," CAUSE/EFFECT, Summer 1994, p 12.

Architectural Component	Standards	Initial Products	Future Products
Distributed Logic	OSF/DCE RPC	Use proprietary RPC from DB manager or TP monitor until 1995	OSF/DCE RPC
Name Service	DNS - Domain nameservices, CDS	DNS generally available through hardware and software vendors	DNS, CDS
Print Service	OSF/DCE Print Service	TCP/IP, LPR/LPD	DME Print Service
File Services	OSF/DCE Distributed File System	Transarc Andrew File System (AFS)	OSF/DCE Distributed File System
Time Service	OSF/DCE Time Service	Internet Network Time Protocol	OSF/DCE Time Service
Security	OSF/DCE Security Service, Enigma Logic one time passwords, RSA public key	Version 5 Kerberos server, ftp Software, Inc. DOS/MS-Windows clients. Enigma Logic gold card.	OSF/DCE Security Services, Enigma Logic gold card, RSA public key.
Operating System/Graphical User Interface	DOS/MS Windows, Mac/System 7 UNIX/Motif	DOS/MS Windows, Mac/System 7 UNIX/Motif	
Database Management	SQL	Oracle, Sybase	Oracle, Sybase
Electronic Mail	Simple Mail Transfer Protocol (SMTP) with MIME extensions	SMTP	SMTP with MIME extensions
Campuswide Information Systems	Gopher and World Wide Web	Gopher and World Wide Web	World Wide Web
Calendaring	None	Departmental use of Oracle Office, Microsoft Office and Meeting Maker	None

Working within the new framework, we then reviewed the OSF/DCE products for distributed computing and the Project Athena environment to begin the development of a tactical plan for the deployment of services. It was immediately clear that the OSF/DCE products were incomplete and too immature for deployment in a production environment. Our alternative environment, Project Athena, provided the most cohesive interim solution while OSF/DCE products were under development, but the tight integration of services did not accommodate a staged campuswide deployment. Given the lack of a comprehensive suite of products, we then decided to develop a tactical plan that would provide solutions to immediate problems but position us well in our transition to standard products. Our analysis of the standards and systems in place showed that in all of the distributed infrastructure development, databases of information on networked entities, people, devices and services, were central to the interoperability of infrastructure services. We concluded that efforts which began to assemble this data, create a uniform name space and automated its creation would be the best way to prepare for the development of new services.

We then began evaluating our highest priority for service development under this new strategy. Our most pressing problem during this time was a side effect of one of the strategic plan tasks:

- Provide a base level of service, funded centrally by a campus allocation "off the top," at no visible cost to the individual user or department, including support for student instruction and access to administrative systems and databases required to perform one's assigned duties, e.g., student, financial, payroll, personnel systems.

This task required the accommodation of every student, faculty and staff member on centralized machines in accessing a base level of service including electronic mail, the campuswide information system and administrative services. Access to many of these services will also require a higher level of security such as that provided by Kerberos. The type of data and functionality needed to support these services had already been refined in one environment through Project Athena. The Moira database system provided us with a good example of how this type of service might be deployed. Using this model we began the development of our local system with the following design goals:

- All University affiliates will have access to computing resources and a base level of services as soon as administrative records reflect their association with the University.

- The system must be platform independent and support the creation of accounts on any computer system.

- The system must be as close to paperless as possible.

- The database must be automatically maintained through normal administrative processes.

- The system must be designed in a highly modular fashion to accommodate the transition to DCE products as they become available.

We chose Oracle as the relational database management system for the new directory service because, as an SQL database it conforms to our stated architecture, UCD has a campuswide site license for the product and there is a great deal of local expertise to support it. However, a conscious decision was made to use it as a database engine only and not to use any vendor specific features that might restrict porting the application to another platform in the future.

Work began on August 12, 1993 with two full time programmers on the project and the need to have a baseline system operational by September 14, 1993. The use of Project Athena's Moira as a model for database design and functional requirements helped us minimize the early phases of planning and design and move directly into development. A new database was created and populated with data from the Student Information System and the Payroll/Personnel System. The new database was designed by Larry Johnson, a programmer with extensive experience working with our administrative systems. Working closely with systems administrators for the U. C. Davis Unisys A11, the U. C. Davis Sequent S2000 and the U. C. Office of the President IBM 3090, Larry coordinated the creation of data extracts and file transfers between legacy systems and the Oracle database. In parallel, Dan Dorough, a programmer with extensive experience working with Unix based networked systems, began working with systems administrators for the academic systems to automate account creation by extracting data from the Oracle database and linking it to the account creation mechanisms on Unix and VMS machines. The two systems were then merged together and on September 14, 100 medical students registered their accounts online using the new system. By October, the new system was managing account creation on all of the Information Technology and Electrical and Computer Engineering central systems and only special requests for accounts required a written request and manual data entry.

The Year End Report

Goal: Complete the tasks outlined in the strategic plan

Last year, during the first week of classes, we automatically registered 200 accounts and continued to add a total of 12,000 accounts during the year. This year, we automatically registered 1,780 accounts during the first week of classes and we are continuing to see a steady rate of account creation at about 300 accounts per week. All of these accounts are accessible within 24 hours of activation and provide our customers with online access to electronic mail through Pine or exchanges using the Post Office Protocol (POP), Gopher, the World Wide Web and all other standard Internet utilities. The account creation system will soon be tied to our Student Information System and is planned for use by the Financial Information System under development. The new system is a success, providing a mechanism for accomplishing the strategic plan task of providing a base level of service to all students faculty and staff.

Goal: Create an infrastructure service aligned with developing standards

The decision to create directory services that support the creation of infrastructure services has also proved successful. The structure of the database system is supporting a proprietary method of account creation, but it also allows us to extend its support to other infrastructure services such as Kerberos and eventually DCE Security Services, mail routing through aliasing and online directory services through Whois, Gopher and the World Wide Web. Several processes that were previously manual have been automated providing cost savings and improved customer service.

During the past year we have used the same model to create a database of network devices that automatically generates configuration files for the domain name system. It is expected that this database may eventually be extended to support version control services for client applications.

Conclusion

The creation of a separate unit within Information Technology to support the distributed computing infrastructure has worked well at UCD and provides us with the resources to respond quickly to the needs of the campus. Our tactical plan of creating infrastructure services with the tools available today, but aligned with emerging standards is allowing us to move forward in a staged deployment, but without wasted effort. However, the most significant contribution to our ability to respond quickly was the mix of experience found in the DCAS team. The team working on this first directory service project combined the talents of a staff member with extensive experience supporting centralized networked systems and a staff member with extensive experience supporting administrative applications on mainframe systems. In retrospect, it was this combination of talents that ensured the success of the project. While neither programmer had previously worked with Oracle, Project Athena or OSF/DCE products, based on their years of experience in providing central services, they were able to quickly understand the technical details of those systems and assess their role within a developing distributed computing environment. Even more important was their understanding of existing computing systems and their ability to work with systems administrators to link the old systems with the new. Finding staff with this combination of experience, flexibility and the ability to bridge the established and emerging technologies is the critical success factor to the smooth transition between centralized and distributed computing environments.

GETTING THE RIGHT FIT: INSTITUTIONAL DOWNSIZING WITHOUT CAPSIZING

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ABSTRACT

Downsizing and rightsizing are buzzwords that have gained much acceptance in current computing literature. Can mainframes be replaced with high performance clusters of workstations? That is a question many computing center directors are asking, as high-end workstations eclipse the capabilities of traditional mainframes. At Lehigh, we have found that the answer, at least for us, is "Yes".

Lehigh University has undergone a dramatic change in its computing environment over the last three years. Starting in 1991, Lehigh eliminated its three academic mainframes, introduced more than 150 workstations, installed compute and file servers, and introduced software to make this combination act as a unified computing system. The result has been much greater computing power, all financed from existing funds.

LEHIGH OVERVIEW

Lehigh University is an independent, academically selective, comprehensive university (4500 undergraduates and 2000 graduate students) which has been described by Lehigh's president as "small enough to be personal, yet large enough to be powerful". Lehigh has four colleges: Arts and Science, Engineering and Applied Science, Business and Economics, Education, and also 35 research centers and institutes. In 1990, Lehigh's primary computing environment consisted of a CDC Cyber Model 180 purchased in 1985, a DEC Vax 8530 purchased in 1987, and two IBM 4381's purchased in 1986 and 1988. The IBM mainframes provided administrative support and support for Lehigh's Campus-Wide Information System (CWIS). Lehigh had also implemented a small workstation site with Sun workstations and provided over 300 microcomputers in public sites. By 1994, this environment had been transformed into a mainly Unix environment supporting IBM RS/6000s running AIX with three of the existing mainframes removed and over 150 RS/6000s placed in public sites. Lehigh has installed three distinct server clusters to serve the requirements of the user community. A cluster of RS/6000s has been designated as compute servers and consists of two IBM RS/6000s, models 990 and 580. Another cluster is designated as network servers which support the needs of our CWIS and consist of IBM RS/6000s models 990, 980, TC10, and 560. Three RS/6000s have also been designated as AFS file servers to provide file services for the 150 distributed workstations. Along with this increased computing power, Lehigh's microcomputer support requirements have continued to grow with over 350 public machines and thousands of other microcomputers appearing on campus. It should also be noted that some administrative applications have been moved to RS/6000s though most of them are still running on the remaining IBM 4381.

Lehigh's high-speed networking activities have also been an integral part of our downsizing plans. In 1985, Lehigh installed a totally digital, non-blocking PBX providing voice and low-speed data connections (19.2 Kps). Data connections were provided everywhere including classrooms and student living units. Lehigh has since expanded its networking capabilities to include a high-speed fiber optic backbone supporting FDDI data rates of 100 Mbps. All of the Computing Center's sites are connected to the high-speed backbone along with most of the campus buildings. Most of the subnets connecting to the backbone are 10 Base-T ethernets with the exception of public sites. These were the first sites networked and were wired with thin ethernet. Connections to the residence halls were started in the fall of 1993 with plans for completion by fall, 1995.

CATALYST FOR CHANGE

The major catalyst for changing Lehigh's computing environment was the development of a five-year strategic plan for computing and communications. This plan was developed in the spring of 1990 and finalized in 1991. The plan called for the removal of all academic mainframes. It also specified the transition to a Unix environment. At that time, the Computing Center was supporting the following operating systems: CDC NOS/VE, DEC Vax VMS, IBM VM/VSE, IBM VM/MUSIC, and the Apple Macintosh and MS/DOS Windows environments. The plan recommended a phased approach with the removal of the academic mainframes and an upgrade to the Administrative IBM 4381. Administrative applications were to be migrated to the workstation environment at a slower pace than were the academic applications. The Vax 8530 and CDC Cyber 180 were to be replaced by a compute server. RISC, vector, and parallel machines were investigated as possible replacements. Another key aspect of the plan was the requirement to implement a common database throughout the campus. For this, the Oracle database was chosen and was used as the basis for replacing the CWIS running under the MUSIC operating system on the IBM 4381 mainframe. Other key components of the plan were the funding of distributed servers for academic departments (with research departments providing their own funding) and the financing of all these changes with existing funds.

IMPLEMENTATION STRATEGIES

A typical university implementation strategy was taken to plan for the removal of Lehigh's mainframes (i.e., form a committee with an "interesting" acronym). The acronym chosen was CINC (Computer Intensive Needs Committee), pronounced "sink", to enable Lehigh to downsize without capsizing. Often during this process we have had "CINCing" feelings so the acronym seemed very appropriate. The committee was composed of three members from the four colleges and the Computing Center. The first task of the committee was to survey our existing users. Users were queried on software applications, current satisfaction with our systems, possible conversion problems, and the characteristics they felt were needed in a new system. The survey indicated that 84% of the mainframe usage was research

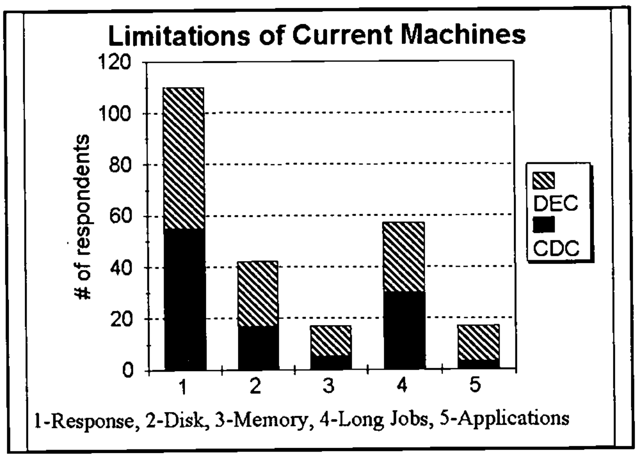


Figure 1

related. Figure 1 illustrates what users perceived as the major limitations of the current machines with response time being the largest problem. Figure 2 shows that users wanted at least 10 times the power of the CDC Cyber with computing speed and better graphics rated as very important features.

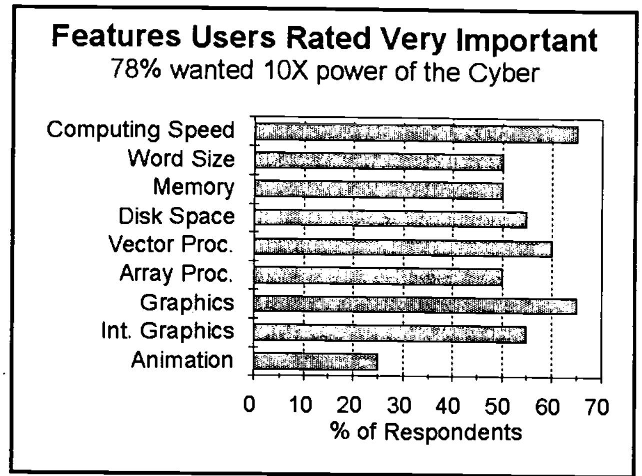


Figure 2

Besides surveying the users of the system, the CINC committee also held an open faculty meeting (with 44 computing intensive users attending) to discuss the five-year plan, the current hardware options, and users' current needs. The result of these activities was a report prepared for the Computing Center Advisory Committee (CCAC). The report stated that: the current mainframes were saturated; researchers had already begun moving to a workstation environment; and high-speed network expansion was critical to the needs of computing intensive users. The final recommendation was that since about 90% of Lehigh's computing power was being consumed by 10% of the users, Lehigh should attempt to provide a computing solution to satisfy this 10%.

The development of a request for proposals (RFP) was the next step in the process of determining an appropriate replacement system. Eleven vendors were originally contacted representing RISC, massively parallel, and vector architectures. Ranking of vendors was based on system capacity, application software, system management, end-user software, and three year costs. Software availability was a major requirement and eliminated three of the vendors. Of the remaining vendors, seven responded to the RFP and were asked to run a set of representative benchmarks. The benchmarks were developed from representative user jobs and ported by the vendors to run on their systems.

The choice of vendors was narrowed to three - HP, CDC, and IBM - based on both the benchmark results and our rankings. During this time, negotiations were also occurring concerning a large acquisition of workstations. An opportunity to work on a development project with IBM was the key factor in Lehigh's final decision to go with IBM and their RISC platform for our replacement solution. The key issues were that the benchmarks were inconclusive when comparing the top three vendors and that IBM offered the best deal financially.

MAJOR TRANSITION ISSUES

CWIS Migration

One of the first issues in replacing Lehigh's mainframes was the migration of Lehigh's current campus-wide information system which had initially been developed on an IBM 4381 running the MUSIC operating system. In 1989, it was decided to move to another platform and work was begun to port the software. A major challenge was designing the system to remain consistent with our existing interface while planning on moving to a client/server platform and an eventual graphical hypertext interface. The IBM 4381, which utilized flat ASCII files that were accessed by a control file, was replaced with a distributed database model using the Oracle database management system on a cluster of RS/6000s.

Lehigh's CWIS provides the following applications to a user base of over 7000 active accounts: electronic mail, bulletin board and conferencing facilities, access to national and international networks, on-line forms and survey processing, fax delivery and retrieval, and an access point for library services. This system is widely used by the campus with 95% of the community using the system on a regular basis. Lehigh's goal of decoupling the user interface from the actual database was accomplished to some degree and recent developments have allowed the client portion of the interface to run using Mosaic and World-Wide Web.

Another important design feature is the concept of "distributed services" encompassing both the management and the location of databases and applications. Data management activities are the responsibility of individual topic coordinators. Topics on the CWIS are fed and nurtured by, and the responsibility of, the information providers. Another aspect of distributed services is the ability to access designated hosts or data directories. Distributed applications are also being explored to allow selected applications to transparently run on another host. The overall goal is to move from a tightly coupled cluster supporting all available services to a more diffuse system. This will allow data and processing power to be distributed to the most appropriate location.

Software Identification and Licensing

Software identification was first done by surveying users and contacting vendors on availability of software. Committees were also formed to identify software which would increase the functionality of the workstations in the distributed environments. Reports were prepared on: desktop environments, graphics/CAD software, text processing, database and spreadsheets, mathematical software, scientific libraries, and statistical software. These reports resulted in obtaining a number of attractive site and floating licenses. The major site licenses obtained were Maple, NAG, and BMDP. Floating licenses were obtained for Matlab, Island Graphics (Write, Paint, and Draw), AutoCAD, WordPerfect, and Lotus. Another major agreement that made the IBM RS/6000 platform very cost effective was IBM's HESC (Higher Education Software Consortium) program. This program dramatically reduced Lehigh's operating systems cost. Lehigh's overall software costs for the CDC Cyber and DEC Vax was $150,000/year, while it is only $130,000/year for the RS/6000s. This is in contrast to the first estimates that had the software costs in the distributed environment at over $250,000/year. Figure 3 illustrates that Lehigh's major savings have been in the area of operating system costs while application costs have been very similar.

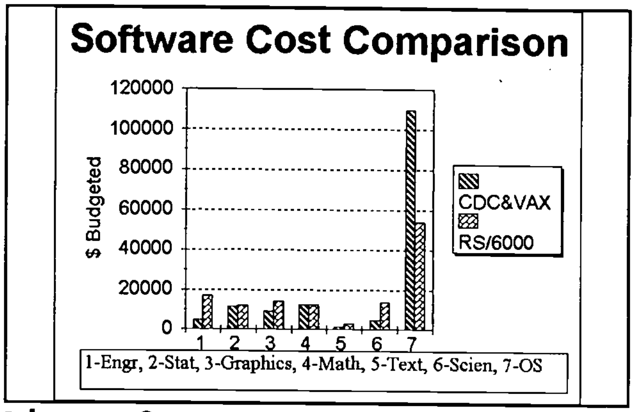


Figure 3

User Training and Documentation

The overall transition to the new environment required a great deal of additional staff and user training and a revamping of practically all the existing documentation. User training was accomplished in a variety of ways with special seminars developed to deal with users' transition problems. These were hands-on sessions which dealt with the new operating environment, and also special conversion problems that needed to be addressed in moving from the NOS/VE and Vax operating systems to Unix. The move from MUSIC to Unix was easier since we kept the same interface in moving from the IBM 4381 to the RS/6000s. Figure 4 illustrates the growth of our Unix-related seminars over this timeframe.

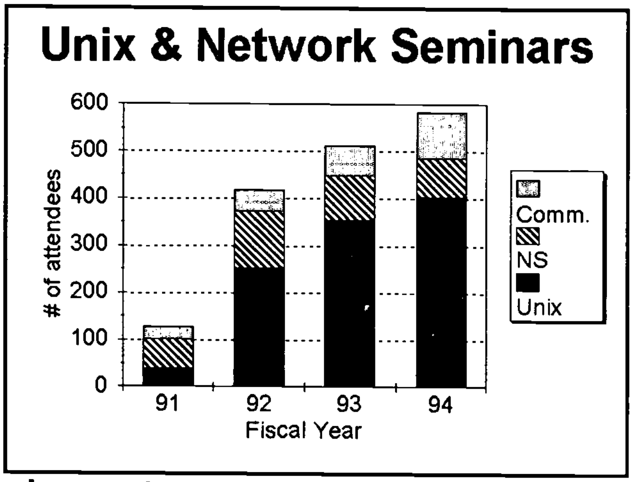


Figure 4

User documentation was and still is a big issue that needs to be addressed in the workstation environment. Essentially, all existing documentation had to be revised or rewritten during this transition period. The Computing Center investigated a number of tools such as IBM's Infoexplorer, utilizing Unix man pages, and possibly creating a searchable WAIS server to provide on-line documentation. Initially, a simple text help file was placed on-line which listed all available commands and where to go for help on running them. The Computing Center has also started to provide all its documentation on WWW; User's Guides, Technical Bulletins, and seminar handouts are currently being converted into HTML documents.

Tape, Program, and File Conversion

The conversion of tapes, programs, and files presented another interesting problem for the Computing Center. Hundreds of tapes resided in the machine room and many of them had been in the tape library for years. Each tape user was sent a list of his or her tapes and also was contacted by students hired to work over the summer to assist with tape conversions. This process went better than expected and many users determined that the data that they had stored for years was really not worth saving.

Program conversion was handled by providing hands-on conversion training sessions and by individual consultation. Back-up sites were arranged to assist with tape and program conversion for users who had problems getting the conversion done. Files were migrated automatically for CWIS users while Cyber and Vax users issued a command that transferred files to individual Cyber and Vax directories on the compute server cluster.

Hardware Maintenance

A major cost issue associated with distributing hundreds of workstations throughout the campus is how to maintain these devices. The cost to provide reasonable maintenance for all of these devices was double our existing budget. Vendors were contacted and proposals were received from each. After analyzing the costs, it was decided to provide self maintenance through our Computer Store with a parts contract from a parts supplier. Critical machines such as the compute servers, AFS file servers, and CWIS servers were kept on vendor maintenance. Figure 5 shows that the overall

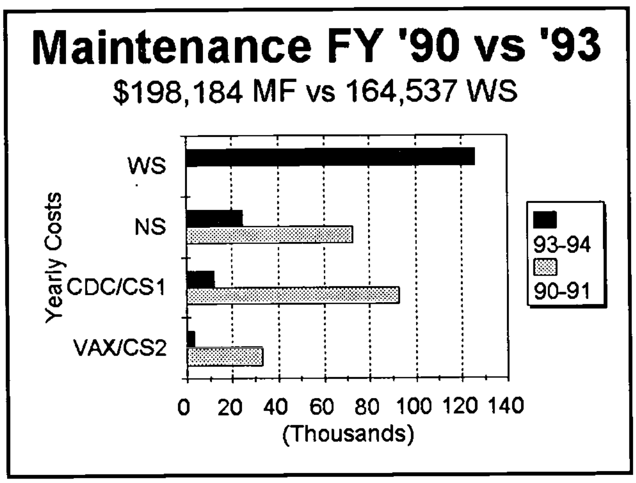


Figure 5

hardware maintenance costs have been reduced by over $30,000/year.

Distributed Support Issues

Once the university entered the agreement to receive the 150 RS/6000 workstations, space needed to be found to house them. Departments made proposals outlining how they would use the workstations, the space they had to house these workstations, and their software requirements. This resulted in the creation of 12 semi-public sites which were to be available to the public when not in use by the departments. Procedures were established for providing support for these sites with each site having a department contact and Computing Center support personnel from Systems Programming, User Services, and Operations. Meetings were initially held to establish the guidelines for support of these sites, and software requests were directed to Lehigh's existing software committee. A minimal set of documentation was provided for each site with the emphasis placed on using on-line documentation for most tasks.

SUCCESSES AND PROBLEMS

The CWIS migration turned out to be a success and problem at the same time. The transition to the new environment went very smoothly with usage growing to new levels. The problem has been that the continual growth has put added strain on the system which has been expanded to three servers and exceeding 10,000 logins a day (see Figure 6). The redesign of the system utilizing Oracle did make the transition to gopher and WWW much easier. Our current implementation allows the CWIS to be accessed through WWW with authentication, but most of the campus is still accessing the system in text-mode using TCP/IP or serial protocols. Microcomputer pop mail programs and workstation mail are encouraged as users become connected to the backbone network. It is hoped that some of this, along with the transition to Mosaic/WWW, will reduce the load on the CWIS servers.

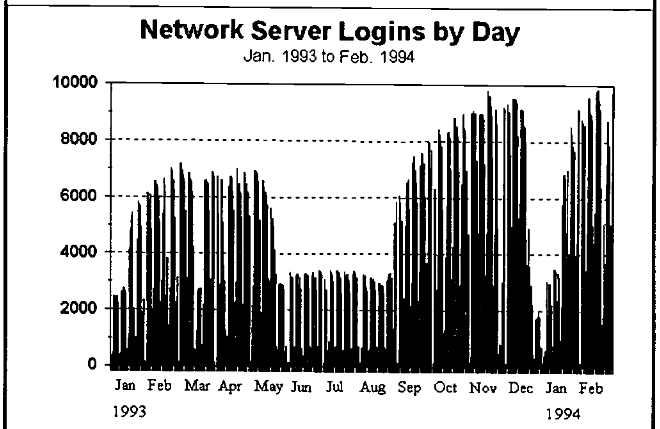


Figure 6

The implementation of the compute servers and the workstations throughout campus has dramatically increased computing usage. CPU usage was compared from the month of May 1991 to the month of May 1993; it had increased from 63,000 CPU minutes to over 1,800,000 CPU minutes. Many researchers have been able to complete tasks that were not possible in the past using existing mainframes. Another part of the equation, however, is that the 90/10 rule for usage which was referred to previously had changed to a 95/5 rule with 5% of the users using 95% of the CPU (see Figure 7). Some reasons for this will be discussed in the next section which shows that the nature of the work being carried out on the workstations has changed from what was previously done on the mainframes. Another success and also a problem has been the use of the AFS file system, which has provided a common userid and password for all of our systems along with support for distributed files and security features. Some serious AFS reliability problems were encountered during the last few years which have been very frustrating to our users.

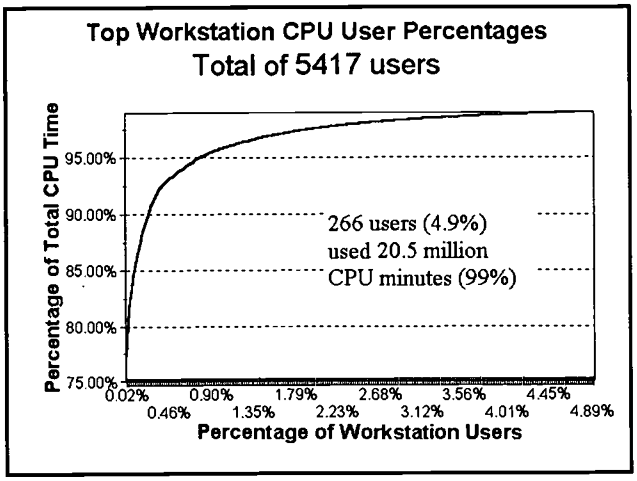


Figure 7

The implementation of the distributed environment has also dramatically increased our disk and tape management problems. As workstation use has grown, disk requirements have increased at a much higher rate than in our previous mainframe environment.
System backups are taking an inordinate amount of time and a project is currently underway to examine hierarchical backup systems. During the transition, our overall disk capacity went from 35 gigabytes to over 100 gigabytes without any sign of this demand stabilizing.

User Survey Summary

To determine the extent of usage and also to find how users felt about the new environment, a survey was distributed to all workstation users. The survey results indicated that 54% of the respondents were from the Engineering College, 31% from the Arts and Science College and the remainder from the Business and Education colleges. The survey results showed that most users were satisfied with what they could do on the workstations. Users were queried on their satisfaction in 16 areas relating to the new environment; in all areas there was a surprising level of satisfaction with the workstation environment (see Figure 8).

The lowest-rated factor was response time, with 68% of the users satisfied or very satisfied with response time. The survey also found that there was a major shift in how the new machines were being used. In the past the major usage of our mainframes was for research. In the distributed environment only 33% used the systems primarily for research while 54% used them for communication purposes and 10% for course usage.

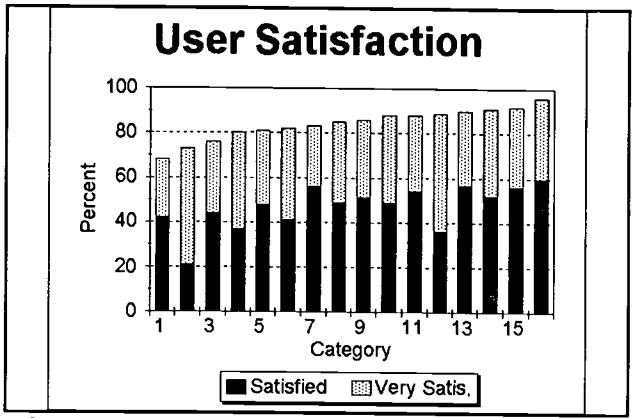


Figure 8

KEY FACTORS AND SUMMARY

User involvement was a major factor in accomplishing the transition to a distributed environment. It was crucial to keep the user community informed and involved in the decision making process. Lehigh was also under strict financial constraints so everything had to be done within the context of existing budgets and the reallocation of funding from the former mainframe budgets. The creation of a RFP and user benchmarks also helped to clarify computing needs. The benchmarks helped in eliminating some vendors and in determining that there was little distinction between the performance of the three top companies. Another key factor was the establishment of very aggressive timelines and goals. Often these seemed unreasonable, but they were being driven by our financial constraints. Finally, a willingness to compromise in coming to a decision to take part in a development project allowed this transition to be made within our existing budgets.

In summary, Lehigh was able to remove three mainframes within a nine-month timeframe, deploy 150 workstations in 18 months, and increase its overall computing power by a factor of 500. The result has been much greater computing power, all financed from existing funds. Users have access to more computing power, better interfaces and more advanced software, thanks in large part to the savings realized from eliminating the overhead and maintenance on the former mainframes. Administrative Computing is still running most of its applications on the IBM 4381. Admissions and Development software are running on RS/6000s but in general the administrative transition is going to take considerably longer than the academic transition. Microcomputers are also still a very major factor in Lehigh's computing structure. They have not been reduced and replaced by workstations (which was suggested in our five-year plan). A new five-year plan is currently under construction which will stress the enhancement of the new computing environment along with goals to further incorporate this technology into the educational environment of Lehigh's students.

Rightsizing - Changing the Culture

Sue Borel and Natalie Vincent

Syracuse University
Syracuse, New York

Syracuse University has embarked on a project to move all of its administrative computing applications from a mainframe to a client/server environment. Early in this project, it became apparent that many of the challenges would not come from the technological transition but from the changes required in the way both we and our clients work. This paper details some of the changes that our computing organization has made in the first eighteen months of this transition, the changes we have asked our clients to make. Initiatives such as restructuring the Information Systems organization, retraining existing technical staff, training clients and finding new ways to do business with our client base will be examined and evaluated.

Syracuse University is a private research institution located in central New York state. It has 12 schools and colleges with an enrollment of around 15,000 grads and undergrads. In March, 1993, the Vice-President for Research and Computing published a document which 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."[1]

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 which would move both our staff and our clients into the future.

We, like many other institutions, are a mainframe shop. Information Systems (IS) has a programming and technical staff of 35 FTEs to support administrative applications. Our client base is approximately 2600; we have a portfolio of sixty application systems, a well satisfied customer base and have done a good job at providing systems and reporting needed to support the administrative operations of the University. We have not, however, 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 for meeting 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, financial accounts easily accessible to stakeholders.

To provide our end users with an easy to access reporting environment with appropriate software.

One of the assumptions of our plan was that we would use existing staff rather than outsourcing the majority of the work. At the time we began this project we had a very stable, experienced staff. We felt we needed people who knew and understood our business and we would retrain them. The first phase of our migration involved setting up a client/server evaluation platform - a sort of laboratory. As we evaluated 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.

[1]Benjamin R. Ware, 93 Forward Directions for Computing at Syracuse University, March, 1993, p.1

Reorganizing

Our own structure was a hindrance to the way we needed to work. The programming staff reported to three application managers. Each manager was responsible for a specific suite of applications and clients. Resource was managed within each group with occasional transfers from one group to another. One advantage of this model was that our clients had a stable point of contact with programmers who were very familiar with their systems. Clients often would go directly to a programmer with questions and problems. Requests for system enhancements went to the appropriate application manager who would set schedules and priorities using the resource 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:

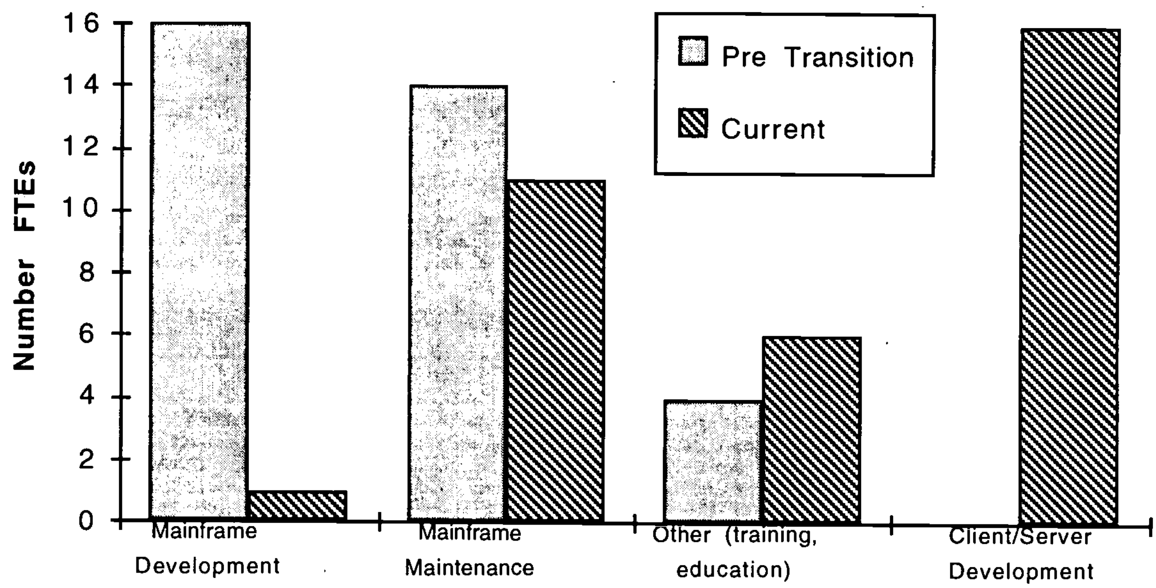
- Establish an internal organizational structure which would be flexible and responsive to ever changing resource needs for both the mainframe and client/server environments.
- Ensure that our legacy systems were maintained but enhanced only when absolutely necessary.
- Change the way our clients communicated 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 should be 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 they are the primary contact and coordinator, they jointly oversee project schedules and manage programming resource. Programmers were told to refer all calls from clients to one of these application managers. This moved our clients' "stable" point of contact to the managers making fewer interruptions for the programming staff and allowing the managers to be the master schedulers for all work. It also provided our clients with their first visible effect of the technology transition. For our staff, this model emphasizes work in teams which are organized for the life of a project.

We have three groups of technical support in the computing organization, two in the academic area and one for administrative. We evaluated combining these groups last year. Although it makes sense that they will be combined at some point in the future, there is not yet enough commonalty to make the change feasible.

Having settled our internal organization we looked at how we would interact with our clients during the transition. Our vice-president sent a letter to the administrative vice-presidents stating that the majority of our programming resource would be directed to client/server projects and mainframe applications would be enhanced only to meet changing legal requirements. We waited for the roof to cave in - it didn't! About two months later, reality set in 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 extremely diplomatic and sympathetic but firm with our clients. We made a smooth organizational transition with the aid of their facilitation, listening and negotiating skills. We have found, however, that we will need to spend some resource in enhancing those systems which will not be replaced until after 1997. We are working with our clients on a case by case basis to decide what will need to be done for these applications. The change in the distribution of work effort is reflected in the following graph:

Computing Resource Distribution



Rethinking

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

Use object oriented analysis techniques
All of the application development tools that we evaluated were using some object orientation principles. We felt that the staff would need to understand these principles and they should be used in our system development methodology.

Use a three tiered architecture for building our applications
One of the productivity gains we wanted was from reusable code. From reading, conversations with consultants and others experienced in client/server architecture, the three tiered approach to programming seemed the way to go. This would divide an application program into three parts - presentation, process logic and database services.

Define specialists for some areas
Given the long list of new technologies, we would need to designate specialty areas where we would concentrate training on a small number of people who would then be available as a support resource to project teams. We refer to these people as mentors to reflect their role as an educator and guide.

Foster success
With so many things going on in parallel we would 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 just 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 evolve 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

A notebook is provided to the team leader of each new project. 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 has provided some structure to projects and gives us a common ground on which 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. Our experience is that 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 - namely, student systems, space and facilities management, classroom scheduling, and alumni development. By the time we were beginning to feel comfortable with the work we had done in systems development, we found that 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? No indeed, the principles we have learned have 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 is over. We have 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 is 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 used a variety of ways to reskill ourselves 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 was told to spend a minimum of 20% of their time reading about client/server or enhancing their microcomputer 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 rapidly as possible.

Many of the mentors attended professional training but we have 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 - and 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 learning about object oriented analysis - this turned out to be 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, it reinforced team concepts and helped transition staff into the client/server project even 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 underway, 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 - one thing that is evident is that a large part of our job will be to bring things together - people, processes, software and hardware to provide a solid computing environment. We are already putting these skills to good use.

Current Issues

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. This is an ongoing process and we continue to evolve as professionals and as an organization. Some of the issues which we are currently attempting to address are:

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. The more we look at them, the more we realize that 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.

Employee Recognition
This has been an issue for some time, it has just become larger. 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.

This transition is not without pain, all of the changes that we have been making began at the same time that the University was restructuring. Once we started changing, we had to begin to reeducate our clients.

Dismantling the old

Before we began our move to client-server, as we met with staff from many other universities as well as contacts in the business world, 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 are 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 another group, an even 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 resource 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 a terminology we used to describe this data that is particular to the business or interests of a school, college or department.

Each group offered unique challenges, but had one thing in common: they were faced with moving from their current technology, re-investing both time and dollars into a new way of retrieving and reporting on data. Prior to 1992, Information Systems had provided quick turnaround, ad hoc reporting services for a nominal fee. In 1992 we moved to a process which 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 mainframe, on-line systems which provided these services. However, few faculty or staff in academic offices needed or wanted access to these systems. Client server will change both the need and the source of the data available for reporting. Mainframe 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.

While the cost of standard desktop machines has moderated over the past few years, the level of equipment that is required to handle multiple software products accessing large reporting 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 continue to issue new guidelines based on advances in technology. But what we have come to understand and accept has caused many of our clients to suffer from 'sticker shock'. A natural reaction to this ongoing, rapid change is for the client to say, 'I'll just wait a little longer to get just the right equipment, just the right version of the software, just the right training'.

Some are enthralled with technology and want to set up the office of the future immediately; others are overwhelmed by the complexity of the new environment. Our job has been to work with all areas to develop hardware, software and training guidelines based on the information needs of each client and to encourage them to start down the information super-highway sooner rather than later. The operative word here is start. Our evaluation may show that an office should start using the data warehouse. That 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 on-line computing services which 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

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 involved educating large numbers of individuals about a new computing environment, client software and applications, and for those using the data warehouse, providing information about information! 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. Her degree path had originally been directed toward teaching and 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 strong network of volunteer training staff with professional consulting and training organizations, we have put in place a wide range of training opportunities. We have opened one training facility, away from phones and every-day interruptions and will be opening another in the Spring. Class schedules are mailed to staff and faculty, posted via electronic mail and published in our campus newspapers. 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 Beginning WORD, Using the Internet, Windows at three levels: Beginning, Intermediate and Advanced. Courses are available throughout the year, in convenient time slots. Some are directed toward faculty and students while others are designed to address the needs of the administrative or academic department staff. We have negotiated with professional training organizations to provide reasonably priced, on-campus training to University personnel and continue to survey the staff to plan for future offerings. We believe in 'just in time' training; coordinating new software, new releases of currently used software or implementation of new systems by scheduling sessions that have a client leaving the training course, returning to his/her desktop machine to begin putting new skills to use immediately.

Initiatives

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 effect 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 time-line projecting movement of major systems. We made this presentation to our 'old' clients, to our new audience, to faculty, to staff, to students, to anyone who wanted to learn more about our plan. All of our sessions were inter-active, providing an overview of the project, encouraging client input, offering to speak to focus groups, and just generally trying to put this change into perspective. Like us, 'THE ROADSHOW' kept changing; as we gained new insights and understandings about the client-server environment, we passed that information on to our audience. In addition to the presentations, we provided multiple avenues for clients to contact us with questions, suggestions and yes, even criticism. We set up an electronic mail ID, we published phone numbers where we could be reached and encouraged clients to let us know what issues needed further explanation. We stressed open communications because we felt, and continue to believe, that fear of the unknown can undermine a project, that information can allay fear and build understanding. Understanding the impact that this change will have on our client community has enabled us to begin working together toward a successful implementation of our computing plan.

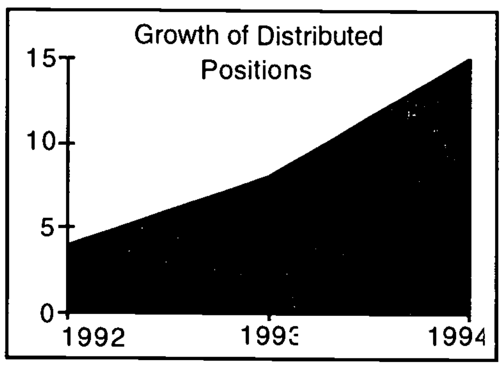
One of the portions of 'THE ROADSHOW' that was met with interest and enthusiasm was the prospect of a data warehouse, an easily accessed repository of University information which could be used to meet the day-to-day reporting needs of a wide range of staff: administrative and academic. The warehouse categorizes data into subject areas such as Student Information or Financials and will include current, historical and summary data in each of the areas. Human Resources information was our first subject area and has been available since Spring 1994. This fall we are providing information on currently registered students and will have Admissions, Financial Aid and historical student information available during the Spring 1995 semester.

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 and access to information is an absolute necessity if these areas are to successfully discharge their new responsibilities. 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 needed 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, 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 which we feel meet our current needs. We have recently completed 'train the trainer' sessions which included Computing & Media Services staff members as well as key individuals from the administrative areas supporting the data warehouse such as 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 the 'point and click - create a query' class to 'so you really want to learn SQL!' level. Because understanding the software is only half of the learning experience and creating reports is only productive when you understand the data you are using, classes will also be available for staff to help them understand all the information that is available from the data warehouse. We have also created an on-line meta data database -- information about data: what do these code values mean, what operational system supports this piece of data, are there special considerations related to this information?

Two other initiatives are also playing a part in helping our clients deal with change . Last year several of our administrative clients banded together to form a user group, New User Technology Support Services. This group has sponsored several forums to discuss various aspects of managing departmental computing services. Many of them have experienced the 'pain' as well as the 'gain' associated with computing and would like to share their experiences with others, providing support and guidance to staff in areas just beginning to investigate how access to information can work for them. While Information Systems participates in this group, and offers support when requested, the driving force behind the discussions and presentations is from a client perspective.

Second, a program was developed to enable university offices to have some computing expertise in their department by subsidizing the hiring of staff with computing experience. We call these distributed positions - the department funds 2/3 of the person's salary and our computing organization funds 1/3. The distributed staff work in the client office but have an informal organization coordinated by a member of our organization. They have monthly meetings and are included in all of our departmental mailings and events. 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. We all gain through this program since we are able to focus on some long term goals while we continue to support each other in our day-to-day operations.



Areas which 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.

All of these initiatives have one thing in common: they represent our attempt to provide support to our clients and to our staff. We are continually evaluating the impact that all of these changes have on us as information providers and on our clients, as the accessibility of information becomes an integral part of their job responsibility. We say that there are two words to describe our mission for the next few years, but we say them over and over again. Training, Training, Training followed by Support, Support, Support. Two issues related to training and support are currently underway:

Help desk software.

We have convened a committee to look at help desk software. Our help line handles a wide variety of inquiries dealing with all aspects of computing services at Syracuse University and we anticipate increased demands as more applications become available in the client-server environment. While this new environment often raises more questions than it answers, we know 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 recently 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 which this group is attempting to address require an on-site visit, not always an easy task since some units within Syracuse 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 a variety of 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.

We know that 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. Since many of our solutions rely on technology which remains in the future, we have added *interim solution* n to our vocabulary. But we have developed a plan; we have set goals and are moving forward. A positive attitude and technical training will be equal partners in our ongoing staff development as we begin to use new skills to provide better service and support to our clients. Our advice: Look forward and never believe that you and your organization don't have what it takes to succeed.

A Data Warehouse--The Best Buy For The Money

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ABSTRACT

Most, if not all IT professionals in university environments are operating in the extremely stressful reality of shrinking resources and expanding demands for service. Coupled with this dynamic is an increasingly rapid technology cycle. If demand could be held level this factor alone would be exerting extreme pressure on the IT environment.

The beginning of the paper briefly describes why Data Warehouse technology is a smart investment, in both resources and technology, and why it provides added value to the user community. The Catholic University of America's (CUA) experience in successfully implementing a pilot Data Warehouse project is also described.

A DATA WAREHOUSE--THE BEST BUY FOR THE MONEY

CUA's MIS department is continuously trying to answer the "Where do we go from here?" question. To accomplish this, current technology is constantly analyzed to separate the fact from the hype. Once the facts are established, a determination is made as to where our very limited development dollars should be spent to provide the greatest possible service improvement to the user community. Our goal can be stated as rule: Provide the greatest short term Information Technology (IT) improvement to the user community within the long term context of building an IT architecture that will be capable of evolving to the technologies of the future.

Data Warehouse technology fits this metric. This technology is based on the premise that there are two fundamental types of data existing within any enterprise. The first and most widely understood is termed operational data. Operational data is the data that directly supports the business functions and for which the majority of applications have been written since business programming became a practice. The second type of data is informational data. This is the data that supports the decision-making process of an organization and as a specific form of data, it is not as well understood as operational data. Many organizations have not as yet made the distinction between the two data forms.

> W.H. Inmon (1993), in his landmark work, *Building the Data Warehouse* (QED Press, Wellesley, Massachusetts), offers the following definition of a data warehouse: "A data warehouse is a subject-oriented, integrated, time-variant, non-volatile collection of data in support of management's decision making process."...The driving force behind the evolution to the data warehouse is the need to gain *informational access* as opposed to *operational access* to corporate data. Operational access means access to the current state of specific instances of data....Informational access, by contrast, implies access to large volumes of data for higher level assessment, planning and strategic decision-support activities. (Ferrara and Naecker, 1993, pp. 26-28)

Differentiating operational data from informational data dictates a fundamentally different design criteria for the operational database versus the data-warehouse database. An operational relational database is (theoretically) built according to the rules of the first three normal forms. In brief, data is stored in its elemental form, there is no redundant storage of data, and any required data that does not represent an elemental data element is derived from an amalgamation of elementary-data elements. Data can be both extracted from and stored into the database. In general, the database is optimized for the update process not the extraction process.

The source of the operational data is generally from interactive on-lines and the operational database is designed with great care. The functional processes of the enterprise are supported by the implemented structure, which is built according to the rules of the standard Software Development Life Cycle (SDLC). On-going revisions to the basic data structure are not part of the plan.

The data warehouse is not built to support the functional process of the enterprise. It is built to facilitate the use of information. The source of data for the data warehouse is the operational database, which is optimized for the extraction process. In fact, the data warehouse can only be updated by the operational database; it is a read-only resource. Unlike the operational database, the normal-form rules do not apply and any de-normalization in the design that will facilitate the information-gathering process is acceptable. Therefore, fields containing summarized and other forms of derived data are perfectly acceptable. "Most access of the warehouse is at the higher levels of summarization. These levels contain less data than the lower levels do and are indexed on many fields. The lower levels of data are indexed on only a few fields" (Inmon and Kelley, 1993, p. 38). Furthermore, the design is iterative in nature. Since a warehouse does not support a suite of update applications it is not dependent on a pre-defined data structure; and, because the warehouse assumes the predominance of ad-hoc usage, design changes can be made as the need becomes apparent. Therefore, there is minimal impact resulting from design-change requests because only the interface between the two databases is affected.

The first step in data warehousing is to simply create a specialized, replicated database that is optimized for the "what-if" informational needs. The only additional technology needed for this step is a method to perform the extraction of data from the operational database into the data warehouse including the appropriate machinations for aggregation. Although it is certainly possible to develop this interface, there are a number of commercially-available solutions from the major database vendors.

The data warehouse is ideal as a centrally-maintained, distributed resource. The user community can help design it and is then free to use Rapid Application Development (RAD) technology to build its own applications for access, with the support and encouragement of the IT staff. This is a significant role reversal for the IT and user communities--IT is doing the data entry and the user community is building the tools to use the data!

At CUA we decided to build a prototype data warehouse. The first step was to identify a pilot group. A pilot group should have certain characteristics, the primary one being an active interest in the concept of a data warehouse. Furthermore, the members of this group must be willing to set aside time in their schedules to participate in the process. The choice of members for this group is very important because a successful pilot project sets the precedent for enhancements and expansions that will follow the project into its production phase. The success or failure of the pilot project will influence resource allocation for additional data-warehouses around the campus.

At CUA, three individuals, the Registrar, the Enrollment Management Analyst for Admissions & Financial Aid, and the Assistant Director for Financial Aid were asked if they would be interested in participating in a data-warehouse pilot project; all three accepted. These individuals do not have comparable positions on the university's organization chart, but they each had an active interest in more efficient data access for reporting purposes. Two additional individuals, the Director of Financial Aid and the Assistant Registrar lent support and suggestions to the group out of general interest for the project.

The first phase of the warehouse project focused on the immediate improvement of the reporting capabilities available to the pilot group. With the exception of this pilot project, CUA's operational database serves as the sole source of ad-hoc reporting on administrative data. This database contains 100 tables and 921 data domains; it was designed to support the functional processes of the university rather than the decision/planning processes. Although the functional structure provides the ability to perform ad-hoc reporting, it is not the ideal structure for report generation.

In a normalized database, data stored as elementary data elements, serves the on-line update applications very well. However, the query process is complex for even simple types of extractions, such as extracting a translation of a code along with, or instead of, the code itself. Extracting code translations is one of CUA's biggest problems with ad-hoc queries and provides a prime motivation for building a data-warehouse. For multiple translation retrievals, one must make the database treat the INDIVIDUAL_CODE table as if it were a series of separate tables, each containing the values for a specific CODE_TYPE. Each reference to the INDIVIDUAL_CODE table must have a unique name or alias. For some "real-life" queries, this can quickly reach a level of complexity that is too intricate for the user, an ad-hoc query tool, and eventually the system itself. Retrieval times shoot up into hours rather than minutes; some retrievals have run for more than a day in a test environment before having to be terminated.

An additional problem with using CUA's operational database as a query resource relates to the large amount of data that it stores. In private industry the operational database is a relatively small entity designed to control daily functioning. For example, once the widget is manufactured, sold and paid for, the operational database does not need to track it. In this environment the data-warehouse is the larger of the two databases. It is designed to provide a resource for historical data, and management uses it for analysis and planning.

A university environment is the exact opposite of most industries and is also opposite the general concept of data-warehousing. In a university environment, data stays active on a student for many years; so the historical database is the operational database. On-line programs quite often access, and sometimes update student data from prior semesters. Also, the operational database contains preparatory information for future semesters. Management, however, does most of its analysis on the current and future academic years, and is only rarely interested in the full historical database. The historical data often present an un-necessary level of complexity for managements queries.

Discussion of Project

General Discussion of VAX Data Distributor

Because CUA participates in Digital Equipment Corporation's (DEC) Campuswide Software License Grant (CSLG) program, and because CUA is already using DEC's Rdb for our operational database; DEC was the prime candidate as a source to provide a tool to implement the data-warehouse project. Included in this program, which allows CUA to use much of DEC's software for one low fee, is a product titled VAX Data Distributor (VDD). The following description from the VDD documentation provides a general overview of the product:

> Data distributor makes data available to users and applications at multiple sites in a network. From a source database, Data Distributor enables you to perform the following tasks:
>
> > Transfer an entire source database or a subset of that database. The target of the transfer can remain on the same processor or can be on a remote processor.
> >
> > Create a target database that maintains a relationship with the source database. By maintaining this relationship, Data Distributor can periodically update the target database to reflect any changes made to the source database.
> >
> > Transfer data from multiple source databases into a single target database.
> >
> > Schedule transfers for future, automatic execution. (DEC, 1993, p. 10)

Conceptually, VDD does not do anything that could not be done manually by an experienced database administrator. The strength of the product lies in its ability to automatically generate all the database code that is necessary to create and maintain a target database, the contents of which are based on the contents of a source database. It can be thought of as a 4-gl for database administration. Based on a set of user-supplied requirement definitions, it generates complex database code.

The VDD process of creating and/or maintaining a target database from a source database is called a Transfer. There are two fundamental types of Transfers:

extraction and replication. Both types of Transfers can be done on demand, or they can be based on a defined schedule. Extraction Transfers create a complete new target database each time that the Transfer executes. A replication Transfer only transfers those data items that have changed (insert/update/delete) since the last Transfer process executed.

The replication Transfer was initially considered to be the superior choice because the total transfer time should theoretically be shorter than an extraction Transfer on a database that does not generally experience heavy updating, . Except for some pre-defined periods, CUA's database fits this criteria. However, further research into the replication Transfer revealed enough negative characteristics that, at least for the pilot project, the extraction method was chosen. The two major drawbacks were: a) the performance impact on the operational database, and b) the replicated tables had to match exactly the source tables, eliminating the possibility of moving the translation values from the INDIVIDUAL_CODE table to the same level as the coded values (denormalizing).

Creating a Transfer

Once the extraction method was chosen, the process of creating a workable Transfer began. The first step was to create the necessary VIEWS on the source database that would create the TABLES on the target database. The VIEWS needed to incorporate three criteria (a) they needed to contain matching translation fields for the requested coded fields, (b) they needed to contain only those student records from and including the first semester of the 1993-1994 academic year, and (c) they needed to exclude any records that had been marked as deleted.

The relationship between three key tables; CORE_DATA, ACADEMIC_CORE, and PROSPECT, presented a problem for the Transfer process. These are the three parent tables to all the other tables for the Admissions system, the Registration system and the Financial Aid system. There is a row in the CORE_DATA table for every student who is represented anywhere in the database. It is the basic table that contains fields like NAME, TITLE, etc. The ACADEMIC_CORE table contains basic academic data like SCHOOL, MAJOR, CUMULATIVE_AVERAGE, etc. The PROSPECT table contains basic Admissions data like SAT_SCORES, HIGH_SCHOOL, etc. Many of the VIEWS required logic that would include a data row if the student was represented in either the ACADEMIC_CORE table OR the PROSPECT table. When this limiting logic was combined with other criteria in the WHERE clauses, some selection processes took over an hour to start returning data.

It was necessary to create a special-purpose "driver" table in the source database to solve the problem. All records in the database for a particular student are related by a special-purpose field that contains a unique number, ID_SYNTHETIC. To solve this processing problem a table (WH_DRIVER_AD_FA_RG) was created that contained a single field, ID_SYNTHETIC for those records that met the limiting "OR" condition. Because this statement contains only one field and because there are no other conditions added to the WHERE clause, this selection starts returning rows almost immediately. The source database can actually load the 59,801 qualifying rows in 00:05:49. The remainder of the selections now include only an equality match to this *driver* table. The previously complex WHERE conditions are now simplified to:

```
WHERE
     some_table.ID_SYNTHETIC = WH_DRIVER.ID_SYNTHETIC  AND
     {any other conditions specific to the table}       ;
```

With this method, the selections written for the 20 tables requested by the user group all started returning rows in 00:02:00 or less.

To use this method, the driver table must be re-created before every Transfer. Fortunately VDD provides for user-controlled Transfer pre-processing and Transfer post-processing. VDD permits the definition of a Prologue command procedure and an Epilogue command procedure. These command procedures can contain any valid commands that can normally be executed in either Digital Command Language (DCL) or interactive SQL. In this situation, a prologue command procedure was created to perform the following steps:

I. Drop the existing special driver table (WH_DRIVER_AD_FA_RG)
II. Create a new driver table
III. Load the new driver TABLE based on the above explanation
IV. Create a unique index based on the sole field, ID_SYNTHETIC

With this process in place, the environment was established to create an actual test Transfer using the tables and fields requested by The Group. VIEWS for each of the twenty tables were created on the source database and a simple epilogue procedure was written to place indexes on the target tables after the Transfer was complete. The most translations requested by the Group for any single table were six on the ACADEMIC_CORE table. Once all syntactical problems were corrected, the Transfer was initiated. The total process took approximately 00:01:45 to complete.

Refining the Transfer

After the initial prototype proved to be functional, The Group was reconvened. Each member was handed a packet identifying the tables and fields that were contained in the new data-warehouse and a list of questions designed to further refine the design. They were asked to review the material and return all suggestions within a week. When the materials were returned, the following refinements had been requested:

I. A number of additional translations had been requested, in particular five additional translations had been added to the ACADEMIC_CORE table, raising the total number of translations on this table to eleven.

II. A number of tables had been further refined to contain fewer fields.

III. Two tables, the ADDRESS table and the FA_ALLOCATION table, were asked to be de-normalized. The ADDRESS table as designed in the operational database contains seven possible address types for each individual. To retrieve a particular address the user has to, (a) cross the ADDRESS table with the ADDRESS_DATA table, (b) specify the correct ADDRESS_TYPE code, and (c) specify a linking field, ADDRESS_NUMBER.

The Group was only interested in two of these address types for the data-warehouse. Therefore, two new tables were created: CURRENT_ADDRESS and PERMANENT_ADDRESS. Addresses can be retrieved directly from them without any crossing.

The FA_ALLOCATION table contains the dollar figures indicating how much money a student is to receive in aid per semester. If the user wants to retrieve all allocations for a particular academic year the FA_ALLOCATION table had to be crossed over itself three times to retrieve the data. The data-warehouse FA_ALLOCATION was de-normalized to contain parallel fields for FALL, SPRING, and SUMMER all in the same row.

These changes were added to the VIEW definitions that had been initially defined and the Transfer was re-run. Eight hours later the Transfer was manually terminated without having run to completion. When the log files of previous runs were compared to this run, the transfer time on the ACADEMIC_CORE table had increased from 00:12:35 to 02:31:59. When the transfer time for the table was divided by the number of records transferred it was evident that the data-record transfer rate had dropped from 46 records/second to 3.04 records/second. Obviously, the additional translations that now had the ACADEMIC_CORE table crossing the INDIVIDUAL_CODE table over itself 11 times, had reached some critical mass.

CUA's systems manager was consulted and the machine resource Input/Output statistics were reviewed for a test Transfer that included only the ACADEMIC_CORE table. From reviewing system performance statistics it was evident that all the activity was absorbed with the database's attempt to resolve the translations, while very little actual data was being accessed.

The multiple crosses of the INDIVIDUAL_CODE table were the obvious source of the problem. The first attempt at a correction was to create, on the source database, individual tables for each of the required translations. These individual translation tables contained only those code values that matched the code type of a specific translation. The idea was based on the assumption that Rdb would have an easier time loading values from many small tables than it would with loading values from one large table that had many virtual copies of itself. Since the ACADEMIC_CORE table contained the most translated fields, it was chosen as a bench-mark test table. A special Transfer process was defined to create a target database containing just ACADEMIC_CORE. The WHERE condition in the SQL code replaced the multiple crosses of INDIVIDUAL_CODE with 11 equality conditions, each satisfying a single translation value. This extraction method produced a transfer time on the ACADEMIC_CORE table of 04:33:28 and data record transfer rate of 1.6 records/second, which was surprisingly worse performance than the use of the single INDIVIDUAL_CODE table.

It was next theorized that the performance problem may be related not only to the large number of crosses or tables in the select statement, but to characteristics of VIEWs that may not be encountered if native TABLEs were used as the source for the Transfer. Although VIEWS appear to the user as a TABLE, they do not actually exist until a selection request is made against them. However, another VDD limitation was encountered at this point. In the Transfer definition statement, a SELECT statement can be used on a TABLE to filter the data that is actually transferred to the target TABLE. However, a SELECT statement used in this manner is restricted; only the TABLE being transferred can be named in the SELECT statement for that TABLE. Since the WH_DRIVER_AD_FA_RG table was necessary to make the selections start returning rows in a reasonable time-frame, this had a major impact on the project. If the driver table was to be used, VDD syntax dictated that VIEWS must also be used.

The next idea was to remove all processing involving the code translations from the source database VIEWS. The INDIVIDUAL_CODE table would be added to the list of tables in the Transfer and re-created on the target database. Once the Transfer process had completed, the epilogue command procedure would then create individual code_translations on the target database. The transferred data tables would then be ALTERED on the target database to contain fields for the required translations. The tables would then be UPDATED on the target database using these individual code tables as the source for the translated values.

Another test Transfer was defined for ACADEMIC_CORE. The select statement only contained a cross with the driver table and a few fields to force the use of an existing index. This time the Transfer of ACADEMIC_CORE took only 00:04:16 and had a record transfer rate of 127 records/second and the system performance statistics now showed a much more balanced I/O picture. This method was then extended to all 20 tables that were to be part of the pilot data-warehouse. The full Transfer ran with a total elapsed time of 02:58:24. The elapsed times for the individual components of the Transfer were:

I. Elapsed time for the prologue command procedure--00:08:16
This included the time to drop, create, and reload the special driver table.

II. Elapsed time for the actual Transfer procedure--01:27:04
This included the time to create and load the 20 tables in the target database that were specified in the source database.

III. Elapsed time for the epilogue command procedure--01:23:04
This included the time to:

A. create indexes on all the new tables,
B. create and load the individual translation tables,
C. alter the data tables to contain short and long translation fields,
D. update the data tables with the actual translations,
E. create and load the VALID_FIELD_VALUE_LOOKUP table. This is the table that gives the users an on-line dictionary resource for all the valid coded values and their translations.

A Transfer schedule was then created and the process was scheduled to run every day at 22:00:00. The Transfer log was examined each morning for any reported errors until all syntactical errors had been removed from the Transfer. A review session was then scheduled with The Group for their first hands-on experience with the data-warehouse.

Results

Response to the product was very good. The Group felt that the data-warehouse demonstrated all the requirements they had asked for in the design stage of the project. They were particularly pleased with the ability to look up code values and as expected, the existence of the translation at the same level as the coded fields was very well received. The user group has now been given access to the warehouse and they are in the process of evaluating it. They have been reminded that this is an iterative process of building successively better prototypes and that they should feel free to be critical of the product. The project will continue past this initial delivery and it should evolve into a production system within a fairly short time period.

Conclusions

The successful completion of the data-warehouse pilot project and the pilot group's enthusiastic response to it has demonstrated that it is a needed resource at CUA. In a recent interview for Forbes magazine, Michael Hammer makes an interesting comment about the nature of work. "Work is the way in which we create value for customers, how we design, invent and make products, how we sell them, how we serve customers" (Karlgaard, 1993, p. 70). It is an extremely important concept. It is increasingly easy for managers of technology to lose touch with the "added value to the customer" component of the job. It is exceptionally easy for those managers to justify technological change from a technological perspective, and it is often difficult for them not to. The rate of technological change is so great that significant amounts of time are spent figuring out how to maintain functioning systems as technology continously changes out from under them.

The data-warehouse adds value to the CUA user community. It provides users a way to perform a portion of their work more quickly and easily. The data-warehouse is also in line with current technology trends.

As the distributed computing, client-server paradigm evolves, the issue of information retrieval must be totally re-evaluated. In many respects the industry is still attempting to do flat-file reporting against relational databases. In the future we will need to develop technology that can abandon the process of examining retrieved data for information, and instead will be intelligent enough to automatically provide the end product (information) to the appropriate clients, be they silicon or carbon-based.

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The Data Warehouse: 2 Years Later...Lessons Learned

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Abstract

A data warehouse is often the first client/server application that institutions attempt. Such was the case at Arizona State University (ASU). Two years ago, ASU initiated a project that brought together student, financial and human resources data in an integrated data warehouse. In this presentation, we plan to share the lessons learned after two years of work. Some of those lessons include: learning new technologies, understanding warehousing concepts, integrating data, designing the warehouse, marketing the idea, finding resources, establishing "officialness" of data, evaluating impact on Data Administration, defining data, making a production system, prioritizing information going into the warehouse, data access tools, training and security. We plan to share our success stories as well as our challenges. There will be a discussion of how the ASU Data Warehouse fits in the University's information architecture, future plans and a live demonstration showcasing the ease of use and power of this innovative information resource.

The Data Warehouse: 2 Years Later...Lessons Learned

It's amazing that the words data warehouse have become such a glamorous, *sexy* expression.[1]

Introduction

To remain competitive in today's business climate, an organization needs a solid foundation of quality data. Institutions of higher education need this capability as much as Fortune 500 companies. To give colleges and universities the "edge," many are turning to data warehousing. These institutions see the data warehouse as the *de facto source* of quality data for tactical and strategic decision making. Some critics believe data warehousing adds to an organization's information problem by adding yet another data source. However, the success organizations are experiencing with the data warehouse is evident. Data warehousing is a solid business strategy for the 1990s.

In this paper, we share the lessons learned from Arizona State University's (ASU's) data warehousing experiences. Building a data warehouse is extremely complex and takes commitment from both the information technology department and the business analysts of the institution. It takes planning, hard work, dedication and time to create a relational database management system (RDBMS) that delivers the right data to the right user. A data warehouse excites, but also disappoints. ASU's data warehouse is not a panacea for all the university's data woes, but a darn good start.

Data Warehousing Popular...But Not New

Data warehousing is not new. Data warehousing reminds us of an old mainframe concept from the mid-1970s: take data out of production databases, clean it up a bit, and load the data into an end-user database. International Business Machines Corporation (IBM) was first to coin the phrase "information warehouse" in late 1991. IBM's original concept met with skepticism because accessing non-relational data stores (such as IDMS®, IMS® or VSAM®) was too complex and degraded operational system performance. Based on these experiences, experts now agree that a warehouse needs to be a separate data store built with an RDBMS. While names such as "information factory" or "information refinery" surfaced and went, "data warehouse" is now the generally accepted term.

Definition

The most widely recognized definition of a warehouse is a subject-oriented, integrated, time variant, non-volatile collection of data in support of management's decision making process.[2] ***Subject-oriented*** means the data warehouse focuses on the high-level *entities* of the business; in higher education's case, subjects such as students, courses, accounts, and employees. This is in contrast to operational systems, which deal with *processes* such as student registration or rolling up financial accounts. ***Integrated*** means the data is stored in a consistent format (i.e., naming conventions, domain constraints, physical attributes and measurements). For example, ASU's production systems have four unique coding schemes for ethnicity. In the data warehouse, there is only one coding scheme. ***Time variant*** means the data associates with a point in time (i.e., semester, fiscal year, and pay period). Lastly, ***non-volatile*** means the data doesn't change once it gets into the warehouse. At ASU, even if a person's gender was unreported in a previous semester, the warehouse won't go back in history to correct that.

Use Increasing

In higher education, glimpses of data warehousing exist in the file extracts which institutional research departments receive or the end-user reporting databases that information technology provides. Consequently, data warehousing is nothing new; it is an old concept with a new name and better technology. The data warehouse is likely to become the cornerstone of client/server activity in 1995.[3] So popular is the notion, that a recent META Group report indicates 90% of their clients are undertaking warehouse initiatives, up from less than 10% just a year

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[1]Inmon, W. H. (1992). [Conversation with paper's author.]

[2]Inmon, W. H. (1992). What is a data warehouse? (Tech Topic Vol. 1., No. 1) Prism Solutions, Inc.

[3]White, C. (1994, December). Client/server obsession. Database Programming and Design: Special Supplement, 7.

ago.[4] Similar trends are occurring in higher education, judging from the number of inquiries about ASU's data warehousing efforts. Some of the universities developing warehouse capabilities include Stanford and the University of Michigan. In the business market, analysts estimate the industry will grow to $2.1 billion by 1998, almost three times the 1993 total of $753 million.[5] Some of the major players vying for this money include IBM, Hewlett-Packard Co., Oracle Corp., Sybase, Inc., AT&T GIS and SAS Institute, Inc.; as well as Prism Solutions, Inc. and Red Brick Systems, companies already established in the warehouse market.

ASU's Warehouse Development

History

Development of ASU's data warehouse started in the summer of 1992 as an effort championed by the Department of Data Administration. Negotiations with an RDBMS vendor and a UNIX workstation vendor resulted in a one-year "lease" of their products for the cost of the annual maintenance contract (approximately $8000). While getting the warehouse server in place, over 20 companies agreed to provide complimentary copies of their data access tools. Although many of the access tools reviewed were in their adolescence, accessing data was much easier with these graphical user interface (GUI) tools than with the fourth generation tools in use. After successfully connecting to the warehouse server through the network middleware, Data Administration started compiling minimum hardware and software requirements for Macintosh® and PC/Windows™ machines.

A warehouse team of twelve individuals from Data Administration and Information Technology formed a development team to "prove" the warehouse concept. The team selected a representative group of ASU staff to serve as pilot users to test the data warehouse and access software. During the next few months, the team designed a student warehouse model based on over 200 questions, which the pilot users considered difficult to answer using current information resources. By extracting data from the operational IDMS database and loading that data into a Sybase® SQLServer™ database, the first client/server application was in place at ASU.

During 1993, many of the original warehouse team shifted back to their regular duties, which left the team with a core of about five people. That core group has remained intact, receiving additional help from ASU's Institutional Research Office and business area improvement groups (BAIGs). The BAIGs, organized to improve ASU's operational and informational data processing capabilities, contribute significantly to ASU's data warehousing project. Meanwhile, Data Administration initiated formal classes to train users on the warehouse. To date, there are over 150 trained warehouse users, with two classes being taught each month. The goal is to train 1,000 warehouse users, approximately 20% of ASU's full-time work force.

Before the production release of the data warehouse to ASU, the team introduced a logo for the warehouse (see Figure 1). Presentations, warehouse brochures, training materials and other documentation display this logo. This simple, yet effective, design helps individuals identify with ASU's data warehouse, establishing the warehouse as a distinct entity.

ASU DATA WAREHOUSE

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Figure 1. ASU's Data Warehouse Logo.

Methodology

[4] Hammer, K. (1994, September-October). Will the data warehouse be warehoused? Relational Database Journal, 32.
[5] Cafasso, R. (1994, October 10). Praxis forges data warehouse plan. Computer World, 32.

Methodologies assist in managing a project's development. Formal principles, practices and procedures comprise a methodology. Examples of formal methodologies include Martin, Chen/Bachman, IRM, etc. The best definition of a methodology is Paul Strassmann's. He defines methodology as "a procedure that I understand and like." At ASU, the data warehouse team "understands" and "likes" the concepts of William ("Bill") Inmon. Reading any literature about data warehousing without seeing Inmon's name is rare. He was the first to coin the phrase "data warehouse," and is the evangelical voice on the concepts and benefits of data warehousing. In developing ASU's data warehouse, the warehouse team follows Inmon's ten critical success factors (see Figure 2). ASU's warehouse team still revisits these principles.

Inmon's Ten Critical Success Factors

1. Separation of operational and warehouse data and processing.
   (i.e., different data and processing, different technologies, serve different communities.)
2. Data volume management.
   (i.e., sheer volume defeats purpose, partitioning for performance.)
3. Coexistence with older legacy systems.
   (i.e., warehouse not rewrite of operational system, remember $ invested in legacy systems.)
4. Feedback loop implementation.
   (i.e., not single massive effort but iterative, users initially only give rough estimates of need.)
5. Rigorous and proactive treatment of metadata.
   (i.e., store directory of data, maps data between operational system & warehouse.)
6. Data integration.
   (i.e., warehouse fed from diverse & unintegrated data sources, time consuming & difficult.)
7. Proper user mindset.
   (i.e., users operate in discovery mode, warehouse architects understand and react quickly.)
8. Knowledge of historical versus current-value data.
   (i.e., warehouse not updated, serves management, what-if processing, data driven.)
9. Cost justification.
   (i.e., after warehouse power unleashed, support comes but not based on cost justification.)
10. Knowledge that existing systems aren't perfect.
    (i.e., can't wait until operational systems cleaned up, build independent of reengineering.)

Figure 2. Inmon's Critical Success Factors in Building a Data Warehouse.[6]

Architecture

ASU's data warehouse resides in a client/server environment. [*Client/server* is an emerging computing architecture where processing occurs on both the server and client, radically different from the mature centralized world of the mainframe.] As seen in Figure 3, we extract data from the mainframe and load it into a UNIX server running an RDBMS. ASU's warehouse server is a Sun® Sparc 630™ with 512 megabytes of memory and two processors, running the Sun Solaris 2.3™ operating system. The RDBMS is Sybase SQLServer release 10.x. Users connect through Ethernet to the warehouse over ASU's network backbone via Transmission Control Protocol/Internet Protocol (TCP/IP). [*TCP/IP* is the predominant network protocol used by UNIX systems attached to Ethernet and ASU's "preferred protocol."] The suggested GUI data access tool is DataPrism™ from Brio Technology, Inc., which runs identically in both the Macintosh and Windows environment. Microsoft Access® and Q+E™ from Intersolv, Inc. are some of the other tools used.

GUI tools build the structured query language (SQL) requests and bring the results back to the client machine. [*SQL* is the dominant query language for accessing relational databases and accepted by most non-relational databases in a standardized form.] The retrieved data *exists* on the client machine. This process is much different from the 3270 protocols the users are accustomed to, where the client machine is a "dumb" terminal connected to a mainframe. With client/server architecture, the data existing on the client machine is both

[6]Inmon, W. H. (1992, April). Building the data bridge: The ten critical success factors of building a data warehouse. Database Programming & Design, 69.

empowering and liberating. The users "own" the data, cutting and pasting at will, using their favorite client tools (i.e., spreadsheet, word processor, graphic tools).

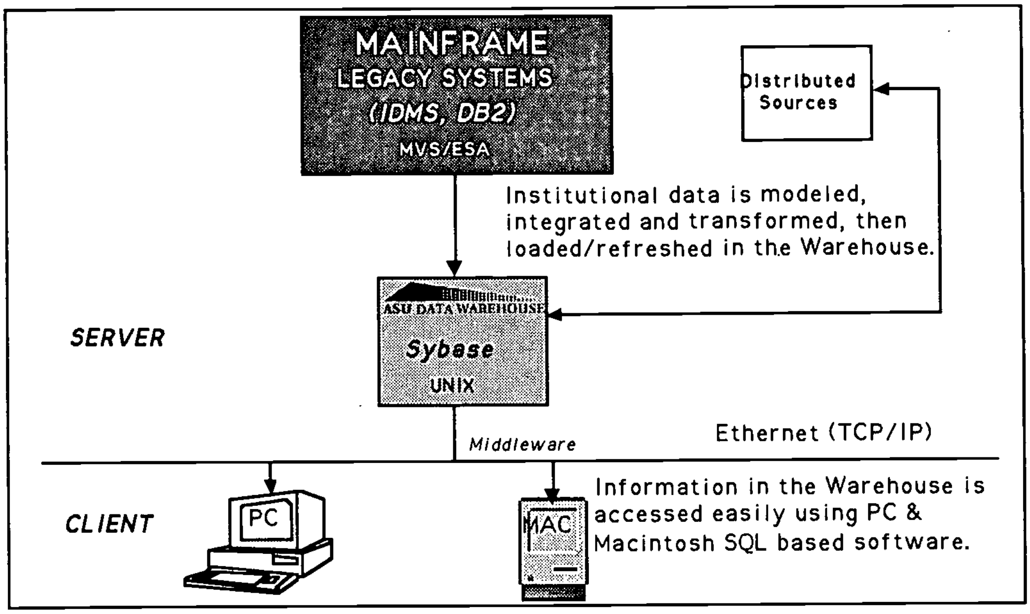

Figure 3. Diagram of ASU's Data Warehouse.

Modeling and Design

As business requirements and database technology become more sophisticated, the need for data modeling and design increases. ASU uses an "upper" computer aided software engineering (CASE) tool to design the warehouse. However, the entity/relationship (E/R) diagramming function and the object repository are the only features of the CASE tool used. [The *E/R diagram* is a pictorial representation of entities, the vital business relationships between the entities, and the attributes or fields used to describe the entities.] The E/R diagramming tool creates a graphical representation of the data in the data warehouse and automates the creation of data definition language (DDL), the technical language used to create the warehouse's tables, views and indexes. The object repository insures consistent definitions and characteristics of fields in the data warehouse. While an upper CASE tool is not imperative in building a data warehouse, it does help automate the development process and the E/R diagrams produce "road maps" to the data.

Designing a data warehouse is an iterative process. Warehouse models change as much as 50% after completion of the design. Designing a data warehouse is different from designing an operational system. First, the data content of the model is different. The warehouse wants data with a high value for executive decision making, whereas the data content of an operational system is more requirements driven. Second, since data is often unavailable, referential integrity in a data warehouse is sometimes inherently wrong. [*Referential integrity* is a feature of database management systems that ensures that each foreign key value has a matching primary key value.] In an operational system, business rules (relationships in an E/R model) dictate that an entity *must* have a relationship with another entity. In a data warehouse, that may or may not be the case. For example, in an operational system, *a student must have an address*. If that address is not available to the operational system, the ability to add that student to the warehouse still must exist.

There are four basic types of tables in ASU's data warehouse: data tables, lookup tables, virtual tables and summarized tables. ***Data tables*** contain raw data, extracted at the unit record level from the operational system. ***Lookup tables*** are code tables, defining the cryptic coding schemes that exist in the operational data. Lookup tables save space, improve flexibility, and allow the description of a code value to change while retaining its meaning. ***Virtual tables*** are views into the warehouse data. Views simplify the user's perception of a data warehouse, presenting data in a different way or restricting access to certain data (i.e., class roster appears as a single table, but the data resides physically on multiple tables). Lastly, ***summarized tables*** contain summarized data. These tables improve response time to frequently queried data and may become the foundation for subsequently developed executive information systems (EIS).

Database design is a creative process. In fact, given the same set of requirements, two designers usually produce different but acceptable solutions. Often, in database design, it is easier to just do it, than explain exactly what you did.[7] ASU's warehouse team follows the design guidelines in Figure 4.

ASU's Warehouse Design Guidelines

√ Identify major subjects or topics (i.e., define as tables on warehouse).
√ Add an element of time to the tables (i.e., semester, fiscal year).
√ Name fields in the tables or views appropriately (i.e., naming standards).
√ Add derived fields when necessary (i.e., calculated age, GPA).
√ Duplicate data if necessary (i.e., to decrease number of tables users need).
√ Exclude extraneous fields found in operational files (i.e., flags).
√ Create logical tables or views for ease of use (i.e., class roster w/ names).
√ Take security into design considerations.
√ Determine if data model answers business questions.

Figure 4. Warehouse Design Guidelines.

ASU's Warehouse Data Issues

What Data to Collect

A data warehouse must deliver the **right data to the right people**. However, the data warehouse may not be able to deliver all the data people want. People are always asking new questions, so predicting what they need is difficult. We started by asking users what data they wanted. Users e-mail or write down their questions, and send them to Data Administration. Another good starting point is to look at the data going to the institutional research department and the data included in official university reports (e.g., data provided to government agencies like EEOC, IPEDS, or NCES). Our experience is that warehouse users quickly let us know what data they want.

Update Frequency

A data warehouse must deliver the right data to the right people, **at the right time**. What is the right time? The answer is, "it depends." In ASU's data warehouse, we enter data yearly, by census date, monthly, bi-weekly, weekly, and daily. By rule, the more often you update a table in the data warehouse, the more operational in nature it is. For example, ASU's data warehouse extracts daily address changes on students. Many warehouse users create labels for student mailings and need current address information. Updates to code tables occur daily too. However, we try to limit the number of data elements loaded on a daily basis, since there is a cost associated with loading the warehouse. [Authors' note: In the future, daily updates to ASU's data warehouse will "replicate" data in operational systems. *Replication* is a popular industry solution of copying data and placing it locally for processing, which appears to users as direct access to data.]

Integration

Integration is the most important characteristic of a data warehouse, and the characteristic lacking in most operational systems. Integration gives a data warehouse credibility, consistency and **real power.** When designing these capabilities into ASU's data warehouse, the team recognized data in need of integration and data that integrates (see Figure 5). Data in need of integration in ASU's data warehouse include fields like ethnicity, gender, and name. A major integration problem at ASU exists with the department code structure. There are three or four recognized sets of department codes in the various operational systems. Because of the number of department codes

[7]Date, C. J. [Discussion on database design.]

in use, we plan to rectify the problem on the operational side first with a single code, before adding the department code to the warehouse.

Data in need of integration

- Name
- Ethnicity
- Marital Status
- Organizational Unit

Data that integrates

- Fiscal Year, Semester
- Account
- Unique Identification ID
- Organizational Unit

Figure 5. Integration examples.

Integration also requires data that integrates. This is the data that spans the high level subject areas of the data warehouse. At ASU, these high level subject areas are students, financial information, human resources, and courses (see ASU data warehouse high-level design in Appendix A). Examples of data that integrate or cross-walk the high level subjects are fiscal year, semester or term, department, course, a person's unique identifying ID, and account number. Data elements that integrate are the very fabric of an operational system. If these elements differ in format or domain between systems, integrating the data in the warehouse is difficult or impossible. [*Domain* is the set of allowable values that a data field can legitimately take, i.e., permitted values, range of numbers, allowable dates.] When data successfully spans high level subject areas, consider the data warehouse completed and "self-actualized."

Officialness

Making **official numbers** available in a data warehouse brings credence and appeases the user getting different numbers with every query. We add official "numbers" to the warehouse to limit how much our users must understand the impact of timing on data. To achieve officialness, institution's select census or "cut-off" dates for measuring data. For example, at ASU, there is the "21st day" (of the semester) census for student enrollment; in the financial system, fiscal year end; in human resources, September 30. With these census dates, there is a distinct period of measurement, making historical trends much easier to compare and allowing integration across systems. For some requests, official numbers are better to use (i.e., historical trends), while at other times the most current data is best (i.e., financial decisions). At ASU, both numbers are available on the data warehouse. To simplify user queries, official and current values appear in separate databases (see high-level design at Appendix A).

Security and Privacy

Security and safeguarding privacy are **major concerns** in a data warehouse. Security in a database means protecting data against unauthorized disclosure, alteration, or destruction. Granting SELECT (authorization to read only) access to tables (or views) achieves security in a warehouse. Although many RDBMSs support column level security, ASU has not implemented this feature, primarily due to the high cost of administering user access. In traditional operating systems, tasks or screens control access. This usually results in access to a single record or instance of data (i.e., verifying admission status of a student, etc.). However, in a data warehouse, employees have access to a table or all tables in a subject area, which means access goes beyond retrieving individual records to retrieving groups of records.

At ASU, read-only access to the data warehouse is at the database level, which means access to a group of tables. This procedure follows an open access policy for employees approved in 1993. For example, the Office of the Registrar is the trustee of the STUDENT database, the Human Resources director trustee of the HUMAN RESOURCES database, etc. In these databases, read-only access excludes access to name and address. To obtain name and address information, our data trustees grant access to the PERSON database. The user's business need determines access to the PERSON database. Additionally, training classes emphasize the Buckley amendment and Family Educational Rights and Privacy Act (FERPA). Also, users receive training on the appropriate use of warehouse data.

Results

The diagram in Appendix A shows ASU's high-level warehouse design in the context of databases. [*Database* is a collection of tables or files and is loosely equivalent to a subject area.] The STUDENT, FINANCIAL, HUMAN RESOURCES, and COURSE databases comprise the foundation of the warehouse. These databases contain the "granular" or detail data and updates occur on a weekly, bi-weekly or monthly basis, depending on the database (i.e., STUDENT = weekly, COURSE = weekly, HUMAN RESOURCE = biweekly, FINANCIAL = monthly, etc.).

Name and address exist in the PERSON database. This database integrates with other databases through a unique identifying ID. Updates to PERSON occur on a daily basis. Individuals creating class lists or labels are the primary users of this database. Although warehouse "purists" may scoff at the idea of daily updates (i.e., reproducing the operational environment), creating labels is a legitimate business need at ASU. For an employee to get access to name and address, they need permission from the trustee (the Registrar for student information and the Human Resources director in the case of employees). We protect names and addresses for security and privacy reasons in PERSON, but the utility of the warehouse for planning and decision making through the other databases is unaffected. The LOOKUP database contains all lookup tables for the entire warehouse, and is updated daily.

The OFFICIAL database contains census values for frequently used data. Instead of hundreds of tables as in the STUDENT database, the OFFICIAL database only contains dozens of tables. The OFFICIAL database helps users understand the concept of officialness and the smaller size makes a good starting point for new warehouse users. The OFFICIAL database is actually a collection of views into the larger, granular databases, such as STUDENT. Besides being easier to use, the OFFICIAL database achieves a summarized flavor, which less sophisticated users can comfortably use. In the OFFICIAL database, properly constructed queries result in answers that match the official reports released by the Department of Institutional Research.

Ten Lessons Learned

During ASU's data warehouse development, we learned many valuable lessons (see Figure 6). Most of these lessons are general in nature, in that any institution starting to build a data warehouse can learn from them. A few lessons are particular to ASU, given our setting and how we decided to use the warehouse. The most significant decision was to make a **management decision making resource** like the data warehouse. Most system developments at ASU support the needs of the operational user, failing to provide management the information they need for decision making. In designing ASU's data warehouse, we decided to focus our resources in addressing the needs of this important, but previously, ignored group of users.

Ten Lessons Learned

1. New technologies have shortcomings.
2. Costs are shifting to the customer.
3. Security and privacy are major issues.
4. Warehouse impacts data administration.
5. Training pays dividends.
6. Support structure needs to be in place.
7. Invest in a warehouse dictionary.
8. Officialness is hard to achieve.
9. Educate on warehouse concepts often.
10. Avoid cost justification if possible.

Figure 6. Lessons Learned

Technology Shortcomings

Client/server technology is still less reliable, secure, and timely than its predecessor. UNIX servers are not as reliable as mainframes and data access tools are just reaching adolescence. Networks add new layers of complexity and monitoring performance and tuning of servers is imperfect. The results are gaps in available technology and software leaving users' needs unmet. One such example is matching a cohort on a desktop machine with the data warehouse. Most query and retrieval tools do not support this type of function (local table join with server table). If the tool allows this function, joining data is slow, making the match process prohibitive for large databases. Allowing users to create tables containing the IDs of records being tracked on the server solves this problem. However, this solution defeats benefits of client/server technology, moving emphasis back to the host machine. The result is user frustration with the warehouse, when the problem is the technology. Also, with new technology, there is always new vocabulary to learn, adding further to the problem: client/server, relational databases, middleware, join, UNIX, decision support, SQL, TCP/IP, Ethernet, Cartesian joins, data administration, E/R models, ODBC, DAL, etc.

Customer Costs

Information technology departments and technology infusion funding traditionally absorb much of the cost of computing at ASU. With the warehouse and client/server computing, the cost of upgrading hardware and buying software for enterprise systems shifts to the individual or department. Employees seeking access to the warehouse need to know the cost of connecting. At ASU, a "connection checklist" is available, detailing all the steps necessary for access. The checklist includes information on these items: data access approval, PC or Macintosh, printer, Ethernet connection, communications software, data access software, software installation, and training. The checklist informs potential users about exactly what they need, how to get what they need, and how much it costs. We find this checklist to be a very helpful document (see Appendix B).

Security and Privacy

Client/server technology will ultimately force society to redefine privacy and organizations to rethink security. A data warehouse brings security to the forefront of this discussion, slowing development and frustrating users. Unfortunately, security and privacy issues may stall or limit development of a data warehouse at many institutions. Even though a data warehouse does not involve update capability, the ability to extract and convert groups of records to usable information is threatening. As a result, one of ASU's early initiatives was to develop a new data access policy that recognizes the value of placing data in the hands of our customers. There will be problems, but training and accountability are the most appropriate ways of dealing with this issue at the present time. At ASU, there is only one case in which we revoked warehouse access due to misuse.

Data Administration

Data administration at ASU has followed the evolution of data administration according to Bill Inmon. Inmon says the data administrator's role has changed dramatically from managing the data dictionary to designing and constructing a data warehouse.[8] ASU's data warehouse put the Office of Data Administration on the map and brings a new awareness of enterprise data. Users do not believe how bad their data is until they see it. For example, one college uses the data warehouse to verify professional program information and correct mistakes on ASU's operational systems. However, the data warehouse is a double-edged sword for Data Administration. Once users start using the warehouse, a "never-ending" list of enhancements quickly appeared, inundating Data Administration. Institutions need to identify permanent resources for warehouse development and support, or other data administration activities begin to suffer.

Training: A Good Investment

The need to train data warehouse users is critical and pays good dividends. In most computing projects, management recognizes the need for training, but does not always fund training. The is true of ASU's data

[8]Inmon, W. H. (1992, January). Winds of change: A brief history of data administration's amazing growth and development. Database Programming and Design, 68-69.

warehouse. With every new database there is a need for another training course, complete with reference materials. Every enhancement or change to the warehouse must be documented and communicated to warehouse users. Data Administration assumed responsibility for training and documentation at ASU. While training adds to the critical mass of warehouse development and helps our users, it distracts from development.

Initial training at ASU focuses on the *tool*, the *logic*, and the *data*. While a data warehouse supports hundreds of different access tools, training with one tool reduces a trainee's learning curve. After an extensive review of data access tools, Brio Technologies' DataPrism (an access tool that works in both the Macintosh and Windows environment) is our access tool of choice. Logic training is important also (i.e., SQL operators, Cartesian join, etc.). While this functionality is inherent in most access tools, training on query logic avoids many questions down the road. Lastly, training centers on the data. Data is what users know the least. We spend up to 60% of class time training on data, and hope to increase this percentage as users become more familiar with access tools and query logic.

User Support

While training reduces the number of data warehouse questions, a support infrastructure handles other support needs. At ASU, there is an e-mail address (ware-q@asu.edu) where users can send their questions or problems. Experts on warehouse data, networking, and data access tools receive these messages and respond within 24 hours. We log responses in a searchable database. Also, users can telephone a central help line that will send an e-mail message for them. Second, there is a file transfer protocol (FTP) site available for warehouse users. This site stores postscript copies of all documents associated with the data warehouse and copies of the data models. This is also a site for sharing common queries built by users or the warehouse team. Lastly, there is a Warehouse Users Group (WUG). WUG meets monthly to share findings, educate members about the data warehouse, and provide feedback to the warehouse team (currently there are over 75 WUG members). WUG also gives warehouse users an opportunity to find a "warehouse buddy," so they don't feel alone in ASU's world of data.

Invest in a Warehouse Dictionary

One of the more daunting tasks is to provide users a good data dictionary and source for metadata. [*Metadata* is data about the data, including layout, format, encoding/decoding algorithms, domain constraints, etc.] The problem is that there are thousands of data elements, and populating definitions and metadata is an endless task. Although this process is time consuming, the dividends paid are significant. At ASU, we draw resources from the BAIG to populate definitions (see page 4 for explanation of BAIG). [Authors' note: One of the reasons we recommend users adopt DataPrism as their access tool is the "remarks" feature. This feature functions like a pop-up data dictionary, allowing users to quickly determine the definition and code values of a data element or table in the warehouse.]

Officialness

Providing "official numbers" in the data warehouse greatly improves warehouse credibility. However, delivering "officialness" is not as easy as it sounds. The programs that extract and transform the data from the legacy databases must produce numbers that balance with the official numbers released by ASU. Since different algorithms and extract programs exist, there are often differences between the warehouse and official university reports. The problem multiplies because of ten years of data in the warehouse. Creating and validating ten years of official data is difficult. Going forward in time when building a warehouse is easier than attempting to reconstruct and validate history.

Data Warehouse vs. Administrative Systems

Many users tend to look at the data warehouse as another administrative system. This phenomenon happens since the data warehouse is in relational format. While the warehouse can makeup some of the data shortfalls operational user's experience ("data gaps"), it is not the warehouse's primary role. To help our users understand the difference between the data warehouse and their administrative system, we developed Figure 7. This figure compares a data warehouse to an administrative operational system on a variety of dimensions. Every talk or presentation on the data warehouse includes this slide underscoring the differences between the two. We reiterated these differences frequently, or our users begin to make unreasonable requests of the warehouse.

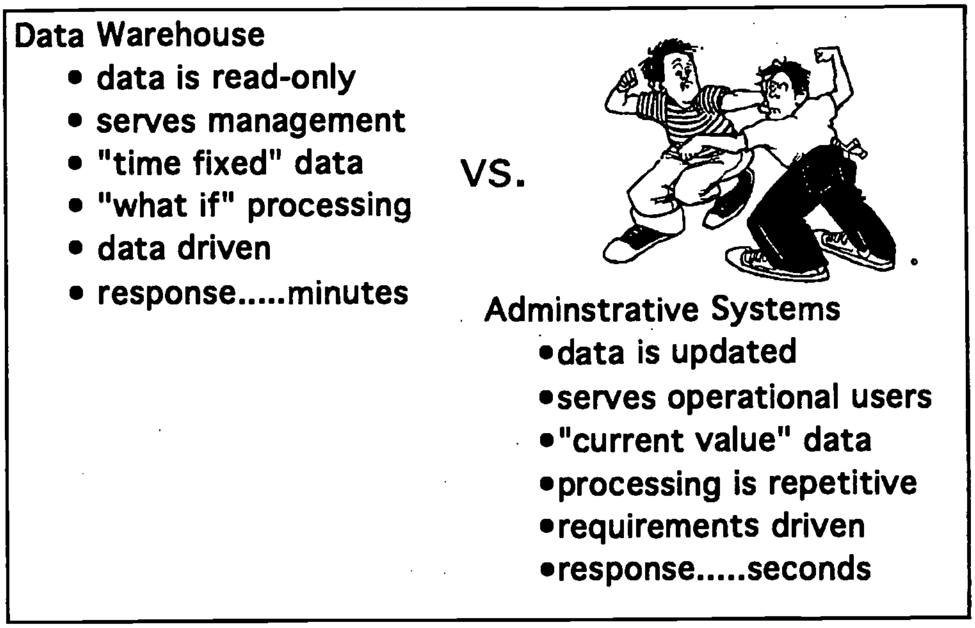

Figure 7. Data Warehouse vs. Administrative System

Cost Justification

If possible, avoid the traditional cost/benefit analysis in justifying a data warehouse. Since a data warehouse benefits the entire organization, ascertaining the benefits from improved decision making is difficult. Fortunately, at ASU, a limited demonstration of the warehouse concept was enough to sell the project. If a more complete cost/benefit analysis were required, the project may never have started. In other words, don't spend too much time justifying a warehouse, just start building one! [Authors' note: A data warehouse may be inevitable, since there is little chance that a technical breakthrough will occur, making access of legacy data easier or cheaper than a data warehouse. The Gartner Group says "Organizations employing a data warehouse architecture will reduce user-driven access to operational data stores by 75%, enhance overall data availability, increase effectiveness and timeliness of business decisions, and decrease resources required by IS to build and maintain reports."[9]]

Conclusion

The future of ASU's data warehouse is just beginning to take shape. Initially, the warehouse served as a resource for accessing information from legacy systems. Now, the warehouse fills a vital role in a client/server environment as a telescope into ASU's distributed data stores. Some of this data will reside in the data warehouse, while other elements will be "viewed" from the RDBMSs where the data resides. We foresee a time when the telescope extends beyond ASU to other institutions with common goals, such as the Maricopa County Community College District. The real power of the warehouse will be actualized in years to come.

The data warehouse also fills an important data administration role in a client/server environment. As distributed application developers move further away from the central computing core, the data elements in the warehouse insure the integrity of the institution's enterprise data. The definitions and coding standards in the warehouse are what distributed developers follow. The warehouse is the "glue" holding enterprise data stores together until a mature repository comes along.

The most important contribution of ASU's data warehouse is the new focus on data integration. While attempting to achieve integration in the warehouse, ASU conceived a new data model which not only integrates the

[9] Gartner Group (1994). [Proceedings from Conference Presentation on Data Warehouse.]

warehouse, but our administrative operational systems as well. By integrating the warehouse, we obtain more powerful data. By integrating our operational systems, we provide strategic new levels of customer service.

The bottom line is that warehousing is here to stay. Data warehousing can give institutions the opportunity to "get their feet wet" in client/server technology, distributed solutions and RDBMS. This is essential for any future mission-critical application. A data warehouse is a low risk, high return investment. The question for corporations and higher education is not simply whether to build a warehouse, but when. Based on predictions by Peter Kastner, an analyst at the Aberdeen Group in Boston, "All companies will build [a data warehouse] in the next five years."[10]

[10]Brandel, M. (1994, October 31). AT&T GIS dives into vertical markets. Computer World, 4.

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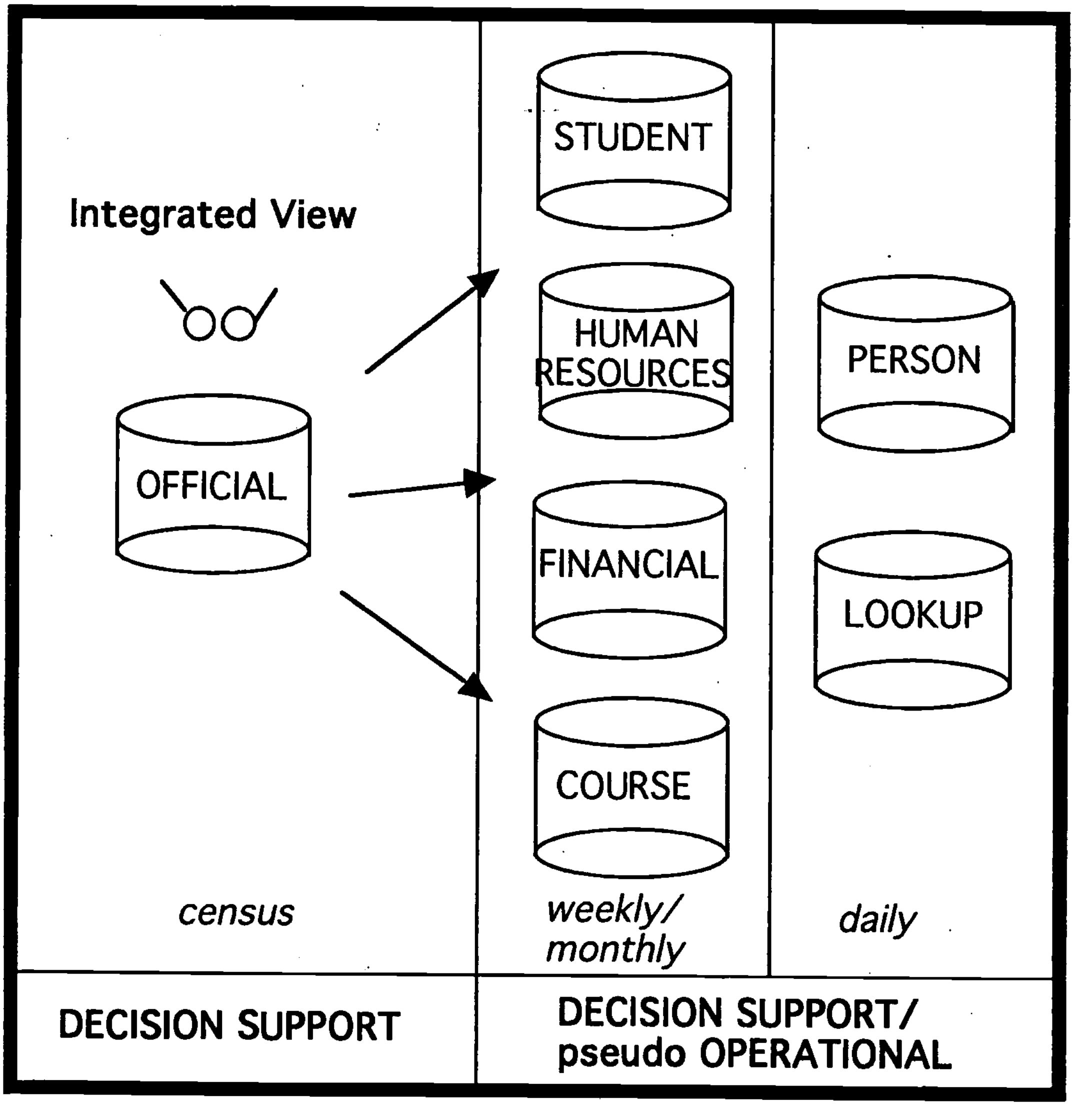
Appendix A

ASU DATA WAREHOUSE



Databases in ASU's Data Warehouse

Appendix B

Arizona State University

ASU Data Warehouse

Connection Checklist

ASU DATA WAREHOUSE

Revised August 1, 1994

♦ Introduction

This checklist is designed to assist you in determining if you have everything necessary to access the ASU Data Warehouse. Some of the information included in this checklist is, by necessity, of a technical nature. We encourage you to call your local or distributed consultant or 965-CNCS if you have any questions related to this document.

The Warehouse requires a number of components that are described in detail in this document.
The checklist includes the following items which must be considered when connecting to the ASU Data Warehouse:

Data Access Approval

- PC or Macintosh
- Printer
- Ethernet Connection
- Communications Software
- Data Access Software
- Software Installation
- Training

After reading this document, please complete one of the attached worksheets for a PC or Macintosh. This will assist you in estimating the costs associated with connecting to the Warehouse. Please keep in mind that the prices listed in this document are estimates only and should be verified based on current pricing structures.

♦ Data Access Approval

To obtain read-only access to the ASU Data Warehouse, you need to do the following three steps:

1. Complete the attached Request for Access to Computing Facilities form, **omitting your signature** in the "Owner Signature" section. A sample form is attached as a guide to completing the request. You will sign the form in training class after the instructor explains security issues.

   For student data: Graduate students requiring access to the Warehouse as part of their ASU employment will require signature from their department sponsor.

   Undergraduate or graduate students not employed by ASU will not be given access to the Warehouse.

2. Obtain supervisor's signature in Sponsor Signature block.

3. Forward the form to the Registrar's Office (Student Data Trustee) for approval (mail stop 0312, SSV B121).

Your userid and password will be established and issued to you by the following process:

Data Trustee will approve the level of access and forward the approved form to the Data Administration Training Instructor.

Data Administration Training Instructor will forward the form along with forms for other students registered for a specific class date to the Computer Accounts Office.

Computer Accounts Office will create your userid and password, and then forward the form back to the Data Administration Training Instructor.

To activate your userid for use with the ASU Data Warehouse, you will need to attend an introductory training class (Accessing ASU Data Warehouse) to become familiar with the Warehouse. Please refer to the section below for training information.

Data Administration Training Instructor will explain security issues in class and obtain your signature on the Request for Access to Computing Facilities form. The instructor will then give you a copy of the form and forward a copy to the Computer Accounts Office.

♦ PC or Macintosh

A PC or Macintosh is required to access ASU's Data Warehouse. Both minimum and recommended configurations for PCs and Macintosh computers are listed here for your reference. These configurations are appropriate for compliance with the ASU Rational Information Technology Environment (ASURITE).

PC Configuration

	Minimum Requirements	**Recommended Configuration**
Processor	386	486
Memory (RAM)	4 MB	8 MB
Disk space	40 MB	230 MB
Monitor	EGA, color	VGA, color or mono
Mouse	Yes	Yes
Keyboard	Yes	Yes
Operating system	DOS 5.0	DOS 6.2
Windows version	3.0	3.1
Ethernet card	Yes	Yes

Macintosh Configuration

	Minimum Requirements	**Recommended Configuration**
Processor	68020	68040
Memory (RAM)	3 MB	8 MB
Disk space	40 MB	120 MB
Monitor	RGB, color	RGB, color
Mouse	Yes	Yes
Keyboard	Yes	Yes
Operating system	System 7.0	System 7.1
Ethernet card	Yes	Yes

♦Printer

With access to the Warehouse, you are most likely going to be interested in printing your reports and diagrams of the Warehouse databases. In order to accomplish this, you will need access to a laser printer. If you are presently connected to a local area network, such as a Banyan, Novell or AppleTalk network, there may already be a laser printer that exists in your office area that can be used for warehouse printing. If you are not connected directly to a local area network and do not have a printer, we suggest that you consider purchasing a laser printer. In order to print the diagrams, you need a printer that can print postscript files.

♦ Ethernet Connection

An Ethernet connection is a requirement for accessing the ASU Data Warehouse. Ethernet allows you to connect to other computers and printers on campus and provides high speed communications. Ethernet has become a standard for new data communication connections on campus and is rapidly becoming wide spread throughout all university departments. If you already have an Ethernet connection, you may proceed to the next step. If you have a connection such as dial-in, Kermit, Forte, Irma or LocalTalk, you will need to obtain an Ethernet connection in order to access the Warehouse.

To obtain an Ethernet connection, you will need to do the following:

1. Obtain a copy of the Application for Data Network Connection. This form is available from COMPASS at Computing Commons, 2nd Floor or by calling 965-5939.

2. Complete the form. There may be questions on the form which you cannot answer. The Data Communications department, at 965-5911, will assist you in completing the portions of the form that are not clear. Also, they will provide current up-to-date pricing, so that you may complete the necessary PO9 for payment.

> NOTE: Page 2 of the Application for Data Network Connection will ask if you need an Ethernet interface card. If you presently do not have an Ethernet card, we recommend that you request services of the Tech Shop to provide and install the card. When you contact Data Communications, specify that you will need an Ethernet card so that you can complete one PO9 for the connection, card and installation.

> NOTE: Page 2 of the form also asks questions pertaining to the installation of the NCSA/Telnet software. When completing this form, please indicate that you will not be using the NCSA/Telnet software. If you are using a PC, you will need the LAN Workplace software which is described in further detail in the Communications Software portion of this checklist. If you are using a Mac, you will be using MacTCP, which is available through COMPASS.

3. Submit the completed form to Data Communications with a printed screen from the CUFS system showing that you have obtained Level 1 approval for the PO9.

4. A representative from Data Communications will make the necessary arrangements for the Ethernet connection and installation of an Ethernet card, as specified in your application.

♦ Communications Software

In addition to the Ethernet connection described above, communications software is required for your computer. There is a ***minimum*** of two communication programs required for using the ASU Data Warehouse:

1. TCP/IP (also known as Telnet) software is required for you to use your Ethernet connection.

If you are using a Macintosh, this software is included with System 7 and is called MacTCP. If you do not already have a copy of MacTCP, you may obtain this software through COMPASS, at the Computing Commons.

If you are using a PC, we recommend use of the ASUNET program for your TCP/IP software. ASUNET is available through Compass in the Computing Commons, 2nd Floor. If you are currently using ASUNET, you will need to obtain the upgrade to a version dated February, 1994 or more recent. This up-to-date version contains a program called WINSOCK which is required for accessing the Warehouse.

Alternatively, you may use FTP PC/TCP or Novell LAN Workplace on your PC as the TCP/IP package of choice.

2. A program known as Sybase Open Client, Net-Library is also required to access the Warehouse. This program is available through COMPASS for the PC and Macintosh environments. Be sure that your Ethernet connection is installed and working prior to attempting to install this software.

3. Another program, Sybase Open Client, DB-Library may also be required depending on the nature of the data access software that you are using. This Sybase Open Client, DB-Library software is only applicable to PC users and is not required for the Macintosh. This software is required if you choose DataPrism for the PC, but is not required for the Macintosh version of DataPrism. If you select some other product for data access, such as SAS/Access, Microsoft Access, Q+E, Forest and Trees or PowerBuilder, you will need to consult with the vendor to determine if the Open Client DB-Library software is required to run their application program. If the Open Client DB-Library software is required by the vendor, you may purchase this software at COMPASS.

♦ Data Access Software

Several data access software products have been researched by the staff involved in setting up the ASU Data Warehouse. While we have found many to work very well in providing access to the Sybase server supporting the ASU Data Warehouse, DataPrism is the recommended tool. The features of DataPrism are summarized as follows:

- Easy to learn, requiring minimal training to get started
- Useful for generating simple ad hoc queries and reports that may be viewed or printed
- Useful for exporting data to other applications, such as Word, WordPerfect or Excel
- Rapid report generation and execution
- Supported for the Data Warehouse environment

DataPrism is available through COMPASS, at the Computing Commons. Special pricing has been negotiated for this product. Please refer to the attached worksheets for pricing information.

NOTE: There are numerous products available through software vendors that will allow you to access the Data Warehouse. Each of these products offer advantages and characteristics that differentiate them from each other. Several of the products we evaluated for use with the Data Warehouse have problems which effect the usefulness of the product. If you are considering using a tool other than DataPrism, please contact a consultant by calling 965-CNCS or by sending an electronic mail note to WARE-Q to inquire about the product that you are interested in.

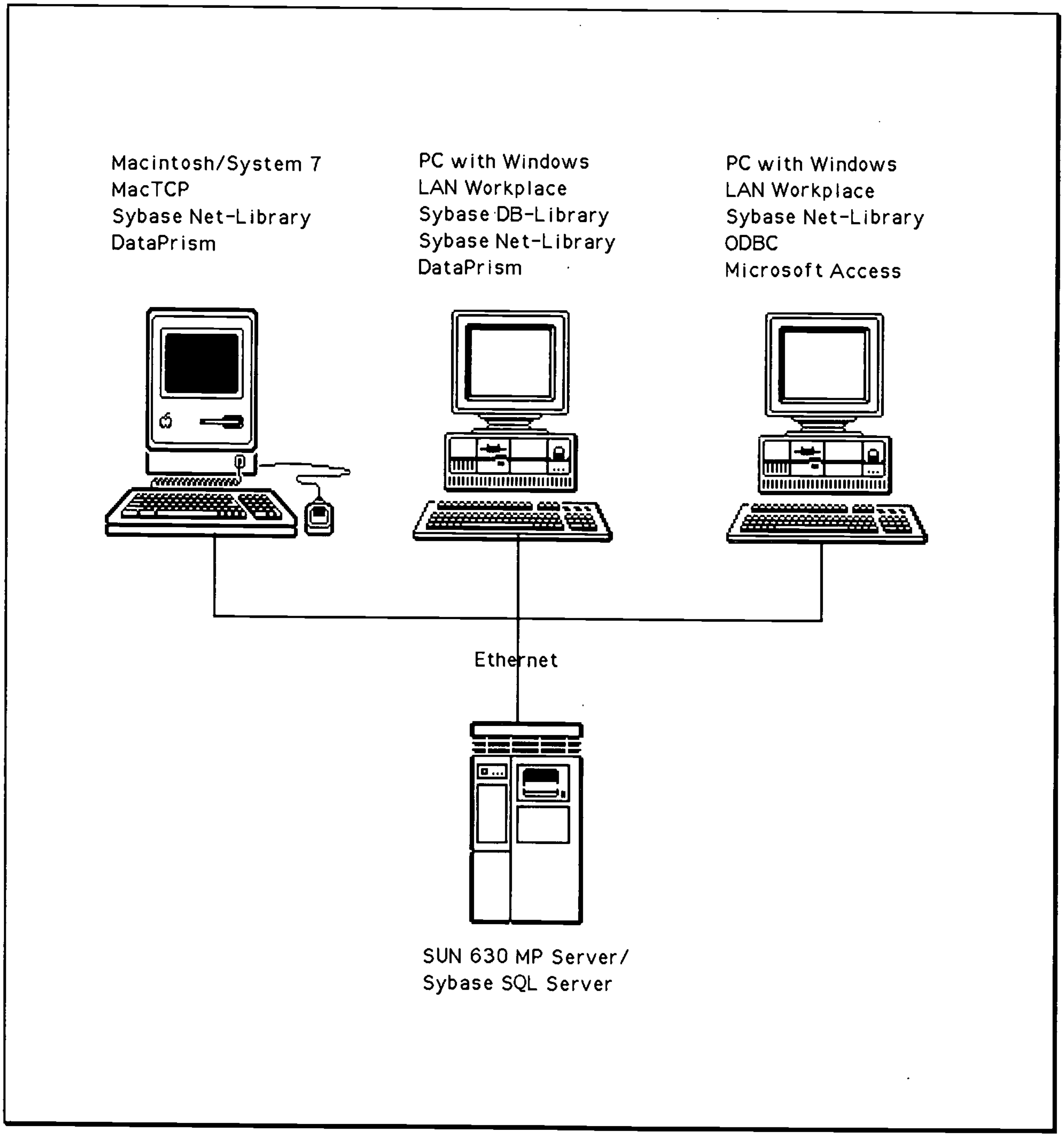
♦ Software Installation

The communications and data access software described in this document is complex and involves configuration options. While there are instructions included with the purchase of these software packages, we encourage you to contract with Facilities Management to perform the installation and configuration of this software. There is a charge of $40 per hour for this service. Depending on the complexity of your configuration and the components required to be installed and configured, this may take from 1 - 4 hours for a Facilities Management technician. To arrange for this service, contact Facilities Management at 965-2826.

♦ Training

After you have all of the pieces in place (data access, PC or Mac, printer, Ethernet connection, communications software, and data access software) you are ready to be trained. Refer to ASU Data Warehouse Training sheet available in COMPASS, Computing Commons 202 on Main campus, or by contacting the IRT Helpline at 543-4357 on West campus.

ASU Data Warehouse Connection Overview



ADMINISTRATIVE SYSTEMS VENDORS TALK TURKEY ON CLIENT/SERVER COMPUTING

John Stuckey

Washington and Lee University

Everybody talks "about" client/server computing, although the careful listener notices that they frequently mean different things by the term. In this panel, product-development managers for three prominent administrative-systems vendors will discuss their products' evolution and their company's strategy. All will refer to the Gartner Group's classic "Five Styles of Client-Server Computing." We drew lots to determine order of presentation.

1. Datatel: Laird Sloan, Director of Product Development

2. SCT: Roy Zatcoff, Vice President, Product Development

3. CARS: Duane Burris, Vice President for Research and Systems Development

After the vendor presentations, Grey Freeman of the Gartner Group will comment.

DATATEL IN THE CLIENT/SERVER ENVIRONMENT

Datatel, Inc., Fairfax, Virginia

Goals

To give our customers and prospective customers an option to choose the client/server style that is compatible with their technological direction and budget.

To protect our customers' investment in computer hardware and infrastructure.

To preserve and enhance the functionality of our existing Colleague and Benefactor software by enabling them to perform in a client/server, character-based or hybrid environment.

To use "open" and "standard" desktop software wherever possible.

To use our CASE tools as the enabling software to move to the client/server environment.

Client/Server Styles

Datatel is currently supporting the Distributed Presentation, Remote Data Management and Distributed Logic styles of client/server, as defined by the CAUSE/Gartner Group white paper on client/server computing.

Distributed Presentation Style

Distributed Presentation is the style where the database management and application logic reside on the server and the user presentation processes are divided between the client and the server. Datatel introduced a graphical user interface (GUI) for this ..style.

The client display technology is based on wIntegrate, an MS Windows-compatible desktop product.

Envision, Datatel"s CASE tool, was enhanced to generate GUI and character-based displays.

All existing application software developed under Envision can be upgraded to GUI through a simple regeneration process. (This includes client-developed applications.)

The enhancement to GUI preserves the use, style and training associated with our current products

The GUI technology supports DDE and Clipboard for interfacing to third-party Windows applications on the client.

The GUI supports multiple terminal emulations using serial ports or TCP/IP; also allows display of report formats (132X66) on a screen.

The GUI includes desktop functions, such as full mouse support, window and dynamic font resizing, icon bars, full color support, dialog boxes, push buttons, list boxes, radio buttons and images.

Multiple server sessions can be supported.

The clients includes extensive script support, executable from the client or the server.

The client supports an online, user-prompted query builder with the ability to import the results into Windows applications

Remote Data Management Style

Remote Data Management is the style where the database management resides on the server and the application logic and user presentation processes are located on the client. At CAUSE in 1993, Datatel introduced the prototype of TopView, our executive information system, formally released on October 10, 1994.

Datatel has created the schema to support executive information functions; the resultant tables (files) can support any SQL-based front end or analytical tool.

The client application is based on a decision support system, Forest & Trees, a product of the Trinzic Corporation.

By generating SQL queries to the Colleague or Benefactor database on the server.

TopView can create application views from multiple servers using SQL and clients using DDE.

A variety of user presentation tools are available on the client, including; tables, charts and graphs; buttons, list boxes and bitmaps; cross-tabulation matrices; printed and on-screen reports.

The applications on the client can incorporate important user alert tools, such as visual and audible alarms and alarm triggers.

TopView supports real-time, system-generated and user-demand calculation functions for the application views.

The applications can use drill-down functions from the top view to a specific view of the information, providing the option to present the data in both tables and charts at each level.

Datatel has created EIS applications for each major system of Colleague: Alumni & Development, Financial, Human Resources, and Student.

Customers can use TopView to generate their own EIS reports and application views to support the unique needs of their institution.

The system includes a full security system for the client applications.

Distributed Logic Style

At CAUSE in 1994, Datatel is introducing its comprehensive Distributed Logic client/server system.

All Colleague and Benefactor processes can run on the client or the server.

The current version supports UNIX on the server and MS Windows on the client.

The system can simultaneously support client/server computing and a traditional character-based environment.

All Datatel and institution-developed software, created under Envision, can be upgraded to the client/server environment through a simple regeneration process. (Envision, itself, is also generated in client/server mode.)

Envision creates user presentation processes using Microsoft design guidelines and is fully compliant with Windows standards.

The system includes a full online "help" capability using the Microsoft paradigm.

Communications between client and server are handled via ODBC for future compatibility with other systems.

The system supports the Cut-and-Paste, Drag-and-Drop and OLE interfaces between the Datatel and PC applications on the client.

Full automatic client version control to simplify system administration is a feature of the system.

The institution has the option to distribute the application software processes to either client or server to optimize their unique computing environment.

SCT APPROACH TO CLIENT/SERVER PARADIGMS

SCT, Inc., Malvern, Pennsylvania

The SCT BANNER products support all 5 styles of client/servercomputing as defined by the Gartner group. BANNER can be installed such that the server only provides database services or a portion of database services (distributed), database and cooperative logic, database and all of the logic, or database logic and presentation service. The client may also contain one or more of these services depending on the BANNER installation options. More importantly, BANNER supports a concurrent mix of all 5 styles. One user may have presentation and all logic services on their client machine. One user may have presentation and all logic services on their client machine which communicates to the database sertver, while another user may be using cooperative logic and/or cooperative presentation services on both their desktop and the server.

SCT software also supports the current popular GUIs (MAC, Windows, MOTIF, X) as well as character cell devices with one code set, and therefore, can also be deployed in a mixed environment. This allows for a controlled or staggered expenditure for both clients and servers, since they may be introduced over time while everyone still uses the same application and data. The software may also be deployed in a multi-tier client server approach where presentation servers, application servers, and database servers are all used as desired or required. Additional servers for mail, security, imaging and others can work in concert with BANNER client/server applications. The BANNER client/server architecture is extremely robust and flexible, allowing an endless variety of client/server deployment scenarios ranging from very simple architectures to very sophisticated infrastructures. These decisions can be made while enjoying the benefits of a single code set with portability and deploying the portions of the applications to client and servers as is best for an institution.

YOUR PRACTICAL GROWTH PATH TOWARD CLIENT SERVER

CARS Information Systems Corporation, Cincinnati, Ohio

Introduction

One of the most revolutionary advancements in computing today is the emerging of client/server architecture systems. However, the client/server paradigm could also be considered a practical evolution of two other rapidly growing architectures in computing today, namely: a) the widespread use of PC systems on the desktop designed to enhance productivity and b) the rapid growth in capability of minicomputers containing relational database engines and serving as the institution's main data processing system. From this perspective, the development of client/server systems is simply the logical outgrowth of the institution's desire to merge two existing disparate systems which have already been deployed, leading to major enhancements in the operation of each.

I. Technological Advancement

Categorized from the application perspective, the Gartner Group distinguishes five styles of client/server computing models. As mentioned, in the Gartner Group Research Notes August 10th "What Lies beyond the "Five Styles of Client/Server Computing", from an implementation perspective many businesses find the five styles too simplistic. Institutions decide to purchase a system from the very practical perspective. They may have a huge current investment to protect and, at the same time, a limited budget for change. However, because of their current system limitations and pressures from their users, they must change. MIS personnel feel frustrated trying to meet the demands of increased capabilities with limited resources. Dire necessity may prove to be the real mother of invention here in moving to a new system.

II. The Practical Path to Client/Server

In considering the college computing scene, the CARS view is "Your predicament is our challenge". The problems institutions face in moving to C/S represent the primary challenge to CARS as a vendor of C/S systems. Our responsibility is to design and build a client/server administrative system that institutions can not only move toward but also afford. In CARS' view, any movement away from traditional host-based computing toward C/S systems must take cognizance of the resources available to the institution. These resources include the host computer, campus-wide network, existing PC's, software, and, very importantly, the skills of the users. The actual types of systems in place today fall into four distinct categories:

1) Dumb terminals attached to host computers.

2) Dumb terminals attached to terminal servers which in turn attached to a network backbone.

3) PC's acting as dumb terminals attached via serial lines either to a host or to terminal servers.

4) PC's with full network access to the host computer. Of course the actual systems may well be a combination of several of these categories. Institutions in category one have a long, expensive path ahead of them to migrate to a C/S system. On the other hand, clients in category four are nearly there except for the C/S software itself. When constructing a strategic plan for technology addressing its Information System needs, the institution must consider the current status of the campus in its migration.

III. Toward Client/Server

When moving the CARS System toward the Client/Server architecture, we have identified three major tasks within product development for utilizing the PC as the client workstation and the UNIX host as the server. We will first provide the Graphical User Interface (GUI) on the PC as the user interface to the application software within the CARS System running on the host. The PC will be used as a workstation for accessing CARS applications versus being used as a dumb terminal. The GUI platform can be either Microsoft Windows or the Apple System 7 environment. With this GUI front-end, users can access the CARS System utilizing the GUI standard GUI features. The user can use the mouse to select from a set of fields the particular field they wish to update. The user is no longer restricted to a series of up and down arrows to move to the desired field on the screen. With the use of multiple windows within the GUI, the user can click the mouse on the window of the desired application program to be reactivated. The user is no longer required to suspend one application and select through a series of keystrokes the next application to be reactivated. The user is able to use the vertical scroll bar to select an entry in a table that is being displayed in a separate window. The user is no longer required to page through the entries of a table with a series of keystrokes. Furthermore, users prefer the visual appearance of information using the GUI display over the character display.

A "Windowing" PC user appreciates the standard GUI functionality provided within the host-based application processing of the CARS System. This is achieved within the CARS System through the use of the winsock protocol to communicate over the network to a GUI presentation server. The CARS GUI server running on the PC receives the information necessary to present the GUI display from the host. Gartner Group labels this style of client/server computing as "distributed presentation". This approach makes the first step into client/server supportable by both CARS as vendor and you as the client. First, there is only one set of screen definition files to be maintained for both the character and GUI displays. Second, since the same screen definition file is used for both character and GUI displays, the user of the CARS System within even the same office on a campus can be operating the same application software on a combination of terminals and PC's. If the client happens to have a campus-wide system which is predominately in category four above, then the cost of making this step will be primarily the training costs.

The second task is to provide direct access to the database on the server from the productivity software available on the PC. For example, the user of the spreadsheet expects the data elements within the database on the host to be readily accessible from the desktop PC. The user does not want to hear the words "import/export" any more. Since both the productivity software within the office suites and the Informix On-Line Database Engine are supporting the Open Database Connectivity (ODBC) standard, it is finally true that the spreadsheet can issue an SQL (Structured Query Language) statement as a query directly against the database on the host to access data elements for a worksheet. Thus,

the data within the CARS System which is maintained by the On-Line Engine is now directly accessible by the third-party software that is ODBC complaint without "import/export".With the direct access to the database by third-party software, there is the need to maintain the integrity of the database. The "foreign" third-party software does not have the knowledge of the implied structure and constraints of the data elements which were incorporated within the "native" application software that accesses the database (nor the corporate business rules). Thus, the database must be expanded to incorporate this additional information along with the actual data in order to enforce the implied logical operations on the data.

The third task is to code the software, one module at a time, to deliver distributed processing, true C/S applications where the host computer serves as a database server while much of the processing occurs elsewhere. This processing can be done on the workstation or on additional application servers. With hardware costs dropping as rapidly as they are, one could, in fact, envision multiple servers such as a report server which just runs reports on demand. The distribution of the processing load of the administration

applications is a means of addressing the overall cost/performance of the system. When it is both cost effective and feasible, the applications should be running on the client workstations or an application server. It must be recognized that the users are only interested in the perceived performance of the overall system. They do not care about the location of the executing software. The users desire that the functionality is there with a fast response time.

Conclusion

CARS is creating a client/server system that allows our clients to undergo a gradual, cost effective migration using the benefits of their existing systems. During the migration, the users on the client sites will benefit from the inherent attributes of the PC as a workstation. These include the GUI and the productivity software which are familiar tools for the user to use in conjunction with the CARS system.

Migrating from Host-based Computing to Client/Server

Jay Blum
Computer Center Director
Thomas More College
Crestview Hills, Kentucky
and
Richard Reno
CARS Information Systems, Corp.
Cincinnati, Ohio

Abstract

Thomas More College is working to successfully evolve the CARS System from a host-based computing system to client/server architecture. The CARS System provides the institution with the ability to migrate individual offices or office users at a time best suited for them, independently of the migration plan for other offices or users of the administrative system. Technologically, the key benefit is the PC utilized as a workstation on the administrative system versus as a character-based terminal through a terminal emulation package. Thus, the workstation provides for the following:

- Initial balancing of the processing load
- An easy-to-use interface to the host-based applications
- Efficient and effective PC tools that are familiar to the user

This case study of Thomas More College involves the prototyping of the practical path from host-based computing to the client/server architecture of the CARS System. The thinking and the planning for the right architecture at the right time are critical. The implementation and support of this architecture must be feasible for both the institution and its personnel. The appropriate architecture allows the Computer Center to realize the benefits of using the client workstations with the server/host. The CARS System, running on a host computer, acts as the server for the workstations, which are acting as clients. This enhances the users computing resources and CARS as the vendor server enhances the computing of the institution as a client.

Introduction: Partnering the Clients and the Servers within the Campus Information System

One can hardly pick up a computer magazine today without seeing the term "client/server," and many institutions are evaluating the possibility of moving toward that type of system. We hope that our experience at Thomas More College (TMC) will be informative for other institutions considering moving toward client/server architecture.

For our continued discussion, we define "client/server" as follows: The "server" is the computer where the data and maybe the executable program resides. The "client" is the PC or workstation where the executable program is loaded at the time of execution. This client only accesses the server when the program loads or when there is a need to access data.

For Thomas More College, this process began in February of 1991 when the President commissioned the VP of Finance and Administration, to form a task force to develop a long range plan for computing on campus. The group was made up of computer center personnel, faculty, staff, students, administrators, and representatives from IBM. At the time, the TMC administration was running CARS software on an HP 9000/832 connected via serial connections. Academic Computing was using a Micro VAX with twenty-one networked PCs.

As members of the task force, we first assessed the current situation at TMC. We distributed a written needs assessment survey to faculty, staff and students. Based on the responses from that survey, we developed a list of campus needs. From this needs list, we determined the consequences for the campus if these needs were not addressed. We then met with users in small groups to get feedback and begin finding solutions. Armed with this user information, the group then developed a solutions list. With this list, we proceeded to list the benefits. From this work, TMC developed a three-year plan for the installation of a campus-wide network. Total cost of the project was estimated at $1.5 million.

In 1991, TMC was awarded a $750,000 grant to begin the installation of a campus-wide network. Installation began in May of 1992. TMC installed 1400 individual connections using Level 5 UTP, with at least two connections in each room, office or classroom. Some offices and classrooms had as many as 25 connections. Installation included the Computer Center's central concentrator and five (5) other concentrators on the campus connected via a fiber optic backbone.

The grant also allowed us to upgrade the PCs on campus. When examining the direction of computing, we found we needed powerful workstations. Our original plan called for the purchase of forty (40) 386 PCs for users. As an example of how fast technology and pricing can change, in only eight months from the plan's acceptance to completion, we ended up purchasing sixty-seven (67) 486 and thirty (30) 386 PCs for the campus. Forty-six (46) of the 486 PCs went to student classrooms and labs, and the rest to staff and faculty offices. Because of this installation, we were immediately able to consider moving our administrative computer system to a client/server system.

Because of our network, CARS Information System Corporation asked us to be their Prototype Site for the Graphical User Interface (GUI) for the CARS System. CARS has developed a two-step approach to moving to client/server architecture. The first step is to convert the interface for the user from the current character-based interface to the Graphical User Interface (GUI). During this phase, the programs still reside and load on the central computer, whether mini or mainframe. The user interface changes to GUI, allowing the users to learn to use the Windows interface without a major disruption of their work. Step two would be the expanded migration to the client/server architecture.

I. Thinking: The Current Issues of Evolving Computing for a Small Institution

When thinking about the direction in which campus computing should evolve, the following important issues must be considered:

- The available technologies, both in the present and in the immediate future
- The limited resources that the institution can allocate to the project
- Any proposed change should be developed within the framework of a strategic plan for information technology utilization
- The current use of PCs by the staff, since these may be considerable

A. Consideration of the New Technology within Computing

When considering an upgrade for your institutional computing environment, consider the rapid rate of development in technology today. Administrators have a hard time understanding that something that was top of the line only two or three years ago is now literally unusable to carry out current tasks. To ensure that fundamental needs are discovered before implementation, the institution must consider the rapid rate of technological changes in its plans. Because hardware prices are plummeting so fast and the technology is developing so rapidly, an institution benefits from lower prices overall or greater computing power through the implementation cycle.

The most important aspect of considering new technology is to try to foresee the future as much as possible. Institutions must also research new emerging technologies to decide whether they will be important to the institution within the lifetime of the current plans. Good technological examples today are real-time audio and video transmission across the campus networks and presentation of the transmissions to the desktop. This technology promises to be very important to academic institutions. Other technologies of interest include document storage and virtual reality systems.

We believe that the single most important component for any computing model today is the campus backbone network. An institution could get very detailed in terms of anticipated network usage to decide which cable to use. However, if such consideration is based upon current usage plus reasonable growth estimates, and if the network is expected to last ten years, then any such detailed consideration will surely be wrong. These considerations do not consider the future technologies involving the distribution of images, audio, and video across the network. The network usage demanded by these technologies will dwarf the use of the network for "standard" computing operations.

B. Realization of the Limited Resources Allocated within the Institutions Budget

Most academic institutions today are facing shrinking budgets, while simultaneously receiving increasing requests for computing resources from various constituencies. The requests become even greater after a network is set up, and users begin to see what others can do. When the user base encompasses most of the campus, computer center staff can more easily justify purchasing the necessary computing resources. The institution must consider realistic funding estimates when planning. Because Thomas More College experiences the same budgetary constraints as many other colleges, we decided we needed to incorporate our existing resources when moving forward.

C. Recognizing the Need for a Strategic Plan for Information Technology

To change an institution's computing environment, a large segment of the campus community must support it. One way to accomplish this goal is to provide a strategic plan for information technology. In preparing a strategic plan, the computer center must solicit opinions from as many constituents as possible. When users participate in the process, they are more likely to support the plan. If most of the campus supports the IS strategic plan, administrators are more easily able to carry out components of the plan.

D. Using PCs within Administrative Processing

As previously mentioned, TMC started by evaluating the current campus situation and developed a three-year plan. Because of the participation of the whole campus, we had a great deal of support for carrying out our plan. In the plan, we recognized that utilizing PC workstations would be an important component. For budgetary reasons we decided initially that only users using wordprocessing or spreadsheets on a daily or weekly bases would require a PC. The grant allowed us to expand usage with our original purchase, but we still need about seventy (70) PCs to meet the demand.

II. Planning: The Right Architecture for Administrative Computing on the Campus

In planning for an evolutionary change in the computing environment, the architecture of the new system must be considered to find the best fit with the current resources and expertise. Capitalizing on users particular computer expertise and using tools with which they are familiar, the system must effectively tie together the users (clients) with the information sources (servers) for a system to be successful.

A. A Plan for Integrating the Clients and the Servers into Administrative Processing

At TMC, the primary server within the administrative system is the administrative minicomputer. TMC currently has an HP 9000/G30, with HP/UX operating system, running the CARS administrative software package. Before the installation of the network, there were about four users, which was 20% of all users, using a PC workstation with a terminal emulation package, while the rest used character-based terminals. After the installation of the network and the PCs, the percentage of users increased to more than 50%. This increase PC use allowed us to begin looking at client/server.

Because the CARS System features an open system design, TMC could become the prototype site for the CARS System GUI software. This allowed TMC to retain the CARS software with which it was familiar and still move forward as fast as practical with the evolution to a client/server system.

B. Migrating Administrative Systems that are Fully Operational Systems Today

TMC wanted to migrate from the old system to this new technology without disrupting the entire campus. Besides requiring a substantial financial expenditure, such a migration would also entail a major training effort. TMC wanted the migration to take place over an extended period. To meet these concerns, CARS proposed the following two-step approach:

1 Allow users to experience some benefits of a GUI C/S system without requiring a complete changeover. With the graphical user interface, the campus can simultaneously carry out both traditional host-based computing and C/S computing.

2 Expanded migration to the client/server architecture.

C. Allowing the Institution to Evolve Over a Time Frame According to the Needs of the Institution

The primary new requirement for the CARS Graphical User interface is a PC operating as a workstation with a network connection. Because TMC had recently installed the fiber optic backbone on campus, the computing staff simply converted PCs to C/S ready workstations and hooked them to the network. This process can now continue as funds are made available until all CARS users are using C/S style workstations. Users have the flexibility to switch back and forth between terminal mode and GUI according to their individual preference.

III. Implementing: The Practical Path to Client/Server Computing Using CARS Graphical User Interface

Presently, TMC is well along the way to implementing CARS Graphical User Interface across the campus. Those people who are presently using this system, and who had previous PC background, are for the most part happy with the operation of the system. The MIS staff is in the early stages of learning to cope with the problems that will arise in a expanded C/S system. In particular, the staff is learning how to deal with the problems of more users accessing the network, and the increased load on the backbone.

A. A Graphical User Interface for the CARS System

The CARS Graphical User Interface is a CARS application specific tool that resembles an X-windows server. The GUI program server (currently only for Microsoft Windows) acts as a display manager for the software running on the central host. It uses a direct network connection to the host for communications. The CARS GUI allows the user to have multiple sessions active in different windows, move those windows around on the screen, and use a mouse for some selection operations. The most commonly stated benefit of using the GUI is that most users like the uniform operation and the reduced time hitting a return while doing data entry. "They love the point and click."

B. Integrating Familiar User Tools

Allowing the user to interface directly to the system using familiar standard PC tools is one strong argument for moving to the client/server model for the administrative system. The CARS Graphical User Interface allows TMC personnel to get some experience with this now and to prepare for a client/server architecture solution in the future. With the CARS GUI, the user can copy and paste into other GUI products. In addition, the CARS GUI is expected to support file transfer between the host and the user's PC. Users will be able to easily enter scanned images into the database (documents, signatures, photos etc.). Similarly, users will be able to retrieve these stored images and paste them into other applications.

C. Introduce New Software over an Evolutionary Timeframe

TMC hopes to eventually install the link software that will extend the database access to the PCs. One future example might include Q+E software that will link any PC software that allows OLE connectivity to have access to the database. In particular, TMC expects to use spreadsheets and third party report writers. We hope these report writers will relieve some pressure on computer center staff to create special reports. Frequently, the spreadsheet will be the natural interface to the database for the user: for example, applications running projections and statistics. Using a spreadsheet, users who are currently running reports on the system and uploading or hand-entering the data into a spreadsheet, will be able to add the queries in the spreadsheet to get data from the database directly.

IV. Supporting: The Feasible Approach in Computing Architecture for the Campus Personnel

As an institution evolves its computing environment, the computer staff endures great stress to support this change. When institutions try to cut corners in staff training during the change, the success of the change is at risk. It is surprising how many institutions of higher learning do not believe in education for their employees. In the move to the client/server paradigm many, if not most, of the staff may not yet know how to use a GUI interface. Training must be a high priority.

A. Implementing at the Right Time for Each Individual User

At TMC the conversion is now well underway. One distinction of the CARS System Graphical User Interface is the fact that the computer center staff only has to maintain one screen definition file for both the underlying host computer and the CARS Graphical User Interface. The user is still running the same program on the host that they used to run when using a character-based terminal. The application program senses that the PC is running the CARS Graphical User Interface at startup and modifies its behavior correspondingly. Because the programs adapt to the situation on the workstation, TMC staff can on an 'as desired basis' move users to CARS Graphical User Interface. For example, an individual office may be moved, an individual may be moved or an application may be moved. If for some reason users want to suspend using the Graphical User Interface they can turn off the GUI server program and rerun the program; the program will appear in character-based mode.

B. Updating the Administrative Software with Mandatory Changes from the Vendor

Recognizing that institutions are constantly changing, whether to meet regulatory changes or to adapt to institutional policies, CARS realized the Graphical User Interface would need the same flexibility as the rest of the CARS System. When enhancements arrive from CARS, the computer center staff need only install one version. Because of the way that the Graphical User Interface operates, the same screen information a character-based terminal utilizes is also used by the GUI server program. Therefore updates must be made only once.

V. Evaluating: The Benefits of the Practical Path in Enhancing Computing for the Campus

A. How Did the Process Go?

In evaluating this process at Thomas More, we found that the process worked very well. Realistically assessing where we were and where we wanted to go, TMC could map out a plan that incorporated the following:

- Available technology
- Our available budgetary resources
- Our current investments in technology
- Our strategic plan for information technology utilization

Because the MIS plan incorporated the needs of the entire campus, the campus as a whole had a commitment to its success. We found users taking ownership of the process, because they were actively involved. We believe this better equips our campus in preparing for a client/server architecture administrative system.

B. What Did We Learn Along the Way?

A major lesson we learned was that any strategic plan must be flexible, to meet the constantly changing needs of the institution and also the emerging technologies. For TMC, the network provided an excellent example of this needed flexibility. Because TMC installed a fiber optic network, the institution was immediately able to begin testing CARS Graphical User Interface. Through this testing, TMC was also able to see how use of the Graphical User Interface increased network load.

Because the CARS Graphical User Interface allows individual users to migrate on their own time schedule, TMC could carry out an evolutionary migration of the entire campus without disrupting its day-to-day operations.

C. What is the User's Perspective?

Our first user for testing the GUI was a data entry person. This person did not have any PC Workstation experience. After a week of Windows training, the user preferred using the GUI for entering information into the system. In the midst of this process, when the user switched offices, the first question to the Computer Center was, "Will I have the same GUI capabilities in my new office?" From Alumni and Development, another user used the CARS System testing the Graphical User Interface. This user prefers using the GUI, because she finds it easier to use. The data entry users like pointing and clicking on fields versus hitting a return during data entry. "They love the point and click."

D. What is the Computer Center Perspective?

Because both the GUI and the character-based CARS System are maintained by a single screen definition file, the GUI does not require any additional maintenance of the Computer Center staff. When TMC incorporates a new enhancement from CARS, these enhancements will be used in both character mode and GUI mode. Concerning training, we also found that users who were familiar with PC applications, were easily able to switch to using the GUI. For those users for whom the GUI was their first experience in PC capabilities, once they learned how to use it, they were able to easily learn other PC applications. While positioning us to migrate to a full client/server architecture in the future, TMC has found CARS Graphical User Interface to be a cost-effective solution that incorporates current resources while allowing users to enjoy the benefits of a PC workstation.

CAUSE 94

Track VII
Professional Development

Coordinator: Howard J. Ramagli

NEW OPPORTUNITIES IN TRAINING FOR INFORMATION SYSTEMS PROFESSIONALS

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ABSTRACT

Technologies are created or enhanced with such speed, that there is little time for data processing professionals to explore all of the new and different areas in the world of information systems. However, these professionals must receive training in order to keep pace with developing technology and meet the ever increasing demands of their information systems' end-users. Our major challenge was providing this training within a limited budget.

This paper outlines how we found the time and the resources to create a training program, motivate a sometimes reluctant staff, and identify creative funding alternatives available through college and vendor partnerships.

NEW OPPORTUNITIES IN TRAINING FOR INFORMATION SYSTEMS PROFESSIONALS

MIAMI-DADE COMMUNITY COLLEGE

With an enrollment of more than 119,000 credit and non-credit students, Miami-Dade Community College is one of the largest colleges in the United States. The city of Miami is a growing international metropolis with a unique and rich mixture of cultures. The student population of the College mirrors the ethnic make-up of Dade County: 57 percent of the students are Hispanic, 21 percent are Afro-American, and the remaining 22 percent from other backgrounds.

The mission of the College has been to provide open access to an education for this very diverse population while maintaining high academic standards with a goal of excellence for all.

Miami-Dade Community College serves Dade County through its five main campuses and many outreach centers. The Computer Services Department, headquartered at the Kendall Campus, provides services to the entire College. Within Computer Services, the Computer Applications Programming Department is responsible for the maintenance and development of student and administrative software systems.

THE GROWING NEED FOR TRAINING

At Miami-Dade Community College, new or updated services and software are regularly purchased to upgrade the mainframe, personal computers, and the local/wide area networks. These items are acquired in order to streamline operations, enhance student and business services, lower operating expenses or simply to replace outdated services and products. If information professionals do not know how to use these tools properly, then they will remain unused or under-used, and the funds used to purchase them will not have been well spent. Attempting to concurrently learn and use these products is both difficult and inefficient.

Even within the programming department, new work tools are continuously being generated to automate and simplify activities. While these utilities are available to all, training is required to know when and how to use them.

Experience has shown that for an information systems department such as ours, maintaining an "up-to-date" operation over the long term requires constant training in the ever-evolving disciplines of the field. Rapid change is not just confined to software and hardware. The way in which new software is built and used also requires retraining and adjustments. Two examples of this have been the move to structured programming techniques, and the wide use of databases. Currently, object-oriented programming is gaining acceptance as a mainstream technique. Even those programmers not working in an object-oriented language find that they are increasingly immersed in a world requiring knowledge of object-oriented concepts.

In an educational environment finding resources to commit to such training can be difficult, and Miami-Dade Community College is no different. Traditionally there has been little or no money available for such programs.

BUILD A TRAINING TEAM

In 1991, the need for training in our Computer Services area was increasing and there was no organized program or budget to address the situation. Looking for a solution, the Director of Computer Applications Programming decided to form a small group, known as the Technical Training Team (T3). The team's objectives were to ensure that training be made available to correspond to the specific software and programming engineering techniques used by our department, to motivate employees to take advantage of the training, and to keep the staff informed of new developments by making training available in new state-of-the-art industry-wide disciplines. These objectives were to be met without interfering with regular business operations and within a very small budget.

In order to succeed, it was clear that commitment from senior management was essential. In our case that included all of the Directors within Computer Services, and our project team leaders. It had to be made clear that attending training classes was an essential activity and not a frivolous waste of productive time. Our program would not have been nearly as successful if management had not been behind it 100 percent.

It was also very important that the "right" people serve on this new training team. Our Director sent an open invitation to all individuals in the department, welcoming them to participate. Everyone who responded had a genuine interest in training and was willing to work in collaboration to produce and implement dynamic programs. They enjoyed experimenting and kept abreast of new developments in the field. These respondents became team members. This free-thinking group would work on a volunteer basis, with flexible deadlines. The Director appointed an enthusiastic individual with great interpersonal skills as chairperson. We knew the people serving on this committee would either make or break the program.

Once the committee was in place, we had to assess our training needs. The department was surveyed through E-mail messages and written questionnaires, inquiring about the type of training needed. We also asked for recommendations on subjects of personal interest. From the responses it was clear that we were dealing with a variety of personalities with different interests. Tailoring a training program for this diverse clientele was going to be both complex and challenging.

MOTIVATE EMPLOYEES

Motivation is an area of primary importance. If people aren't motivated, they won't attend the training programs. To overcome this, we had to ensure that the training topics were not only relevant to the work environment, but interesting as well. The T3 made sure that all training materials such as videos and interactive computer-based training were previewed for relevance and interesting presentation. Additionally, the T3 developed a syllabus for each vendor-supplied class to ensure that these costly sessions were tailored to our specific needs.

One of the first sessions we sponsored was a pizza luncheon. Food can be a powerful motivator! The money came out of our department's coffee club surplus. The topic was "In Search of Excellence". We showed the video and carried out the theme by honoring one of our own excellent people for his efforts in assisting his peers and in training the department in a new database product. We sent out invitations, and over 25 people gave up their lunch hour to attend. The session was a smashing success.

For subsequent video training sessions we included the incentive of a raffle. Each time a staff member attended a session he/she would fill out a raffle ticket. At the end of the scheduled series we held a drawing. The more sessions attended the better the chances of winning a prize. We procured prizes by calling vendors in our area and asking them for donations. We had an array of prizes, i.e., T-shirts, gift certificates, mugs and copies of software. This reward system paid off. Many people that did not attend training sessions in the past participated in these sessions.

Certificates of participation were given for every class attended. Additionally, we awarded Continuing Education Credits for participation. Ten hours of in-house training are equivalent to one CEU (Continuing Education Unit) and four CEUs are equivalent to a 3 credit course. We grouped the training sessions so that they formed a "subject series" of at least 10 hours so that whole CEU's could be awarded. Recordkeeping has been automated using a PC database and information about all activities and attendance is included. When yearly performance evaluations are due, every supervisor is given a report which lists the CEU's each employee has accumulated. This data is used in the employee's evaluation and is also taken into consideration when an employee applies for promotion.

We have found that the timing and scheduling of these activities is an important factor in attracting optimum participation. Programs are scheduled on different days of the week and offerings are balanced between mornings, afternoons, and make-up sessions. Due to limited space or funds, sometimes it is necessary to restrict the number of people attending a training session. An announcement is made as to the fact that participation will be handled on a "first come, first served" basis. In this way everyone is given an equal chance to participate: this has eliminated the notion of preferential treatment among staff members.

These different motivational strategies have helped to achieve a high degree of participation in our training program, which in turn has improved our job performance and work skills to better serve our user community.

KEEP THE STAFF INFORMED

Communication is an essential factor in the success of any program. If the staff members were not aware of the training offered, they could not participate even if they were motivated. We advertised the events well ahead of time so people could plan for it. It is beneficial that everyone take advantage of this education. Creative flyers attracted attention. When these were followed by E-mail meeting invitations, it became a part of the employee's work calendar. Personal interaction was sometimes required to encourage attendance or to persuade a supervisor to allow the staff to participate. This extra step may have changed the way future training sessions are perceived. Distribution of the Technical Training Team's minutes which included a calendar of upcoming events also allowed the staff to plan ahead.

OFFER TRAINING WITHIN A RESTRICTED BUDGET

In the absence of a formal training budget the T3 was constantly faced with funding problems. As the financial constraints became more severe over the last few years, it became clear that reliance on traditional support accounts would no longer be sufficient. To expand our limited resources, we have ventured into partnerships with staff members, other departments within the college, and most recently with vendors.

REDEFINE YOUR TRAVEL ACCOUNTS

Our travel account had to encompass funding for both travel and training. Shrinking travel accounts sliced in half from one year to the next called for closer scrutiny of priorities. Trips with essential, clearly defined training objectives were identified and given preference. In many cases there was only enough money to send one person for training. Upon returning, this individual would conduct a training session for the rest of Computer Services. This creative financing has allowed us to provide training for our department even in the face of diminishing budgets.

MAXIMIZE AVAILABLE RESOURCES

In an effort to maximize available resources we examined our most pressing needs and matched them to the staff members individual fields of expertise. There was not always a perfect match, but with the incentive of both intrinsic and concrete rewards, these people were often willing to train others. If a particular software package offered the promise of being of value to the department, a set of manuals was acquired. One person would learn the product in depth and provide training for other members of the department. The person's satisfaction of being viewed by his/her peers as being the "expert" in a particular skill or product provided ample motivation. The Technical Training Team (T3) made sure that the effort of these individuals was publicly acknowledged. Often their names and contributions appeared in the department newsletter which is distributed college-wide.

We were able to obtain funding to bring in a software company to provide training for the department in Natural--a fourth generation programming language. We felt we would get the most for our training dollar by scheduling an advanced class. The problem was in bringing some recently hired employees (who had no previous training) as well as other staff members who felt they needed a refresher course up to the knowledge level required by this course. Our solution was to schedule a series of weekly one hour sessions taught by one of our department "experts" on the basics of the language. We hoped to build a strong foundation for the advanced class and that the department as a whole would rise to a more productive level of expertise. Approximately 75 percent of the staff has been attending these sessions, with a "graduation ceremony" being planned for the last day of the class.

Our staff is also encouraged to participate in training provided by the Center for Teaching and Learning, an independent college facility dedicated to the professional development of Faculty, Staff, and Administrators. Its main focus is microcomputer technology in the classroom and the workplace. Through this program we have scheduled classes specifically tailored for our department in subjects such as WordPerfect, Windows, and Internet Access. At the end of a training session employees are given a certificate of participation, a copy of which is included in their personnel files.

Miami-Dade has recently entered a partnership with seven other Florida community colleges to standardize their data reporting structure to the State government in the functional areas of Finance, Student Services, Personnel/Payroll and Facilities. Using a common software product, these colleges are modernizing their basic functions and developing integrated, comprehensive systems that will meet state-mandated guidelines. Those employees involved in developing the joint systems are being exposed to new ideas and training on software packages, systems design, and Rapid Application Development techniques. Everyone is sharing newly acquired skills with colleagues, thus creating a state-wide learning network.

NEGOTIATE SOFTWARE AGREEMENTS

A review of vendor software agreements occasionally uncovered new training opportunities under favorable terms, either as offered sessions, or as follow-up training. On-site training classes were of particular interest as a greater number of people could benefit. Vendors often were willing to negotiate training sessions which targeted and met our specific needs.

In many cases "complimentary" training was available with the purchase of software. Frequently that training had a tight restriction on the number of people who could attend. Our team Chairperson and our Director became very proficient negotiators and often training was extended to the entire department.

APPLY FOR GRANTS

Special grants may be obtained from various sources within the college structure for training purposes, particularly for systems where the benefits to students can be most readily demonstrated. We were able to arrange valuable classes and make a great variety of video training tapes available to our staff. Also, through the campus' Teaching and Learning program, some Faculty/Staff Program Development monies were obtained, allowing us to provide our entire staff with additional customized courses.

ACCOMPLISHMENTS AND THE ROAD AHEAD

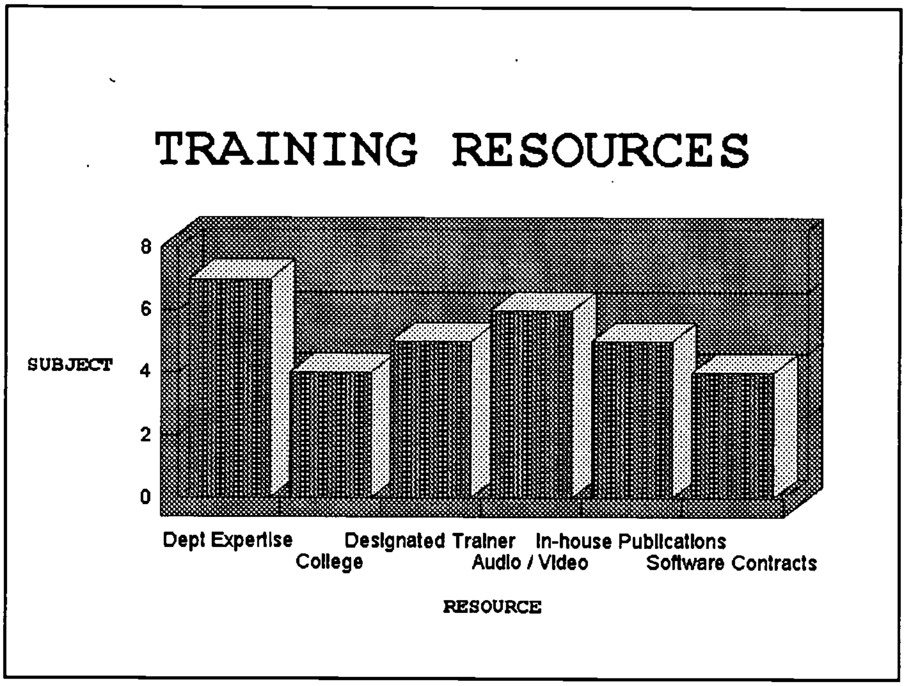
Since its inception over three years ago, the Technical Training Team (T3) has become the vehicle for gathering and disseminating information on new products and programming techniques throughout our department. All departmental reference manuals, such as utilities, macros, and software guides have been reviewed and updated. By working closely with standards and documentation committees, all current standards and guidelines are now available on the departmental network: these can be accessed at any time, even from home.

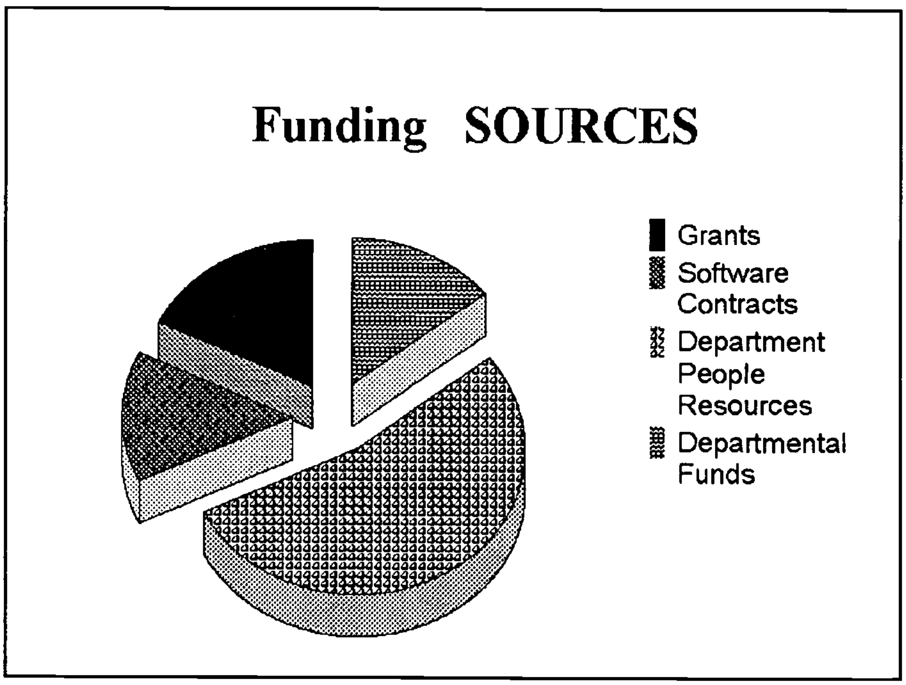
Training has been offered to over fifty professionals in a variety of subjects ranging from mainframe and PC-based software to management courses. Four one-CEU "courses" have been completed: an overview of Rapid Application Development based on James Martin's book, and three video training series (Object-Oriented Programming, Client/Server Concepts and Techniques, and Introduction to LANs). Additional training is presently being planned in the areas of Natural, ADABAS, PC applications, and INTERNET access.

The T3 was the catalyst in the inception of a new organizational unit devoted to the training of the college's user community. This facility is already in place and beginning to interact with both staff and end-users for training on systems developed within our area. Miami-Dade's mainframe computer system is the host for the Florida Community Colleges Consortium software development, described earlier. The Training Center staff will be involved in consulting with and providing training to the members of the Consortium in the use of our E-mail, on-line editors, and connections to the Miami-Dade environment.

Recently, the Computer Services area was functionally reviewed by an outside consulting firm. The quality and significance of the Technical Training Team program was confirmed by the recommendation made to the College President to establish a separate training budget in the Computer Applications Programming department commencing with the 1995-96 fiscal year.

APPENDIX


TRAINING RESOURCES
8
6
SUBJECT
4
2
0
Dept Expertise
College
Designated Trainer
Audio / Video
In-house Publications
Software Contracts
RESOURCE


Funding SOURCES
Grants
Software Contracts
Department People Resources
Departmental Funds

ACTIVITY/RESOURCE TABLE

The following table describes some of the subjects of our training sessions and the resources which were used.

RESOURCE	SUBJECT
Internal Expertise	Time Management TRMS Outbound Paradox
External Expertise to Computer Services	Windows FIRN Access Management Courses Object-Oriented Programming
Designated Trainer	Predict Natural Construct Train the Trainer How to Handle Difficult People Rapid Applications Development
Audio/Video/Text	Creating Teamwork Omegamon II for MVS In Search of Excellence Education A/V Courses
In-House Training Publications	CAP Employee Handbook O/L Predict Users Guide Quick Reference of Programming Tools Cobol II vs. Cobol MVS Macros Availability and Usage
Training Support from Software Contracts	Strobe Natural Elite (ADABAS) Construct

(M-DCC)

CAREER INSURANCE - FLYING ABOVE THE TURBULENCE

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Abstract

This paper will allow the information systems professional to identify exactly where he or she resides on the continuum of the 'change' paradigm currently captivating the executive minds of our society. As hundreds of Fortune 1000 companies 'downsize' or 'rightsize,' the resulting tensions cannot help having detrimental effects if allowed to progress unchecked. The paper reinforces how those who deal with daily technological change must evolve using concepts explained with future-based personal development strategy models.

The 'age of specialization' is over. Executives embark on rampages requiring greater results on less money and fewer personnel, and 'closet programmers' may no longer be welcome. The primary element ensuring continuing personal growth, security, and advancement is presented with suggested means of attaining the necessary personal skill set to survive and advance amid the turbulence of the 'nanosecond nineties'.

THE WORD

Turbulent -- *(adjective) wild or disorderly; full of violent motion*
Webster's New World Dictionary

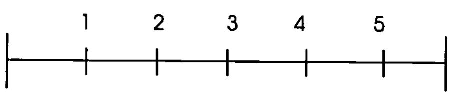
THE PROBLEM

No other adjective could describe as well the times in which we now live. With the advent of downsizing, rightsizing, and reengineering, we spend much time and effort attempting to penetrate the haze of the future and prepare accordingly. The current trend in organizational structures is an intense drive to increasingly accomplish more work with fewer resources. Unfortunately, the resources many organizations are cutting back on include their employees. On May 9 of this year Business Week reported that since 1991 approximately 624,000 employees have been released by the 25 most-reduced companies. How do we survive these 'nanosecond nineties'? As information professionals, we must dedicate ourselves to continuous, self-motivated personal growth, security and advancement. In essence, we must learn to 'fly above the turbulence.'

THE REASON

To accomplish this lofty goal, we must first understand the underlying currents that are driving today's organizational events. To protect ourselves from the chaotic environments we sometimes find ourselves, we need to understand *why* the environment is so turbulent. Once we identify the causes, we have the framework from which we derive our individual strategies to protect ourselves as much as possible. How do we judge what tools are necessary for this? My suggested answer is we must first judge the environment itself in which we are operating. The only way to match our skill set to future career requirements is to grasp what our environment as a whole will require.

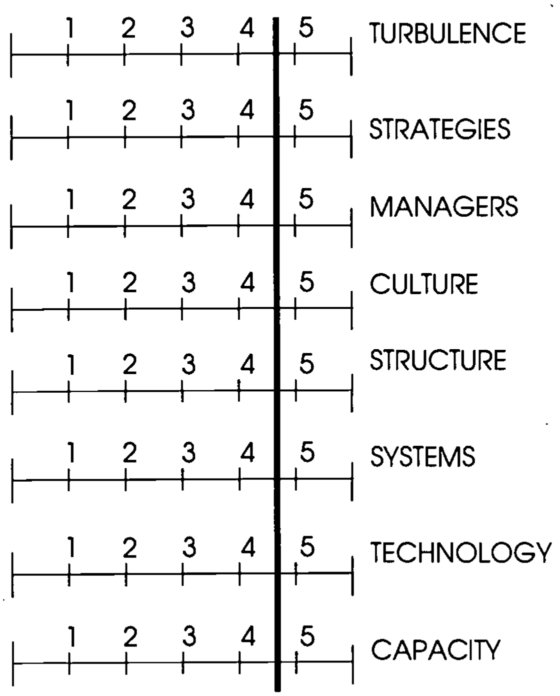
FIGURE 1 - ENVIRONMENTAL TURBULENCE



Low Turbulence Characteristics	High Turbulence Characteristics
Slow change	Rapid change
Demand>>Capacity	Demand<<Capacity
Monopolistic	Chaotic Competition
Long Product Life Cycles	Short Product Life Cycles
Extrapolative	Nonextrapolative

One good way to anticipate environmental demand is to utilize the concept of 'environmental turbulence' as referring to today's global competitive environment. Turbulence usually rates on a scale of 1 through 5. The slower and more predictable the environment is, the lower the environmental turbulence. The more chaotic, complex, novel and changeable the environment is, the more we labeled it as 'highly turbulent.' The higher the turbulence level, the more flexible and changeable an organization must be to survive and flourish. The primary characteristic of high turbulence environments is that of being nonextrapolative, or different from the present.

FIGURE 2 - THE MATCHED ORGANIZATION



The higher education field has a turbulence level approaching level 4. As seen in Figure 1, the environment is one of rapid change, capacity outpacing demand, and aggressive, competition. The necessary conclusion is that organizations must match their internal structure and capabilities to the environment in order to meet future demands. In Figure 2, we see exactly what factors to examine for determining the future potential of the entire organization.

As the environment moves up the turbulence scale toward level 5, the resulting changes pressure organizations to adjust accordingly. However, the focus of this paper is on the final category, capacity. Specifically, the focus is the capacity and capabilities of the most important resource -- the people.

Today's roles and requirements of Information Systems (I.S.) personnel have evolved to a much higher level of active organizational participation. The demands on us are greater than ever before. Once, the majority of I.S. staff communicated with a direct supervisor, manager, or technical liaison only. Today, entry-level programmer/analysts must be able to interact with all organizational levels from data entry clerk to CEO. As the demands of our career change, so must we.

As an organization must increase its internal turbulence level to match that of the external environment, so must each employee make the effort to match their *personal* turbulence level to the same standard. As the environmental flux around us increases, it is imperative that we develop the flexibility and adaptiveness to survive. Career advancement will truly become survival of the fittest. Only by matching *our* individual turbulence levels to the environment may we aid our quest for continued advancement and success.

THE RESPONSE

"We want every person to be a businessperson."

Ralph Stayer
CEO, Johnsonville Foods
Inc., November 1990

In the same way that your institution must gauge the future and adjust, so must each of us read the future and prepare ourselves accordingly. Today's technical personnel must develop a 'multi-stock portfolio' of skills and strengths. Those familiar with investments know that a portfolio consisting of stocks that are unrelated carries the least amount of risk. In addition, developing varied stocks of personal skills lessens your risk of an employment 'market crash.' As mentioned before, the future will become more nonextrapolative. The career development strategies handed to us in the past will no longer meet the requirements of our environments. The ritualized 'ladder of success' personnel development programs used by many organizations do not take into account the changing demands on employees. In addition to job-specific training and education (hard skills), there needs to be an instilling of more general strengths that applies to any position (soft skills). Listed below are these characteristics of survival in high turbulence environments.

Identifying -- anticipating needs of your organization. Become affiliated with your firm's management elite, or those 'in the know.' Learn what your firm's directions are and examine your areas of operations to insure that your activities are not in conflict. Being able to identify future trends could possibly be our greatest aid to advancement.

Preparing -- having answers ready before the questions. This means reading and research. Be aware of current trends not only in the technical arenas but also your industry. This aids in identifying future opportunities also. Live by strategic planning. Never begrudge the time -- the job you save may be your own.

Marketing -- where most highly technical people fall by the wayside. To advance, you have to enjoy the limelight, accept scrutiny, and be visible. Most of all, avoid the 'us vs. them' syndrome. Alienation does not win friends and influence people, at least positively. When dealing with resistance or apathy to your ideas, always relate your plans and projects to achieving organizational goals. This ensures the success of the entire enterprise and identifies you as a team player.

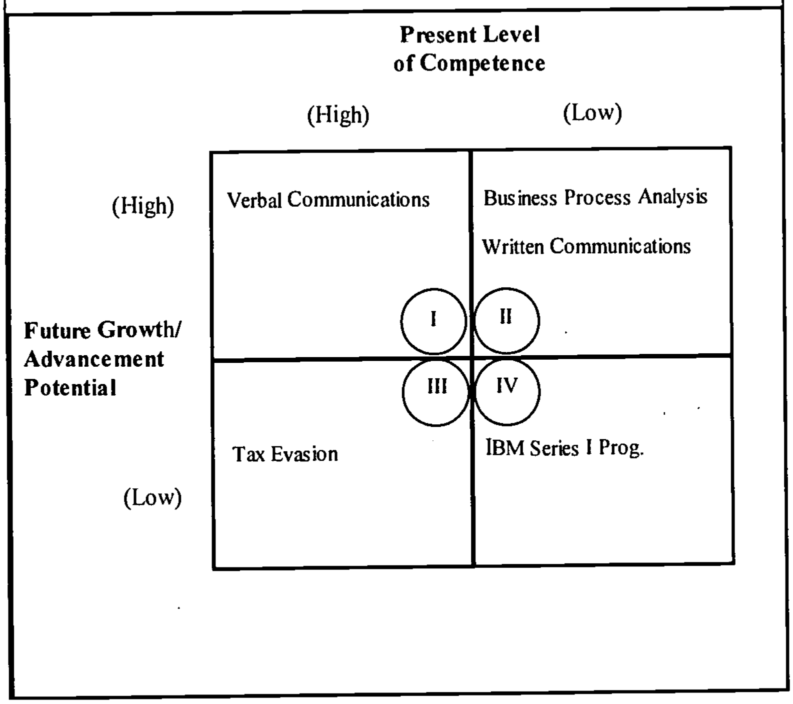
Facilitating -- taking our fabulous ideas and making them happen. You will have to deal with people constantly -- messy, emotional, illogical, and seemingly endless series of interpersonal struggles. However, in any organization, the only way to major accomplishments is through groups of people. The better we work with others, the more we will accomplish.

Implementation -- As you climb the career ladder, daily routine moves from task-based to project- and goal-based. Fortunately, if we achieve the skills discussed here, the vision necessary to make the transition is almost a side-effect.

OK, now we have our goals and direction. Where do we go from here? How we take these five characteristics of survivors and incorporate them? How do we weigh our present strengths and skills in relation to what see needed in the future?

One simple yet highly informative method uses a variation of the Boston Consulting Group (BCG) product decision matrix. The matrix is composed of two axes, the X-axis for the present level of competence, and the Y-axis for the potential future reward for acquiring or possessing that skill. Figure 3 gives a hypothetical example of this skill chart.

FIGURE 3 - Skillset Decision Matrix



This overview gives us a visual aid to see the strengths and weaknesses of our individual skill sets. The skills we have that are charted in Quadrant One are money in the bank. These skills are attractive for the future and we have developed the necessary level of expertise. Those skills that fall in Quadrant Two are those that will require further investment. These skills are what we need to align our personal goals to acquiring. The items in Quadrant Three are those that need no more investment of time or training. We have become highly proficient, but there is a declining need for these particular tools. The items in Quadrant Four are those with no particular place in the future and unworthy of our time or resources. As we view each personal strength or skill in terms of its future growth and advancement potential, directions for continuing professional development tend to become obvious and imperative.

THE ACTION PLAN

Not intimately knowing your organization's business limits advancement and long-term survival may be questionable. The simplest way to expand your horizon is acquiring a variety of literature dealing with business topics, both general and industry-specific. Beyond that, I recommend entering graduate school or other course of study for an MBA or equivalent. You will expose yourself to new ideas, methods, and acquire the vocabulary necessary to communicate with many highest level administrators.

Become a communications expert. Managers spend up to 90% of their time communicating. Learn to speak confidently and well, if necessary with speech training. Take a business writing course. Learning to say much in few words is invaluable in communicating with a busy executive. Unless you communicate your ideas, enthusiasm, and convictions effectively, your efforts will be hindered if not halted.

Consider cross-training with other organizational functions. Know the core activities of your business, even if it means being 'in the field' for a time. Our positions on campus frequently require intensive interaction with the faculty. What better way to build relationships and enhance rapport than teaching a few classes? A primary guideline for interpersonal communications is the development of rapport among the party or parties trying to communicate. Sharing experiences as well as vocabulary enhances the clarity of these communication channels.

SUMMARY

The world continues to change. However, the very character of today's changes is different from those of 20 or even 10 years ago. No longer are organizations progressing along an 'evolutionary' path. Today's universities and colleges are moving along 'revolutionary' paths. The institution of higher education of the future will bear little resemblance to the staid halls of learning from which we graduated. As competition for students becomes more intense, so will the pressure on university administrations to become more aggressive and innovative. Especially among the smaller public and private universities, there will be a continued drive to provide high quality services to the student with severely limited resources. This competition will permeate the entire organization. The only question will be involve whether or not we have what it takes to compete, survive, and flourish. Only by developing the traits of the survivors will our potential for success be insured. Only by actually developing ourselves above and beyond today's expectations will we be ready to meet and beat the future and the turbulence sure to come.

SUGGESTED RESOURCE LIST

Communications

How to be a Great Communicator: In Person, on Paper, and on the Podium
Nido Qubein, Nightingale Conant, Chicago, Ill., (800)323-5552. *Tape Series*

Business Writing for Results, Fred Pryor Seminars, Pryor Resources, Shawnee Mission, KS., (800)255-6139. *Seminar Materials*.

Business Communications Workbook, Raymond A. Dumont, Little, Brown and Company, Boston, Mass.

McGraw-Hill Guide to Effective Communications for MIS Professionals, Larry M. Singer, McGraw-Hill, Inc., New York, NY.

Change Management

Managing Change, Todd D. Jick, Richard D. Irwin, Inc., Homewood, Ill.

A FUNNY THING HAPPENED ON MY WAY TO THE MEETING: THE USE OF HUMOR AS A MANAGEMENT TOOL

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ABSTRACT

Budget cutbacks, potential and actual layoffs, changing technology and the constant demand to increase productivity and quality while resources are diminishing, all add to the everyday stress level of information technology departments. In this environment, it is important that IT professionals develop skills to avoid burnout as individuals, and strategies for creating an environment in the IT organization that is motivating, healthy and humane. This session will focus on the use of humor as a set of learned skills that relieve tension in the face of relentless change and enable IT managers to improve communications, resolve conflicts, increase productivity, and enrich the overall culture of the organization.

A FUNNY THING HAPPENED ON MY WAY TO THE MEETING: THE USE OF HUMOR AS A MANAGEMENT TOOL

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In their book entitled *Lighten Up: Survival Skills for People Under Pressure*, C.W. Metcalf and Roma Felible define humor as:

> ". . .a set of survival skills that relieve tension, keeping us fluid and flexible instead of allowing us to become rigid and breakable, in the face of relentless change."(1)

If we view humor in this way, we come to understand several very important concepts. First, a sense of humor is not about jokes or joke telling. It is a skill set. Secondly, since humor is a set of skills, it is not innate. We are not born with a sense of humor. As a result, the set of skills that we call humor can be developed or learned on both a physical as well as a psychological level.

IMPORTANCE OF HUMOR AS A SET OF LEARNED SKILLS FOR THE INDIVIDUAL

Psychoneuroimmunology or PNI is the medical discipline that studies the connection between psychology, neurology and immunology. PNI studies have shown that the brain, on a biochemical level, cannot tell the difference between events that are real and events that are imagined. In addition, PNI research indicates that "prolonged stress may cause not only a direct attack on the organs [of the body]..., but may also [have] a direct and measurable effect on the immune system." (2)

The reason for the connection between prolonged stress and the human physical condition harkens back to the days of our prehistoric ancestors and what has been called the "flight or fight" syndrome. Medical research indicates that when the brain perceives a threat, the following physical reactions occur:

(1) Adrenaline amounts rise to give the body more fuel and energy;
(2) The pupils of the eye dilate so we can see better;
(3) The mouth goes dry;
(4) Digestion temporarily stops so that more blood can

flow to muscles;

(5) The neck and shoulders tense up to better ward off blows;

(6) Breathing rate increases to send more oxygen to muscles;

(7) The heart beats faster and blood pressure rises;

(8) Perspiration increases to cool the body;

(9) The liver releases glucose for energy;

(10) The spleen releases stored blood cells and cortisol, a blood clotting agent; and

(11) Lactic acid rushes to the muscles for added strength.

In prehistoric times when the tiger was at the door of the cave and our ancestors correctly perceived a threat to life, this physical reaction was appropriate. The biochemical changes in the body enabled them to stand and fight the tiger or flee. Regardless of whether they fought and won or fled, they used the physical strength achieved through the body's reaction to threat, and then relaxed when the situation was over so that their bodies returned to "normal" until the next threat to life occurred.

Today, our bodies still have the same biochemical reaction to "perceived threats" or stress. Unlike our ancestors, however, we don't use all of the physical strength provided through the flight or fight mechanism when are bodies are aroused, and continued exposure to stress can be extremely damaging to our physical and psychological well being. The results of prolonged periods of biochemical stimulation are often real physiological problems such as ulcers, chronic muscle tension, respiratory problems, chronic blood pressure problems and immune system dysfunction.

There are five "antidotes" which can be prescribed to help the individual develop a set of humor skills to counteract the physical and emotional impact of stress.

Rx #1: Learn To Overcome Fear of Failure on the Physical Level.

As Metcalf and Felible point out, each of us dreads appearing foolish because "foolishness can lead to ridicule, and ridicule, to loss of status or--in the most terrifying extreme--exile."(3) No one wants to look foolish, but no one ever died from looking foolish either. If we can learn to stop worrying about how we appear to others, we can come a long way toward minimizing the day-to-day stress that fills our lives. Fostering the ability to laugh at ourselves when we do foolish things and to even purposely make ourselves look foolish when it is "safe" to do so will help us to alleviate the stress that comes from this fear.

Rx #2: Learn to Laugh.

Martin Luther has been quoted as saying "If you're not allowed to laugh in Heaven, I don't want to go there." C.W. Metcalf, Norman Cousins and others who have documented the "healing power" of laughter would likely agree because their research indicates that smiling and laughter are physically, as well as emotionally, beneficial. Laughter decreases heart rate, lowers blood pressure, increases blood flow to the brain, and releases endorphins - the natural pain killer produced by the body to stimulate the body's immune system. The odd thing about laughter is that we tend to "out grow" it as we get older. Children laugh much more often than adults. We can "relearn" the skill of laughter, however, through techniques such as thinking of things that made us laugh in the past, renting comedy videos or going to the movies, reading funny books, etc.

Rx #3: Learn to See the Absurdity in Difficult Situations.

Most of us realize that, scientifically, we are NOT at the center of the universe. Yet, many of us react to situations in our personal and professional lives as if we WERE at the center--as if everything in the world revolved around our abilities to complete projects on time, to say the right things to the right people, or to perform as others would have us perform. If each of us can develop the ability to see that such an egocentric view of the world is really absurd, then we can come to realize that the consequences we often fear are blown out of proportion, thus reducing the stress we feel.

Rx #4: Learn to Take Yourself Lightly and Your Seriously

As Elsa Maxwell so aptly said, "Laugh at yourself first, before anyone else can." Most adults have been programmed over the years to take themselves way too seriously. We each grew up hearing things like: "When the going gets tough, the tough get going"; or "Grin and bear it"; or "No pain, no gain"; or, my all time favorite, "Wipe that smile off your face and get serious." To survive in these stressful times, each of us needs to learn to separate ourselves from our work or other stressful situations and "lighten up." We need to learn that we can be serious ABOUT our work without taking ourselves so seriously.

Rx #5: Develop a Disciplined Sense of Joy in Being Alive.

This prescription is closely related to our ability to take ourselves lightly while taking our work or other things around us seriously. When we take ourselves too seriously, we can become depressed and inwardly focused. While there is definitely such a thing as clinical depression, most of us do not suffer from it. What we suffer from is really a "negative" attitude. When we get "down" or depressed because of situations that appear to be outside of our control, we need to remember that happiness is a conscious choice, not an automatic response. We need to remember that, even when it appears that we have no choice, we always of the choice of attitude.(4)

C.W. Metcalf and other humor specialists suggest a number of "tools" for individuals to increase individual personal sense of humor. Among these tools are:

* *Books and tapes* - Find authors, humorists, or movies that make you laugh and then read or view their work on a regular basis. Keep some of these books or tapes in your office so that you can reference them as you need to.

* *Draw the line* - Find ways in which to both physically and mentally separate yourself from your work or your office for breaks or at the end of the day.

* *Joy list* - Compile a list of things, events or people that bring joy to your life and write them down. Keep the list with you to reference when the stresses of work or life make you forget that there are many things that make you laugh, smile or just feel good.

* *Humoraerobics* - C.W. Metcalf has coined this term for "physical and mental exercises that enhance humor skills."(5) Making faces, silly noises, peculiar gestures, etc., are part of the humoraerobics exercise plan.

* *Photo funnies* - Spend a couple of dollars and have your pictures taken in one of those instant picture booths that are still to be found in Penny Arcades and other amusement areas. Close the curtain behind you and make the craziest faces you can think of. Stick the pictures in your briefcase or desk drawer for "future reference." No one else needs to see these pictures, but you'll smile every time you think about the experience.

HUMOR AS A TOOL FOR MANAGERS IN THE IT ENVIRONMENT

> "If you are not having fun doing what you are doing, chances are you are not doing the best you can do. And the same is true for others. . . Every moment cannot be fun, but the overall experience can be."(6)

Fun is not, nor should it be considered, a "perk." More and more companies are realizing that there are actually business reasons for incorporating the concept of fun into the way in which they do business. Southwest Airlines, for example, derives their organizational culture from the following three core values:

> "Value 1. Work should be fun... it can be play enjoy it.
>
> Value 2. Work is important...don't spoil it with seriousness.
>
> Value 3. People are important...each one makes a difference."(7)

At Southwest Airlines, a sense of humor and caring are criteria for employment.

Fun in the workplace can be beneficial to the "bottom line" for a number of reasons. First, fun can be used to avoid or manage conflict. In his book, The Light Touch, Malcolm Kushner says that humor can

> "provide a velvet glove around the iron fist of authority. A request for cooperation phrased in a funny way--a humorous hint--can eliminate resistance and resentment caused by direct order. Humor cushions the blow." (8)

When conflict does arise, Kushner says that

> "humor can buy time until a solution presents itself . . . .Humor [is] particularly useful as an 'interrupter' - a message designed to prevent assertive behavior from becoming aggressive."(9)

Secondly, fun can be used to motivate employees and improve productivity. James M. Kouzes & Barry Z. Posner provide support for this theory in their book The Leadership Challenge: How to Get Extraordinary Things Done in an Organization. They state:

> "Systematic studies indicate that people communicate their expectations primarily by the character of the socioemotional support and encouragement that they provide people. Treating people in a friendly, pleasant, and positive fashion and being attentive to their needs produce increased performance because of the favorable effect on employee motivation."(10)

Howard R. Pollio from the University of Tennessee at Knoxville has done studies on humor and increased productivity. His studies indicate that if employees are having a good time they will "stick with it longer." He states that "if people enjoy their jobs, have fun, and laugh together, they'll probably form a tightly knit group that works well together."(11) People simply work harder and are more productive when they are having fun.

Third, fun in the workplace helps to improve morale. As Kushner states, "Humor makes people step back and say, 'It ain't so bad. We may have problems in our work, but we can handle them.'"(12) Shared laughter builds team spirit and, when disaster or crises strike, the ability to laugh rather than cry puts the disaster into perspective, allowing people to continue being productive.

Finally, fun in the workplace provides relief from stress for the entire workforce just as it does at the individual level. Where people can release tension through practical jokes, celebrations, laughter, and play, they can remain flexible and fluid to meet the stressful challenges that are becoming more and more a daily fact of work life.

Tools for introducing humor into the workplace and maintaining it there include:

* *Celebrations* - Find ways to celebrate the joy of working in your institution. Invite employees to identify the types of events they would like to celebrate and their preferred methods of celebration. As you introduce celebrations to the organization, it is important to remember that you must celebrate often, and do not stop celebrating when things "get tough." It is during the touch times that it is even more important to celebrate the small victories that indicate success and forward momentum.

* *Rewards and recognitions* - Find people doing "something right" and reward them for it. People do what they are rewarded for doing and rewards/recognitions can be fun. Again, it is important to involve employees in the development of reward and recognition programs so that such programs are meaningful to them.

* *Self-effacing humor from the top* - Good leaders have a sense of humor and know how to use it. In fact, the "ideal boss" has been described as "demanding and caring, challenging and supportive, intense and playful." (13) Humor can only work in an organization when the leadership (at all levels) is willing to lead the charge and to demonstrate that it is okay to have fun at work.

* *Visual demonstrations of humor* - One of the easiest ways to send the message that it is okay to have fun at work is through visual displays of humor. Funny posters, cartoons, and office decorations can be used to telegraph the message to employees that the workplace need not be dull or boring.

CONCLUSION

Metcalf and Felible assert that:

> "Humor can help you thrive in change, remain creative under pressure, work more effectively, plan more

> enthusiastically, and stay healthier in the process. But the skills have to be practiced until they're a habit, a part of your routine. . . . Humor is a set of skills, [and] it is also an outlook on the world."(14)

Despite the fact that most of us, as individuals, would agree that we work harder and feel better when we are having a good time, many IT managers and CIO's don't make the effort to ensure that the IT workplace is full of fun. There are several reasons why this may be so. Some IT people may feel that it is "unnatural" for them to display a sense of humor at work. Many may feel that it would somehow diminish their stature as "executives" in the organization, or that they have too many "important" things to do to worry about inserting fun into the work environment. Still others may doubt the real bottom line benefit of fun in the workplace.

In this era of budget cutbacks, potential and actual layoffs, changing technology and the constant demand to increase productivity and quality while resources are diminishing, IT leaders can ill afford to ignore any approach or technique that will help to reduce stress and increase productivity in the workplace. We have to abandon the belief that our problems can only be solved if we just "get tough enough, work a little harder and get really serious." It costs relatively nothing to reintroduce fun into our daily work environments, but the payoffs can be astronomical.

Footnotes:

1. C.W. Metcalf and Roma Felible, *Lighten Up: Survival Skills for People Under Pressure* (Reading, Mass: Addison-Wesley Publishing Company, Inc., 1992) p. 9.

2. Ibid., p. 49.

3. Ibid., p. 45.

4. Judith M. Knowlton, as quoted by Ann Wilson Schaef. Meditations for Women Who Do Too Much (San Francisco: Harper & Row, 1990) p. 118.

5. Metcalf and Felible, p. 52.

6. James M. Kouzes & Barry Z. Posner, *The Leadership Challenge: How to Get Extraordinary Things Done in an Organization*, (San Francisco: Jossey-Bass, 1987) p. 53.

7. J. Quick, "Crafting Organizational Culture: Herb's Hand at Southwest Airlines," *Organizational Dynamics*, Winter 993, 45-56.

8. Malcolm Kushner, *The Light Touch* (New York: Simon & Schuster, 1990), p. 116.

9. Ibid., p. 114.

10. Kouzes and Posner, pp. 243-244.

11. Howard R. Pollio as quoted in Kushner, p. 128

12. Kushner, p. 124

13. Kouzes and Posner, p. 262

14. Metcalf and Felible, p. 5.

Now That I've Empowered My Staff, What Do I Do?

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Abstract
What is the impact on managers of implementing a teams environment? The usual line on teams is that the manager stops making decisions, stops giving orders, and becomes more of a "coach." Unfortunately, this coaching concept is typically not very well defined. Few reasons are provided as to why a manger might see this as a beneficial career move! In this paper, we will explore a new role definition for a manager as team "advisor" or "advocate" in order to give a manager facing the prospective deployment of teams some sense of what she/he may actually be *doing* in the new teams environment and how that is a desirable thing.

Introduction

There is a management revolution gaining momentum in this country and its name is teams. The wholesale downsizing of the private and public sectors over the past several years has served as a sort of shock therapy to the workforce. Job security is a thing of the past. Employee loyalty has been shattered. Workloads are up dramatically as we all have to do more with less. Opportunities for advancement are limited. Our organizations have been forced to re-examine their basic goals and operating principles in order to compete in a global economy and keep the workforce effective and productive.

Much has been written about this state and several movements have emerged to help address these challenges, including the quality movement spawned by Dr. W. Edwards Deming[1] and its Total Quality Service off-shoot, the stewardship movement (Block), the entrepreneurial management movement (Osborne and Gaebler), and the reengineering movement (Hammer and Champy). One of the common threads that runs through all these is the need to get the most out of the workforce by establishing empowered work teams. Many managers believe that "teams" merely represents the latest management fad and will pass along with all the others leaving the status quo. We believe this view to be short-sighted at best and self-serving at worst.

Much has also been written about teams; most of it focusing on the effectiveness gains that are possible, the quality improvements that can be made, the reduced overhead and competitive advantages that can result, and quality-of-life gains for the work force. However, what about the impact on managers?

The literature generally focuses on managers as expendable, no longer needed in the new empowered team workforce. In fact, management is routinely identified as the largest single obstacle to achieving the benefits promised by a teams environment (Manz and Sims, Business 23). We suspect there are two reasons for this. First, an effective teams environment reduces the need for managers in the classic sense. (It's worth noting that the managerial ranks have already been thinned steadily as a result of downsizing over the last 10-15 years.) Secondly, there has been too little focus on the role the manager *should* play in the new environment. The tendency to resist change coupled with the failure

[1]The Deming Library. Videotape. Prod. and dir. Claire Crawford-Mason, nar. Lloyd Dobyns. Films Incorporated, 1992. 21 videotapes.

to articulate effectively the new managerial role makes it understandable that managers might resist the teams movement.

The typical description of a teams environment is one in which the manager stops making decisions, stops giving orders, and becomes more of a coach. Unfortunately, this coaching concept may not be very well defined in any specific way. In addition, there is no clear reason given for why a manager might see this change as beneficial to his/her career. This article will explore the new developing role for managers in sufficient detail to give a manager facing deployment of teams some sense of what she/he may actually be *doing* in the new environment and how that job can prove to be a desirable, enriching experience.

Teams Environment

There are three kinds of teams typically discussed:

- *quality circles*--groups of employees focus specifically on quality problems in delivery of the products or services the organization produces;
- *Total Quality Service (TQS) teams*--groups of employees focus on business activities as a set of processes that can be incrementally improved; and
- *self-directed/self-managed teams*--groups of employees manage themselves collectively and assume responsibility for many of the traditional managerial functions, such as, performance appraisals, disciplinary actions, and budgets.

The three types of teams share common conceptual underpinnings and build upon one another. Quality circles were the first to gain popularity in the early 80's, but are more or less considered passé today. Manz and Sims consider the latter two (TQS and self-directed teams) a particularly powerful combination (Business 207). Quality circles recognize that it's the people who do the work who best know how to fix problems. TQS teams build on and extend the quality circle concept to recognize that a problem may be the result of more systemic issues, requiring a look at the entire business process to address the fundamental problem. Self-directed teams go one step further to recognize that the processes themselves are affected by the organizational structures we build and the mindsets of the people within them.

Each type of team involves some degree of change in the traditional perception of the manager as the person having the most expertise and who rightfully should make all the decisions. In quality circles and TQS teams, the existing organizational structure is usually retained, thus leaving the existing power structure in place. Thus these two team types are fundamentally *evolutionary* in nature. However, self-directed teams challenge the basic power structure: the right of the manager to make decisions and to be in control. This makes them fundamentally *revolutionary* in nature (Manz and Sims, Business 211). We will focus on the new role of the manager within a self-directed teams environment as we believe that is where the teams movement is going.

High School Management Model

Traditional management is based upon what we call the "high-school management model." We contend most organizations have been managed like high schools. They have traditionally been run by a professional staff of hierarchical authority figures (teachers/managers) who ensure that everything runs smoothly, that everyone is where they are supposed to be at the appropriate time (time clocks/bells), that no one is goofing off, and that property is not stolen or damaged. These authority figures tell everyone what to do and how to do it, and are responsible for creating and enforcing "the rules." The students/workers compete with one another and cannot be trusted to work on their own or to make their own decisions. They receive grades (performance reviews) and are punished if they make a mistake or violate the rules.

Unfortunately, the above describes too many of our organizations. Is it any wonder we have seen so much childish behavior in the work place? A first job experience at a large insurance company located in the midwest illustrates this point. This company rang bells to signal the start and end of the work day and start and end of the lunch period--reminiscent of school class periods. Employees were not allowed to leave their desks early. Grown men in three-piece suits cleared their desks five minutes before quitting time and waited for the bell with their hands folded on their desks. Once the bell rang, they literally *sprinted* to the parking lot to get ahead of traffic! You can believe that this company got *zero* additional time or effort from these individuals as they were simply not engaged in what the business was all about. This experience taught a valuable lesson: if we *treat* people like children, they will *behave* like children.

Teams Management Model

The teams approach is about treating people like adults; recognizing that work is a voluntary activity and that everyone wants to enjoy and take pride in her/his work. Dr. Deming makes this point a hallmark of his philosophy[2]: that there is intrinsic value to work and people want to do a good job. We need to ensure organizational processes support workers' ability to do a good job and ensure employees' ability to affect the outcomes of their efforts. If the processes do not allow workers to do a good job or if workers are unable to affect the outcomes, they become disillusioned and disengaged...they become like high school students again.

In treating people like adults, the teams approach recognizes that each person has a critical role to play in the delivery of the organization's products and services. It also recognizes that each person--once he/she is trained--is in the best position to understand the details of any process and serves as the best source for identifying ways to improve each process. The teams approach recognizes that a synergy occurs when everyone is working together towards a shared goal and everyone understands the issues and challenges involved in meeting that goal.

The Manager Psyche

We managers have a vested interest in maintaining the status quo. We have all grown up in the traditional hierarchical system and, indeed, have prospered by it. The unpleasant truth is that we tend to like to control others, like the notoriety of being the decision-maker, and enjoy the special status being a manager provides. Thus managers are often *not* thrilled at the prospect of giving up control and sharing decision-making and the limelight with others (Manz and Sims, Business 202). It challenges our view of ourselves as important and necessary to the organization. It can be a serious blow to our egos to recognize teams can do the job--and usually do it better--than we can. These provide some powerful reasons why managers might resist the implementation of teams.

An early formal teams training experience--where a new team was being introduced to a pair of tools, brainstorming and multi-voting--provided a object lesson on the power and value of teams. One of the participants was knowledgeable about the topic being discussed and contributed a number of ideas in the round-robin technique being used. There were many other contributions, however, and when it came time to vote for the best alternatives, he did not vote for a single one of his own ideas! He was forced to admit his ideas had simply not been as good as those generated by the rest of the team.

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[2]The Deming Library. Volume 15.

The Manager's New Role
Is there anything positive the teams environment has to offer managers from the old hierarchical structure? We believe the answer is yes, however, the role and environment is significantly different from the one they have been used to (Manz and Sims, Super 206). A good way to underscore this is to abandon the title of "manager" and adopt something different such as "team advisor" as suggested by Manz and Sims or perhaps "case manager" as suggested by Hammer and Champy. "Advocate" is another possibility.

The traditional managerial roles are simply not needed in the new teams environment. Those managers who define their role in the organization simply on the basis of control may not make the transition to the new order. However, managers who define themselves on the basis of leadership, advocacy, the removal of barriers, facilitation, coordination, and the development of staff should make the transition to teams smoothly since they already possess the appropriate mindset for a teams environment. In the following paragraphs, each of these elements will be described.

Leadership--providing direction for the organization; establishing a vision. People don't want to be managed, they want to be led(Manz and Sims, Super 99). We assert this has always been the most important role of management. Teams have shown that they can manage themselves on a day-to-day basis thus freeing management's time to concentrate on moving the organization to where it needs to go. Whether we like it or not, change is the one given in today's organizations. Nothing will kill an enterprise faster than stagnation. The following metaphor evokes how many of us feel today: life in the 90's is "permanent white water[3]." Forget the idea of shooting the rapids and coming to a area of calm where we can collect our senses before hitting the next stretch of rough water; we're in an environment of constant change: permanent white water. Leadership has never been more important than it is today and teams can release managers from the imperatives of daily crises to focus on determining where the winds of change will take the organization and how it can profit from those changes.

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[3] Taking Charge of Change. Videotape. Prod. Kirby Timmons and Melanie Mihal. Dir. Jeff Brady. CRM Films, 1992. 20 min.

Advocacy and Removal of barriers--battling the bureaucracy, forming partnerships, and overcoming negativism to advance team goals. A leader in an organization needs to "clear the way" for progressive ideas to be implemented. As Hammer and Champy point out, many barriers are erected against new ideas in any organization (28). A worker comes up with a new idea that he feels has merit and takes it to his boss. If she likes it, she takes it to her boss, and so on. Anyone along the chain of command has veto power; any single "no" can kill it. Conversely, look at all the "yeses" that must be garnered in order for the idea to go forward. Is it any wonder our organizations stifle creativity? There is a role for advocacy and removal of barriers that the team advisor can play. This role requires someone who is articulate, who is skilled in consensus-building, who can help explain and sell an idea, who can line up the necessary resources, and who can keep the idea from getting stalled in the bureaucracy.

Facilitation, coordination--help the team find solutions to problems and coordinate activities between teams. There is a role for facilitation and coordination that is crucial to the group process. The team advisor can be tapped to assist the team as they see fit. Not someone to give them the answers, but someone who can help them find the answers on their own. Additionally, coordinating activities with others in the organization to ensure a smoothly operating enterprise.

Development of staff--help staff members continue to progress in their careers. There are many developmental opportunities in the teams environment. Team members are called on to perform functions and roles they have had little or no experience with or expertise in: budgeting, conflict resolution, providing feedback, dealing with different communication styles, and differing levels of interpersonal skills. Ongoing training is needed to help develoip members of the team . They also need access to someone who can serve a mentor role and help individuals develop needed expertise. Technical skills can be provided by the team, but they will need help from outside the team to develop these additional skills.

It should be noted that the above elements for the new "team advisor" position were also key in the traditional managerial role. The difference is that, in the teams environment, it is the team's choice to involve the team advisor or not as they see fit. Or perhaps find another team advisor that better fits their needs. The hallmark here is empowerment and choice. In the new power structure, teams are in the driver's seat.

Conclusion

Managers in the old traditional hierarchical structures have nothing to fear, per se, from the introduction of teams. Change is coming to our organizations. It is being driven by the expediencies of downsized organizations and increased competition. The old hierarchical command and control organizational structures are no longer effective in today's global market and enterprises.

The work force is demanding and receiving a say in how their organizations are run. This is not altruism on the part of management, but rather a recognition there is a better way of doing business. This is truly a win-win situation as everyone comes out ahea--including the former managers, if they understand what their role can become. Those managers who are control-oriented may not survive the transition...but their days were already numbered. Teams will only hasten the process as we transform our organizations into more enlightened institutions that treat people like adults with productive and innovative contributions to make.

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Project Implementation Using a Team Approach

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Lafayette College is a small, private liberal arts college in Easton, PA. The administrative activities of the College are supported by the five member staff of Administrative Computing Services who provide software programming, analysis and training to administrative personnel. In the fall of 1993, Administrative Computing began the process of evaluating commercial software to replace the hybrid home grown/commercial software that had been in use since 1983. In February of 1994 a package was chosen and the process of converting the old system to the new was begun. The Team method of implementation was chosen for this 18-month project. What makes this implementation unusual is that this five-member team is self-directed; there is no formally appointed team leader or project manager. This presentation will serve to share our experiences to date working as a self-directed team; where we have been successful and why, as well as the problems we have encountered along the way and what we have done toward their resolution.

Introduction

Lafayette College is a small to medium size private undergraduate-only liberal arts college in Easton, Pennsylvania. The College's curriculum is distinguished by the rare combination, on an undergraduate campus, of degree programs in both the liberal arts and engineering. The full-time student enrollment is approximately 2000, with faculty and administrative staff numbering approximately 500.

In 1980, the College decided to stop using a local service bureau in favor of in-house processing using a commercial, college-oriented software package. This software has been extensively modified over the past thirteen years with additional modules developed in-house using the development tools present within the package.

In the Fall of 1993, the College decided to evaluate other commercial software packages in order to take advantage of current and future technologies to better support the activities of the College. In February 1994, after extensive evaluation of the available software packages that would run on DEC equipment, a decision was reached and the software was purchased.

The primary objectives of this acquisition were to improve student services through integrated administrative systems, provide consistent information throughout the campus community and to assist the user base in receiving timely information to support their decision-making capacity. This project was started in March of 1994 and encompasses the following: the installation of new hardware and software, training (both technical and user), conversion of existing data, evaluation of work flows in each functional office with an eye toward maximizing efficiency, system and parallel testing and cutover to the new software.

This project will initially affect every administrative area of the College. The systems to be implemented include Student (Admissions, Registration and Student Billing), Alumni, Financial Aid, Human Resources and Finance. The estimated length of time to complete this project is 24 months with the implementation schedule calling for the final module to be implemented by July of 1996.

The Administrative Computing staff is composed of five programmer/analysts who have been with the College five to ten years. Prior to the start of the current project each staff member was assigned to one or many functional administrative areas with very little overlap. For example, one person was assigned to support the Alumni and Development offices as well as the Registration area, another the Human Resources, Admissions and Recruiting offices, a third the Student Billing, Payroll and Financial Aid offices as well as some system management tasks, the fourth person handled Business Office requests (Accounts Receivable, Endowment, and other financially-oriented areas). The fifth person was responsible for developing and maintaining projects that distributed Administrative information (student schedules, transcripts, department budgets) on the campus-wide information system for use by students, faculty and staff. Requests for software modifications, enhancements or new development would be reviewed by the Director and then typically assigned to the appropriate staff member to complete. There was very little collaboration between staff members on projects since a typical request wouldn't involve more than one functional area. Each person was responsible only for their own work and usually didn't need to rely on anyone else for assistance.

Typical Project Management Scenarios

In most projects of a medium to large scope there are defined leadership roles. Some of these roles have been called project leader, project manager, team leader, and systems analyst., among others. As some of these titles suggest, there are leadership activities that are handled by these people in an effort to schedule resources, manage and coordinate tasks, as well as just plain keeping the project running (hopefully) smoothly and on-schedule.

Responsibilities of a Supervisor

- Transmit information, knowledge, and skills, in a timely manner to project members
- Interpret and apply policies and work specifications for the project members
- Teach project members how to manage work processes effectively and evaluate results
- Establish communication channels between departments and project members in order to eliminate duplication of effort
- Support goals of the project to internal and external customers
- Troubleshoot for project members in areas of expertise
- Track and communicates progress to management
- Serve as a mediator in conflicts
- Schedule resources in the most efficient manner

(Harrington-Mackin, 1994). While this list is by no means exhaustive, it does give a glimpse into what the skills are that need to be present in order to manage a project effectively.

Lafayette College's Team Approach to Project Management

While the use of teams to accomplish tasks is by no means a new concept, the manner in which we have decided to use this model is somewhat unusual; we have no permanently assigned team leader. We are what is called a "self-directed work team". What makes this interesting is that we didn't start out to be self-directed work team - it just evolved from the existing staffing structure.

In an effort to understand where we were heading, some research turned up the following:

Self-Directed Work Teams Description

- Comprise an intact team of employees who work together on an ongoing, day-to-day basis and who are responsible for a "whole" work process or segment
- Assume "ownership" of product or services and are empowered to share various management and leadership functions
- Are limited to a particular work unit
- Function semi-autonomously; are responsible for controlling the physical and functional boundaries of their work and for delivering a specified quantity and quality of a product or service within a specified time and at a defined cost.
- Are all cross-trained in a variety of work skills
- Share and rotate leadership responsibilities; team members have equal input in decisions
- Accept the concept of multiskills and job rotation (except for jobs requiring years of training and technical expertise)
- Work together to improve operations, handle day-to-day problems, and plan and control work
- Set own goals and inspect own work; often create own work and vacation

schedules and review performance as a team

- May prepare own budgets and coordinate work with other departments
- Usually order materials, keep inventories, and deal with suppliers
- Are frequently responsible for acquiring new training and maintaining on-the-job training
- May hire own replacements and assume responsibility for disciplining own members
- Monitor and review overall process performance

Most self-directed work teams gradually take on responsibility for these tasks as they gain confidence in their own skills and are able to redefine the role of the supervisor. The shift to self-direction represents change, and with change comes resistance. (Harrington-Mackin, 1994)

An excellent point made by Harrington-Mackin is that this shift in direction is change and that change is always accompanied by resistance. Even though we were all enthusiastic about the new project, resistance managed to rear its ugly head more than once.

When the project began it became obvious that there would be new technical areas of interest. In an effort to maximize our effectiveness, the Director of the department surveyed the staff to find out what areas interested each person with the end objective to be the assignment of an area or areas to each individual. This individual would then become the "specialist" for that area and receive more advanced training than the others in order to become the expert in that area. While this was a great idea in theory, we all soon found out that not everyone could have the area they wanted and this contributed to some tension for a short time. Initially there were some "turf" struggles - especially in those areas that overlapped. Both ends of the spectrum emerged - some people wanted to do their "own thing" and protected their knowledge zealously, others felt some task or the other really belonged to the other person and couldn't understand why the other person didn't see it that way. A big factor in these turf wars seemed to be personalities and egos. Suddenly we were all equals in our technical knowledge. Seniority didn't guarantee "expert' status anymore and while this was refreshing it was also nerve-wracking at times.

Eventually these problems dissipated as everyone settled into their new role; we all soon found out that there was more than enough work to be done by all and that there was no chance that anyone was going to be left behind in their technical knowledge. It also became clear whose strengths could be used positively for the team and what weaknesses had to be worked on. While this change was positive in some respects, it also had a negative side.

Since the implementation schedule was based on the processing requirements of the school year, we had to adhere to the timeline pretty strictly. Everyone was so busy keeping up with the aggressive schedule that there were times when people who needed help with something were told by others that they didn't have time to help. Tempers flared when people believed that the other team members had no appreciation of the pressure that was on them to complete a task for a deadline. It became evident that these situations were due, in large part, to miscommunication between team members.

Prior to this project we had held weekly staff meetings that allowed each person to give a brief review of the projects they were working on and share any new things they had learned that might help someone else. Since we were so busy trying to keep up with our tasks these meetings fell by the wayside which resulted in additional "people" problems. This lack of communication resulted in many misunderstandings between people about their responsibilities. In order to alleviate this problem we re-instituted the weekly meeting with a formal agenda published in advance with input from all the team members on the topics to be covered.

Vendor communication was also an issue that we had to resolve. Initially there was one person designated as the vendor contact on training issues. As the project progressed there became more vendor issues that had to be resolved and no one was sure who was handling what. In this situation, as in so many others, it became clear whose personal strengths best suited the task and this person became the vendor contact on non-training issues.

The turning point for the team actually came six months into the project. During a team meeting a member brought up an excellent point about our method of operation; it needed a mind-shift. We were trying to operate as a team in the same manner we had worked on individual projects. Prior to this project we never had to rely on each other or wait for someone to accomplish something in order for someone else to move on. Although it was something we knew at a logical level, we finally realized that other people depended on us - and that dependency brought added responsibility to the other team members. A breakthrough! We were actually starting to think AND work as a true team - not just a bunch of individuals.

A final difficulty that we needed to resolve was keeping the "big picture" in mind while tracking the progress of the project. We finally had to admit that since we were so busy at the detail level of administering this project we needed someone else to keep track at the macro level. We brought this up to the Director and he agreed that we needed additional support in this area. In order to improve this area he agreed to have bi-weekly individual status meetings with each team member to discuss their current goals and the progress made toward meeting these goals/deadlines. This has helped keep him in touch with where we are as a team as well as head off any potential conflicts before they escalate.

If We Had To Do It All Again

This project is still underway; we have another 18 months until the last module is installed. We have come a long way in the past six months and I'd like to believe that the worst is behind us. However, being a few months older and feeling years wiser, the following recommendations may help other institutions considering using a team approach to project implementation.

- Understand what you are getting into BEFORE you begin. Read some books on team building, attend some seminars, talk to other people using teams.
- Realize that some personality types are not well suited to team work - consider the people you intend to have on the team carefully
- Management must support the team openly and without reservation, including empowering the team with the authority it needs to accomplish the designated tasks
- Identify the roles needed by the team and allow each member to be flexible in these roles. Example roles include facilitator, scribe, timekeeper, single point of contact (SPOC), etc. Participative leadership is a requirement of an effective team. All team members must develop team leadership skills. The facilitator must neither dominate the team nor decide team rules alone (Harrington-Mackin, 1994).
- Team work is risky business - understand that it will take longer than you think for the team to be an effective working unit
- Communicate, communicate, communicate. Meetings are necessary - not time wasters.
- Set clear agendas for your meetings and stick to them. Distribute agendas in advance. Make it clear that all are expected to participate - the facilitator of the meeting must make sure that no one dominates the meeting.
- Realize that conflict will happen - anticipate what methods will need to be used to

resolve conflict

- When identifying tasks to be done make it clear whose responsibility it is to complete the task, when it has to be completed and who is dependent upon that task being completed. We found that posting these tasks in a prominent area helped remind people of their outstanding tasks.

Conclusion

The experiences we have had working as a self-directed team have been enlightening to all of us. While Lafayette still has a long way to travel before this project is complete I believe that the lessons we have learned in the past six months have made us more valuable - to each other and to the College whose activities we support. Team work has been frustrating, maddening and crazy but it has also been very rewarding and mind expanding.

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Restructuring a Large IT Organization: Theory, Model, Process and Initial Results

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Abstract

The Division of Information Technology at UW-Madison (a recent merger of academic computing, administrative computing, and telecommunications) has completed a thoroughgoing reorganization following the structural model and participative design process of consultant N. Dean Meyer. This represents the first application of this approach in education, encompassing a staff of over 600 people.

The model defines four basic types of activities in an IT organization. It separates these activities into distinct units to avoid common problems, such as conflicting demands and technological bias, that beset most organizations. This approach creates greater specialization and expertise, but at the requirement of better communications--most work is done in teams of complementary specialists. One key to success is to provide clear horizontal communications between units. Another is to use "contracting" to define clear roles and responsibilities. Equally important, however, is a change in organizational culture to emphasize entrepreneurship and quality service.

Based on the model, DoIT's design is a flat organization that bears little resemblance to the original. There is now exactly one locus for each activity and a clear picture of where new activities should be implemented. The structure can support frequent changes in both technology and customer needs without structural dislocations.

Restructuring a Large IT Organization: Theory, Model, Process and Initial Results

Background

A committee of UW-Madison faculty and staff was formed in 1988 to study information technology directions for the campus. Among the committee's recommendations was the creation of a Division of Information Technology (DoIT), comprising the existing Administrative Data Processing (ADP), Madison Academic Computing Center (MACC), and Telecommunications departments. The merger was expected to

- Provide campus-wide information technology planning.
- Improve instructional technology.
- Expand student access to information technology.
- Increase computing support for research.
- Provide better access to institutional data.
- Merge services to avoid unnecessary duplication.

The committee further recommended the appointment of a Chief Information Officer (CIO) to lead this new organization. The new DoIT includes about 400 permanent staff and 200 student and limited-term employees. The new CIO, Mark Luker, was hired in July, 1992.

Goals

One expectation for the CIO was to transform DoIT into a cohesive unit. This began with the preparation of a DoIT Strategic Plan, based on a method detailed by John M. Bryson in *Strategic Planning for Public and Nonprofit Organizations* (1988, Jossey-Bass). Top- and middle-level managers created a Strategic Plan for DoIT, published in March 1993, that identified the 10 most important issues for the division, in priority order:

- Improve information technology services to students.
- Facilitate access to data and information.
- Establish a technology architecture.
- Extend the network to the entire campus community.
- Improve customer focus.
- Develop and enhance campus partnerships.
- Enhance the campus backbone network.
- Develop an enterprise information architecture.
- Improve the timeliness of applications.
- Improve the campus Email system.

Making rapid progress on many of these issues required reorganization, such as improving information technology services to students. (The existing three organizations each provided some IT services to students, but there was some overlap and little coordination.) The need for reorganization and integration of network services was specifically recognized in the plan. (Both the academic and administrative computing units, for example, provided LAN services.)

DoIT decided to restructure in order to

- Meet the increasing information technology needs of UW-Madison (for example, expanding services to students in the areas of computer access and instructional technology).
- Sharpen the organization's focus on customer service and quality.
- Unify the organization with one mission and one culture.
- Create a high performance organization, strategically aligned to meet the information technology needs of the future.
- Reduce confusion among users, who were faced with several DoIT units offering similar and sometimes competing services.

As strategic planning neared completion, DoIT also began to implement Total Quality Management. This served as a starting point for merging the cultures of ADP, MACC, and Telecommunications. The first improvement teams were specifically designed to be cross-functional and include staff from the three organizations.

In the spring of 1993, DoIT adopted a theory, model and process for designing information technology (IT) organizations described by N. Dean Meyer in his manual, *Structural Cybernetics*. DoIT was pleased and surprised to find that Meyer's methodology was well suited to a university environment (and specifically to UW-Madison) and needed little adaptation. DoIT hired Meyer as a consultant to assist with several steps in the process. His experience with reorganizing other IT departments was invaluable and saved much time.

Theory

Meyer's philosophy for transforming an organization involves more than just moving to a new structure on the organization chart. It includes five dimensions.

1. Organizational structure--no redundancy or gaps in services and clear boundaries for each unit.
2. Internal economy--the systems of budgeting, priority setting, charges, and tracking, which determine what products are produced for whom and when.
3. Culture and values--organizational culture to include customer focus, entrepreneurship, and teamwork.

4. Feedback loops--rewards to encourage behavior that is in the organization's best interest.
5. Methods and procedures--standard processes used throughout the organization for conducting its business.

We saw the need to address all of these dimensions and followed the consultant's recommendation to begin with organizational structure and culture and values.

The design of the restructured DoIT is based on a set of organizational principles that are detailed in *Structural Cybernetics*, some of the most important of which are the following:

Each individual has a single functional responsibility. This is based on the principle that one person cannot be expert in more than one thing at a time. A person is more effective being an expert in one technology, for example, than being mediocre in a number of technologies.

Multiple units would not offer the same products or services; that is, no internal competition for services. For example, not having several groups provide LAN design.

Business specialists/technology generalists would be separate from technology specialists/business generalists. This would help to identify clearly the areas of excellence for each person/group.

Those responsible for daily operations would be clearly separate from those working with new technologies. Introducing innovation and maintaining reliable operations should be in different units.

Model

The new DoIT organizational groups are of four major types, based on the Structural Cybernetics theory:

Technologists These groups build inventive, state-of-the-art technologies and write articles on leading-edge software or systems design. There are two types of technologists: application technologists are responsible for data-specific systems, and base technologists are specialists in component technologies and off-the-shelf tools.

Service Bureaus These groups are dedicated to providing reliable and efficient operational services. There two types of service bureaus: machine-based service bureaus own and operate shared-use systems and sell services that are primarily produced by machines, and people-based service bureaus provide services produced by people rather than machines, such as help desk support and training.

Architect The Architect is responsible for assembling key decision makers on campus and defining an information architecture for the campus. This person will build a campus consensus for standards, guidelines, and statements of direction that constrain the design of systems for the purpose of eventual integration.

Consultants The consultants are responsible for understanding the client's business and applying methods of business analysis. There are strategic consultants, who serve key opinion-leaders on campus, and retail consultants, who are available to anyone on campus.

Organizational units that provide more than one of the above functions are called "rainbows." An example is a unit responsible for design, installation, and day-to-day administration of a LAN. This creates a conflict between innovation and ongoing operation. "Rainbows" should be limited to the highest level of the organization; individual units should be only one of the above types.

Process

The reorganization began in earnest in the summer of 1993. Some "ground rules" were established to encourage a healthy transformation:

- No reduction in staff would result from the restructuring.
- Salary reductions would be avoided whenever possible.
- The resulting organization would be "flatter" than the current structure.
- The organization would be designed with active participation of existing staff.
- The "Good Citizen" rule, which states that those leading the design of the new organization work for the best structure without regard to how it affects them personally.

The new DoIT was designed from the top down, with the CIO and the directors and assistant/ associate directors from the original three organizations designing the first level ("Tier 1"). Tier 2 was roughed out by the Tier 1 leaders chosen by the CIO, and reactions were requested from a larger group of supervisors and high-level technical staff.

Each design step was preceded by a training session with the consultant, with those trained at each step participating in the training of the next.

While the leaders of the new organization were spending many hours behind closed doors designing the new organization, there was regular communication with DoIT staff. In May, 1993, the CIO presented to staff an overview of the organizational design principles and the design process. Frequent updates were distributed by email in the summer and fall of 1993 and the winter of 1994. DoIT leaders continued to inform staff about the design and the schedule of events through a series of videos and structured management presentations. Staff were encouraged to submit questions directly to DoIT leaders and the DoIT Personnel Office or anonymously via an electronic mail address which disguised the sender. Answers to these questions were made available to staff on the division's internal gopher-based information server.

On February 28, 1994, DoIT was ready to announce its new organization to all its staff. This was done in an all-day event that served as training for "Tier 3", since the new organization has only two levels of management below the CIO office. Presentations were made by the Chancellor, the CIO, the consultant, and many of the new Tier 1 and Tier 2 managers.

Following announcement day, there was still much to do....

- Consultants spent a month or so getting out to all strategic clients to explain the new organization in person
- Two problems in rostering staff to the new units had to be considered
- Staff spent five half-days in more detailed training sessions in their new units
- Staff documented all existing work as formal contracts
- Minor changes were made in staff assignments to balance workloads better between groups

The New Organization

Tier 1 for the new organization contains the following units. Structural Cybernetics names are given first, with the names selected by DoIT units in parentheses.

Applications Technology

Applications Technology acquires, develops, and maintains data-specific application systems. This entails analyzing, designing, and building inventive, state-of-the-art systems; tracking emerging technologies; researching the abilities and uses of new products; writing articles on leading-edge products or systems design; and planning for future systems.

Architect (Architecture)

The Architect works with the University community to build a consensus on campus standards and guidelines for the design of hardware and software systems. Such systems will then (at least eventually) be able to inter-operate effectively, and the University can share training and experience. Agreed-upon standards and guidelines are documented, publicized, and periodically reviewed.

Base Technology--Platforms (Systems Engineering)

The Base Technology - Platforms unit acquires, develops, and maintains systems in the platforms, operating systems, data base management systems, and networks areas. This entails analyzing, designing, and building inventive, state-of-the-art technologies/systems; tracking emerging technologies; researching the abilities and uses of new products; writing articles on leading-edge products or systems design; and planning for future systems.

Base Technology--Tools and Disciplines (Tools and Methods)

The Base Technology - Tools and Disciplines unit acquires, develops, and maintains systems in the end-user computing, instructional technology, software engineering, and discipline areas. This entails analyzing, designing, and building inventive, state-of-the-art technologies/systems; tracking emerging technologies; researching the abilities and uses of new products; writing articles on leading-edge products or systems design; and planning for future systems.

Deputy CIO/Outreach

The Deputy CIO/Outreach shares the duties of the CIO by representing him outside the division. This includes providing campus leadership in information technology and working with state and national groups.

Deputy CIO/DoIT Operations

The Deputy CIO/DoIT Operations represents the CIO in the his role as provider of IT products and services. For example, the Deputy CIO/Internal brokers CIO decisions, including allocation of resources (e.g., budgets, FTEs, and profit/loss targets).

Machine-Based Service Bureau (Production Services)

The Machine-Based Service Bureau owns and operates shared-use systems and provides a stable and secure environment to meet the needs of the customer. Shared-use systems include the computer operations center, telecommunications network operations, applications processing, printing, and computer labs. This unit also provides facilities management for customers who own their equipment.

People-Based Service Bureau--Administration (Administration)

Administration provides administrative, billing, financial, human resources, and purchasing services for DoIT units in support of their missions. DoIT units are businesses within a business and are entrepreneurial in spirit. Administration provides the means for the individual units to have integrated business processes while functioning within State and University rules, regulations, and guidelines.

People-Based Service Bureau--Quality and Effectiveness (Organizational Effectiveness)

This unit helps DoIT staff improve customer satisfaction and provide effective management of projects and daily operations. It helps promote staff awareness of organizational culture, structure, values, and work methods.

People-Based Service Bureau--Services (Support Services)

Support Services provides cost-effective support for installation and operation of information technology products and systems. It also helps clients and customers to use, develop, and deliver information technology products and systems. Examples include help desk operations, telephone operator services and voice mail, delivery services, installation and repair services, training, technical writing, and graphic arts.

Retail Consultancy (Sales Consulting)

The Retail Consultancy provides:

- on-demand needs assessments for most clients
- a showroom for DoIT products and solutions
- a sales facility where customers can purchase DoIT products
- a newsletter and product information for customers
- market research
- promotion services.

Strategic Consultancy (Strategic Consulting)

Strategic consultants maintain close ties with campus opinion leaders. They help clients identify strategic IT solutions and act as a brokers between the client and other parts of DoIT. Consultants are knowledgeable about DoIT products and services and the client's business, and they alert clients to emerging IT solutions.

A new culture for the organization

An important aspect of the new organization is its culture, which is based on a formal set of principles described in a six-page document. The new culture is unlike any of the cultures of the three predecessor organizations and is based on customer focus, entrepreneurial spirit, and teamwork. The "Cultural Principles" fall into several categories:

customer focus
quality

entrepreneurship
empowerment of staff
contracts with customers
risk-taking
collaboration
incentives
decentralization
human resource policies
meeting management
organizational structural principles

Examples of specific cultural principles are

1. The purpose of DoIT is to serve its customers, not control them.

2. Everyone is responsible for his or her own quality. There are no inspectors and no other group to make up for one's lack of quality.

3. DoIT is a "business within a business." Similarly, each department and group within DoIT is its own "business within a business," and each manager is evaluated as an independent business person. This spirit of entrepreneurship will carry through as many levels of the organization as possible.

4. Decision-making authority will be granted to match responsibilities.

5. We form clear contracts with our customers and suppliers. Contracts are not long or legalistic and, for simple projects, they may be verbal. They are, however, clear agreements between customers and suppliers.

6. Customers decide on the degree of "technological and business" risk they wish to take in their projects.

7. Whenever possible, we will buy services from others within DoIT rather than from outside the division. Through this mechanism of subcontracting, teams are formed dynamically in response to project requirements.

8. Performance will be measured against clearly stated, agreed-upon objectives. Recognition will be based on performance. This includes teamwork as well as individual performance.

9. When clients choose to do work themselves, DoIT will support and mentor them whenever possible.

10. DoIT will value staff for a variety of contributions -- such as customer focus, teamwork, knowledge, experience, financial management, strategic im-

pact, external relationships, and supervisory responsibilities -- but not for increasing staff.

11. Meetings will be well managed and will start on time.

12. Jobs will be "whole"; that is, people's responsibilities will be defined in terms of products, not tasks. Each group should be completely responsible for all aspects of producing one or more products (although each group is empowered to use subcontractors), including research, planning, product development, and product maintenance and support. This leads to two corollaries:
    a. The structure will not separate learning (research) from doing.
    b. The group that builds a system maintains that system.

Internal Economy

In the new organization, each group is empowered to run a business within our business, which includes maintaining profit and loss statements and billing each other for subcontracted work. Clients who received free development services are being converted from a budget that was 'awarded' by a University priority-setting process to labor shadow budgets: they each have a budget of DoIT labor that they can spend for any of their projects. Strategic consultants work with them to help set priorities, and the normal University budget process mediates their competing needs.

Some Lessons Learned

Transforming an organization, and doing it well, is a lengthy process. It is more than merely changing the organization chart. To be effective, the reorganization must define the roles of each group and how these groups interrelate. It is also important to change the existing organizational culture to correspond to the new organizational structure. We expect this change process to continue for some time in our organization.

Using an organizational structure model proved to be very worthwhile. The theory and the model gave designers common goals and terminology. It provided a focus and allowed the designers to look beyond personal interest and view the organization as a whole. Hiring a knowledgeable consultant who specialized in information technology organization was also very helpful.

During organizational design, all Tier 1 and Tier 2 staff were trained in Structural Cybernetics and the redesign process. Although achieving a good understanding of the model took much time, it was worth the trouble to carefully describe the domain for each group. Change education and stress management classes were also offered to staff.

Reorganization is very stressful. DoIT leaders were very aware of this and frequently communicated progress to staff. Nonetheless, staff continued to request information, often when it did not exist. More and better communication would have been helpful.

Rostering the large majority of DoIT staff into the new organization was relatively easy. These staff were already focused on a single major function and could be readily placed with that function in the new organization. A number of staff, however, were very "rainbowed" and were more difficult to place.

Supporting tools such as a contract database, billing system and a help desk problem tracking system are required for the new organization, especially when several old organizations using different tools are merged. Our lack of such tools is hindering us in completing the reorganization.

Designers of the new organization needed a complete understanding of the model and regular reinforcement of the concepts. We often questioned whether placement of a function in the new organization fit the model. As new staff join the organization and DoIT adds new products and services, this reinforcement will continue to be critical.

As we got beyond our announcement day and began detailed discussions with staff members about their new roles, we have had misunderstandings about the new processes, like contracting, designed into the new organization. More and better planning of these processes, supported by appropriate tools, would have made the later phases of reorganization much smoother for staff.

Changing the structure of our organization and also its internal economy at the same time have created perhaps too much change at the same time. In retrospect, we probably should have started earlier in the process with the internal economy but made that change considerably more gradual.

Acknowledgments

This paper is heavily based on one prepared for CUMREC 94 by Judy Caruso and Jack Duwe, and relies on the work of the entire DoIT design team and, of course, on our consultant N. Dean Meyer.

Table 1: The New DoIT Structure

Chief Information Officer
Deputy CIO-Outreach
Deputy CIO-DoIT Operations

Administration
- Accounting
- Administrative Support
- Billing
- Human Resources
- Purchasing
- Financial Technologist
- Human Resources Technologist

Architecture
- Associate Architect

Organizational Effectiveness
- Project Management
- Quality Development

Production Services
- Applications Processing
- End User Computing
- Enterprise Data Storage
- Printing and Copying
- System Operations
- Publishing

Applications Technology
- Academic Support Applications
- Business Finance Applications
- Business Operation Applications
- Human Resource Applications
- Library & Information Retrieval
- Student Academic Applications
- Student Finance Applications

Tools and Methods
- Instructional Technology
- Media Technology
- Office Information Technology
- Personal Communication Technology
- Software Development Technology

Sales Consulting
- Marketing Communications
- Product Sales
- Showroom & Solutions

Strategic Consulting
- Academic Support
- Enterprise Support
- Institutional Support

Support Services
- Directory Assistance and Messaging
- Distribution
- Help Desk
- Installation and Repair
- Professional & Technical Education
- Publishing

Systems Engineering
- Data Resource Management Technology
- Network Engineering Technology
- Network Systems Technology
- Platform & Operating Systems Technology
- Systems Management Technology

SPREADING TECHNOLOGY AROUND: AN INVESTMENT IN TOMORROW

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Sacred Heart University, a private, liberal arts university in southwestern Connecticut has, over the past fourteen years through the Faculty of Science, Mathematics, and Computer Science established partnerships with various educational institutions and school systems for both teacher and student enhancement in the science and technology areas. Those who have benefited include teachers grades K-12, senior citizens, corporate and municipal employees in the community, and students in inner city, private, and suburban settings in grades 212.

The programs established for this purpose include the following:

(1) SMARTNET 2000 and **SMART Center** for teacher enhancement in the areas of science and mathematics education and the use of technology;

(2) **Project 2000 and Saturday Hispanic Academy** for students;

(3) **The Institute of Computer Technology,** a series of workshop offerings in state-of-the-art software for the corporate and municipal employee;

(4) **Volunteer** programs on computer literacy for inner city and suburban students as well as for retired senior citizens.

All programs were established with the goal of preparing teachers, students, and future leaders with the science and technology of today in order to face tomorrow's challenges. Without partnerships, this would not have been possible.

SPREADING TECHNOLOGY AROUND: AN INVESTMENT IN TOMORROW

As we approach the twenty-first century it is an understatement to say that technology surrounds us everywhere. Multimedia, electronic highway, virtual reality, the internet, world wide web, hypertext, and cyberspace are just a few of the terms and phrases that we encounter daily in the media, in our readings, and increasingly in our institutions of learning. As this revolution engulfs the world in which we live, who has the responsibility to link people and their needs? In whose hands lie the tasks of creating a society which can not only comprehend but also utilize and gain maximum benefit from the technological boom?

Sacred Heart University, a private, liberal arts university located in southwestern Connecticut has, in the past fourteen years, established partnerships with area school systems, corporations, municipalities, social organizations, and funding foundations in order to provide a science and technology education to the community in preparation for the next century. This paper addresses the various programs which, through partnership, have as their goal preparing teachers, students, and the community with the technology of today in order to face tomorrow's challenges.

The origin of these partnerships dates back to April, 1980 when the High School Institute for Chemistry Teachers was established at Sacred Heart by Dr. Babu George, Professor of Chemistry. The institutes were conducted in afternoons of normal teaching days and the participants were admitted free of charge on a first come first served basis. It is noteworthy that one of the earliest workshops was entitled "Computer-Aided Chemistry" where the lecturers aroused interest in the use of Apple II computers for chemistry applications. All donations were initially through Sacred Heart including the lecturers, who volunteered their services. After several successful workshops outside contributions began to filter through and the program grew tremendously. Eventually, Eisenhower Title II funding came through in the amount of $30,000 and now total funding from all sources for these programs has surpassed $1,000,000.00. The success of this Institute lead directly into **Project SMARTNET and SMARTNET 2000.**

SMARTNET 2000

SMARTNET 2000 is a staff development program for teacher enhancement in precollege science and mathematics education. and the use of technology. The program is a collaborative effort between Sacred Heart University, area school districts and community resources and is co-directed by Dr. Babu George and Dr. Bette DelGiorno. The partnerships formed extend a successful staff development model from southwestern Connecticut throughout the state and impact on approximately 5,000 K-12 teachers of science, mathematics, and technology and their supervisors in 67 towns, of which five have large minority populations.

The mission of **SMARTNET 2000** is to:

1. improve science and mathematics education and the use of technology;

2. revitalize maturing teachers and administrators;

3. integrate new teachers into a systematic professional growth process;

4. provide opportunities for professionals from urban and suburban districts to interact and learn together.

SMARTNET 2000 has evolved from **Project SMARTNET,** a collaborative partnership between a public school district(Fairfield Public Schools) and a private university (Sacred Heart University) that served as a regional model of cooperation.

SMARTNET 2000 is funded in large part by the National Science Foundation for a three-year period to: assist in institutionalizing SMARTNET 2000 as a regional cooperative model for staff development; to support a systematic, ongoing K-12 staff development program that offers many strands so that teachers and administrators can select programs that apply to them to improve their content knowledge and skills; and, to provide a cadre of science, mathematics, and technology leaders to follow-up on workshops and to assist teachers in the classroom and conduct workshops in their schools and districts. All workshops are offered free of charge to teachers.

Technology workshops in **Project SMARTNET and SMARTNET 2000** have varied from programming languages like Quick Basic and Turbo Pascal to software applications such as WordPerfect for DOS, WordPerfect for Windows, Microsoft Excel, Microsoft Word, Lotus 1-2-3, Microsoft Access, Foxpro, and Internet training on the World Wide Web and Mosaic. The participants are primarily math and science teachers grades K-12 who have a varying degree of computer literacy. The goal of all workshops is not only to bring a standard of computer literacy to all teachers in the program, but moreover to encourage the teachers to incorporate the technology in their curriculum as much as possible in order to effectively bring technology skills to their students. Most workshops have been developed by Domenick Pinto, Associate Professor of Computer Science. The workshops are usually held for several hours late Friday afternoon and continued all day Saturday in order to allow the twenty participants the opportunity to gain as much knowledge as possible about the current topic. In summer there is usually one full week of computer workshops where the participants can really delve into a topic and concentrate on a five day programming exploration or software expedition. Programming applications are geared to problem-solving in the science and mathematics area (e.g. designing a program to find area and perimeter for elementary school teachers, a program to find all prime numbers less than 20000 or one to solve a system of three equations in three variables for high school teachers). The software applications cover a wide range of topics from keeping an electronic grade book in Lotus 1-2-3 or Excel to creating desktop publishing documents with graphics in Word or WordPerfect to properly recording data from a science experiment or statistical problem in a database like Access of Fox Pro. All workshops are limited to twenty teachers in order to maintain a hands-on environment with one person to a computer. It is a fact that all computer workshops have a waiting list of between 15 and 30 teachers. As of Fall, 1994 all computer workshops are held in Sacred Heart University's newly established Pentium lab. Quite a long journey from the Apple II computers of 1983!

PROJECT:2000

Another partnership which was developed by Dr. George at Sacred Heart University is **PROJECT:2000, A SUMMER INSTITUTE IN SCIENCE FOR ACADEMICALLY TALENTED YOUTH.** This program was initiated in the summer of 1989 for children grades 2-9. A two week program has been designed to provide its participants with exciting activities in areas of their own particular interest. It provides students with the opportunity to explore areas of science and technology that they would not ordinarily be able to study in a traditional classroom. There is a very modest fee for tuition to cover the cost of instructors, assistants, and supplies. The focus of each course is on "learning by doing" in a relaxed, enjoyable, non-competitive atmosphere.

The Computer Science classes are hands-on with the morning session for grades 4-6 and the afternoon session for grades 7-9. The class size is limited to twenty and the instructor is assisted by two or three college students to provide a ratio of five or six students per teacher. All Computer Science courses in **PROJECT 2000** have been designed by Domenick Pinto.

The morning session (grades 4-6) features a week of Introduction to Microsoft Windows, where the children learn what the author calls "mouse literacy", i.e., the ability to correctly manipulate a mouse to open and close windows, switch between applications, and move around windows. In addition the students customize their desktop with color, wallpaper, and screen savers, use paintbrush, and create documents with WordPerfect for Windows and Microsoft Works. A class database is created and the children are also asked to bring in a list of their favorite sports heroes, TV favorites, movie stars, etc., in order to create their own database. The second week features an introduction to programming using Quick Basic in which the children solve simple problems using programming and then progress to doing graphics programming with various figures like lines, circles, rectangles, squares, and triangles all interspersed with 256 rich colors. The final part of the class is spent on creating personal screen savers which the students take great delight in.

The afternoon session (grades 7-9) deals exclusively with the techniques of programming in Turbo Pascal. The students are taught fundamental structures such as selection iteration and modular programming and are immediately creating games and graphics programs for their own enjoyment. The main focus of this class is to teach the fundamentals of logic for programming in a setting that is fun and interesting for this age group. Often the students will play each other's created games and sometimes challenge their teachers to do so, too. The student-teacher ratio provides a great opportunity for some individualized instruction as needed, also.

SATURDAY HISPANIC ACADEMY IN SCIENCE

This program, founded in 1989, serves Hispanic students from grades 9 to 12 who attend Bridgeport, Connecticut public schools. The majority of these students come from poor or low income families who, because of limited resources cannot provide the encouragement and guidance to keep the students in school, and ultimately to pursue a higher education. The program is funded in part by the United Way, Bridgeport area foundations, and the state of Connecticut. It is offered free of charge to the selected participants.

It has been projected that by the year 2000, Hispanics will be the largest minority group in the United States. On the other hand, the number of Hispanic students eligible for college has remained relatively low. An estimated 40% of Hispanic high school students do not graduate.

The program administrator of the Saturday Hispanic Academy in Science is Dr. Babu George and the computer science instructor is Domenick Pinto. Classes in computer science have centered upon learning programming techniques to solve algebra and geometry problems with all programs making full use of the rich colors and graphics available in Quick Basic. Applications tend to mesh with the ability level of the group with the emphasis being fun in learning. The group has been extremely responsive and enjoyable to work with and in many cases students have asked to stay after class time has ended in order to complete a program.

INSTITUTE OF COMPUTER TECHNOLOGY

Sacred Heart University's **INSTITUTE of COMPUTER TECHNOLOGY** was established in 1994 as a computer training facility for the corporate and municipal employee. One and two day workshops (non-credit) are offered in areas such as Microsoft Word, Microsoft Works, Microsoft Excel, Visual Basic, C++, Powerpoint, Microsoft Access, and Foxpro. Several partnerships are in the works with one already established between the City of Bridgeport and the Institute. The Institute has already given three training sessions to municipal employees in Bridgeport with several more planned in the next few months. It is expected that this partnership will extend for a few years as software trends continue to change and new technology becomes available. All Institute classes are held in the Pentium lab with state-of-the-art technology such as an active matrix LCD panel for demonstrations, a color laser printer for graphics and presentations, and a totally hands-on one person, one computer atmosphere. The Institute was developed by and is directed by Domenick Pinto and is staffed by faculty members from the computer science area. The Institute is totally self-funding with the tuition received from its classes. Although the Institute has only been in existence for a few months, its reputation for quality programs has been well documented.

VOLUNTEER PROGRAMS

In addition to the above programs, Sacred Heart University has been very active in establishing volunteer programs for the community in various computer applications for inner city and suburban teens as well as for senior citizens.

A series of eight Quick Basic classes for eighth grade Honors Algebra classes in the town of Monroe, Connecticut was developed in the fall of 1993 by Domenick Pinto. The classes were two hours each and covered topics such as solving linear equations, factoring, use of the quadratic formula, and solving systems of equations. Students were bussed from Monroe to Sacred Heart on Friday mornings with no cost to the student and no salary to the instructor. The town of Monroe kindly provided the buses. This year the same classes will be offered to a parochial school in Monroe with only the cost of transportation to be provided by the school.

For several years, students in an eighth grade gifted program from the City Of Bridgeport have been attending free computer workshops at Sacred Heart University given by Sandra Honda, Associate Professor of Computer Science at the university. The workshops were primarily designed to promote computer literacy amongst the students as part of a volunteer program to promote technology in the inner city. Both programs have been and continue to be very well received.

Since 1992, Sandra Honda has also been involved with a volunteer program for retired seniors. In this program Sandra runs a workshop every Friday for eight weeks whereby computer literacy and a taste of word processing is introduced using WordPerfect for Windows. This program is maintained by a local community center and the participants are allowed to attend the sessions free of charge. It is a very popular program.

BENEFITS

The benefits of establishing so many varied partnerships with the community are vast. The recognition of Sacred Heart University as a caring, committed institution of higher learning has resulted in a large upswing in enrollment both globally throughout the university as well as locally within the computer science area. The newly established MCIS (Master of Science in Computer and Information Science) at Sacred Heart has been very successful after only one semester. (On a personal note one of the authors was even asked to be a computer lecturer on the QE2 this past spring for a two week transatlantic voyage to England, Ireland, and France with all expenses paid as a first class passenger.)

THE FUTURE

What future partnerships are in planning at Sacred Heart? Currently, Domenick Pinto is working on a $500,000 grant for submission to the National Science Foundation to establish a Multimedia Center complete with a multimedia classroom, authoring room, and multimedia lab for students in order to integrate sound, video, full motion, and computing to its full extent. If funded, this technology would be integrated into all of the programs listed above. The possibilities are endless. With dedication, hard work and commitment we can help to insure that young and old, rich and poor, gifted and slow, all have the opportunity to experience the technology of today in order to make for a better tomorrow.

Strategies for Restructuring IT Organizations

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ABSTRACT

This case study presents DePaul University's 18 month experience in restructuring its information technology division. The strategic realignment was an integral step in the university's own transformation toward a competitive and responsive institution. In July 1993 the university created a new division of University Planning and Information Technology (UPIT) and appointed a vice president to restructure the division. As the chief architect for this restructuring effort, I will discuss in this paper the impetus for change, the mission and goals of the new division, the organizational design and its implementation, and the process for restructuring.

Strategies for Restructuring IT Organizations

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Introduction

This case study presents DePaul University's 18 month experience in restructuring its information technology division. The strategic realignment was an integral step in the university's own transformation toward a competitive and responsive institution. In July 1993 the university created a new division of University Planning and Information Technology (UPIT) and appointed a vice president to restructure the division. As the chief architect for this restructuring effort, I will discuss in this paper the impetus for change, the mission and goals of the new division, the organizational design and its implementation, and the process for restructuring.

Impetus for Change

DePaul University serves 16,700 students at five campuses in the metropolitan Chicago area. Its seven colleges and schools have, over the past 97 years, emphasized excellence in instruction and responded well to the diverse educational needs of traditional undergraduates as well as working adults. In recent years the university has enjoyed successful strategic growth in academic reputation, increased market share of students, physical plant expansion, and successful fund-raising results. However, as the university moved forward, it became clear that a coherent information technology strategy would be crucial to its continued competitiveness in the marketplace.

Prior to July 1993, the university's information technology organization and resources were fragmented:

- o Information Systems, reporting to the vice president for finance and business, supported administrative users via exclusively mainframe computing.
- o Academic Computing Services, reporting to the academic vice president, supported faculty and student computing via clusters of mini-computers and wide-area networks.
- o Telecommunications, reporting to the associate vice president for administration, serviced voice communications and owned most of the communication fibers.

There were several attempts to coordinate the computing directions and resources that fell short because of conflicting interests. As a consequence, over the years both academic and administrative users became increasingly frustrated with divided standards for software, equipment, networks, and the absence of a unified, long-range view. A university task force attempted long-range planning to address these issues but was unable to overcome turf barriers.

In July 1993 DePaul 's new president, Rev. John P. Minogue, C.M., recognized the urgent need for change. He advocated workgroup computing and the use of technology to effect organizational transformation. A new division of University Planning and Information Technology was formed and a new vice president was appointed to lead the restructuring. Central to this new division was its role as an enabler and change agent to realign information technology initiatives with the university's strategic directions. There was also a mandate for efficient resource management.

The restructuring effort, taking place from July through September 1993, resulted in a lean, flattened, and cross-functional organization with new workgroups based upon function, new job responsibilities and new employee skill sets. Four units of different reporting lines and vastly different culture and organizational structure -- Information Systems, Academic Computing Services, Telecommunications, and Office of Institutional Planning and Research (reporting to vice president for planning) -- were consolidated into one division.

Several peripheral support functions (i.e., word processing, audio-visual production, student and staff computing purchase) were eliminated. Duplications in functions, such as networking, help desk, training, and software support were consolidated to achieve a single direction. Many new functions, such as business process reengineering and instructional technology, were added. The full-time headcount was reduced by 15%, from 92 to 78. The design for this division and strategies for restructuring are discussed in the following sections.

Organizational Design

The restructuring effort positioned the new division in a leadership role to enable the university transformation by performing four inter-related functions:

- o strategic planning,
- o process reengineering,
- o information resource and technology management, and
- o organizational learning.

The vice president's position was designed to carry out these functions in three overlapping roles as a strategic planner, chief information officer, and organizational development facilitator. The new division adopted a team-based, horizontal structure to achieve shared values, responsiveness to institutional needs, and significantly improved performance. Several design principles were considered. First, the division should affect the change process in a holistic manner, from strategic directions, process redesign, tools and infrastructure, to learning and delivery. Second, a flat, cross-functional structure would encourage improved performance and responsiveness. Third, division-wide processes such as training and help desk support should be implemented as cross-functional services. Fourth, the structure should support movement toward workgroup computing.

Seven work groups were created to replace formerly large hierarchical departments:

Institutional Planning and Research supports strategic planning, policy analysis, decision support systems (DSS) and executive information systems (EIS).

Business Process Reengineering implements strategic priorities through process innovation, job redesign, organizational change, and technology strategies.

Information and Application Support implements redesigned processes with client server applications, information architecture.

Network and Telecommunications provides university wide connectivity in voice, data, and image through local and wide area networks and gateway services.

Academic Technology Development supports student and faculty computing for dial-in services, computing labs, and proactive consultation for curriculum innovations and creative use of instructional technology.

Systems and Operations provides consolidated systems support for both academic and administrative transactions.

UPIT Management Support enhances divisional effectiveness through strategic and financial planning, human resource management, internal and external communications, customer satisfaction studies, and divisional training programs.

A team approach was emphasized throughout the division, within and across work groups. A management team was formed consisting of the vice president and all the directors. Within each work group, hierarchical titles were replaced by team-oriented titles, such as *project leader* and *team leader*. Cross-functional teams are responsible for most divisional projects. In major projects, users now assume responsibilities as full members of the project team.

Workgroup computing envisions that users -- faculty, students, and staff -- will be able to develop competencies in the effective use and management of technologies and information to improve their work. Such an environment dictates that the new division manage and develop network infrastructure, information and application architecture, training, and reengineering that provides users with easy access to needed information.

During the reorganization at DePaul these principles demanded a different workforce and skill sets for the information technology division. The mainframe oriented workforce had to be transformed into professionals who were proficient in consulting, rapid application development, greater networking knowledge, effective problem solving and team work, broad organizational perspectives and ability to formulate integrated solutions.

Process for Restructuring

Restructuring occurred between July and September, 1993. Before it formally began the mission, goals, organizational design, and timetable for implementation were communicated to the members of the new division. The vice president met with individuals and groups, both inside and outside the division, to address concerns and provide support. All directors' positions (except the Director of Institutional Planning and Research) were opened for applications and interview process. The management team was in place by the end of July.

Each staff member went through a job analysis process involving data collection through skills questionnaire, functional resumes, and a 45-minute interview with a consultant with psychology training. This process helped to identify opportunities for employee skills enhancement; provide baseline data for job reassessment and reassignment; provide benchmark data for performance review, and enable future reorganization and resource planning. Using this data, the vice president consulted directors, human resource officers, and an information technology consultant to match skills profile with functional requirements for each workgoup. Many individuals were then assigned or offered new responsibilities according to their skills and aspirations. Some functions were eliminated and employees were transferred or outplaced. In order to minimize employee anxiety these steps were completed within the first four weeks of the reorganization.

Each director then had two months to develop specific job descriptions and an organizational structure for his or her workgroup. DePaul's human resources office subsequently reviewed each position and re-priced the salary according to market data.

Change Management Strategies

DePaul employed a variety of strategies to effect change in the new division as well as in the user community. Three sets of strategies are discussed below.

High Performance Management. To achieve the optimal effect from the restructuring, we designed and implemented a high performance management program. The management team collaborated with the human resource office and consulted the entire division in this process. This program integrates divisional directions with performance planning, the reward structure, and continuous training and development. A new performance appraisal system was initiated to introduce a set of ten performance attributes as basis for organizational change. These ten attributes are: commitment to the mission, continuous quality improvement, creativity and innovation, customer focus, leadership, openness to change, result orientation, self-directed learning, self-empowerment, and teamwork and collaboration. Every member now participates in reviews every six months to evaluate past performance and to set new performance objectives.

Training and Development. In addition to setting performance expectations, the division adopted a cascading model for training and development. The management team lead and participated in a leadership learning forum which met for one day every six weeks to discuss processes for creativity, teamwork, and change. Participants included nearly one-third of the staff, across all levels and groups, to achieve better working relationships. In addition, three forms of training of technical skills were also implemented: Friday Forums, held every other week, showcase major divisional projects. Vendors conduct technology or product specific training. In addition, the vice president's office sponsors selected individuals for intensive certificate programs in "local area networks," "window applications," "telecommunications," and "client server strategies." Because self-directed training is now a performance standard, employees are encouraged to enroll in formal computer science or relevant courses offered by the university.

Partnering with Clients. To fully achieve the purpose of restructuring, changes needed to occur in the relationship between the division and the user community. Divisional priorities were set and communicated to the users. These included the timetable for networking, policies for software and hardware support, priorities for major application projects, and funding strategies for network and student computing plans. Two formal advisory bodies were established to improve communications and work plans. A faculty-based academic advisory group concentrates on policies and initiatives affecting teaching, research, and student computing. An IT customer service panel addresses emerging program and service unit needs. Several formal communication vehicles were created, including a quarterly newsletter *DePaul Net*Works*, a faculty guide to computing, and various brochures. Communication took place in both a formal and informal manner. Vendors also conducted quarterly forums to inform users about technology trends.

Progress to Date

What has the restructuring achieved over the past 18 months? Most noticeable is the fast deployment of network infrastructure with a much reduced staff and budget. Seventeen hundred users were brought into the DePaul Network during this period. This is an environment of Novell NetWare 4.01, Ethernet, TCP/IP on the network side; 486 Window/DOS for the desktop; Microsoft office suite (Word, Access, Excel, and PowerPoint), WordPerfect Office (Groupwise), Internet applications for productivity tools; Oracle, UNIX, MS Access, MS Visual Basic for the client server environment. In addition, the university's fund-raising process was redesigned and new phonathon and donor tracking systems were developed.

Building on this infrastructure, projects on the current drawing board include: student dial-in service and Internet access, campus-wide information systems using student kiosks, enterprise data architecture, the redesign of student-centered processes and systems, a new telephone switch at one campus and the wiring of residence halls for data and voice communication.

Lessons Learned

These changes could not be achieved in such a short timeframe without the restructuring. The restructuring provided a) a clear strategic vision, b) heightened productivity and expectations, c) an accelerated momentum for actions, and fundamentally, d) new dynamics for organizational and self renewal.

What have we learned from this experience? Although the restructuring and renewal have now become part of our continuous change process, our experiences so far are both rewarding and challenging.

Organizational Change Issues. Implementing radical change in itself is a daunting task. To achieve sustained results, there must be cascading sponsorship, extending from the president and executive level all the way through the information technology organization. This requires constant refocusing of strategic goals and careful selection of the management team. In building a team-oriented organization not only the staff members but also the leadership team has to be trained for team problem solving. Furthermore, once the organization is redesigned for change it is likely to go through self-renewal or further restructuring in response to additional changes in technology, elevation of skills, or user demand. A consequence is that planning assumptions for information technology are more difficult to set. A traditional, less dynamic planning model can become obsolete or counter-productive for fast-paced change.

Drastic change through strategic restructuring could achieve high results in short time, but a process for continuous restructuring or process improvement should be considered to sustain the benefits. A comprehensive organization design should be mapped out first to provide a framework for future actions. Otherwise, the forces and resistance to change could derail the plan. There are high costs, especially human costs, associated with restructuring. Employees experience tremendous anxiety and some may lose jobs. Managers experience burnout from dealing with adverse decisions. Few IT managers are prepared to carry out these tasks. Therefore the pace of change an IT organization undertakes depends largely on its willingness to endure pain and stress.

Human Resources Issues. Radical restructuring tends to freeze people's productivity and destroys the original intent of such endeavor. To balance the pace of change and desired level of productivity, interventions must be considered to bring each individuals into a more human level of communication. Such communication should address fears, anxiety, aspirations, as well as perceptions.

For many employees restructuring can provide new opportunities and challenges; a chance to upgrade skills and move into new positions of responsibility. In this regard, leaders and managers in the IT organization have to address the human resource issues in a proactive manner, as to job redesign, outplacement, performance management, and reward structures. Unfortunately, few human resource offices in universities and colleges are equipped to support change management, let alone changes in the technology areas. Therefore, the IT organization has to quickly learn the advanced techniques and strategies for managing change.

Re-tooling is one of the most critical elements in restructuring IT organizations. Development of new skills, whether for a client server or network environment, can not be an option for a new organization but some new employees with those skills will also need to be recruited from outside the organization. A flattened, horizontal organization requires team work and, more importantly, strong individuals. Both self-directed learning and sponsorship for targeted training are required to achieve the culture of a learning organization.

However, retooling improves employability and employees with new skills are eagerly pursued by other employers, corporate or academic. The IT organization must anticipate attrition and devise retention strategies. Beyond competitive compensation, growth opportunities, systematic training, long-term performance management program, and opportunities for job rotations should be considered. Cross-training has to be a common practice to reduce the impact of staff turnover. In short, a holistic approach to performance management -- from recruiting, selection, evaluation, reward, training to retention -- has to be mapped out before restructuring takes place.

Relationships with Users. A changing IT organization disrupts the users' established relationship with former organizations, functions, and support staff. Confusion caused by realignment, if not addressed right away, could cause user frustration and anxiety. In addition, the fast paced deployment of technologies, applications, and policies heighten user expectations for service and quality. For many users the new environment demands more intense dialogue between both parties.

Communication should occur well in advance of change. There is never enough communication, despite repeated efforts, because new generations of users are continually brought into the technology environment. However, the fast pace of change can motivate users to participate in IT priority setting and learning. This could present a window of opportunity for IT professionals to serve as change agents -- to educate, persuade, and commit users. Formal arrangements for "information leaders" or "one-stop service liaisons" may improve service and communication with users at the departmental level. At the individual level, user training has to be redesigned to include department-wide training when departments are brought on-line, more specific task-based courses, and on-line tutorials and self-paced training modules.

Conclusions

DePaul's effort for restructuring the IT organization has achieved remarkable results. Within eighteen months, the division of University Planning and Information Technology was able to build network infrastructure, brought 1700 users into a highly advanced network environment, reengineered major processes, and implemented client server solutions. These changes were accomplished by high performing cross-functional teams with new skills and a shared vision. A framework for organizational design, a thorough process for restructuring, a holistic performance management plan, and strategies for change management contributed to these positive results.

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CAUSE

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SPECIAL SESSION

Electronic Exchange of Student Records (Transcripts)....and more!

John T. Stewart
Miami-Dade Community College
Miami
Florida

With increasing student demands for improved service and reduced institutional resources, this exciting new technology is one answer. The national project by the National Center for Education Statistics (NCES) and the American Association of Collegiate Registrars and Admissions Officers (AACRAO) successfully addresses both issues.

The use of Electronic Data Interchange (EDI) allows schools to exchange student records from Elementary and Secondary through Postsecondary in a national standard format developed by the AACRAO Committee on the Standardization of Postsecondary Education Electronic Data Exchange (SPEEDE) and NCES Task Force on EXchange of Permanent Records among Students and Schools (ExPRESS). This technology cuts costs and speeds the transfer process.

Electronic exchange of student transcripts, electronic application for admission, electronic enrollment certifications and electronic college catalog will be discussed.

Take a little trip into the not too distant future with me this morning. Imagine that you are sitting in your living room at home with a young man who is beginning his senior year in high school. The conversation leads to a discussion about his future plans. What will he do when he finishes this year in high school?

He has indicated a few interests for his future. He'd like to make a comfortable living; he's interested in helping others; he's not too interested in sitting at a desk in an office the rest of his life; he thinks he might want to be a salesman or an engineer or a teacher.

So you suggest turning on the cable television and explore a little with the computer attached to the TV. You switch to the channel on educational options. The interactive TV screen appears and gives some options to explore. Among these are

- Vocations
- Schools

Using the computer's mouse, you click on Vocations and you can specify an occupation or vocation or you may opt for a series of questions to answer such as

- How much money do you wish to make? (A few ranges are given and a choice is made.)
- Do you prefer indoor work, office work, outdoor work, etc.?
- Do you prefer a job involving a great deal of interaction with other people or do prefer work that you primarily do on your own?
- A few questions about your previous education: what is the highest grade completed? what is your grade average? what's the highest math and science course you've completed? what grade did you make? have you taken a foreign language and how competent are you in that language? what did you make in your last English composition course?

Based on the answers to these and a few other questions, the screen comes back with a list of potential vocations that might be appropriate. Finding one that sounds somewhat interesting, you click on it and see a short video that includes salary ranges common to that vocation, educational training required, descriptions of what the job is all about including interviews with selection people engaged in that vocation, and short and long range job prospects nationwide and in the local and state area.

If you are interested in more, you select on what schools offer the educational preparation needed. You can narrow the search by specifying the geographic area, the relative costs, size of the school, public or private, two year or four year, etc. Once these selections are made, you are presented with a choice of schools that meet the criteria.

You click on a school and you watch a short video about the school, the admissions requirements, the costs, the size and location of the school. The dean of the college that offers the selected program gives the advantages of that program as offered by that school. The dean also gives the latest completion rate data (of the number of first year students who started the program six years ago, how many completed and earned a degree and how many of them got jobs in the field). The president of the college gives a brief sales pitch, a faculty member explains a little about a couple of the courses and a recent graduate relates her experiences at the school and in job hunting.

Since your young friend liked what he heard, he returns to a menu that asks if he would like to apply for admission. He says yes and a series of questions appear on the screen and he uses his computer keyboard to enter the required information about himself and his academic record. A series of pop-up menus appear throughout this process and help screens are also available anytime the young man has questions about a question.

At the end of the process, the young man is given the choice of sending the application now or storing the data for a later time. He's now quite eager and chooses to apply now. The application is immediately sent over the Internet to the selected college. Although most of the college administrative offices are closed at this hour, the data from the application are accepted, immediately processed, and the student is notified that the application has been received. The student is advised to send a check for the admission fee, and that the high school transcript has now been requested electronically and he will be notified in a few days on the status of his admission to the college.

Sound far fetched? Not at all! Many of the features of this scenario are already operational. Programs already exist to provide the selected information on CD Rom. Programs already exist to apply for admission using a modem or by entering data on a microcomputer and returning a computer diskette to the college. Colleges are already exchanging educational records over the Internet and using Value Added Electronic Networks.

But now a little background... A task force was formed by the American Association of Collegiate Registrars and Admissions Officers (AACRAO) in early 1989 to explore the possibility of a national standard format to exchange postsecondary student academic records electronically over a value added network. This was already being done in three states, but each state had its own, different format. Since more states were exploring the idea, AACRAO saw the need for a common format that all schools could use for the transmission. This task force later became known as the AACRAO Committee on the Standardization of Postsecondary Education Electronic Data Exchange (SPEEDE).

In mid 1989, the National Center for Education Statistics, a part of the United States Department of Education, sponsored a task force of elementary and secondary school visionaries to develop a national standard format for exchanging educational data for Pre-Kindergarten through Grade 12 students electronically. This task force later became known as the EXchange of Permanent Records Electronically among Students and Schools or ExPRESS.

Although meeting separately, each group had a representative in attendance at the other's meetings. Initially, each group developed a separate format, but when both groups decided to explore a standard format under the auspices of the American National Standards Institute's (ANSI) Accredited Standards Committee (ASC) X12, the two formats became one. That format is now approved as a national standard for trial use by ASC X12 and is now known as the SPEEDE/ExPRESS format for a student educational record for students from pre-kindergarten through postsecondary. The two committees agreed upon the pursuit of an ASC X12 standard since it was hoped that we would eventually be sending student records to agencies and employers. The use of an existing standards structure would further facilitate this process since many industries already use other ASC X12 standards for transactions such as purchase orders.

The process used by ASC X12 and now by SPEEDE/ExPRESS is known as Electronic Data Interchange or EDI. One definition of EDI is the exchange of information from one computer directly to another computer using a mutually agreed upon format. The first key point in EDI is that the exchange is from one computer to another with little or no intervention by humans. This means the data do not have to be reentered into the receiving computer. The second key feature in the EDI definition is the use of a common, agreed upon format. In this case, the format is the SPEEDE/ExPRESS format.

What are the benefits of EDI for schools? They are many. Among them are cost savings, better and faster service to our students and alumni, better security and fewer errors caused by incorrect coding and inputting.

First is cost savings. It has been estimated by a variety of institutions, that it costs from $3.00 to $8.00 to send a paper transcript of a student's record. This varies depending on the degree of automation already in place at an institution and includes the cost of processing the request, locating the correct record, copying it, preparing it for mailing, mailing it and then refiling the original document. In contrast, the cost of sending a transcript using EDI is estimated at from $1.50 to $2.00 depending on the number being sent in a batch and whether a Value Added Network or the Internet is used for transmission.

However, the biggest cost savings are realized by the receiving institution. Here, the entire process can be automated. The receipt of the record is done entirely by your computer. It is matched automatically with the appropriate student in your student data base. It can be automatically fed into your computerized transfer evaluation program and with a minimum of keystrokes, integrated with your student data base. No need to re-key the courses taken at the previous institution to include in your degree audit system.

Since the entire process is automated, the student, whose transcripts you send via SPEEDE/ExPRESS, gets faster notification of acceptance (or rejection) from the school to which he is applying. Not only is the student notified more quickly of admissions action, but since the transcript is evaluated more quickly and with more accuracy, the placement process is done more quickly and with fewer chances for error. And better placement means the student should graduate in the shortest possible time. This means the student attains his educational goals more quickly.

Security is an important plus with EDI. Very few college registrars and admissions officers today would argue that with the advent and easy accessibility of word processing, desk top publishing, color copiers, etc., our paper transcript is far from secure from tampering and fraud. Security is built in to the SPEEDE/ExPRESS transcript exchange with the use of the acknowledgment transaction. When a SPEEDE/ExPRESS transcript is sent, the sending computer generates a suspense electronic copy of key portions of the transcript and waits for an acknowledgment to be received. When the receiving school returns the acknowledgment transaction, the original sending school's computer compares what was received with what was expected and if it matches, all is well. It retains selected information about the time the original transcript was received by the other school so this information can be supplied to the student if an inquiry is made. This additional service of notification upon receipt was far too labor intensive in the paper exchange of transcripts, but requires no effort under the EDI process.

Of course, if a sending school's computer receives notification of receipt of a transcript and the sending school has no record that a transcript was sent to that school for the student, the computer advises the sending registrar's office of a possible security violation. And, of course, if transcripts are not acknowledged in a reasonable period of time, then the computer notifies the sending registrar that there is some sort of a delivery problem. This can then be researched and the problem corrected before the student complains. In the paper system, a student complaint is the only way of knowing that the transcript was somehow lost in the mail.

It should also be obvious that fewer errors are made by the receiving school in using the data on the electronic record since little or no re-keying of data was required to integrate them into the receiving school's student data base.

At this time, SPEEDE/ExPRESS has four transaction sets that have been approved as Draft Standards for Trial Use by ASC X12. These are

- Student Educational Record or Transcript (Transaction Set 130)
- Acknowledgment of the Student Transcript (Transaction Set 131)
- Request for Student Transcript (Transaction Set 146)
- Negative Response to Request for Student Transcript (Transaction Set 147)

In addition, the student lending group of ASC X12, in cooperation with the SPEEDE committee, has also received approval of the Student Enrollment Verification Transaction Set (190).

Finally (at this time), the SPEEDE/ExPRESS group is in the final stages of approval of two other transaction sets:

- Application for Admission to a Postsecondary School (Transaction Set 189)
- Course Inventory (Transaction Set 188)

We hope to have both of these transaction sets approved by ASC X12 by February 1995. The first of these is eagerly awaited by several software vendors who have already agreed to utilize the format in their software packages which allow students to apply for admission on a microcomputer and send the application information to the colleges electronically either on diskette or over an electronic network (Internet or a VAN).

The course inventory transaction set will allow a school to inquire electronically and receive additional information from another school about the courses offered there. This would include additional information such as course description.

All this sounds great, but is this just a dream or are any transcripts actually being exchanged electronically in North America. Yes, things are happening with EDI in education. In Florida, during the past twelve months, over 270,000 student transcripts were exchanged electronically among high schools and postsecondary institutions. Over 75% of the high school seniors in the state of Florida attend high schools that are in production in the exchange of electronic transcripts. Over 75% of the students currently enrolled in public postsecondary education institutions attend a college or university that is in production in the exchange of electronic transcripts.

Over 25 colleges in Texas are in production in the exchange of electronic transcripts. Virtually all the public postsecondary institutions in Maryland are in production. States in which production exchanges are now taking place include Arizona, California, District of Columbia, Florida, Georgia, Idaho, Maryland, Oregon, Pennsylvania, Tennessee, Texas, Utah and Wisconsin. In addition, several provinces in Canada are either in production or pilot mode.

The SPEEDE committee invited anyone interested in the project to attend a workshop on SPEEDE in 1990 in Phoenix and 100 folks showed up. This year in Raleigh, the fifth such workshop was held and the attendance was close to 400. There is excitement and momentum about the project. Recently AACRAO, with financial assistance from NCES, has been able to expand its staff to include an EDI coordinator, Betsy Bainbridge. Betsy has greatly facilitated the project and enables the SPEEDE committee to be far more productive than in the early stages of development. With continued funding and assistance from AACRAO and NCES, we anticipate the project to continue its expansion in the volume of transcripts and other transactions being exchanged in the United States and Canada.

CAUSE

94

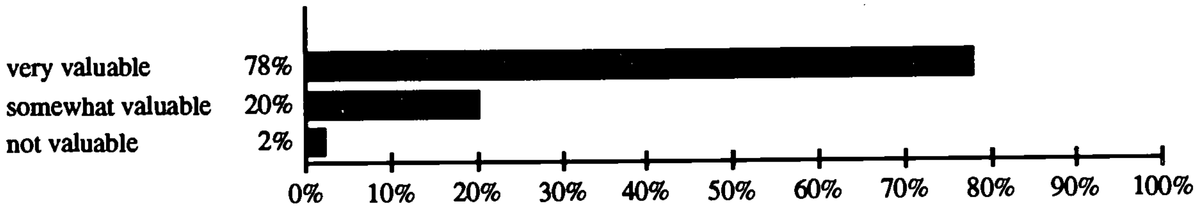
CONFERENCE EVALUATION SUMMARY

Summary of CAUSE94 Conference Evaluations

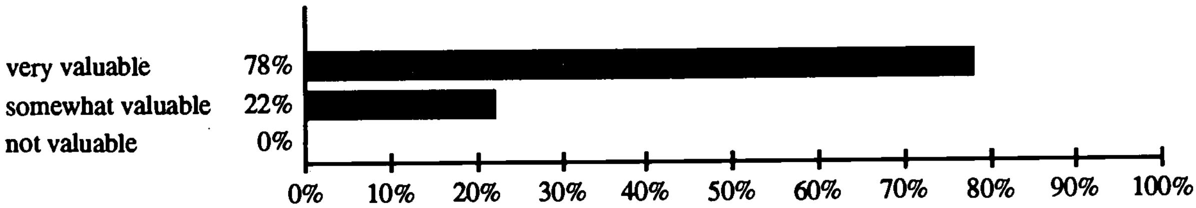
365 Evaluation Forms turned in

Rate the following CAUSE94 activities in terms of their value to you:

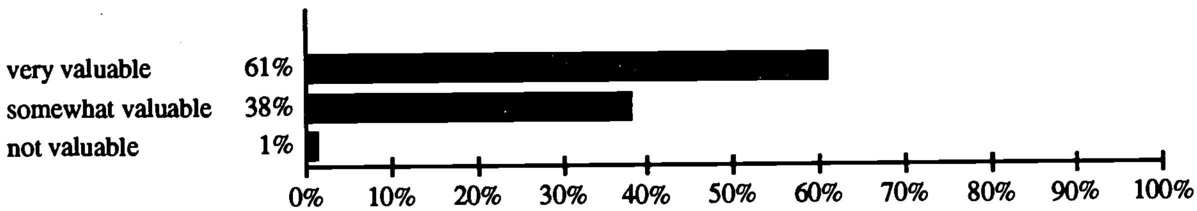
General Session by Jennifer James *(343 responses)*



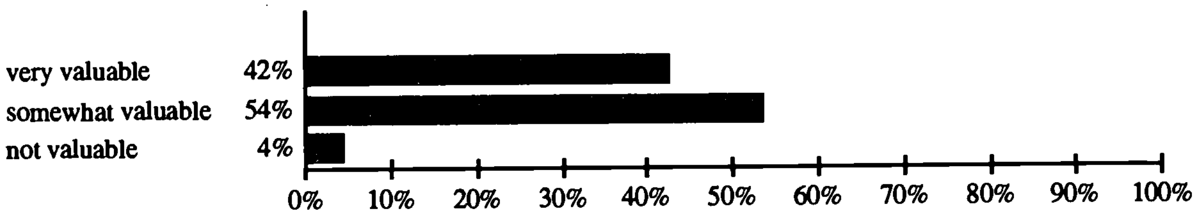
General Session by Dennis Snow *(307 responses)*



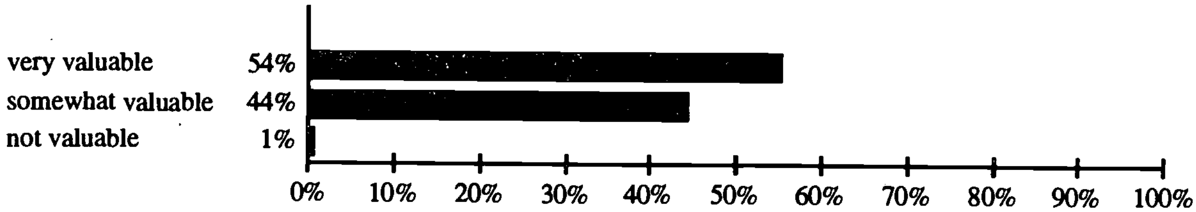
General Session by Glenn Ricart *(166 responses)*



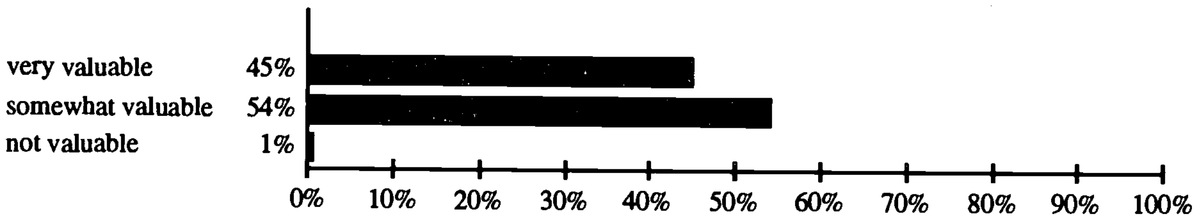
Current Issues Forum *(213 responses)*



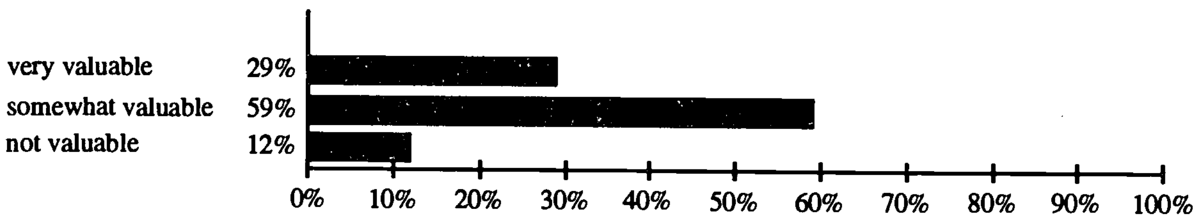
Track Sessions *(353 responses)*



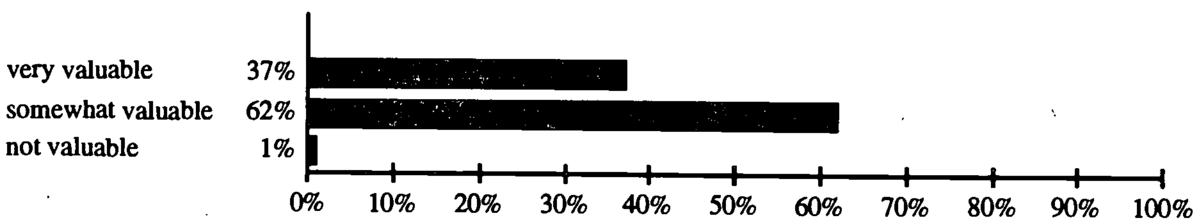
Special Sessions *(250 responses)*



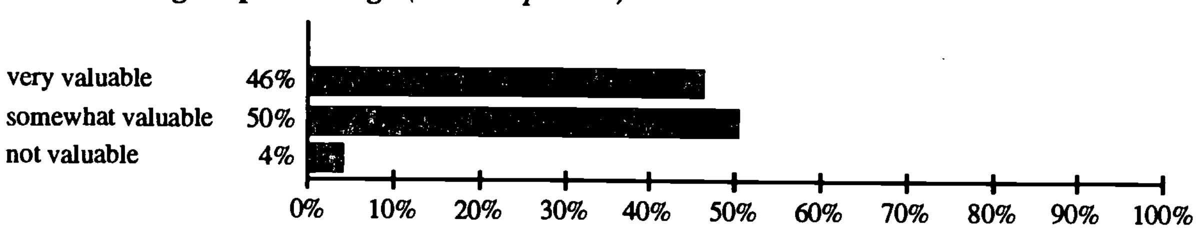
Poster Sessions *(235 responses)*



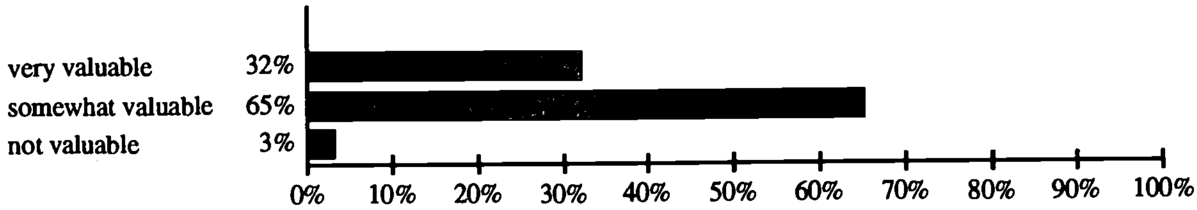
Current Issues Sessions *(198 responses)*



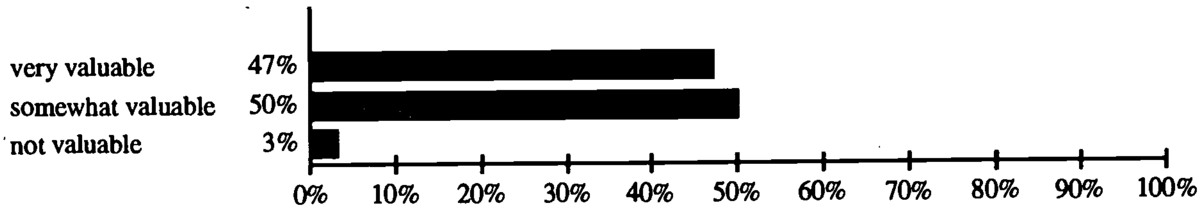
Constituent group meetings *(177 responses)*



Corporate Presentations *(262 responses)*

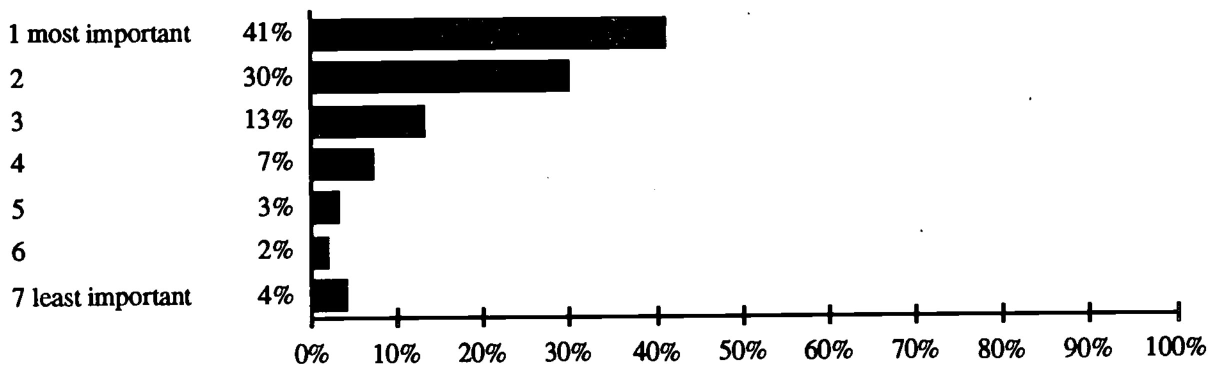


Corporate demonstrations *(302 responses)*

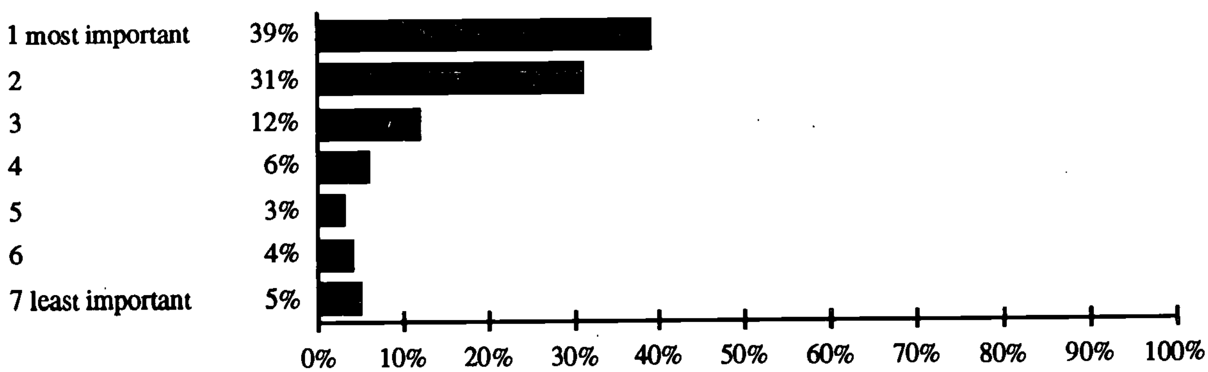


What made you decide to attend CAUSE94? On a scale of 1 to 7(1 being most important, 7 least) rate each of these factors in their importance on your decision to attend.

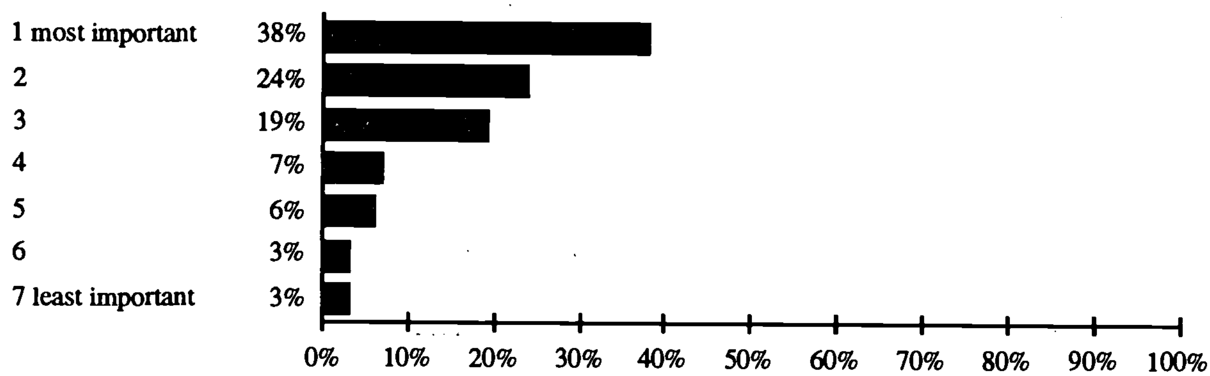
Program Content *(361 responses)*



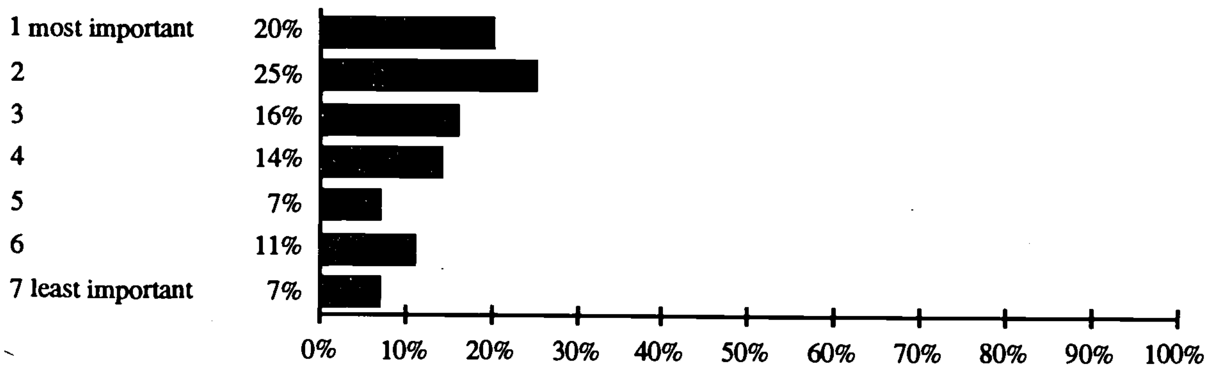
Professional development *(358 responses)*



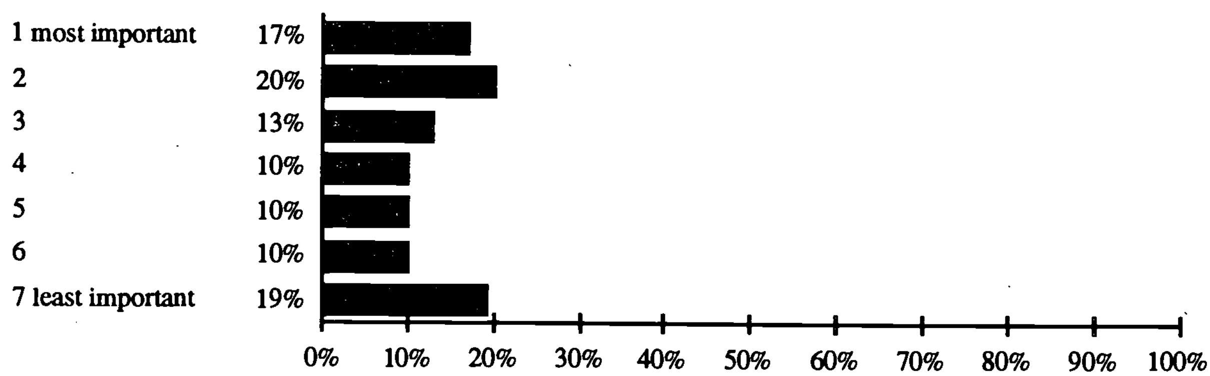
Networking with colleagues *(355 responses)*



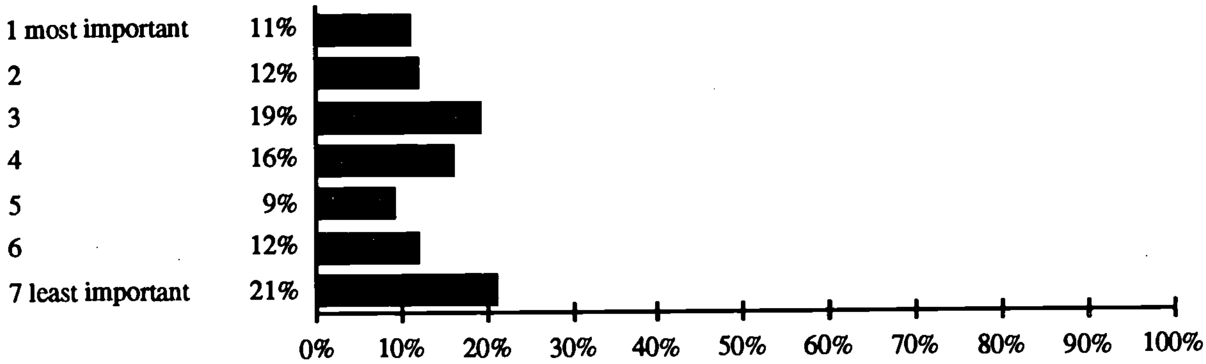
Identification with CAUSE *(356 responses)*



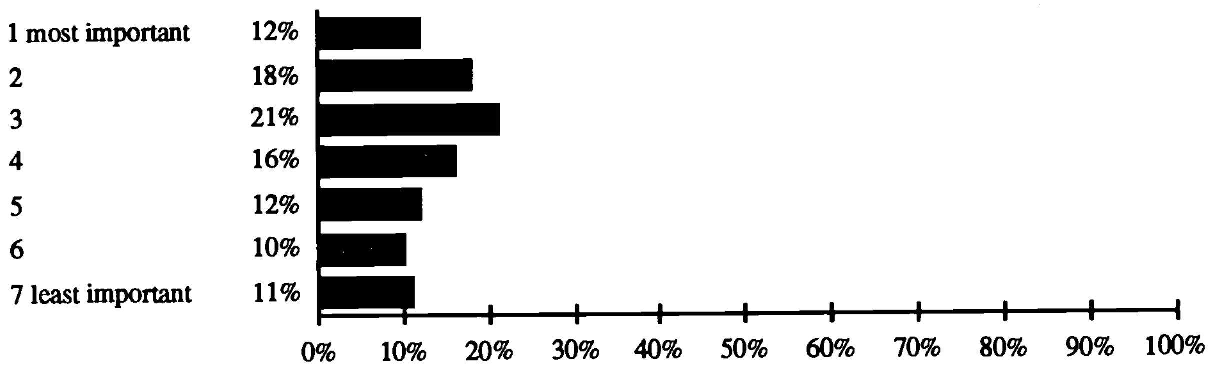
Peer recommendation *(348 responses)*



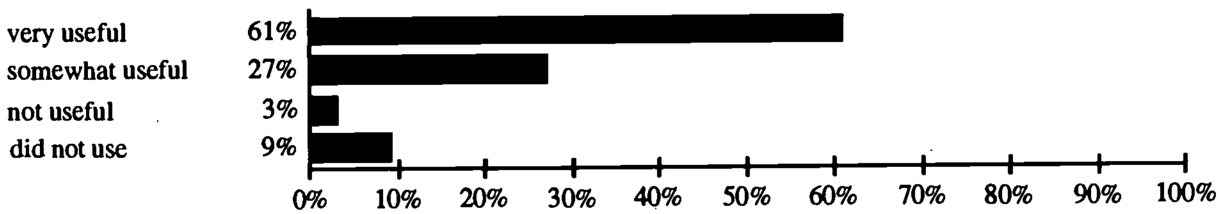
Conference Location *(359 responses)*



Coporate demonstrations *(358 responses)*

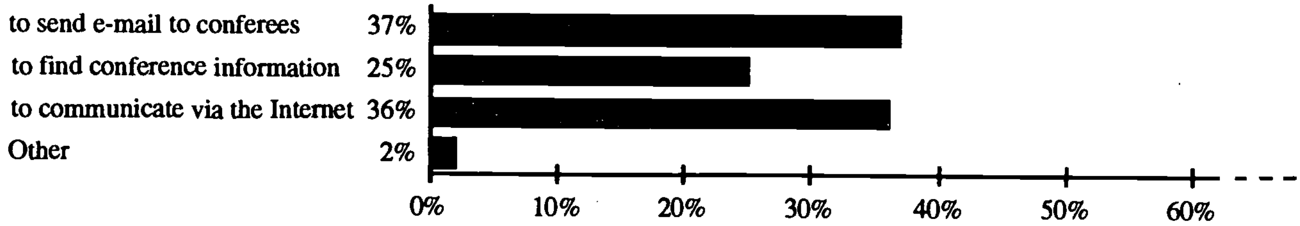


How useful did you find the CAUSEnet e-mail message system? *(331 responses)*



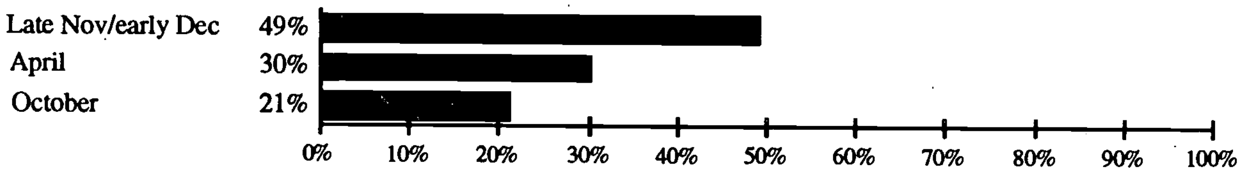
- Too hard to get a free machine - 3
- Internet connections did not work as well as previous CAUSE conferences
- Expand on the network connections table idea
- Worked fine locally, useless for Internet. Work on it please.

How did you use the CAUSEnet e-mail? *(295 responses)*



- Sign up for workshop sessions - 2

CAUSE and Educom are considering scheduling their conferences six months apart. Please indicate your preference for the date of the CAUSE conference: *(311 responses)*



What topics/speakers would you like to hear at future conferences?
TOPICS:

- Academic Computing
- Applications of technologies and utilizing IT - 2
- ATM - 2
- Business Process Re-engineering - 2
- Business/financial systems
- Client/Server implementation plans / corporate update - 2
- Copyright and licensing arrangements
- CWIS / Client-Server / Internet Tools - 5
- Database construction and administration - 2
- Data access security
- Data Warehousing - 2
- Difference that IT makes to education
- Distance education / standards / digital library - 3
- Distributed computing environment/architecture management
- Effects of technical changes on people in higher education - 2
- Electronic classrooms and more on Imaging - 2
- External pressures on the academy
- Financing IT - 3
- Future of the University / Internet - 2
- Help desk / Customer -Client/Server
- Integrating academic and administrative computing functions in a server environment
- Incorporating IT to become part of the critical decision making process of the institute
- This years topics were good and worth keeping for next year - 11
- Management of distributed computing resources and access
- More attention to the issues that academic computing managers face
- Motivational managers of change - 2
- More managerial, less technical - 2
- More on the Mac platform

- Multimedia, integrated voice, data, video - 2
- Networking policies, use and applications - 5
- Object development
- Organizational structure - 2
- Partnering - 2
- Partnership within university or college creating vision/mission development
- Passing the American education institutions experience in IT to foreign universities
- IT planning
- Presentations from consultants on organizational and process methods used by institutions, e.g.. Team Concepts.
- Professional Development - 3 / Staff/personnel development - 3
- Portable computing issues and Laboratory management issues
- Re-engineering and the support technology required - 4
- SCT/DG teleconference video format, very visible to "folks at home"
- Sessions on medical center IT issues
- Small college topics and speakers - 4
- System Applications -3
- Technical content, more of it - 2
- Technology and outcomes assessment
- Those that focus on the educational mission of our institutions
- TQM and specific vendor product implementation - 2

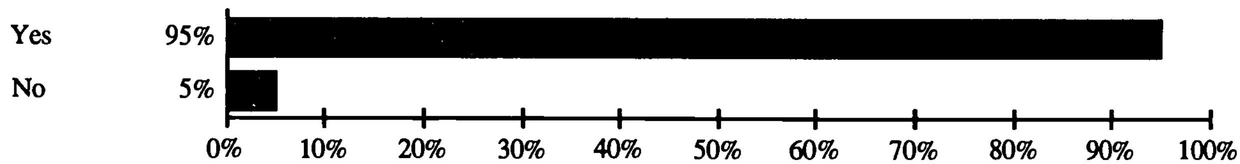
SPEAKERS:
- Lynda Applegate
- Dave Barry - humorist approach to IT, stress, ...etc
- Donna Cox
- Michael Hammer and Peter Drucker
- Bob Skinner /Carolyn Kacena SMU
- Patricia Fripp-excellent customer service speaker, spoke at ACUTA 1993
- Futurist - 2
- Jennifer James - 5
- Michael Vance & Bob Kriegel
- Nicholas Negroponte, John Rock art (Sloan School, CISR)
- Dennis Snow - 2
- Howard J. Strauss
- Any Corporate CEO or University CIO - 4

Do you have any comments about the site of CAUSE94?
- Great / Excellent / Spectacular / The Best / Magical - 106
- The best of five that I have attended
- Good choice for families / my family loved it - 4
- O.K. / Good / Pleasant. - 12
- Alternate hotels needed to be closer within walking distance - 13
- Don't need Disney - 3
- Did not care for Orlando
- Expensive - 28
- Florida and California are nice, but why not use some other states - 2
- Great events, it gets better every year
- Great location, easy to get a flights, something to plan a vacation around
- Keep it at the Dolphin - 2
- Keep it in the South, keep it first class, and not near Thanksgiving
- Liked the warm weather and local attractions.- 9
- Locate near more "civilized" areas, where restaurants and supply stores are within walking distance to avoid high hotel prices - 2

- Not much interest in Orlando/Disney World. I will look forward to New Orleans - 2
- Plenty of space, very accommodating, clean - 3
- Presenter Facilities poor-too small, too cold, too noisy background noise form adjourning rooms too loud-setting up table, chairs, vacuuming, talking, ...etc
- Pretty expensive for those traveling from west coast, limits our ability to send participants
- Service/people were excellent/great quality - 8
- Shuttle service problems - 7
- Shuttle buses are a wonderful way to get around
- The service and rooms at the Dolphin were not up to Disney standards
- Trapped feeling- 6
- Very well done, extremely easy to get from session to session-very comfortable
- Would like to see you move West again, not always in the South
- When you are so busy with what the conference offers, it shouldn't matter

- I generally don't like "resorts" as locations, preferring city locations and that's true of Disney World. Pleasure Island was ***fantastic*** and a pleasant departure from the traditional banquet at previous CAUSE's.
- I would prefer less 'grand' locations. I attended for the conference content, not the resort, we are in a state of extreme financial re-examination and for the boss to go to Disneyland while we are cutting staff sends a poor message. Attendance may be high for resort destination conferences but the marginal attendance may be at the park not the conference; and us real attendees get to pay a premium. This particular hotel is very poor for a conference-rooms too far apart, too small, this was serious: commercial exhibits much too far away.
- I was not all that excited about being in Orlando, but this turned out to be a great site.
- Yes, Disney World is a scary and intimidating place. It is depressing to see a place like this while dealing with financial stress, cutbacks, ...etc.

Did you learn anything at CAUSE94 that may affect the way you do things at your institution? *(285 responses)*



- Access to administrative data by MOSAIC - 2
- Admin. computing and student information access-and introduce pilot programming - 2
- Administrative computing software - 3
- Approach to benchmarking
- ATM migration and hesitations - 6
- Business Process Re-engineering - 2
- Client/Server -new tools and overviews - 13
- Contacts
- Conversations with vendors & attendees will help us avoid using a network consultant and changes in mail distribution lists
- CWIS implementation strategies and upgrading - 8
- Data Administration / Data warehousing- 19
- Dealing with people / customers / employees - 10
- Decision Support Systems / EIS
- Disney's approach to quality and service - 7

- Document imaging technology, accessing administrative data using Internet features
- Facilitating change - 4
- Good ideas about adjusting organizational structures - 4
- Gopher & WWW - 3
- I have a better picture of chief needs, and I achieved that aim
- I plan to focus more on attitudes and service when I return - 2
- Information policy issues- how they're being handled at other institutions - 2
- Issues relating to change - 4
- IT organization and planning or restructuring - 7
- Keynote speakers / General Sessions were excellent and helpful - 3
- Legacy systems, how to deal with them - 2
- Library IT collaboration - 4
- Networking trends and plans for future - 8
- Network financing, implementing, and training - 8
- Networking residence hall - 2
- New vendor products - 3
- Partnering / Collaborations - 10
- Planning methodology - 2
- Reorganization / Restructuring - 9
- Script X for multi-media
- See the big picture, to lighten up
- Security issues
- Service issues - 14
- Software selecting/installation - 4
- Staff/personnel development and improvement - 9
- Strategic Planning - 7
- Take your job serious, not yourself. Communicate more with customers
- Teamwork techniques - 14
- That we need to pay more attention to detail
- To be more open with information, get it all out there- 2
- Use of Internet kiosk and use of vendor products for student systems - 3
- Use of Internet tools / Internet access and Issue - 9
- Ways to make do with what we have - 3

What changes would you like to see in future conferences?

- A location less resort like where one can get out of the hotel to the local area
- Another general session later on Thursday to keep people around
- At the AM breaks have something other than coffee, not all people drink coffee- 3
- CD ROM of articles, registrant, ...etc
- Coordinate better with CNI so overlap is in joint program only, not so much overlap- 3
- Consider having poster sessions opposite track session to allow for more choices
- Crowded sessions, need more sessions or larger rooms - 8
- End the conference on a Saturday so it makes it easier to stay overnight
- Enlarge Institutional name on name badges - 2
- Ethernet connections for poster sessions
- Fewer Vendors
- Handouts at all sessions would be very useful - 7
- Have a light breakfast served and start a little later in AM - 2
- Have presenters summarize, "what we did" and "what we are doing now"
- Have screens in the back of large rooms for those of us in the back.
- I would prefer a Mon-Wed or Wed-Fri schedule, including seminars
- Increase vendor showing and hours - 5
- Increase time for face to face discussion in small groups

- Keep costs down
- Keep it warm in the winter and cool in the summer
- Larger conference/presentation rooms
- Lighter and healthier lunches- 5
- Longer conference - 3
- Longer session time - 7
- Lower costs of alternative hotels, even without a shuttle if necessary
- Microphones for questions at sessions
- More attention to blurring of lines between administrative and academic computing
- More focus with an overall theme
- More sit down meals without loud music
- More coffee before beginning morning session at breaks- 3
- More constituent group meetings
- More free time
- More methods of personal networking
- More on information policy, use
- More technical information
- More small college presentations - 2
- No smoking in areas outside meeting rooms- 6
- Not so close to Thanksgiving-traveling is really hard - 2
- Open registration on Tuesday evening during reception
- Perhaps have vendors ship paper material via e-mail, too much for my suitcase
- Pre-conference seminar for CIO's
- Poster sessions (more emphasis, include handouts, and have each afternoon) - 3
- Re-schedule popular sessions to minimize conflicts / Too much happening at the same time
- Reserve more rooms in hotel where conference is being held - 2
- Schedule stronger sessions around weaker ones to avoid time conflicts- 3
- Session evaluation forms need space for comments
- Shorter conference days
- Speaker dinner rather than a speaker breakfast- 2
- Stronger keynote speakers with respect to content
- Start general sessions later in the AM, 9:00 - 3
- Take refreshments out of vendor area.
- Why not combine CAUSE & Educom into one annual meeting? - 2
- It was just fine - 5

- A session for first timers. Give opportunity to learn about how conference works, to maximize time, meet a few people. Perhaps a day before the conference.- 2
- A little more "truth in advertising" from presenters. Sometimes presentation abstracts and titles are clever, but presentation not.
- On the registration form, eliminate the mention of the receptions. Helps stretch tight travel allowance for food, stretch it to other meals in these expensive hotels.
- Would like some very structured professional development in skills needed by IT managers in higher ed. and overviews of technology directions and developments, how does it all fit together.
- More care in choosing seminar presenters, the seminar I attended was good and good value. From what I heard, others were not so lucky - 2
- At conferences and in other CAUSE surveys/questionnaires/databases I would like to see inclusion of coordinating governing board and planning commissions.

"I would like to say..."

- CAUSE staff were extremely helpful / Great staff / Good Job / Thanks - 40
- Conference was: Great / Excellent / Professionally run / Wonderful - 36
- Good conference but I think that it is getting too big
- Charging for wine and beer while offering free soft drinks is discriminatory, nonetheless great conference
- Conference didn't seem as well organized in sessions as previous conference
- Content & location are not important I would attend no matter the theme or location
- Dissatisfied with the pre-conference seminar - 3
- E-mail was slow but food and location were excellent
- Exhibit hours/vendor availability were much improved. - 4
- For my first CAUSE conference, I liked what I saw - 2
- General session speakers were excellent! - 4
- Have at site where quarters are more affordable and more spouse activities
- It would be nice to be able to buy "video" copies like the way audio tapes are available- 3
- Keep up the small school presence
- Looking forward to CAUSE95 - 2
- Making new contacts is getting easier each year
- Not very innovative
- Overall sharing of information among members very valuable
- Prefer printed proceedings, hand out at conference with graphics
- Presenters should not read slides/handouts to audience
- Refreshments in Poster Session. Great idea! Brought many people together
- Shuttle service was terrible on Tuesday and Wednesday - 3
- The food and service was excellent. Variety, fast service. This enhanced the conference
- The organization and planning create a wonderful experience - 2
- This is my first CAUSE, and my first impression is that this is an excellent association
- Would like to have vendor exhibition area open later. I find I can't get to all of the sessions I want to and all the vendor interaction - 3

- I have attended both CAUSE and Educom for two years in a row. I find it extremely difficult to maintain my interest through both conferences. I am burned out on conferences by now, and it is difficult to be away from my institution for such a long stretch. I strongly encourage you to move CAUSE to April. In the long run, I think that CAUSE and Educom should merge.
- I was disappointed that some of the most promising topics were covered in fee-based seminars. Even worse, they appear to have been presented by reps from member institutions. Why must we pay extra for these?
- This years' current issues forum was better than last years'. Hope you do a video tape distribution again this year. The conference communications center was a good idea, especially the printing. Please keep it open Friday morning too!
- That this is the first CAUSE, I've been coming since '88, where I have heard numerous complaints about the quality of presentations. Several I attended were outstanding. I want to use my time to the best advantage and I feel it's wasted at a presentation that doesn't meet my expectations.
- General speakers like Snow and James are fun and thought provoking, but would prefer more University/college centered main speakers.
- Poster sessions provide outstanding vehicle for sharing common concerns for networking, for communicating ideas on a personal level. Expand with some re-working that moves from too much specifics to more common general concrete problems.
- Noticeable improvement from San Diego. Better program, better logistics. Conference is excellent year after year, but good to see it improving as well.
- The great attraction to CAUSE is the "all in one hotel" scheme. This is the first time I've been forced to ride buses. Either get the hotels closer together or get a larger hotel. I've felt

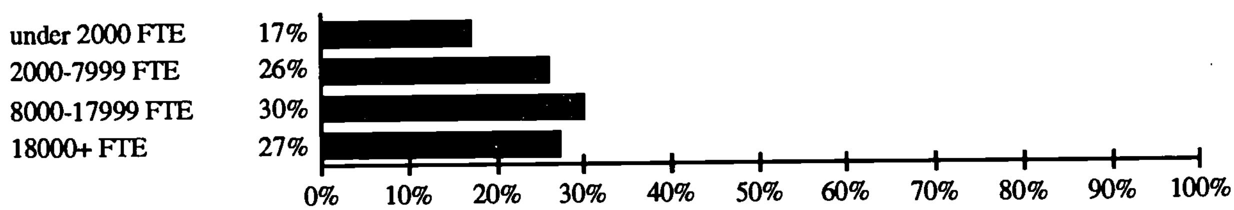
completely disconnected from the main pulse of the conference and I've been coming for 10 years and this was lousy.

- That CAUSE attendees are pretty friendly, the vendor hospitality suites were great, you get to talk to other attendees and get food so you can stay within the meager state daily allowance for food during travel.
- It was nice to have a few minutes between tracks this year to get from one to the other and more fair to presenters. I seem to remember in other years, there were no extra minutes.
- These conference always help me as a user, no I'm not a Techie, either by identifying new products, new information, on gauging where we are at compared to other organizations.
- It would have been nice if the room checkout time at the Dolphin was 1:00 pm so that we could participate in the closing ceremonies without the hurry of checkout.
- I note that for the opening session Jane Ryland remarked on how pleased she was at the growing international participation, to be immediately followed by a keynote speaker who in my mind demonstrated remarkable insensitivity to culture. I found that speech was not a good way to start a conference that is aiming at a global approach.(note: last sentence written in French)
- Some sessions were weaker than others. I believe it is the result of reaching real deep into the pool due to the increased size of the conference and the need for many more sessions.
- Non-conference related but I would like CAUSE to sponsor more SIG's electronically to promote more detailed discussions before and after the conference.
- I was struck by the amount of time spent on Client/Server when that mode of distributed computing is virtually ambiguous in every non-admin. area of computing... Wake up!
- Very disappointed with the pre-conference session. However, all staff were helpful and friendly. The best organized conference I have attended, superb.
- I loved the poster sessions. I was energized by the discussion I had from so many different people. I enjoyed & benefited from the interactions.
- CAUSE is a focal point between academic and administrative communities
- I have attended many conferences and this was the best planned and delivered that I have attended.
- CAUSE, its products and conferences, have become an essential part of running IT at our institutions.
- One of the best conferences I attended. The real power of it is the sharing attitude of colleagues.
- The CAUSE conference continues to be the high point in my professional year.
- I enjoy CAUSE every year I come to the conference with 4 or 5 major tasks to find solutions for. And I usually find 4 or 5 answers.
- It has been an excellent conference in every way.
- This is my first CAUSE conference, and although I've been to many other professional conferences, this one met and exceeded my expectations in quality and content.
- All my appreciation for the excellent work done. Keep up the great work! Incredible topics, fabulous location, foods and entertainment. Best of best! Thanks.
- Great conference! My first CAUSE conference showed me the relevance of the content for planners of institutional researchers, with whom I identify professionally.
- The program was, as always, outstanding. Excellent mix of technical, managerial and general sessions. The only problem was I couldn't attend all the presentations I wanted to due to conflicting schedules.
- Glen Ricart's talk was the most thought provoking talk I've heard in several years.
- CAUSE provides a forum for information professionals to share information and experiences no matter the institutions size or educational mission.
- CAUSE continues to be the best conference that I attend and CAUSE is the best year-round information source available to IT in higher education.
- It's been a wonderful conference—well organized, with delightful speakers at the general sessions, good use of the technology, and a great opportunity to pick up new ideas and visions. Your objectives are clearly in line with the mission of education and innovation.

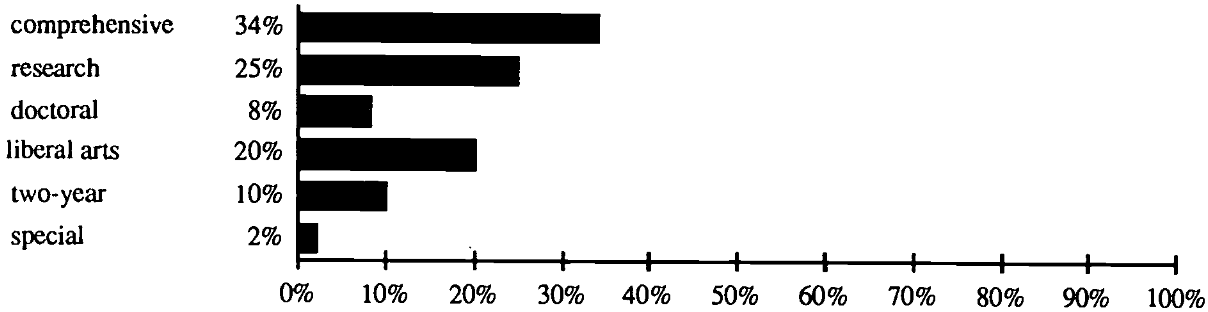
- I usually look for 1 or 2 more ideas. I got more ideas here than I can easily assimilate. Great!
- CAUSE annual conferences offer a high caliber professional development experience at a fair price in a great location.
- This is the third CAUSE conference I have attended and it was superior to the previous two in every way.
- CAUSE continues to be the best place I've found for professional development and net-working with colleagues. The general session speakers were especially good this year.
- As an experienced library director who has recently been given responsibility for all information technology on campus, I found the CAUSE conference to be informational and inclusive. The inviting atmosphere and the quality of the programs made this a very valuable experience for me and my institution. I look forward to attending more CAUSE conferences and plan to send more staff.
- I believe CAUSE gets better every year. I never fail to bring home good ideas to support our organization as we face ever rapidly changing technologies.
- CAUSE represents the highest quality professional association that I am aware of. It makes a profound impact in our institutions.
- CAUSE is a wonderful educational and professional development experience. The theme of "learning" is so powerful, yet not forgotten.
- If I could attend only one conference a year it would be CAUSE.
- This is the "whitest," least diverse conference or meeting I have been to in many years. It's also my first CAUSE meeting. From the conference program structure, one would have no idea there are people with disabilities or different cultural perspectives on everything involving information technology.
- I will encourage other members of the University to attend future sessions.
- Don't change the dates of the meeting. It is one of your competitive advantages to bring people South in early December; don't throw it away. Let Educom move.
- CAUSE94 was a wonderful and enlightening experience. I hope my director will allow me to come to CAUSE95.
- Poster sessions were exceptionally well done this year. I think it helped to have a large number (20+) because attendees felt more comfortable and had a better chance to view displays and talk to authors. Holding sessions in a separate room somewhat removed from vendors (with refreshments) also helped improve the experience. Well done.
- CAUSE keeps getting better and better, and continues to represent the epitome of all our professional lives.
- A good conference for me as a business officer. I hope more will attended in the future.
- I can't tell you how pleased I am with this conference. I hope I can attend future ones.
- Please spare us pundits and self important lobbyist or consultants like James or Atwell. Glen Ricart was excellent, interesting ideas, good presentation and data.

Demographics of the 365 responses

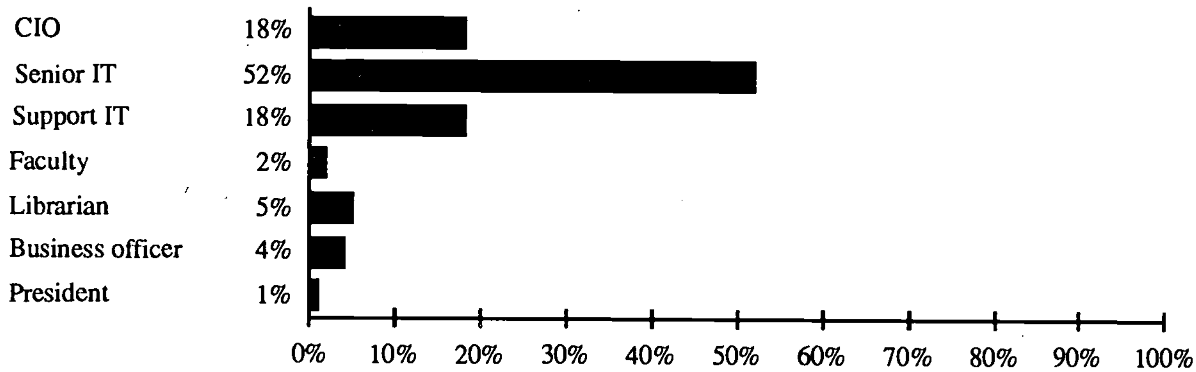
The size of my institution is: *(357 responses)*



My institution is classified as: *(359 responses)*



My job title falls in the following category: *(348 responses)*



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- ☐ TAPE 5 STATEWIDE COMMUNICATIONS STRATEGY FOR SHARED LIBRARIES, LABS, DISTANCE EDUCATION & STUDENT SERVICES - Lee Alley
- ☐ TAPE 6 A UNIFIED MULTIMEDIA APPROACH: SCRIPTX - Edwin J. Pinheiro
- ☐ TAPE 7 RESHAPING THE ENTERPRISE: BUILDING THE NEXT GENERATION OF INFORMATION SYSTEMS - Nicholas C. Laudato & Dennis J. DeSantis
- ☐ TAPE 8 NEW OPPORTUNITIES FOR INFORMATION SYSTEMS PROFESSIONALS - Desiree Abohasen, Mayra Alonso, Ethel Dangot-Pereira, Esther Lozano & Deborah Stedman
- ☐ TAPE 9 EXECUTIVE INFORMATION SYSTEMS: MEETING THE NEEDS OF COLLEGE & UNIVERSITY LEADERS - Datatel
- ☐ TAPE 10 IDENTIFYING COMPARABLE ACADEMIC INSTITUTIONS - John Minter Associates
- ☐ TAPE 11 HAVING YOUR CAKE & EATING IT TOO: A RECIPE FOR A COLLABORATIVE CWIS IN A DECENTRALIZED ENVIRONMENT - Lee Watkins & Laura O'Callaghan
- ☐ TAPE 12 MAKING ORDER OUT OF CHAOS WITH A COMPUTERIZED LOTTERY - Steven A. Oakland
- ☐ TAPE 13 STRATEGIC INFORMATION RESOURCES: A NEW ORGANIZATION - Gordon Haaland & Dennis Aebersold
- ☐ TAPE 14 DESIGNING & IMPLEMENTING A NETWORK ARCHITECTURE BEFORE IT BECOMES OBSOLETE - Noam H. Arzt & Ira Winston
- ☐ TAPE 15 PROVIDING A CAMPUS-WIDE SOFTWARE SERVER, OR, HOW TO BE ALL THINGS TO ALL PEOPLE - Larry D. Conrad & Richard Grover
- ☐ TAPE 16 A TRANSITION STRATEGY FOR MOVING TO A DISTRIBUTED COMPUTING ARCHITECTURE - Joan Gargano
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- ☐ TAPE 27 GETTING THE RIGHT FIT: INSTITUTIONAL DOWNSIZING WITHOUT CAPSIZING - Timothy J. Foley
- ☐ TAPE 28 A FUNNY THING HAPPENED ON MY WAY TO THE MEETING: THE USE OF HUMOR AS A MANAGEMENT TOOL - Jan A. Baltzer
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☐TAPE 78 IMPLEMENTING A CAMPUS NETWORKING INFRASTRUCTURE - Barbara B. Wolfe

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☐TAPE 80 MIGRATING FROM HOST-BASED COMPUTING TO CLIENT/SERVER - Jay Blum

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