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ABSTRACT

This document presents the proceedings of a conference on managing and using information technology to implement change in higher education. Six tracks, with eight papers in each track, address the themes of: (1) leadership challenges for managers of information technology during times of change; (2) leveraging people with technology, to make people and organizations more effective; (3) the impact of quality, especially the use of Total Quality Management; (4) managing in a client/server environment, to minimize risks while optimizing rewards; (5) optimizing the infrastructure to meet the challenges of new networking access; and (6) information delivery to support the institutional mission in teaching, learning, scholarship, and research. In addition, the document contains papers from four stand-by presentations; summaries of the keynote address, general session addresses, current issues forums, poster sessions, special sessions, and constituent group meetings; and information about participating corporations. (JDD)

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CAUSE

Managing Information Technology as a Catalyst of Change

Proceedings of the 1993 CAUSE Annual Conference

December 7-10
Sheraton on Harbor Island
San Diego, California

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CAUSE, the association for managing and using information technology in higher education, helps colleges and universities strengthen and improve their computing, communications, and information services, both academic and administrative. The association also helps individual members develop as professionals in the field of higher education computing and information technology.

CAUSE was organized as a volunteer association in 1962 and incorporated in 1971 with twenty-five charter member institutions. In the same year the CAUSE office opened in Boulder, Colorado, with a professional staff to serve the membership. Today the association serves more than 3,150 member representatives from more than 1,100 campuses representing over 800 colleges and universities, and 63 corporate members.

CAUSE provides member institutions with many services to increase the effectiveness of their computing environments, including:

- the CAUSE Exchange Library, a clearinghouse for documents and publications made available by members through CAUSE;
- the Institution Database (ID) Service, which provides to members information about typical computing practices among peer institutions from a database of member institution profiles;
- association publications, including a bi-monthly newsletter, *CAUSE Information*; a quarterly newsletter, *Manage IT;* the professional magazine, *CAUSE/EFFECT*; and a professional paper series;
- workshops, seminars, regional conferences, and institutes;
- a rapidly expanding program of electronic access to association information, including the CAUSE Gopher server; and
- the CAUSE annual conference.

We encourage you to use CAUSE to support your own efforts to strengthen your institution's management and educational capabilities through the effective use of computing and information technology.

Managing Information Technology as a Catalyst of Change

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INTRODUCTION

by David W. Koehler
CAUSE93 Chair

The CAUSE annual conference is a time of renewal. Too often our day-to-day problems keep us from thinking about the future and our vision for the use of information technology. Learning about what other institutions are doing and planning, and interacting with our peers, give us a chance to get our creative juices flowing again.

With its record-setting attendance of over 1,750 registrants—an increase of more than 20 percent over CAUSE92 in Dallas—this year's conference offered outstanding opportunity for networking, not in the technological sense, but for personal and professional support. All fifty of the United States were represented at the conference for the first time ever, along with over 100 conferees from countries outside the U.S. From comments on the conference evaluations, those of you who attended took full advantage of the opportunity to learn from the creativity and successes of colleagues, and to gather new ideas from the diverse offerings of over 50 corporations who participated in CAUSE93.

Our program committee structured the schedule for this year's conference for maximum flexibility, running special sessions and corporate presentations simultaneously with colleague presentations in a complex of nine concurrent tracks. In general sessions, George Welles demonstrated "Imaging for the Future," Jim Young described "Revolutionary Thinking," Michael Mescon brought humor and insight to "World Class and High Performance," and a panel discussion/multimedia forum focused on the current issue of "Finishing Technological Gestation: from High Tech to High Effect." Poster sessions were enormously popular this year: nearly 30 sessions were offered in two time slots, and drew shoulder-to-shoulder crowds.

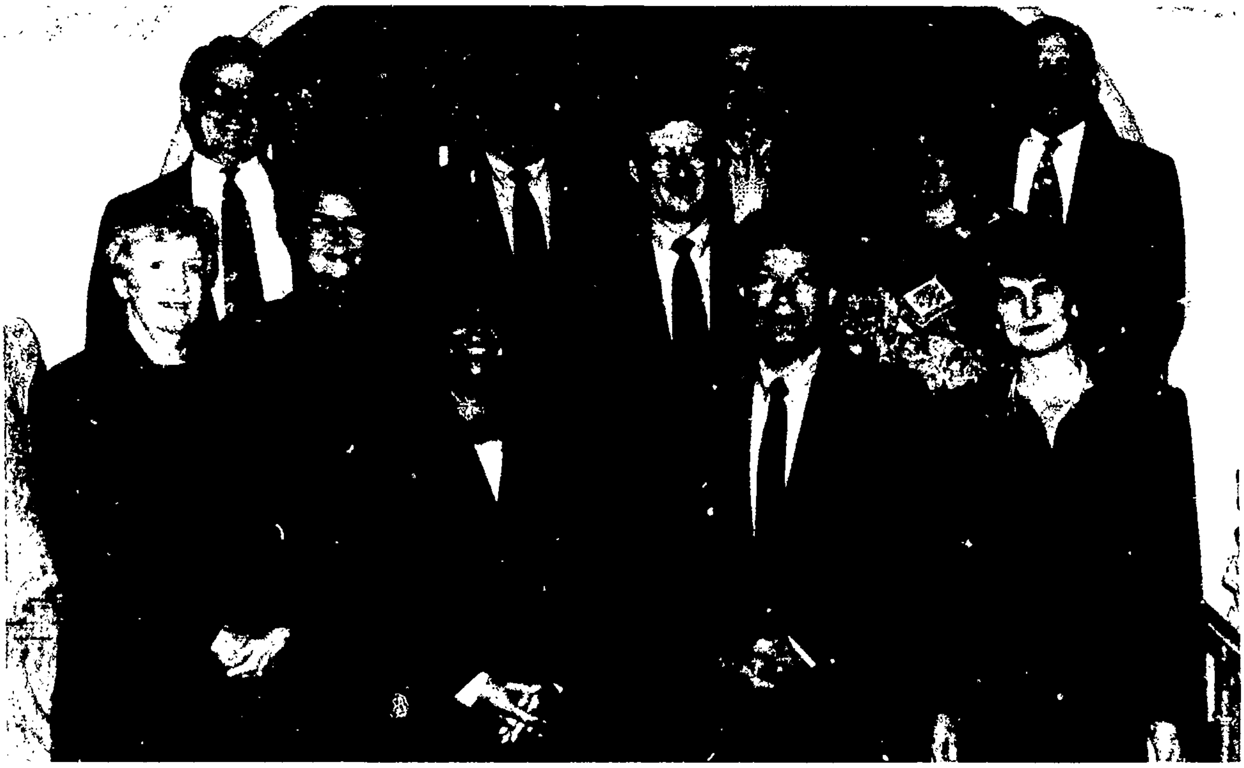
Several people and institutions were recognized during CAUSE93 for significant professional achievements. The Maricopa Community College District won the first CAUSE Networking Award for Excellence in Campus Networking, with special recognition also given to Brown University, Cedarville College, Gettysburg College, MIT, Pennsylvania State University, and Stevens Institute of Technology. Al LeDuc of Miami-Dade Community College received the fourth annual CAUSE ELITE Award for Exemplary Leadership and Information Technology Excellence. Four co-authors of a CAUSE/EFFECT *article on an administrative workstation project at Indiana University were honored for producing the best contributed article published in the magazine in the past editorial year: Polley Ann McClure, Susan F. Stager, Norma Brenner Holland, and Cathy Smith.*

These proceedings provide an in-depth look at the excellent conference offerings for CAUSE93 attendees and for professionals who were unable to come to San Diego. Note that recordings of the presentations are available on cassette tape (see order form on last page), and that most papers are also available on the CAUSE Gopher and via Internet, as described on the copyright page.

I would like to personally thank the CAUSE staff, members of all of the conference committees, and the attendees for a truly rewarding conference experience. I found the conference to be quite enjoyable and thank you for the opportunity to serve as your chair.

THE CAUSE93 PROGRAM COMMITTEE

The CAUSE93 Program committee, under the leadership of Chair David W. Koehler and Vice Chair Daniel A. Updegrove, dedicated countless hours to producing an outstanding program at CAUSE93. CAUSE gratefully acknowledges their enthusiasm, time, and efforts, and the generous support of their institutions.



Left to right, front row: Constance F. Towler, Harvard University; Deborah Stedman, Miami-Dade Community College; John Sack, Stanford University; Margaret Massey, Miami-Dade Community College. Second row: Sharon Rogers, George Washington University; Daniel A. Updegrove, University of Pennsylvania; Kathleen M. Ciociola, Rutgers, the State University of New Jersey. Third row: J. Bradley Reese, George Washington University; Don C. Wolfe, Brown University; David W. Koehler, Cornell University; James H. Porter, University of Chicago.

CORPORATE CONTRIBUTIONS

CAUSE thanks all those corporations who set up exhibits, gave corporate presentations, sponsored refreshment breaks and conference-related activities and items, and provided hospitality on Wednesday evening. Their contributions add an enormously valuable dimension to the conference experience. Special thanks go to:

APPLE COMPUTER — for co-sponsoring with CAUSE the conference information and messaging system, for multimedia support for George Welles' general session presentation, and for speaker equipment support

COOPERS & LYBRAND — for sponsoring a refreshment break, and notepads

DATATEL — for co-sponsoring CAUSE93 tote bags, and for being a host on Hospitality Evening

DIGITAL EQUIPMENT CORPORATION — for sponsoring the registration reception

EDUTECH INTERNATIONAL — for co-sponsoring a refreshment break

FARALLON COMPUTING, INC. — for supporting the CAUSENet system

HEWLETT-PACKARD COMPANY — for co-sponsoring CAUSE93 tote bags

IBM CORPORATION — for equipment support for the Odyssey Pre-conference Seminar, for speaker equipment support, and for supporting CAUSE Communications Central

NOVELL — for sponsoring the CAUSE Award for Excellence in Campus Networking

PERIPHONICS — for providing tablets for registration packets

ROSS SYSTEMS, INC. — for co-sponsoring a refreshment break

SOFTWARE AG — for contributing a leather briefcase for the CAUSE93 Closing Social drawing, and for being a host on Hospitality Evening

SPALDING CORPORATION — for providing a sleeve of golf balls for each participant in the CAUSE93 Golf Tournament

SYNOPTICS COMMUNICATIONS, INC. — for providing pencils for the registration packets

SYSTEMS & COMPUTER TECHNOLOGY CORPORATION — for sponsoring the CAUSE93 Golf Tournament , for sponsoring the *CAUSE/EFFECT* Contributor of the Year Award program, for sponsoring the CAUSE Exemplary Leadership and Information Technology Excellence (*ELITE*) Award program, and for being a host on Hospitality Evening

TEXAS INSTRUMENTS — for sponsoring the CAUSE93 Fun Run

UNIVERSITY OF CALIFORNIA/SAN DIEGO — for supporting CAUSENet links to e-mail and the Internet

US WEST — for providing George Welles as a general session speaker

XEROX CORPORATION — for co-sponsoring with CAUSE the conference newspaper, and for supporting CAUSE Communications Central

ZENITH CORPORATION — for supporting the Current Issues Forum and video

GENERAL SESSIONS

CAUSE93 general session presentations exhorted conferees to stay at the forefront of change, both technical and organizational.

On Wednesday, George Welles of US West offered a multimedia presentation that explored the technologies and societal changes that will alter forever the way we live and work in the era of the virtual reality campus.

On Thursday, Jim Young of EDS urged his audience to join him as "revolutionaries" seeking to "blow up the old ideas that seem outdated and need to be changed."

Friday's Current Issues Forum featured a look at the trends in information technology as viewed by university presidents. Richard A. Detweiler, president of Hartwick College, led a discussion with Paula Brownlee, president of the Association of American Colleges, and John C. Hitt, president of the University of Central Florida. Arthur Levine, of the Harvard Graduate School of Education, Harold (Bud) Hodgkinson, of the Institute for Educational Leadership, and Stephen J. Anspacher, director of Distance Learning at The New School, added their comments through video interviews.

Friday's closing talk by Michael Mescon was a motivational message to CAUSE members, in which he brought his formula for corporate success to higher education.

Wednesday Morning Keynote Address

"Imaging for the Future!"

George W. Welles
Manager of Broadband Applications
Compass Lab, US West

"Information is the currency of the twentieth century," stated George Welles in his general session presentation. "And the gap between the haves and have-nots is increasingly a gap between those who have and those who don't have access to information."

Welles, who is manager of broadband applications for US West's COMPASS Lab, offered insights on the promises of technology. Illustrating his points through a variety of media, Welles stressed the importance of technology in enhancing education. "In 1900 it took 100 years for the amount of information in the world to double; today it doubles every 17 months," noted Welles. "One of the most important roles for technology is as a 'lobot,' a locator robot to help us navigate these vast oceans of information."

Welles sees technology as a necessary learning tool: "By the year 2000, a college degree will be out of date before it's granted. Learning must be a lifelong proposition." Stressing the importance of training, he said, "Technology by itself is worthless. Humanware is the most important element in building the cyber-classroom. We must factor in training and allow people time to adapt to technology in their work and learning."

Welles envisions a time in which technology plays a ubiquitous role in our everyday lives to communicate, educate, research, entertain, and even shop. "In the near future we'll have 4-D: desktop digital distributed data."

The audience toured a virtual museum, glimpsed the Mayo Clinic's new interactive program on the heart, and enjoyed animated learning sequences for young children. As Welles pointed out, these programs do some things better than traditional textbooks—providing audio for a Chowke Thumb Piano, or showing a plant's growth or airflow patterns over an airplane. The true benefits of virtual reality will be realized as it becomes a tool for experiential learning.

Thursday General Session

"Revolutionary Thinking"

Jim Young
Assistant to the Chairman, EDS

Exhorting his listeners to join him as "revolutionaries" and "corporate terrorists," people who are engaged in a "remarkable, positive revolution, doing creative damage to the status quo," Jim Young of EDS said that what he's trying to do is to "blow up the old ideas that seem outdated and need to be changed."

The pace of change has accelerated over the millennia from "accomplishments through genes to accomplishments through ideas," said Young, and he warned that navigating through our rapidly changing world is like whitewater rafting without a guide: "there's no calm water, and none of us has ever been there before." "Change is necessary and change is a given. Opportunities are created by change. You don't have to wait for change, but can create it, and create opportunities," Young declared. He encouraged his listeners to "embrace change rather than resist change. The question is sometimes more important than the answer," he said, "and the search is most important of all."

According to Young, it used to be okay to just be a part of an organization. Now, he says, each of us must add value to the organization, and tie our jobs directly to its mission. He called CAUSE members the leading thinkers in their organizations: "I would challenge you to convert your leadership *opportunity* to a leadership *role.*" "Great dreams are usually accomplished by many working together," he declared. Likening information gathering to "saving string," Young suggested gathering ideas and saving them, making connections between people. "Knowledge is important, but *sharing* knowledge is essential to living well." Young envisions leadership without a leader, where everyone leads and everyone follows. He stressed the need for diverse views, creativity, and collaboration rather than competition in the workplace.

Young proposed that CAUSE form a task force to look at reinventing education, describing education as the most important issue facing our nation. "Virtually every problem we see can be traced back to a problem with education," he declared. "I challenge every individual to find a school and personally share your expertise with children. It will have an enormous effect on you. You'll get more than you give."

Jim Young has compiled a list of recommended reading, and he offered to share it with the CAUSE membership. That list can be found on the following page.

Jim Young's Recommended Reading List

Some highly recommended books

2020 Visions
by Richard Carlson & Bruce Goldman

Ackoff's Fables
by Russell L. Ackoff

The Adventure of Leadership
by Hap Klopp with Brian Tarcy

The Art of Problem Solving
by Russell L. Ackoff

The Art of the Long View
by Peter Schwartz

Barbarians to Bureaucrats
by Lawrence M. Miller

Break Point and Beyond
by George Land and Beth Jarman

The Creative Edge
by William C. Miller

Creative Whack Pack (card deck)
by Roger von Oech

Creativity in Business
by Michael Ray & Rochelle Myers

Crossing the Chasm
by Geoffrey A. Moore

Customers for Life
by Carl Sewell

The Design of Everyday Things
(formerly "The Psychology of Everyday Things")
by Don Norman

Don't Know Much About Geography
by Kenneth C. Davis

The Fifth Discipline
by Peter Senge

Future Edge
by Joel Barker

Get Ahead
by Tony Buzan & Vanda North

How the World Was One
by Arthur C. Clarke

Information Anxiety
by Richard Saul Wurman

A Kick in the Seat of the Pants
by Roger von Oech

Leadership Is an Art
by Max De Pree

Leadership Jazz
by Max De Pree

Liberation Management
by Tom Peters

The Media Lab
by Stewart Brand

On Becoming a Leader
by Warren Bennis

The Rise of the Expert Company
by Edward Feigenbaum, Pamela McCorduck & H. Penny Nii

The Secrets of Consulting
by Gerald M. Weinberg

Selling the Dream
by Guy Kawasaki

Serious Creativity
by Edward de Bono

The Seven Habits of Highly Effective People
by Stephen R. Covey

Six Action Shoes
by Edward de Bono

Six Thinking Hats
by Edward de Bono

Speed Reading
by Tony Buzan

Use Both Sides of Your Brain
by Tony Buzan

Use Your Perfect Memory
by Tony Buzan

A Whack On the Side of the Head
by Roger von Oech

The White Hole in Time (first 111 pages)
by Peter Rusell

You Don't Have To Go Home From Work Exhausted
by Ann McGee-Cooper

Current Issues Forum

"Finishing Technological Gestation: From High Tech to High Effect"

Coordinator: **Richard A. Detweiler**

Information technologists have focused largely on the development of computer and networking hardware and software. It seems clear that we are now entering a period of paradigm shift, increasingly focusing on issues related to accessing, processing, and communication important to individual effectiveness. Because of the increasing power of technology, the technology itself is beginning, appropriately, to play a background role, supporting rather than dictating behavior. Electronic and voice mail are symbolic of this change—people rarely know or need to know about the technology, but they use it voraciously because it meets a very central human effectiveness need. This is truly a paradigm change.

We must begin thinking differently about technology, using a new conceptual model for approaching the human-technology nexus. We must no longer focus on the needs for technology, but on the human needs for information access, processing, and communication.

The CAUSE93 Current Issues Forum examined international, national, and education trends and developments with a focus on their implications for the future role of information technology in higher education. *If we cannot glimpse the future, we cannot lead the way to it.*

Richard Detweiler, Current Issues Forum Moderator, is president of Hartwick College. He interviewed Arthur Levine of the Harvard Graduate School of Education, Harold (Bud) Hodgkinson of the Institute for Educational Leadership, and Stephen J. Anspacher, director of Distance Learning at The New School, on topics relating to their vision of the changes in information technology in higher education. These interviews were videotaped and shown at the Forum, where two panelists, Paula Brownlee, president of the Association of American Colleges, and John C. Hiatt, president of the University of Central Florida, added comments of their own.

Friday General Session

"World Class and High Performance: More than Just a Catalyst"

Michael Mescon

Chairman, Mescon Group

"If you don't like what's going on at the bottom of an organization, take a good look at what's going on at the top," advised Michael Mescon, former dean of the School of Business at Georgia State University. He told conference attendees at the Friday general session that he is a believer in revolution from the top down, and insisted that those at the bottom need "sky hooks," cultural reference points to hold on to and believe in. "We're drowning in mission statements," he said. "We need statements of behavior."

Mescon emphasized that our institutions are "in dire, immediate need of proactive behavior." In higher education, as in business, he insisted, the customer is the boss, and should be served by people who feel they are a vital, valuable, and significant part of what they do. "Handle every single transaction, no matter how small, with each person as if you had to live with that person in a very small room for the rest of your life," he advised.

Mescon, author of *Showing Up for Work and Other Keys to Business Success* and co-author of the widely used business textbook, *Business Today,* encouraged his listeners to move from a "Why me?" stance to "Why *not* me?" in confronting challenges in their jobs. He urged CAUSE members to become mentors and role models, taking action in shaping the future of their organizations.

PROFESSIONAL PROGRAM

CAUSE93 brought together over 1,750 conferees from around the world for nearly 50 professional presentations in six tracks at the Sheraton on Harbor Island, in San Diego, California. In addition to these track presentations, conferees could choose from Current Issues discussion groups, Poster Sessions, Constituent Group meetings, Campus Perspectives, Special Sessions, and Corporate Presentations.

This section includes the text of papers presented in the concurrent track sessions, followed by summaries of many of the other sessions.

CAUSE thanks all those who organized and led sessions, especially those on "standby" status who agreed to present their papers if a presenter had to cancel. One of these papers was presented, and three standby papers that were not presented at CAUSE93 are included here.

TRACK I

LEADERSHIP DURING TIMES OF CHANGE

Coordinator: Don C. Wolfe

Universities and colleges have come to accept change as the only constant in their institutional processes. Information technology is and will continue to be in the forefront of those change agents that will distinguish successful institutions from the less fortunate. In this era of rapid change in mission, economics, and technology, what special leadership challenges do managers of information technology face?

ASURITE

How to Avoid Creating a Distributed Computing "Tower of Babel"!

Neil Armann, L. Dean Conrad, Darrel Huish
Information Technology
Arizona State University
Tempe, AZ 85287-0101

ABSTRACT

The entire computer industry is racing at breakneck speed to implement client/server applications and begin reaping the benefits of the new distributed computing paradigm. However, there are many ways to implement a client/server environment and institutions must plan their implementations to avoid technological anarchy and keep from creating a "Tower of Babel" in which the pieces do not communicate or cooperate. This paper discusses the distributed computing architecture Arizona State University has established to ensure all the new distributed pieces will actually work together. This architectural approach is called ASURITE, ASU Rational Information Technology Environment. We describe ASURITE and the impact this architecture will have on the academic and administrative computing communities.

I. INTRODUCTION

The Problem

Computers are getting continually more powerful and consistently less expensive. This has encouraged the pervasive use of information technology throughout the University. Despite our historical reliance on mainframe computing, the majority of ASU's investment in technology now sits on the desktop.

When viewed at the department level, this evolution toward distributed computing is a good thing. It allows the department to improve their operation without long delays waiting for external expertise. However, when technology is implemented in piecemeal fashion, units can find themselves unable to accomplish work that crosses organizational boundaries. This is usually because the various departments' computing environments have not been designed to work together. Computer people call this situation "Islands of Technology." For example, a faculty member may have a useful computing "island" for tracking records and grades of his students, yet find it impossible to send final grades to the University's student information system.

When faced with the obstacles presented by these isolated islands of technology, many organizations attempt to centrally control or coordinate technology implementation. Some organizations try to settle on a single vendor to insure that all pieces of technolcgy will operate together. This approach is not practical for ASU because we have a high degree of autonomy within our various units; we have already made a large investment in a de facto heterogeneous computing environment; and even if we could all agree on a homogeneous set of technical products, we lack the massive budget required to replace significant portions of our technology.

So, we need a better strategy to address this problem. Departments need to answer three basic questions:

If I'm buying technology and want to maximize my ability to work cooperatively with others, what should I buy?

If I have limited budget but want to improve my technological situation incrementally, how can I evolve in the same direction as everyone else?

If some functions are going to be handled centrally for efficiency's sake, what tasks will be done for me and what tasks should I prepare to do for myself?

Approach

In a simplistic sense, the way to guarantee that we can cooperatively share technology is to identify standards. This approach has worked well in the area of audio music. We can all buy cassettes and expect them to work on any cassette player made by any manufacturer. The same is true for compact disks. One can plug a Sony amplifier into a Technics receiver with Bose speakers and easily construct a viable audio system. This is because the manufacturers adhere to standards.

Unfortunately, we don't yet have widely accepted standards for most aspects of computer technology. There are emerging standards that hold promise for improving our situation, but today there is no "plug and play" ability among all vendors. A significant obstacle to the ultimate success of any standard is the rapid pace of change among computer technologies.

ASU's Rational Information Technology Environment (ASURITE) is an information technology architecture that positions the university to take advantage of emerging standards. It also recognizes the need to accommodate budget constraints, moderate the pace of change and preserve the autonomy of the individual departments.

ASURITE describes a distributed style of computing that is constructed of modules. Each module performs a specific function and can be thought of as analogous to an audio component. The components are frequently called "servers." So, the computing environment at ASU will have several data servers which store and retrieve data. Several print servers will produce output at various locations. Mail servers will store and forward mail throughout the university, etc.

Some modules lend themselves to being implemented and supported centrally. For example, security can be best maintained by allowing a single method to gain access to computing resources. Customers would typically identify themselves during their first interaction with any computing resource and then be granted authority to all valid and appropriate services. One server can be maintained centrally rather than have multiple security checks with multiple procedures and passwords.

Departmental implementation and support is more appropriate for other modules, such as a database used only by a single department. But that departmental database may need to obtain some of its data from a central database, so the ability to interact with central services must be maintained.

ASURITE is an architectural framework which describes how all supported components will interact within such an environment. The architecture encompasses various styles of computing including client/server, distributed computing, cooperative processing and object orientation. It is intended to help ASU achieve flexibility, adaptability and efficiency in information technology, by putting processes on the right platforms, in the right location, and in a consistent manner.

ASURITE treats the individual as the focal point of a series of software "services" supporting the individual's dual role as both **data producer** and **information consumer.** In general, services can exist on any combination of hardware and physical locations deployed in an "intelligent" network. It is primarily the desktop which invokes the services where and when needed to satisfy an individual's need.

The desktop will become the focal point of the individual's interaction with enterprise systems and data, as well as with collaborative groups, research data bases, etc. Data, voice/sound, graphics/images, and live video will converge on the desktop as the common denominator for synthesizing information from data. All applications will reside in a robust, intelligent network which presents the information consumer with a single system image. ASU systems and links to the external world will appear to be a single network composed of services and data, invoked by name regardless of the physical locations and technology used to provide those services and data.

The diagram in Appendix A provides an overview of the ASURITE as it will be implemented over time.

II. GENERAL CHARACTERISTICS

In order to achieve the overall ASURITE architectural objectives, the following qualitative characteristics are established:

Adaptability - change as national & industry standards evolve, so we can enhance and incorporate new ways of doing essentially the same business function without major developmental impact.

Manageability - centrally manage or coordinate and monitor, including the orderly planning for capacity changes of various essential services.

Reliability - remain in continuous operation even if part of the system suffers failure, needs maintenance or upgrading, or is destroyed or damaged by a disaster.

Securability - provide different access to individuals based on the classification of data and the user's business function. This will require that all basic ASURITE services use standard (ASURITE) authentication and authorization services.

Extensibility - easily add new kinds of functionality to existing processes without major impact.

Scalability - increase or decrease size or capability in cost-effective increments without software impact or "spikes" in the unit cost of operations due to step functions in procuring additional resources.

Performance - fast response and high throughput.

Connectability - communications access to a variety of area, national, and international networks.

Consistency - relative stability of the person/machine interface over time.

Accessibility - university community members should be able to access and use ASURITE services wherever they are, provided that they have a properly configured "client" workstation.

III. CHARACTERISTICS OF INDIVIDUAL SERVICES

The following qualitative objectives are established for each individual service offered within ASURITE:

Like an extension to the desktop - how information is presented to, manipulated by, or provided by the user needs to be consistent across all applications no matter where the application is actually running -- on the desktop or on a network server. The user interface can be made more consistent by making it appear as if the information is completely under the control of the workstation software with which the individual user is already familiar. Just as the user can tailor the workstation software to satisfy her needs, so should she be able to tailor the interface for information from and to external systems.

Interoperable - (1) any supported service is available to any supported client no matter the particular brand of server or client hardware and software and (2) the interaction between clients and servers is transparent to the client, e.g., the client does not need to know where the service is coming from.

Incorruptible (virus-free) and as secure as practical - computer viruses are detected and prevented from spreading to servers and clients, and data and computer systems are protected from unauthorized use and tampering. Absolute guarantees, however, of virus prevention and security are not feasible.

Fault-tolerant - reduce the impact of hardware and software failures. Highly critical servers might have redundant processors and databases so recovery from a failure would be immediate and transparent to the user; other, less critical servers could have backup servers that could be put into operation within a few hours.

Disaster-tolerant - restore services in a timely manner when a disaster, such as a fire, destroys equipment.

Expandable - additional capacity can be added to meet the demands of more users or increased functionality without modification to user procedures.

Peer to the client - no master/slave relationship should exist between client and any server - the client is not controlled by the server. A client makes a request of a server and is prepared to receive a response (or a request to supply more data to the server) but is free to do other processes in the meantime.

Restricted in access as needed - since all services are technically accessible to any user on the network, individual service providers may limit access to their services if necessary; e.g., a departmental printer may be restricted to use by members of the department.

Non-interfering and non-conflicting with other services - any user can use any service or combination of services concurrently.

Appropriately interactive with the client - the client can monitor and alter its requests for services. The server should make the status of a request for service available to the client so the client/user can cancel or modify the request if needed; e.g., it should be possible to determine that a data base query is retrieving much more data than anticipated and to cancel that query if desired.

Optional - local (to the client) services are allowed; e.g. a local printer may be completely under the control of the local client.

IV. SPECIFIC SERVICES THAT WILL BE PART OF ASURITE

A. The following services are considered basic to ASURITE, and must be in place before other services can be added:

Authentication and authorization - authentication is the verification process that confirms the identity of a person requesting service; this process must be done in a secure manner to prevent others from determining the method of verification. Authorization is the process that permits only those who have been granted permission to use a particular service to actually use that service.

Finder/navigator - permits users, clients, and servers to reference services, devices, and people by name rather than by physical location or network address. These services also permit transparent relocation of devices, servers, etc.

Time - synchronize date and time of day on all the servers and clients so that time-dependent processes are coordinated.

File management - provides for the storage, access, and security of data (e.g., text, images, and voice) particularly to facilitate the sharing, interchange and security of data. File management services include

backup and recovery services make duplicate copies of data in case the working copies are damaged and provide procedures to restore lost data from the backup copies, and

archiving services provide facilities to store and retrieve seldom used data on low-cost media, such as tape.

Print - provides for the transmission, temporary storage, and production of paper output of data (including text, plots, and images) from clients and other servers.

Configuration management - set of services to coordinate the software and hardware on the servers and clients and includes

notification of changes,

update by subscription,

coordination of non-optional upgrade of software, and

verification of hardware compatibility.

Network management data base and status - maintains data concerning the network configuration and operations.

B. The following are examples of services or classes of services that will be added to the basic ASURITE services over time:

Collaboration support is a set of services that facilitate human communication between individuals, within a group working on a common effort, or among groups interested in a particular topic. These services include messaging, computer-facilitated conferencing, electronic mail, voice mail, calendaring, and groupware.

Enterprise applications are those computer applications that support the major administrative functions of the university.

Object catalog contains data about enterprise data (e.g., names, descriptions, and usage rules) and common processes using enterprise data (e.g., a complex query that extracts data from several data bases and puts them in a spreadsheet). An object catalog is an extension of the data dictionary concept.

On-line consulting is a repository of information and previously asked questions and answers to help users and support personnel solve hardware and software problems.

Computation servers handle resource-intensive calculations that are inappropriate for running on a local workstation.

Software library services provide for the distribution of shareware or site-licensed software and the lending of software for trial use.

Databases services make information available to any client and are provided by commercial, research, administrative, and other sources (e.g., the administrative data warehouse).

Scheduling of tasks services control processes that do not need to be run immediately, e.g. long reports or database backups.

External access services permit use of the servers from locations outside of the university-operated network, e.g. from Internet sites or via dial-in from home.

Problem reporting and tracking services receive and facilitate the resolution of system problems.

Approval and signature services permit the electronic (i.e., sans hardcopy) authorization of official documents, e.g., purchase requisitions, grades, and payroll.

V. PRODUCT ARCHITECTURE

The intent of this section is to list some specific products and standards that currently appear to comply with the general characteristics and services that form the core of ASURITE. The list of products and standards is incomplete because in some cases no product or standard exists that conforms to the ASURITE architecture. However, current products and standards will evolve and new ones will emerge to fill in the gaps.

An example of emerging distributed computing standards are the Distributed Computing Environment (DCE) and Distributed Management Environment (DME) standards provided by the Open Software Foundation (OSF). OSF is an independent company formed by a coalition of computer and network product suppliers. Its goal is to provide a set of open industry standards for distributed computing. Manufacturers that conform to these standards are assured of interoperable products. Because DCE and DME also provide extensive coverage of the services listed earlier, ASURITE will be relying heavily on products that use them.

Users view ASURITE from their desktop workstations, each with the individual's own preferred method of interaction. In acknowledgment of this, ASURITE will provide support to the general community for desktop Operating System-Graphical User Interface (OS-GUI) combinations that will interact with appropriate servers. The initial set will be:

DOS 5 - Windows 3.1
Mac System 7.1
UNIX-Motif.

These OS-GUI are expected to evolve or be replaced over time. Possible successors include Windows NT and Windows for Workgroups for DOS/Windows and AOCP for the Macintosh.

The primary network communications protocol set required to obtain ASURITE services will be Ethernet and TCP/IP. However, protocols in addition to TCP/IP, e.g., Appletalk, IPX, and DECNET, will also be supported on the university backbone for use by individual work clusters and departmental local area networks for the near term. It is expected that additional network capacity will be needed at ASU, particularly on the University Backbone, to support all of the new services, so ASURITE will be evolving to new, higher speed protocols as needed and funds allow. Examples of new network standards being considered are FDDI and ATM. In the near future higher speed protocols will be used primarily on the backbone and to connect high volume servers and workstations, but the vast majority of workstations will be connected via E[illegible]net.

With the large number of LAN's at ASU, it will be important that ASURITE coexist with the LAN's and interoperate with LAN services such as file sharing, local mail, and print services. Client workstation connectivity via Ethernet provides access to both LAN services and ASURITE services even though the LAN might be using a non-TCP/IP protocol. The ASURITE file service, initially, will use the Andrew File System (AFS) which at present can only be directly used by UNIX clients. However, Network File System (NFS) software can be installed on Mac and DOS/Windows workstations and access AFS files via a NFS/AFS translator provided as part of the ASURITE file service. To the user the AFS files appear in the directory as if they resided on the workstation and can be moved to a LAN server or the workstation by simple drag and drop of the file icons. LAN vendors are expected to incorporate interoperability functions in the future so intermediary services, such as the NFS/AFS translator, are not required.

The following tables summarize the ASURITE standards and related products for basic services, client workstations, and communications. These form the components of ASURITE, but, of course, must interact with each other to form a cohesive architecture.

Table 1: Basic Services Product Architecture

Service	Future Standard	Initial Product	Future Product
Authentication	OSF/DCE	Kerberos v. 4	Kerberos v. 5
Authorization	OSF/DCE	native OS access control	DCE Access Control List
File	OSF/DCE	Andrew File System (Transarc)	DCE Distributed File System
Time	OSF/DCE	Internet, Network Time Protocol	DCE Distributed Time Service
Finder/Navigator	OSF/DCE X.500	X.500 Internet Domain Name Service	X.500
Print	OSF/DME	TCP/IP LPR/LPD Palladium	DME Print Service
Data Base Management	SQL Access Group	Sybase Informix Oracle	Sybase Informix Oracle
Data Base Transaction Management	SQL Access Group X/Open-XA	Encina	
Configuration Management	OSF/DME		
Network Management Database	OSF/DME		
Email	X.400 SMTP	SMTP/IMAP	X.400 SMTP/IMAP
Calendaring	None yet		

Table 2: Client Product Architecture

Function	Initial Product	Future Product
Operating System / Graphical User Interface	DOS 5.0/Windows 3.1, Mac System 7.1, UNIX/Motif	Future versions compatible with initial products
Data Base Access	Sybase Open Client, Microsoft ODBC, Borland IDAPI	SQL Access Group standard
Communications card	Ethernet	Ethernet; FDDI on high volume workstations
Communications software	TCP/IP	TCP/IP

Table 3: **Network Architecture**

Function	Initial Product	Future Product
Wiring	Broadband coax with some fiber optic campus backbone to building router, Broadband coax to floor closet, Twisted pair to workstation	Fiber optic backbone and to high volume workstations, Twisted pair to most workstations
Low-level communication protocol	Ethernet with limited FDDI on backbone	FDDI backbone and to high volume workstations in short term, ATM or other long term; Ethernet to most workstations,
Transmission protocol	TCP/IP (see Note)	TCP/IP

Note: The backbone network also supports DECNET, IPX, and Appletalk for use by departmental LAN's, but access to the ASURITE services requires TCP/IP.

VI. Impact on Academic Computing

While ASU struggles with the challenge of implementing distributed computing for our administrative systems, much of academic computing is already distributed. Starting in the mid-1980's, the administration began a series of "faculty computer infusion" programs where the goal was to place a computer on the desktop of every faculty member that desired one. Most of these were PC and Mac systems. This was followed a couple years ago with a "networking infusion" program where the goal was to get the faculty connected.

The faculty infusion programs were very successful. However, as we began to look at implementing the ASURITE architecture, we realized we would have to do something about all the older, obsolete technology that is the legacy from the earlier programs. The architecture provides the promise of much additional function and flexibility, but it depends on a minimum configuration that will run Windows 3.1 or Mac System 7. Meanwhile, we had literally hundreds of faculty members with PC-XT's, early Macs, or worse on their desktops. Furthermore, we had many old, obsolete systems in our student computing sites. It would require a mainframe-level expenditure to resolve this problem.

Fortunately, we were able to enlist the support of our Provost and Senior Vice President. At the end of FY93, the Provost funded a new infusion program that allowed ~700 faculty to upgrade their systems, which addresses roughly half of the obsolete systems. A similar infusion program is anticipated for FY94 to address the remaining half. In addition, Information Technology (IT) also received funding that allowed us to install ~350 new systems in the student sites. The base systems purchased were 486 and Centris 610 configurations. These upgrades will allow virtually every faculty member and many students to participate in the ASURITE environment.

Over this next year, IT will be focusing on deploying the ASURITE basic services. At the same time, several projects are being initiated or extended -- by IT as well as other units on campus -- that will utilize and build upon these basic services. These include:

- o a distributed client/server e-mail system (including forms routing and calendaring) to replace the present mainframe-based environment -- this will be extended to all faculty, staff, and students as opposed to the present limited availability;
- o a "self-subscription" service for e-mail and other popular services that will allow us to automate the accounts process for the massive number of accounts that will need to be created;
- o transitioning customers off the academic mainframes by deploying adequate statistical, compute, and file servers as well as migrating many faculty primarily to their desktops;
- o a dial-in Ethernet service for access to all ASURITE-compliant services from virtually anywhere;
- o a server for downloading software products including the clients that will be needed to access the many servers that are being deployed, e.g., e-mail, Library CD-ROM, and GOPHER clients;

- a Netnews/Usenet server;
- docking stations in the student computing sites to allow students to bring in their own laptops and plug into the network;
- an on-line CD-ROM data base server in the Library;
- a high quality color print/copy server; and
- a slide maker server for presentation (deferred to FY95).

A robust distributed academic computing environment promises to provide powerful new tools and capabilities to the faculty. However, careful planning will be needed to deliver on this promise. We have initiated a joint planning effort between IT and the colleges to help ensure we fully understand the needs of each college and that faculty and students experience the minimum amount of discomfort as we begin the evolution to this new environment.

VII. Impact on Administrative Computing

ASURITE has had a significant impact on ASU's administrative computing. The technical architecture is now widely accepted as an important part of any decision making about technical projects. There are at least three reasons for this. First is because ASURITE offers guidelines not mandates. In a political environment where autonomy is highly valued, people respond better to a suggestion than a requirement. Second, departments are going to spend funds on some form of technology anyway so they appreciate published information about how to make things work together. This is related to the third reason which is that ASURITE provides some insulation from blame. We have had administrative units call us and ask how they could get their project "certified" as ASURITE compliant. We have resisted the idea of a certification process as too bureaucratic but some customers have been persistent. We have done some informal consulting and recommending about purchases, but don't yet certify projects as architecturally sound.

So, what's really happening?

It isn't enough to have an architecture. We must also build applications that will demonstrate the value of distributed computing. To that end, ASU has acquired an application development environment that will build client/server applications from an enterprise model. We will be using the IEF from Texas Instruments as the basis for automating new student information processes.

ASU is also implementing a server-based data warehouse. Initially populated with student data, we expect to follow soon with financial and human resource data. Customers will form queries and manipulate the results from their workstations.

We are also seeing a strong growth in gopher style services. One project may make admissions information available to high schools while another is as simple as electronically publishing the minutes of the advisory committee meetings.

There is also an emerging need to interoperate between new distributed style applications and legacy IDMS applications. We have a financial aid downsizing project underway that will have data residing on a server as well as using data on our old IDMS database.

Challenges

There are, of course, challenges. One is a feeling of false security that can come with being aligned with the technical architecture. Some departments may ignore other important issues in distributed computing. For example, the need for departmental disaster recovery planning is still very real. In addition, we need to have applications that are not only technically compliant but also consistent with the university's business model and production standards.

Another issue is funding. Who pays for the new costs associated with this style of computing? ASU has managed to provide additional funding to place more workstations on faculty desks, but we haven't yet been able to do the same for administrative staff. Another more concrete example is that we've had customers resist using data access servers to print their own mailing labels because they would then need to buy labels. Under our centralized model, the labels had been provided for "free." From the institutional perspective this should be a non-issue, but for a struggling department all expenditures are significant.

VII. Summary

We face many critical issues as we deploy ASURITE-compliant services. The following are the most immediate; resolution of these will be crucial to achieving our vision of a distributed computing future:

- funding for servers: after the past three years of budget cuts, IT no longer has the funds to provide all campus-wide computing services;
- funding for maintenance: for the environment to work smoothly and be reliable, we will need to carefully coordinate release levels for critical software components on clients and servers alike -- however, it's very difficult to dictate how other units spend their budget dollars;
- network management: problem and change coordination for critical components of the network is already a problem on our campus and the situation will only get worse; and
- systems management: the faculty do not have time to become systems managers, yet software will need to be upgraded, system backups taken, and files archived/restored -- we are actively pursuing solutions with various vendors, but not all of the necessary pieces appear to be available as yet.

Establishment of an architecture will make addressing these challenges possible and will ensure the resulting systems environment will deliver on the functions and flexibility that a distributed computing paradigm promises. Perhaps the fundamental issue is the client/server paradigm itself. Can all this stuff work? We hold frequent meetings under the heading of "Client/Server Reality Check." We focus on what products and services will be needed as compared to actual product availability. The frequent conclusion to these reality checks is "yes, we'll get there--but it won't be easy and it won't be soon." The key to ASURITE is keeping in mind that it will evolve and will never be "completed." It is a journey, but not a destination.

Without an architectural framework we risk computing anarchy and creation of a distributed computing "Tower of Babel!"

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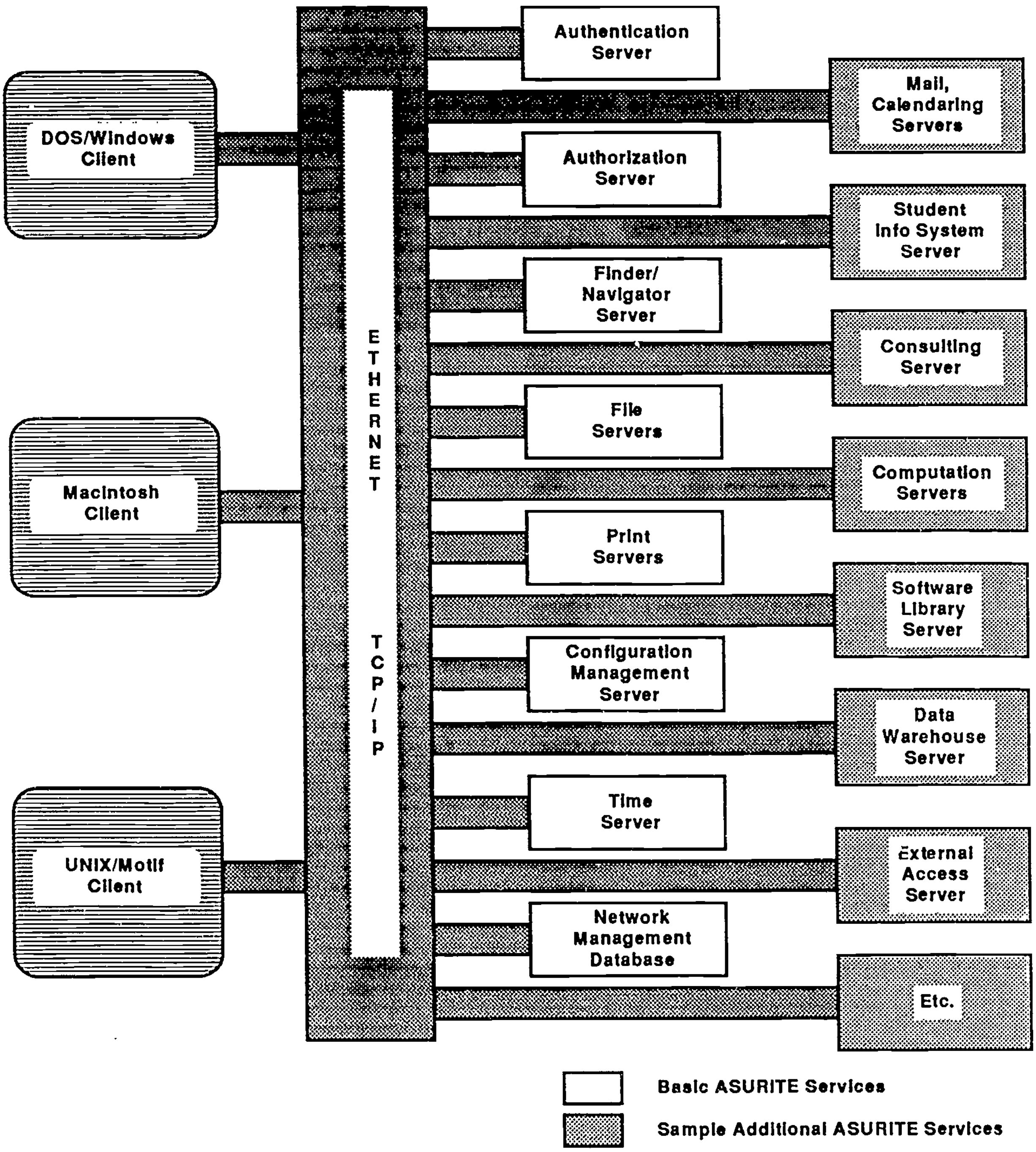
APPENDIX A

ASURITE Overview



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Integrating Computing Resources: A Shared Distributed Architecture for Academics and Administrators

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Abstract

At the University of Alberta we have defined a computing architecture that enables the University community to share computing resources distributed across campus. This architecture provides users with an integrated electronic environment, with easy and transparent access to academic and institutional data, high performance computing, printers, and other peripherals. The sharing stretches beyond departmental boundaries. On demand, researchers can, for example, share each others' workstations, and take advantage of idle cycles on servers that are otherwise managing institutional data.

We explain how the vision of shared distributed computing was developed and how it is being implemented; we give a high-level description of the architecture and the users' view of the electronic environment; we show the budgetary advantages of the project; we explain the technical, and especially the managerial challenges behind and ahead of us; and we list the campus-wide human infrastructures necessary to manage such an integrated electronic environment.

Some Historical Background

During the mid-eighties computing at the University of Alberta underwent some dramatic changes. As the economic boom of the oil industry declined, funds to the University shrank quickly. Consequently capital funds for computing were reduced from $8 to $1 million a year. This prevented the University's central computing organization from keeping up with technology. The reduction of funds happened at the same time as workstations became affordable. Researchers and University staff did not hesitate to take advantage of this new commodity and started realizing their own computing solutions using their own funds, such as research grants or re-directing other sources of money. This led to a peculiar environment: at the end of the eighties the University computing organization was managing second or third-hand computing equipment, while the campus (having 7,000 staff members and 35,000 students) had bought state-of-the-art desktop computers by the thousands (see Table 1).

In the early nineties, users started to perceive the burden of managing their own computing equipment and actively demanded that the central computing organization change in nature to provide support for distributed computing. The users also demanded that computing at the University be raised in profile to match the standards of computing that the University had enjoyed during the seventies when funds were generous and computing at the University could compete with the top universities in North America.

This is why in 1991 Computing and Network Services (CNS), the computing department at the University of Alberta, formulated, in collaboration with senior University administration and the user community, a strategic plan in an attempt to define a road map that would restore the state-of-the-art computing and support that the University had enjoyed earlier (see "Computing Services Planning, Downsizing, and Re-organization at the University of Alberta" proceedings of the CAUSE conference, Dallas, December 1992; and "Networking Computers and People on Campus and Beyond" Computing and Network Services strategic plan, University of Alberta, February 1992,).

While we formulated the strategic plan we knew, however, that one important parameter had changed: the level of funding that had been enjoyed in the past would not be available again. The University President, Dr. Paul Davenport, recommended that the computing organization transfer salary funds to capital funds at a rate of $200,000 a year for five years, which would result in the department having an additional $1 million a year for capital allocation. Although painful to staff, this recommendation helped improve our financial position.

The capital funds we could count on were, however, still not large and it was clear that raising the profile of computing despite this meant that we had to develop a new way of thinking. Besides financial considerations, several other factors contributed to conceiving a new computing environment for the campus.

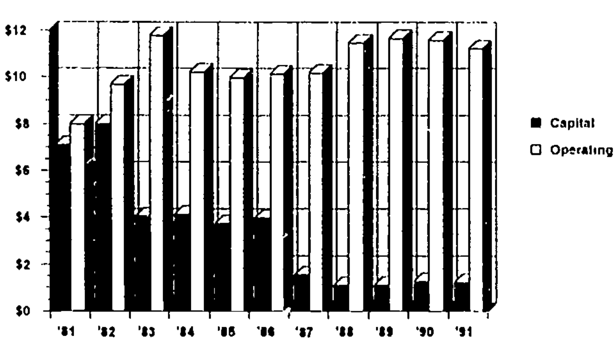

Figure 1: Retrospective of CNS Capital and Operating Funds (millions of dollars)

Central Mainframes	
Amdahl 5870	MTS
Amdahl 5880	MVS
IBM 4381-R14	VM/XA
Convex C210	UNIX

Campus Workstations	
Microcomputers (PCs, MACs, Clones, etc.)	10,000 units
Workstations (RS/6000s, SUNs, SGIs, etc.)	1,000 units
Operating Systems	UNIX, DOS, etc.

Table 1 Central Computers and User Environments at the University of Alberta, 1993

Rationale for Defining a Shared Distributed Computing Architecture

Implementing the Strategic Plan

The first shift in our thinking occurred when we started implementing the strategic plan. The plan contains fifteen strategies. They call for:

- various aspects of distributed computing support, such as installation of a high-bandwidth campus network, services to help clients with the management of their own computing equipment, and the establishment of guidelines for purchasing equipment to ensure adequate support and interoperability
- increased computing capacity for both researchers and administrators
- integration and modernization of administrative applications
- enhanced support for instructional computing (instructional labs and computer-assisted instruction tools).

Originally, we distributed the strategies among the CNS management team with the mandate to prepare operational and financial plans for each strategy and then provide the resources and project management for implementation. We soon found out that this was not the optimal way of implementing the strategic plan. Several difficulties arose.

Need to Abolish the Distinction between Administrative and Academic Computing Support Staff

No strategy could be implemented within the jurisdiction of one single manager. For example, integrating and modernizing administrative applications using a new client/server architecture could not be implemented by the Information Systems group alone, which in the past had primarily dealt with mainframes. Expertise was needed from staff with networking and workstation experience. Similarly, implementing a distributed open system environment for research could not be implemented by staff with only workstation background; expertise in system software and networking was required. We were very fortunate to be able to address this problem easily, thanks to some organizational changes that had occurred previously.

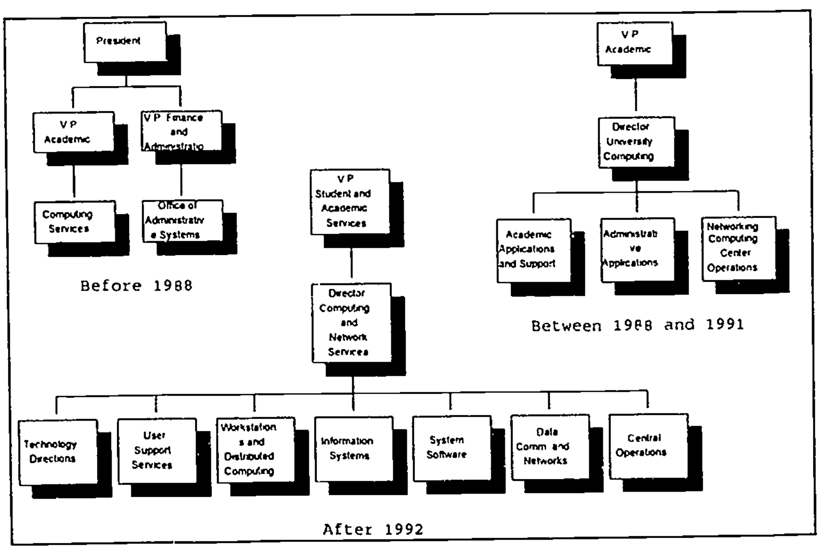

Figure 2: Retrospective of Computing Reporting Structure

The University of Alberta used to have two computing departments: the Office of Administrative Systems and Computing Services. The former department reported to the V.P. Finance and Administration and the latter to the V.P. Academic. Following suggestions put forward as early as 1985 by some visionary University staff, in the spring 1988 the two departments were put under a single director reporting to the V.P. Academic. At that time the two computing rooms were amalgamated; the rest of the organization, however, continued to operate as two independent entities. Administrators and researchers used different equipment and sought support from different staff. This led to substantial duplication of services and in 1992 we carried the organizational change a step forward by eliminating in the computing organization the distinction between academic and administrative computing.

reorganizing along technology lines. Even though the new organization was efficient to give day-to-day support to clients, it was still too rigid to implement the strategic plan effectively. Thanks, however, to a new way of thinking that had developed over the years it was easy to break departmental barriers even further. We established task forces with staff from various CNS groups and technical backgrounds. Each task force has a leader and has the mandate to implement one strategy in the plan. By mixing staff with different backgrounds new ideas soon started to flourish.

Need for Architectural Cohesiveness and Integrity

It was good to generate new ideas, but we were left with the problem of organizing and selecting them to ensure effective and compatible implementation of the strategies defined in the plan. Filtering ideas was difficult since within each task force we had staff with different technology backgrounds and beliefs: some were wedded to mainframes, while others had embraced workstation technology to the extreme. Also, due to the intricacy of distributed computing some strategies had overlapping requirements. Since each group was working without an overall technological guideline, groups tended to find different technology solutions for the same requirements. For example, implementation of electronic forms and general purpose communication required e-mail solutions. These solutions were being looked at separately without an attempt to coordinate.

We therefore felt the need to define clear architectural directions for computing and networking, which could guide CNS and the users in their decisions. Will English, who had helped pinpoint these problems, was appointed manager, Technology Directions, with the mandate to define a computing and network architecture for the campus, taking advantage of as much staff wisdom as possible. To cause minimal disruption to the work of the task forces, he decided to formulate and publish the architecture plan a chapter at a time, starting with the most urgent issues that needed coordination between the task forces.

Guiding Principles

The campus computing and network architecture is being defined with some basic principles in mind:

- *Do Not Resist the Distributed Computing Trend:* Clients had been frustrated for many years by the obsolescence of the central computing power and by the backlog of work in administrative applications development. As a result many clients had already found alternative solutions using workstations. It was clear that distributed computing was happening no matter what. New solutions had to acknowledge this and had to accommodate the desire of clients to choose their own solutions while still benefiting from a central coordinating infrastructure.
- *Avoid Paying Mainframe Bills:* Our budget was too tight to be able to think about mainframe upgrades. We had to find a way to increase and modernize the computational power using cheaper technology.
- *Capitalize on Existing University Investments:* Our clients had already invested heavily in new technology by purchasing workstations by the hundreds. We had to find a way to capitalize on this investment.
- *Create an Integrated Electronic Environment:* It was clear that we could add value to the investments that already existed on campus by tying together the distributed computing resources; for example, by providing easy access to academic and institutional data and to special devices such as high speed printers or high performance computers.

Breaking the Barriers between Academic and Administrative Computing

As the architecture was being developed an idea emerged which we think is fundamental to changing the way computing resources are used on campus. For decades academics and administrators used different computer systems. With the way technology has evolved lately, this is no longer necessary, nor desirable.

A decade ago when many scientists started moving away from aging mainframes, seeking faster respond times from workstations, manipulation of large amounts of institutional data could still only be handled by mainframes. Today, the same workstations being used for scientific work can also handle large data bases. If used wisely, they can entirely substitute mainframes for that use. Furthermore, in the past, UNIX was primarily used for scientific computing. Today UNIX, if used in connection with other tools, can also handle secure manipulation of data.

It seems that today many ingredients are available to define a uniform architecture for both academic and administrative computing. Pushed by the desire to make use of economies of scale and by making full use of campus computing resources, the CNS staff defined an architecture that allows academics and administrators to share resources across campus. Even though the sharing comes with considerable management challenges, there is strong support on campus to make the shared environment work. We describe next this shared distributed architecture.

Description of the U of A Shared Distributed Architecture

The Network Backbone

Fundamental to a distributed architecture is a solid network. Distributed resources on campus are harnessed via a fast network backbone. The backbone being installed is a 100 million bits per second fibre optic FDDI network installed along the University tunnels in a figure of eight (see Figure 3). The network is being connected to concentrators at preferred ring node locations (denoted with letters in the figure). The concentrators are used to extend the fibre from each ring node location to the machine room of adjacent buildings. The fibre optic cable has 24 strands. Twelve strands have been reserved to implement the distributed architecture described below. The rest of the strands have been reserved for future applic tions, such as energy and utility management.

The network is being installed in phases. The north route is functioning, the rest of the ring will be ready by 1994. The ring is being financed by converting salary funds into capital.

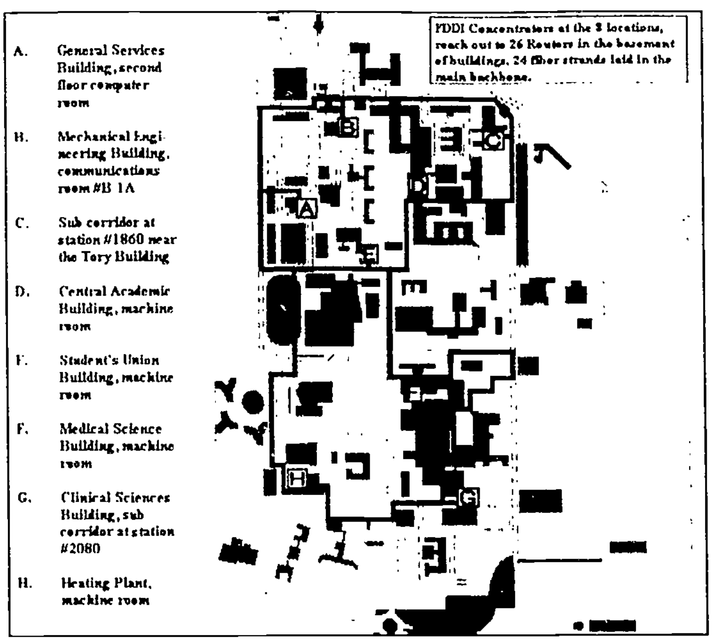

Figure 3 University of Alberta FDDI Backbone Network

The Campus Ring

Two strands of the fibre optic backbone are used to form a general purpose Campus Ring. The Campus Ring will harness most computers on campus. This is done by connecting the fibre in the machine room of each building to routers which, in turn, connect to the departmental local area networks (LANs) (see Figure 4).

The Campus Ring is being used to provide general purpose services, such as e-mail, file transfers, distributed printing, and manipulation of institutional data. Institutional data will reside on six enterprise severs placed at strategic locations on campus and connected to the FDDI backbone network. To provide maximum performance, each Enterprise Server will be located near the local area network of the administrative unit that the server primarily supports. Information and applications of interest to only one administrative department will be handled within the department's local area network. The servers will handle information and applications that are of interest for all campus users. The Servers will support enterprise-wide applications, such as:

- enterprise data used by many applications across the campus
- enterprise file libraries housing the programs and files needed to support the users in accessing the enterprise data
- enterprise services supporting cross-platform applications, such as electronic University form processing or enterprise document management.

We are currently installing new information system tools which will eventually handle this client/server architecture. Some of the tools will have to evolve further before they will be able to handle our desired environment.

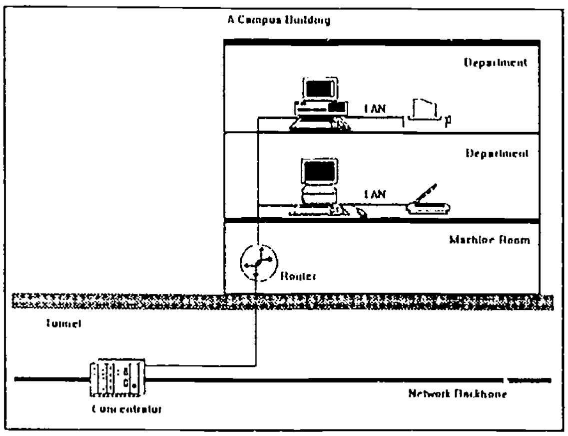

Figure 4 Connecting Department LANs to the Network Backbone

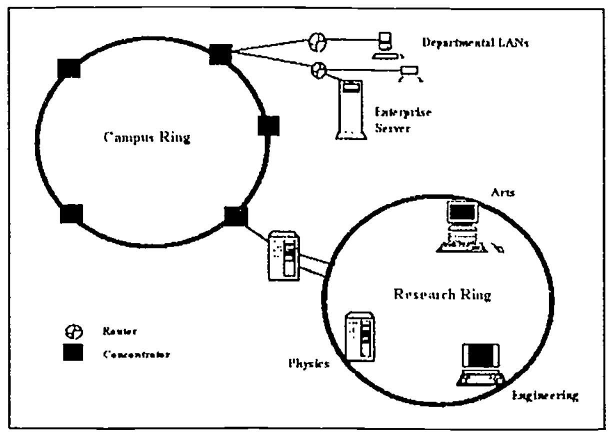

Figure 5 Campus and Research Rings

Research Ring

Two strands of the backbone will be used to network research workstations across campus. For each workstation, four fibre strands will be extended from the nearest concentrator to the workstation. The goal is to better utilize the campus investment in workstations by allowing researchers to execute their jobs on idle workstations. The ring can contain workstations and larger systems from different vendors. The workstations connected to the ring can be on researchers' desks or in instructional labs. The jobs submitted to the ring can be sequential or parallel:

- *Sequential Program Execution:* Researchers will be able to utilize workstation cycles on the ring to execute their sequential jobs. Each workstation on the ring will run an NQS-like software package (Network Queuing System). The software allows users to submit a job to a queue on a particular machine on the ring or to submit a job to a "ring queue" which will then select the best available machine on the ring.
- *Parallel Program Execution:* Researchers will be able to utilize workstations on the ring for parallel processing. The workstations will run the Parallel Virtual Machine (PVM) software package from Oakridge National Laboratory, a tool which provides an environment for designing, testing, and debugging parallel applications.

Both software packages mentioned above allow the research ring to be formed at particular times of day. Researchers wishing to use their workstation alone can disconnect from the ring. They can connect to the ring when they desire. There are two primary reasons for connecting:

- if researchers need more computational power than their personal workstations can handle, they can connect to the ring to ship some of their programs to idle workstations on campus. At night, for example, computers in instructional labs can thus be easily used for production runs.

- if researchers anticipate that their personal workstations will not be fully utilized for some time, they can donate some of their cycles to colleagues.

"Foreign" programs run on a workstation are always "niced," so that researchers always have first call on their worksta ions.

Many other institutions have already networked workstations in this manner. The novelty here, is that the workstations do not all reside in one machine room and are not centrally owned; they belong to researchers or instructional labs dispersed across campus. Obviously, there are various management and security issues that come along with the research ring. We describe them later in the paper.

Sharing of Resources
The Campus Ring and the Research Ring will be connected to allow researchers to have full usage of the Campus Ring. We also anticipate that the Enterprise Servers will not be used at full capacity all the time. Researchers will be able to use the Enterprise Servers, especially at night, for the execution of their programs.

CNS Workstation Farm
CNS is also building a "farm" of workstations to be located in CNS machine room. The farm will run the same tools as the Research Ring, and more. Researchers will be able to off-load their programs to the farm as well.

Open System Environment
The Campus Ring and the Research Ring will be managed under the auspices of the Open System Environment Project. This project is dealing with:

- authentication services to ensure data security, such a Kerberos
- a user ID service that uniquely identifies campus users, such as UNIQUENAME
- a campus-wide network file system, such as AFS
- monitoring tools to measure computing resource usage in a distributed open system environment
- system administration guidelines for managing distributed resources in a collaborative manner with faculties and departments

The Demise of Mainframes
The computing resources on the Campus Ring and the Research Ring will slowly replace our mainframes. We anticipate that by 1998 CNS will not host any mainframes.

The Users' View of an Integrated Electronic Environment

Many devices and utilities are already attached to the network backbone and their number will grow over time. It is essential that we present to the user an easy interface to the network environment, hiding from the user the complexity of the operation. The goal is to provide to users (students, faculty, staff, and the community) access to an integrated electronic environment from any workstation on campus, be it located on the user's desk, in an instructional lab, or in the library. Access will be provided to academic data (library, special data bases), to institutional data (student records, classes, forms, etc.), and to special devices (workstations, printers, publishing devices, high performance computers). These resources might be situated on campus, directly attached to the backbone, or they might be somewhere on the Internet.

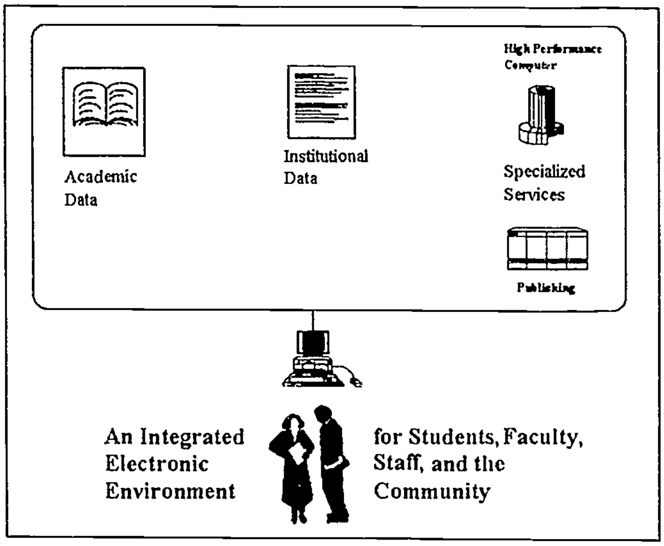

Figure 6: An Integrated Electronic Environment

Budgetary Gymnastics to Move from Mainframes to a Distributed Architecture

The shared distributed computing environment we want to establish will be much cheaper than the current mainframe environment (see first graph in Figure 7). However, while mainframe maintenance constitutes a large drain on our budget, mainframes are also responsible for very substantial revenues for CNS (see second graph in Figure 7).

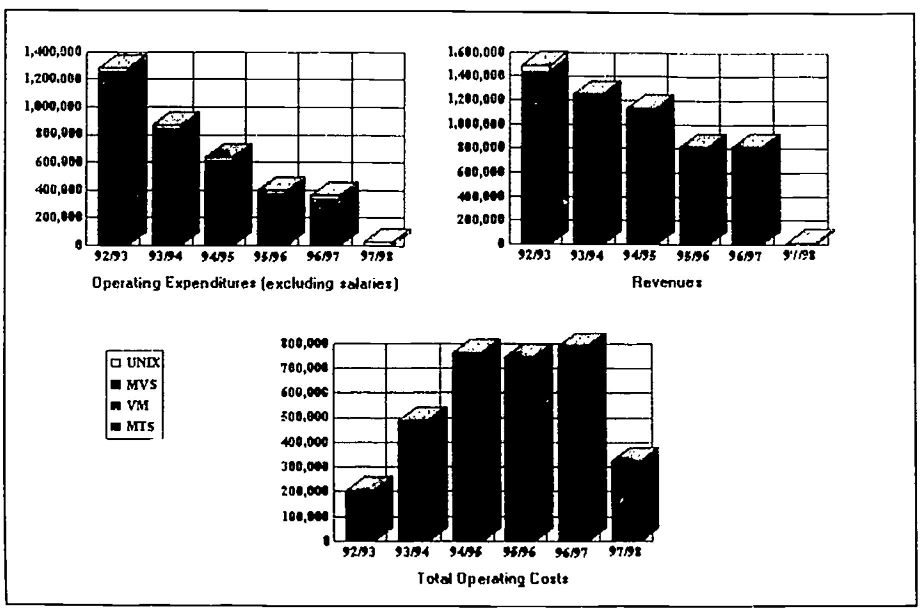

Figure 7: Projected Expenditures, Revenues, and Costs during the Transition Period from Central to Distributed Computing (Costs are Expenditures minus Revenue)

As the mainframes disappear, the revenue will disappear with them. We have agreed with senior University administration that we would not seek other sources of revenue, once the mainframes are decommissioned. It was felt that internal University accounting is expensive, and that computing should eventually be regarded as a utility.

We all believe this is a very desirable environment to establish for users, but it leaves us with an interesting budgetary challenge:

- Users will move off mainframes faster than we can transfer mainframe applications (such as administrative applications) to a distributed client/server environment. Therefore, as users move off mainframes, the decline in revenues will be faster than the decline in mainframe maintenance costs. The result is a net loss in CNS revenue.
- During the transition period from central to distributed computing, we will have to maintain both types of systems. Our expenses will therefore temporarily grow.

The last graph in Figure 7 shows the overall projected operating costs of moving from mainframes to the shared distributed computing environment. We are currently devising with senior University administration various methods of how to bridge the transition period. We are extremely fortunate to have a senior University administration that understands the issues, and is supportive of initiatives (such as ours) aimed at improving University operations.

Supporting Human Infrastructures - Managing an Extended Enterprise

Implementing and supporting a distributed computing environment comes with various managerial challenges. We believe that these challenges far outweigh the technical challenges. In the past, central computing organizations dictated computing solutions to the campus. Today, both computing resources and computing expertise have spread on campus and management of a computing infrastructure has become an endeavor to be shared with the users.

Advisory Committees

There a various tasks which we are trying to share and coordinate with user input and participation. Besides the University Computing Advisory Group (UCAG) which reports to the V.P., Student and Academic Services, and which has existed for many years, we have established other advisory committees. Officially these committees report to the same V.P., but it is CNS that is managing them. All these committees have representatives from faculty and administration. Some of the committees also have student representatives. The committees help gather user requests, provide a sounding board for CNS plans, help establish policies and procedures, and help us coordinate campus activities related to information technology:

- *Network Advisory Committee (NAC):* The committee was used as a sounding board for the FDDI network backbone architecture. Current challenges comprise educating the campus on how to plan for and connect departmental LANs to the network; managing a presidential fund to cover the cost of connecting departmental LANs to the network; and teaching users on Internet access and potentials.
- *Numerically Intensive Computing Committee (NICC):* The committee advises on directions for high-performance research computing on and off campus. The challenge ahead is management of the Research Ring. A special user committee will be set up to establish policies and procedures and to coordinate collaboration. Other challenges relate to connecting the Research Ring to high-performance computers in Alberta and elsewhere in North America.
- *Technology and Standards Committee (TASC):* The committee is used as a sounding board for the information technology directions formulated by CNS. It is also being used to help determine which information technology tools are recommended to the campus (and thus supported by CNS).
- *Information Systems Advisory Committee (ISAC):* The committee advises on information systems directions and plans. The committee will be pivotal to help us migrate institutional data from the MVS mainframe to Oracle running on the enterprise servers and client workstations distributed across campus. Tasks ahead of us for which we will seek advice from the committee are:
  - establishment of a training and support program for customers to learn about the new Oracle tools
  - establishment of criteria to select some pilot projects to test the new Oracle tools
  - establishment of University-wide criteria for selection of industry applications to run with Oracle, such as financial or student record systems.
  - CNS will define a data dictionary and the data management infrastructure, deciding, for example, which data is to reside on the enterprise servers and which data is to be stored within departmental LANs.

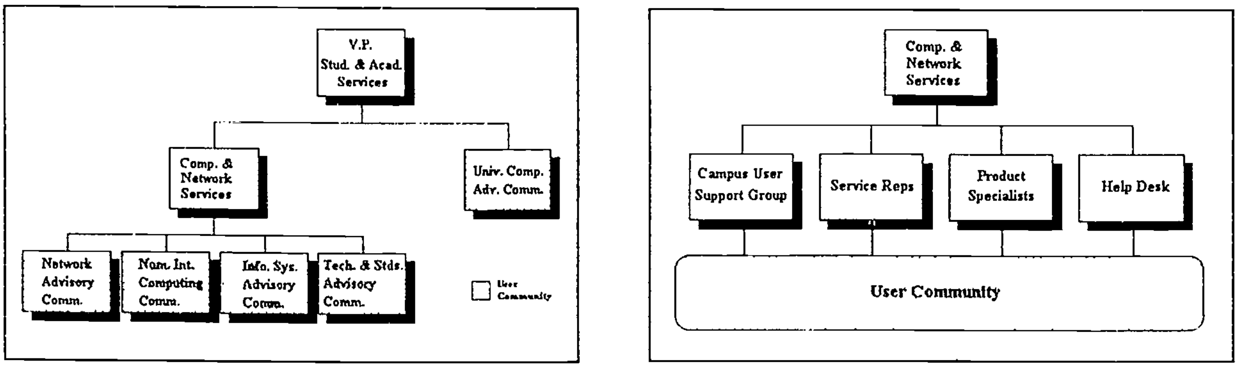

Figure 8: Managing an Extended Enterprise: Advisory Committees (left) and CNS Outreach Program (right)

CNS Outreach Program

Besides advisory groups, CNS has established additional outreach programs:

- *Campus Computing Support Group:* Departments with large computer needs have appointed local computing support staff. The primary task of these staff is to manage the departmental LANs. In the past, this departmental computing support staff has worked in isolation. CNS is now starting a program to establish an extended user support enterprise on campus. By exchanging information, coordinating training and user documentation, CNS will collaborate with the departmental support staff to provide computing support on campus.
- *Service Representatives:* CNS has also appointed staff to help faculties and departments plan for computing and networking. The task of a Service Rep, a CNS staff member assigned to a faculty, is to understand the way computers are used in that unit, guide users in high-level plans, disseminate information on CNS directions, and keep CNS appraised of issues and user wishes.
- *Product Support Specialists:* While Service Representatives are assigned to faculties, Product Specialists help users with the use of specific products. Since different faculties may in many cases use the same products, Product Specialists transcend faculty and departmental boundaries. Product Specialists keep track of departmental expertise and experience and establish a network among users with similar technology interests.
- *Help Desk:* The Help Desk collaborates closely with the Campus Computing Support Group, the Service Representatives, and the Product Specialists to establish and maintain a network of users with various expertise and responsibilities in information technology.

CNS is still learning how to manage these outreach programs. Initial feedback from the user community is good, but we feel that there is still room for improving how we capitalize on the information we gather from the user community and how we use it to constantly improve services.

Technology Planning for the Nineties: Responding to the Challenge to Do More Work With Fewer Resources.

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Abstract:

Kent, like most universities, is being challenged to do more work with fewer resources. Information technology is expected to play a more important and strategic role as the University responds to this challenge. Kent developed and implemented a plan for information technology that builds on current strengths, promotes broad commitment and ownership, and helps ensure that scarce technology resources are allocated to strategic activities.

Using IBM's Information Planning Study (IPS) Methodology, Kent organized a nine person Study Team and charged them with developing an information technology plan.

The objective of this paper is to share the results of Kent's study.

Background:

Kent State University, located in northeastern Ohio, is a state-assisted institution with eight campuses, i.e., the Kent Campus and seven Regional Campuses. Kent, was established as the Kent Normal School in 1910, renamed Kent State College in 1929 and became Kent State University in 1935. The University, which is the 28th largest in America, serves approximately 33,000 students with 23,000 on the Kent Campus. The Kent Campus, located in Kent, is 35 miles southeast of Cleveland, and 11 miles east of Akron. The Regional Campuses names and locations are Ashtabula (in Ashtabula), East Liverpool (in East Liverpool), Geauga (in Burton Township), Salem (in Salem), Stark (in Canton), Trumbull (in Warren), and Tuscarawas (in New Philadelphia). Kent's total full-time and part-time faculty, staff and student employees is approximately 6,000. Kent's total annual budget is approximately one quarter billion dollars.

Undergraduate students can pursue studies in over 135 majors and 111 concentrations. Graduate students can pursue 13 different graduate-level degrees in 118 masters majors and 62 doctoral majors. As a member of the Northeastern Ohio Universities College of Medicine, (a consortium of Kent State University, the University of Akron, and Youngstown State University), Kent offers students the opportunity to earn combined bachelor of science and doctorate of medicine degrees in six years. Kent State University's academic programs in Liquid Crystals, Fashion Design, Psychology, and Education among others are known internationally for their quality. The Kent State University Library has been designated as an official depository of U.S. documents - one of only four such libraries in Ohio.

Kent State University encompasses 2,300 acres, including 824 at the Kent Campus and 663 for the Regional Campuses. Other acreage includes an airport, golf course and numerous conservation areas. The physical plant on the Kent Campus includes 102 buildings with 30 residence halls and 230 family-housing apartments capable of housing 7,000 students.

Kent State University is organized into the following divisions: Academic and Student Affairs; Business and Finance; Institutional Advancement; and Human Resources. The Information Services Department, which supports both academic and administrative computing needs, is in the Division of Business and Finance. The Director of Information Services reports to the Associate Vice President for Business and Finance. Information Services is organized into five major functional areas: Administrative and Clerical Support; Application Services; Technical Support and Operations; Network Services; and Computer Equipment Services. Information Services has 69 full-time staff members and approximately 32 student staff members.

The central computing facility consists of an IBM 3090-200S mainframe that runs under the MVS/ESA operating system, and an IBM 4381-R24 mainframe that runs under the VM operating system. The two systems share 134 gigabytes of random access disk storage. Other peripherals include IBM 7171 protocol converters, IBM communication controllers, fiber optic channel extenders, local and remote laser and line printers, cartridge tape drives, and an automatic tape library robotics system. The IBM 3090 is used primarily for administrative and library support while the IBM 4381-R24 is used primarily for academic support.

Complimenting the Computer Center are numerous resources in various other offices. They include network-based and free-standing work stations that support day-to-day functions such as word processing, spreadsheet, record keeping, local data processing, etc. Also, there are over 40 local area networks. Academic departments provide students and faculty with computing support in shared "public" and restricted-access facilities in over 23 separate buildings and 50 different sites. Computing resources in support of academic programs consist of a variety of equipment ranging from PC to RISC networks in the departments of Mathematics and Computer Science, Physics, Geology, Architecture, Technology, and the Scientific Computing Laboratory in the Liquid Crystals Institute. Direct access to computing resources is made via both fiber and coax trunk lines with unshielded twisted pair and coax connections to individual work stations and terminals.

Rationale:

Kent, like most universities, is being challenged to do more work with fewer resources. Along with responding to this challenge, Kent State University also must continue to improve the quality of service and support to its diverse group of stakeholders in order to remain competitive with peer institutions. In her state of the University address, delivered in November 1992, President Carol A. Cartwright stated:

> *"We're at a point in higher education when we can either create a few temporary safety nets to bring us through this crisis, or we can seize the moment to bring about meaningful and fundamental change. Quite frankly, I'm eager to get on with the next phase of development and provide leadership for these changes..."*

Computing and information technology is expected to play an important and strategic role as Kent State University responds to this challenge by developing and implementing new and creative approaches to sustain academic programs and support operations.

Over the years, Kent State University has made a significant investment in computing and information technology to sustain its academic programs and support operations. As a result, Kent students, faculty and staff have become increasingly active in the use of technology to fulfill their scholarship, research and support needs. However, like most universities, Kent is being challenged in its effort to maintain a sufficient level of resources to meet demands. Furthermore, this situation is exacerbated by the kind of budget constraints that colleges and universities currently are experiencing all over the country.

Thus, Kent is faced with the need to expand its use of technology at the same time that it faces budget constraints. Kent concluded that it needed to develop, implement and maintain a strategic computing and information technology plan - with input and consensus from its primary stakeholders. The purpose of this plan would be to provide a blueprint for allocating scarce technological resources to the "right things", i.e., allotting them to activities that are high priority (from an institutional perspective) and consistent with the University's mission. This analysis and planning effort would build on previous plans; and define computing and technology issues, strengths, recommendations, benefits and implementation priorities.

IBM offered to assist Kent with this planning effort by providing the use of its Information Planning Study (IPS) methodology as well as a consultant/facilitator to assist a small working committee with completing this project. IPS (formerly referred to as Application Transfer Study or ATS) is an IBM developed methodology that was first developed in 1978 to assist customers with reviewing their computing and information technology operations and preparing strategic plans. IBM was one of many vendors that Kent established a closer association with and received support from during this period.

The primary goal of the IPS methodology is to facilitate the development of a document that represents a consensus on the direction and priorities for computing and information technology. In addition, the process of going through the IPS methodology encourages involvement and input from a variety of students, faculty and staff, and promotes broad commitment and ownership for plans and recommendations.

In a preliminary meeting to discuss the IPS methodology, IBM cautioned against making the scope of the study too broad and recommended that it be conducted in two parts. Based on recent feedback from students, faculty and staff, the primary areas of concern were campus-wide communication networking and information systems support. Thus, Kent decided to focus the initial IPS study on Network and Information Systems. Also, it was decided that the second part of the study would focus on the needs of Academic Computing and Instructional Technology.

The Study Team, appointed and charged by the President, Vice President for Business and Finance and Provost consisted of nine individuals representing the following areas: Provost's Office, Regional Campuses, Student Affairs, Library, Faculty, Financial Affairs, Information Services, Business Services, and Business and Finance. The Associate Vice President for Business and Finance was appointed chair of the committee because computing and information technology is one of his areas of responsibility.

Goal and Charge:

The nine-person Study Team was asked to build on previous studies and conduct a University-wide analysis of communication network and information systems with:

- the goal of developing a plan for establishing an integrated infrastructure to facilitate the access and use of computing and information technology by students, faculty and staff.

The charge to the Study Team was:

- to assess network and information system needs, in part, by interviewing and gathering information from Kent students, faculty and staff from all divisions of the University;

- to develop a plan that defines communication network and institutional information systems requirements, objectives, issues, recommendations and implementation priorities.

Methodology:

Using the IBM IPS methodology, the Study Team completed the following major tasks:

- **Planning and Team Orientation**. A one-day planning meeting was held in September, 1992 to brief senior management and the Study Team on the methodology, finalize the project work plan, begin developing the interview schedule, and prepare a draft of the instruments that would be used to survey students, faculty and staff. Also, during the orientation session, it was emphasized that technology would be used during every step of the IPS process to facilitate the capture and evaluation of data.

- **Interviews and Questionnaires.** After finalizing the interview schedule and survey instruments, the Study Team solicited information from students, faculty and staff concerning their experience and opinions about current information systems and network facilities.

  Twenty interview sessions were held (including one open session) and approximately 100 individuals were interviewed. Interview comments and notes were captured after each session via a lap-top computer. Also, some interviewees submitted written reports.

  Over 3,000 questionnaires were mailed to all full-time faculty and staff and a random sample to 300 students. In addition, questionnaires were circulated to students utilizing the computer laboratory sponsored by undergraduate student senate located in the student center, and more were circulated by leaders of the undergraduate and graduate student governments. A total of 905 completed questionnaires were returned with 285 from faculty, 76 from students, 294 from classified staff and 249 from administrative staff. The questionnaire results were entered into a personal computer and analyzed.

- **Identification of Problems and Strengths.** The interview sessions resulted in over eighty pages of notes summarizing the discussions. The Study Team analyzed the information received in the interviews, in the reports prepared by interview participants and in the questionnaires. The Team then prepared strength and problem statements. Note that strength statements were prepared to provide balance to the overall document and to ensure that strengths were considered in the recommendation development process. A lap-top computer linked to an over-head projector was used by the Team to expedite the process of synthesizing data and developing problem and strength statements.

- **Description of Current Environment.** Concurrent with the identification of problem and strength statements, a chapter outlining the current environment was developed. This chapter was prepared by Study Team members representing the Library, Information Services, Business Services and the Regional Campuses.

- **Study Team Education.** The Study Team also was updated on computing and information technology trends and directions in the University environment. Study Team education included presentations on administrative systems, enrollment management, network communications and local area network-based electronic mail. IBM sponsored and coordinated this education by bringing in several of its business partners with expertise in the above mentioned areas to conduct presentations.

- **Solutions, Alternatives and Recommendations.** In preparation for developing recommendations, the Study Team reviewed problem statements, supporting interview documentation, and questionnaires. In addition, they considered the strengths of the current computing and information technology environment at Kent State University as well as current trends in technology. Furthermore, the Study Team reviewed the results of a previous study on information systems and a recently completed University-wide Network Communications Plan. After the Study Team completed this analysis process, it deliberated over alternative solutions and prepared a series of forty-seven recommendations.

- **Benefits.** During this step, the Study Team identified the potential numerous benefits that would be realized if the recommendations were implemented. The determination of potential benefits was based on interview comments, questionnaire comments, and individual opinions. Benefits were categorized by student, faculty, staff and institution.

- **Implementation Plan.** The final step in the Study Team's deliberations was the preparation of an action-oriented, five-year implementation plan.

<u>Key Recommendations:</u>

Following is a summary of the top fifteen recommendations:

- **Mission.** The University should develop a statement that reflects the strategic importance of information technology. Furthermore, this statement should articulate the role that information technology plays in support of the achievement of the University's mission and strategic plans for the future.

- **Peer Institutions.** The University should identify a peer group of institutions which would serve as a benchmark against which comparisons could be made on information technology and network communications development.

- **Technology Policy Advisory Committee.** A broad-based committee should be established to advise the Vice President for Business and Finance on policy matters related to information technology and network planning, standards and priorities. The committee should include representatives from faculty and staff.

- **University-wide Planning Process.** A University-wide plan for information technology and network communications should be maintained and updated on a biennial basis. Therefore, plans for all units (including Regional Campuses) should be shared biannually and integrated with University-wide plans.

- **Data Access/Authorization.** The University needs to develop and implement a more flexible and uniform approach to authorizing data access. In the context of migration toward an integrated administrative data base, common standards for data access are needed. Procedures and policies should be developed which facilitate appropriate levels of authorized access to needed information.

- **University-wide Network.** The University should recognize that a University-wide network is becoming a required utility (like water or heat) for the survival of a modern campus. The network should be ubiquitous, reliable, and provide an adequate capacity to support voice, data and interactive video communications.

  The existing network plan should be enhanced to include single-mode fiber in the backbone and from the backbone to the Office of Teleproductions. This enhancement will allow interactive video transmissions from Teleproductions to locations along the backbone. Also, this enhancement will provide the network infrastructure to support the establishment of fully mediated classrooms and distance learning programs.

  The network should permit evolution to integrated campus-wide access by students, faculty and staff to University facilities such as the Library and other information resources, computing resources and student information systems. This would include improved access from student laboratories and dormitories, faculty and staff work areas and off-campus locations.

- **Electronic Mail.** Convenient access to an easy-to-use electronic mail system is of strategic importance to the University. This should allow all users to communicate within and beyond the campus in a seamless manner.

- **University-wide Systems Implementation Perspective.** The University should establish an approach to systems implementation that considers both institutional and departmental needs, while at the same time, supporting database distribution and systems integration. Student information should be implemented as one integrated system in order to enhance competitiveness and better support the achievement of enrollment goals.

- **System Data Infrastructure.** The database infrastructure for an integrated information system should be installed. It should consist of a relational database management system with a data dictionary and user-friendly query and reporting capabilities; and integrated and seamless support for distributed computing and document imaging technologies.

- **Need for Training.** The University should provide better overall coordination and systematic strategies to meet existing and future training needs. The University must recognize the added importance of appropriate training as it migrates into a more integrated information systems and network communications environment.

- **Document Handling and Process Flow Evaluation.** Technology alone will not provide the break-through solutions that are envisioned for administrative operations. Therefore, the University should review existing office work flow processes and determine where document handling and duplicating can be streamlined, integrated or possibly eliminated.

- **University-wide Information System.** The University should implement user-friendly access points such as kiosks or touch-tone phones to University information systems. The purpose would be to allow various users to gain direct access to general information about the University and to allow students to access specific information about themselves.

- **On-Going Hardware/Software Resources.** The University needs to plan for on-going budget resources to address the need to support, upgrade, maintain and replace hardware and software. The plan should consider that the appropriate level of technology varies widely from department to department. In addition, the plan should incorporate the migration of equipment from users with high-end work station needs to users with low-end work station needs. Note that there is a base level below which it is not cost effective to retain old equipment because of operating and maintenance costs.

- **Central Computer Upgrade.** The University should plan to upgrade its central computing capacity to support the data base, integration and access requirements of the proposed student information system and network. This upgrade plan should consider replacing the existing "water cooled" mainframe computer system with a more energy efficient "air cooled" system. An analysis of capacity requirements should be performed and used to determine the appropriate processor capacity needed to serve current and future needs (i.e., three to five years). If current technology trends continue, this may be the last mainframe processor that the University will have to acquire because administrative application systems are being re-engineered to run on smaller down-sized and network-based computers. These new application systems are expected to be widely available to universities in the latter part of this decade.

- **Academic Computing Plan.** The University should develop an academic computing plan. With the exception of the network infrastructure, the scope of this study did not include academic computing. Members of the Study Team believe that the full potential benefits of this study will not be realized without an institutional plan for academic computing and an overall instructional and classroom support plan which integrates research and instructional technology with the overall strategic infrastructure proposed here. Further, the plan should include an evaluation of the concept of a student computer usage fee to help fund academic computing requirements on an on-going basis.

Key Anticipated Benefits

The Study Team identified numerous benefits that would be realized as a result of implementing the aforementioned recommendations. Some of the key benefits are as follows:

- A statement that articulates the role that computing and information technology should play in supporting the achievement of the University mission will help provide consistency and direction.

- Identifying institutions that the University considers peers or competitors will allow Kent to identity the level of services that it must maintain to remain competitive in the recruitment and retention of students, faculty and staff.

- Establishing a Technology Policy Advisory Committee will help ensure broad-based participation in computing and information technology plans, priorities and standards.

- University computer equipment will be able to be connected to an integrated University network. The network will provide University-wide access to various services such as E-mail (including BITNET and INTERNET), mainframe databases and services, library databases and services, selected departmental systems and others.

- Electronic interaction and collaboration among students, faculty and staff across the Kent Campus, the seven Regional Campuses and other universities will be significantly improved.

- The network infrastructure will provide faculty with the means of developing mediated classrooms which will enhance the University's image with students, as well as, prospective faculty, employers and funding agencies.

- The student recruitment process will be improved because of better capabilities for identifying, contacting and responding to potential student requests with timely and accurate information; thus, enhancing the yield rate and maximizing enrollment.

- Students will be able to access their own financial aid, academic record, current class schedule and billing information as well as other general information such as directories, etc. This will reduce the time that students currently wait in line to get general information and free up staff to work with students who have more complex issues.

- Student retention may be enhanced because of better access to computing resources and the availability of more integrated information system support for advising and other services.

- There will be a significantly improved technological environment for supporting administrative services, student support services, instruction and research.

- The integration of information systems will provide data which will be both easily and widely accessible. Similar reports containing conflicting information will be reduced. Flexibility will be enhanced as well as the capacity to expand to meet future needs.

- A more effective training program will help ensure that existing hardware/software capacity is better utilized by faculty and staff. More effective and accessible training also should increase productivity, computing skills and job satisfaction.

Implementation Plan:

The final step in the Study Team's deliberations was the preparation of a draft of an action-oriented implementation plan. Each action item in the plan was analyzed in the context of the recommendations and the benefits to be derived. The plan included an initial schedule for completing each item. An individual or a team was assigned the responsibility for developing the necessary tactical plan to complete each item. The Associate Vice President for Business and Finance was assigned the responsibility for monitoring the plan implementation. Examples of key action items currently in progress include: the academic computing study; the integrated student information system; and the upgrade and expansion of the University-wide network.

Conclusion:

The principal content of this study was the result of the Study Team's analysis of interview comments, questionnaires, and written statements provided by members of the Kent State University community. The process of going through the study promoted involvement and input from a variety of students, faculty and staff, and resulted in a broad commitment and ownership for plans and recommendations.

The completion of the University-wide network was the number one priority because it was consistently raised as the top priority issue by the University community in interviews and questionnaires. The need for an integrated student information system was a close second.

The Study Team concluded that technology alone would not provide the break-through solutions that are envisioned for administrative operations. Existing office work flow processes and document handling procedures also need to be reviewed and re-engineered (where necessary) to make more effective use of new technologies.

The recommendations in this study provide a strategy and blueprint that Kent State University plans to utilize as it develops and implements the integrated systems and network infrastructure that it needs to take full advantage of new technologies in the nineties and beyond. With this infrastructure in place, the University will be in a better position to enhance the quality and productivity of its instruction, research and support programs and, therefore, to provide better service to its stakeholders as well as remain competitive with peer institutions in the recruitment and retention of students, faculty and staff.

LOTS OF DATA! NO INFORMATION!
(Why Universities and Colleges Do Not Take Full Advantage of Their Information Systems)

Bethany M. Baxter
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Kentucky

Over the past five years, IBM Academic Consulting and Services Group has worked with over 200 colleges and universities to establish strategic plans for academic and administrative information systems. From these studies, a common set of problems has emerged.

Most schools originally automated paper systems without making the necessary changes to take full advantage of their investment. The primary reason that these changes did not and do not occur is an unresolved power/authority struggle. Most often, the authority to automate is delegated to director(s) of information systems, yet power to change the approach to tasks resides with administrators whose knowledge of technology varies. Furthermore, many essential changes require collaborative efforts across work groups unaccustomed to collaborating.

This paper will examine three key changes which need to occur for schools to fully utilize their information systems. These include changes in: organizational structure; resource allocation; and approaches to academic and administrative tasks.

LOTS OF DATA! NO INFORMATION!
(Why Universities and Colleges Do Not Take Full Advantage of Their Information Systems)

During the past five years, IBM's Academic Consulting and Services Group has worked with over 200 colleges and universities to establish strategic plans for information systems. Interviews have been conducted with over 20,000 faculty, staff, administrators and students, and over 100,000 faculty, staff, administrators, and students have responded to questionnaires. As a result of these studies a common set of problems has been identified across all types of schools, regardless of size, orientation, and mission.

The key to these problems is the fact that initially most schools simply automated their paper systems without making appropriate changes to take full advantage of the investment they made in information systems. In fact, if schools purchased administrative systems they frequently modified these newly-acquired information systems in order to match their paper systems, thereby reducing the efficiency already present in the purchased systems.

Our studies have indicated that the primary reason appropriate changes were not and are not made is an unresolved power/authority struggle. On most campuses, the authority to implement information systems has been clearly delegated to the director(s) of those systems. However, the power to change the approach to tasks has remained with the departmental administrators whose knowledge of information systems varies from campus to campus. In fact, the experience of the Consulting and Services Group suggests that administrators' attitudes toward information systems are a far better indicator of the efficiencies to be gained by the implementation of such systems than are the skill sets of the computing center directors. Furthermore, many of the changes that need to occur require collaborative efforts across work groups that are not used to collaborating.

There are three key areas in which changes need to occur. These are changes in organizational structure, changes in the allocation of resources, and changes in approaches to tasks, including both the administrative tasks of handling data and the academic tasks of teaching, research/scholarly activity, and service. This paper will examine each of these areas.

Organizational Structures

Even though automation has significantly changed job responsibilities, on many campuses reporting structures have remained unchanged. As a result, multiple officers frequently manage information systems at various levels, and multiple offices may be charged with similar tasks. For example, it is not uncommon to find a satellite dish funded by an engineering college, the cabling from it the responsibility of Telecommunications, the storage and delivery of taped material under the auspices of the library, the facility for uplinking programs through the satellite in Continuing or Distance Education and the development of video materials in the Drama Department. Multiple groups may be wiring campuses for academic networks, administrative networks, television, security, telephone, Electronic Data Interchange (EDI) and facilities management.

Similarly, the committees which are in place to accomplish collaborative tasks may not be designed or charged to address the concerns of today's technological world. Such committees include long-standing committees and more recently appointed technology advisory committees. For example, the Director of Telecommunications may not be a permanent members of the Physical Facilities Committee, and the Director of Information Systems may not be a member of the Strategic Planning Committee. With increasing frequency, changes on campuses require information resources. Unless directors of systems are included in the initial stages of planning, both the costs of the technology required and the efficiencies to be gained by using technology are not identified. Furthermore, some strategic planning time cycles do not identify the service orientation of information systems providers. It is not uncommon for such offices to be required to submit yearly plans at the same time as the plans of other departments on campus, before they know what will be required of them.

On the other hand, newly appointed technology advisory groups may not be appropriately representative of the applications or the users on campus. Too often the criteria used to select members of these committees is technological knowledge and skill. This approach often results in advisory committees who advise on technology only. Such committees often become deadlocked over issues such as "UNIX versus VM or VMS" or "fiber versus ATM." Meanwhile, other important issues, such as the prioritization of projects, standardization of tools, and cross-discipline sharing of resources, remain unaddressed. Users in these environments have no identifiable representation and may become frustrated. Frustrated users may attempt to meet their own needs by installing their own "shadow" systems. Ultimately, this approach may result in the degradation of the integrity of the data on the entire campus as individual units begin to rely on their own databases with a resulting disregard for the accuracy of the central system.

Finally, there are committees that are not established on many campuses. For example, the current trend for faculty, staff and students to use their campus identification cards as Smart Cards, Debit Cards and for electronic building access, automated library check out, and other functions has resulted in many groups planning for the use of these cards with little sharing of information between the groups involved.

Resource Allocation

At this time, as funding is being reduced for many colleges and universities, improving the efficiency of operations is critical. In many areas a great deal of efficiency can be gained by having well trained personnel use appropriate technology. However, the criteria for the distribution of resources and the training of personnel are often based on premises that are no longer relevant. This is particularly true in state universities, although this problem is prevalent on many other campuses.

On many campuses, requirements for positions and criteria for promotion and salary increases do not reflect the skills needed in today's world. In many institutions, job descriptions of support staff still require typing rather than word processing. Similarly, programmers are often only rewarded for longevity or for promotion to management positions rather than for the acquisition of needed new skills.

Regulations regarding the acquisition of equipment are similarly flawed. In many states and on many campuses, capital and operational expenses remain separate, and the ability to purchase equipment to offset the need to hire additional staff or to replace staff is very difficult. In fact, the purchase of equipment is often more easily linked to the renovation or construction of a building than to efficiencies that could be gained in operations. Furthermore, many procurement manuals are unclear about which purchasing categories address certain new elements of technology, such as network design, and purchasing departments may make determinations that complicate the procurement process.

There are also many areas which are not addressed in current financial structures. Equipment procurement is usually seen as cyclical rather than ongoing. Therefore, there are frequently no funds available for maintenance and upgrade of acquired equipment. Similarly, the predetermined length of time that equipment must be kept before it can be replaced may not reflect the rapid advances of technology.

Even without cumbersome regulations, many universities and colleges have separated hardware and software in the procurement process. In effect, they have separated applications from equipment. It is not uncommon to find universities where hardware is provided by the department and software is provided by the university or vice versa. Such separation makes the process of prioritizing less meaningful and precludes the sharing of resources across functional groups. This approach may result in unexpected demands on central resources or the proliferation of underutilized departmental equipment.

Underlying the formal procurement policies, most members of institutions have a preconceived notion, based on experience, of how much resource a given area can request at a given time, whether the request is for programmer's time or for equipment. Therefore, many requests are curtailed to meet the perceived "appropriate" profile. Equipment may be purchased, even though the purchaser knows that it has a short life span, because the price falls within the perceived resource niche. Similarly, requests for services are frequently presented piecemeal so that the requester does not appear to be asking for more resource than (s)he should at a given time. This makes it difficult to understand the real needs of the campus and to address them efficiently.

Approaches to Tasks

Reorganization, new procurement policies, and well trained personnel will not produce the efficiency desired unless universities and colleges change the way they operate. They must look at the way they administer, teach, produce research and provide service to the community in the light of new technology available. Instead, as areas are automated, strong emphasis is often placed on automating all processes exactly as they are carried out manually.

The most common defense against changing is, "We are unique!" Homegrown software has been shown to be as much as four times as expensive as purchasing off-the-shelf administrative packages, but many universities believe that their uniqueness demands this approach. These systems are often designed as separate files that matched the file cabinets in other times. The collectors of data are still seen, not only as the owners of the data, but also as the determiners of what should be collected, how data is stored, who has the ability to access the data, and in what form access may occur. Such narrow definitions may severely limit the ability of faculty, staff and administrators to use data effectively.

As industry moves to business process reengineering, it is imperative that universities also look at the processes they use to accomplish their administrative tasks, identify steps that can be eliminated, and automate steps that can be automated. However, the leadership in many areas does not have the necessary understanding of what technology can accomplished to utilize it well.

The responses to a survey used by the consulting group in a broad range of colleges and universities consistently show that 60% to 80% of the faculty and 30% to 34% of the support staff have computers at home. However, administrators with computers in their homes vary from 20% to 80% on any given campus. Our experience has shown that this particular statistic is a good indicator of the approaches to change that are occurring in administrative areas. The presence of a computer in the home seems to lift it from the status of "glorified typewriter" to tool, regardless of who in the home uses it. Where a computer is seen as a tool, administrators try to identify areas where it can be useful and provide leadership for the reengineering process. On the other hand, if the computer is seen as a "glorified typewriter," there are concerns about who should have one and who should be trained. "Will middle management be doing secretarial tasks if they have a computer?" is a frequently asked question in such environments.

The need for information from administrative systems is a frequent concern of those in academic areas. They particularly desire information that will assist them in advising students and managing budgets. Yet, in too many institutions, pertinent administrative information is not shared because of security concerns or interpretations of the Buckley Amendment. As a result, students may be placed in failure situations, spend extra time and dollars to receive a degree, or have their health needs unidentified in an emergency. Deans and chairs may struggle to manage their resources with limited information. Ultimately, such attitudes may further increase the development of "shadow" systems and further erode the integrity of the institutional data.

Using technology for teaching is too often seen as training students to use computers. To accomplish this, most colleges and universities have developed some "computer literacy" criteria that a student must complete before graduation. The relevance of this criteria to the needs of the workplace or to the needs of the educational institution is often not regularly reevaluated. There is also little recognition in these requirements of the experiences many traditional students are now having in K-12 or that nontraditional students have had in the workplace. Requiring literacy requirements to be fulfilled before graduation means that faculty cannot assume that students have any skills during their time on campus. This keeps many faculty from utilizing many beneficial educational tools.

Support for researchers also varies from campus to campus. Campuses that centrally provide information about funding that is available, identify research interests of other faculty, provide access to appropriate databases, and provide a broad variety of statistical tools have often seen an increase in scarce research dollars. However, in many schools, support for research still occurs on a departmental or individual basis.

Conclusion

In conclusion, although the actions needed to solve these problems vary from campus to campus, most of the solutions must be based on collaborative efforts of those who do not have a history of collaborating. Such efforts must include the collaboration of collectors of data with each other and the users, the collaboration of faculty to determine curriculum that meets the needs of the student as a learner today and as a member of the work force tomorrow, the collaboration of researchers to identify and share scarce resources, and the collaboration of the providers of information systems to provide the most cost effective approach to technology.

Leadership and the Changing Role of the Chief Information Officer in Higher Education

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This presentation reports on the results of a questionnaire, with an 83 % return rate, designed to obtain information on the leadership role of the Chief Information Officer in higher education. The research instrument facilitated the identification of role, perception of role as compared to the business sector, role in the transformation process, comparison of demographic characteristics and institutional practices to previous studies, and the identification of differences in the leadership role of the CIO according to type of higher education institution.

During the Summer of 1992, a questionnaire designed to obtain information on the leadership role of the Chief Information Officer in higher education was sent to 200 individuals identified as serving in that capacity. The return rate was 83 percent. The information provided by the respondents was analyzed descriptively and employed to address the following research questions:

1) What is the role of the CIO in higher education?

2) What do CIOs in higher education perceive their roles to be as compared to roles identified for CIOs in the business sector?

3) What is the role of the CIO in higher education in the process of transformation?

4) Are there differences in the leadership role of the CIO according to type of higher education institution?

5) Are the demographic characteristics and institutional practices identified for CIOs in studies conducted by Woodsworth (1991) in 1986 and by Penrod, Dolence, and Douglas (1990) in 1989 continuing today or have they changed consequently affecting the role of the CIO?

In examining the Chief Information Officer position, this presentation emphasizes role in terms of higher education, comparision to the business sector, and the transformation process. In terms of demographics, respondents in the current research affirm the trends cited by Penrod, Dolence, and Douglas (1990) with regard to CIOs in higher education being 45 to 49 years of age, male, and Caucasian, who do not have academic tenure and primarily come from an administrative background. Respondents in the current study refute the remaining trends and institutional practices cited by Woodsworth (1991) and Penrod, Dolence, and Douglas (1990) by reporting that most CIOs in higher education do not refer to themselves as Chief Information Oficers, were previously and remain directors instead of vice presidents or associate vice presidents, do not report to the president of their institution, do not have academic rank, and do not have the doctorate as the highest earned degree.

Role of the Chief Information Officer in Higher Education

The literature on the role of the Chief Information Officer emphasized executive officer status for the position. Brumm (1989) reported that 73% of the business sector CIOs who responded to her survey had the title of Vice President or higher. Synnott (1987) stated that, in the business sector, the position was effective only if the incumbent had organization-wide authority for information management and the associated technologies. This argument was supported by Rockart (1988) and Gantz (1985). Weiss (1987), Penrod and Dolence (1988), Sherron (1988), Ryland (1989), Dillman and Hicks (1990), and Temares (1991) transferred this argument to higher education by stating that the

CIO position could be effective only if an executive officer at the institution-wide level.

Executive officer status was defined by these same authors as regularly attending board of trustees/regents meetings, serving as an active participant in those meetings, and being involved in the decision-making process as it affects all aspects of the institution including planning, budgeting, academic issues, human resources, facilities, and curriculum. They concluded that as an executive officer responsible for all information units, the Chief Information Officer should have responsibility for academic computing, administrative computing, copying/reprographic services, data communications, institutional research, library services, mail services, media services, planning, printing, television services, and voice communications. These issues were examined in terms of their applicability to the Chief Information Officers contacted for this study. The responses were compared to those received by Penrod, Dolence, and Douglas (1990).

As shown in Table 1, the majority (53.6%) of the respondents in the current study do not consider themselves to be executive officers of their respective institutions. This contrasts with the respondents of the Penrod, Dolence, and Douglas (1990) research in which the majority (58.6%) were executive officers. Based on these results, Penrod, Dolence, and Douglas (1990) claimed that Chief Information Officers were executive officers and indicated that this trend would continue.

Table 1

Executive Officer Status of Respondents in All Types of Institutions

Executive Officer Status	Penrod, Dolence, and Douglas (1990) n	%	Pitkin n	%
Yes	34	58.6	71	46.4
No	24	41.4	82	53.6
	N = 58		N = 153	

They also reported that as an executive officer, the Chief Information Officer regularly attended board meetings as an active participant. Tables 2 and 3 provide data on attendance and level of participation. As shown in Table2, 48.3% of the respondents to the Penrod, Dolence, and Douglas (1990) study attended board meetings. The authors surmised, however, that this would continue. The results of the current study, however, refute this allegation; the majority (63.4%) do not attend board meetings.

In addition, as shown in Table 3, a higher number of respondents to the Penrod, Dolence, and Douglas (1990) study stated that their reason for attending board meetings was to serve as a resource person (17.3%) as opposed to being an active participant (15.5%). Respondents to the current study stated their primary reason for attendance (42.5%) was to be a resource person, meaning that they attended only when called upon for specific information.

In examining the responses to the current study, the conclusion can be drawn that the majority of responding Chief Information Officers are not executive officers of their institutions. They do not attend board meetings on a regular basis as active participants. When they do attend, they do so as resource persons.

Synnott and Gruber (1981), Gantz (1985), and Synnott (1987) argued that the Chief Information Officer's status as an executive officer is exemplified through involvement in executive decisions at the institution-wide level. Penrod, Dolence, and Douglas (1990) substantiated this argument (see Table 4); the majority (65.5%) of their respondents indicated that they were involved in that decision-making process. Somewhat fewer (50.3%) of the respondents in the current study reported to have that level of responsibility. This difference of over 15% in three years indicates that the executive-level responsibility of the Chief Information Officer may be decreasing.

Table 2

Board Meeting Attendance of Respondents in All Types of Institutions

Attendance on a Regular Basis	Penrod, Dolence, and Douglas (1990) n	%	Pitkin n	%
No	30	51.7	97	63.4
Yes	28	48.3	56	36.6
	N = 58		N = 153	

Table 3

<u>Purpose of Board Meeting Attendance of Respondents in All Types of Institutions</u>

Purpose of Attendance	Penrod, Dolence, and Douglas (1990)		Pitkin	
	n	%	n	%
Do Not Attend	30	51.8	36	23.5
Resource Person	10	17.3	65	42.5
Participant	9	15.5	37	24.2
Combination	6	10.3	0	0.0
Observer	2	3.4	12	7.8
Did Not Respond	1	1.7	3	2.0
	N = 58		N = 153	

Penrod, Dolence, and Douglas (1990) discussed in their study the Chief Information Officer's role in dealing with information management. Table 5 presents findings for the Penrod, Dolence, and Douglas (1990) study and the current research. In academic computing, 86.2% of the Penrod, Dolence, and Douglas (1990) respondents and 80.4% of the current study respondents reported responsibility. For administrative computing, 89.7% of the Penrod, Dolence, and Douglas (1990) respondents and 91.5% of the current investigation respondents reported responsibility. For data communications, 96.6% of the Penrod, Dolence, and Douglas (1990) respondents and 92.2% of the current study respondents reported responsibility. For voice communications, 69% of the Penrod, Dolence, and Douglas (1990) respondents and 62.7% of the current study respondents reported responsibility.

Table 4

Participation in Executive Decisions of Respondents in All Types of Institutions

Participation on a Regular Basis	Penrod, Dolence, and Douglas (1990) n	%	Pitkin n	%
Yes	38	65.5	77	50.3
No	20	34.5	76	49.7
	N = 58		N = 153	

Percentages were much less for Penrod, Dolence, and Douglas (1991) and the current research for all remaining areas of information management: copying/reprographic services, institutional research, library services, mail services, media services, planning, printing, and television services. This indicates that the level of responsibility has not changed for the Chief Information Officer across units associated with information management.

In summary, respondents in the current study indicated that the role of the Chief Information Officer in higher education is not consistent with that reported by Penrod, Dolence, and Douglas (1990). Unlike the respondents in that study, the Chief Information Officers in the current research do not consider themselves to be executive officers of their institutions and they do not regularly attend board meetings. Respondents in the current study (50.3%) reported a decrease, as compared to the Penrod, Dolence, and Douglas (1990) respondents (65.5%), in their participation in executive decisions. As reported earlier, however, the respondents in the current study do agree with the respondents in the two previous investigations concerning areas of information management over which they have responsibility.

Table 5

Areas of Responsibility of Respondents in All Types of Institutions

Area of Responsibility	Penrod, Dolence, and Douglas (1990)		Pitkin	
	n	%	n	%
Academic Computing	50	86.2	123	80.4
Administrative Computing	52	89.7	140	91.5
Copying/Reprographic Services	10	17.2	23	15.1
Data Communications	56	96.6	141	92.2
Institutional Research	11	19	34	22.2
Library Services	9	15.5	17	11.1
Mail Services	10	17.2	22	14.4
Media Services	9	25.5	29	19
Planning	19	32.8	29	19
Printing	10	17.2	20	13.1
Television Services	16	27.6	42	27.5
Voice Communications	40	69	96	62.7
	N = 58		N = 153	

<u>Synnott and Gruber's (1981) Roles of the Chief Information Officer in the Business Sector</u>

In writing about the Chief Information Officer concept in the business sector, Synnott and Gruber (1981) stated that "EDP [Electronic Data Processing] managers are . . . taking on new and broader responsibilities" (p. 45). As Chief Information Officers in executive-level positions, they are "responsible for establishing corporate information policies, standards and procedures" through providing "centralized management and control over information processing and utilization, even though it may be distributed geographically and functionally throughout the organization." (pp. 66-68)

Synnott and Gruber (1981) identified nine roles of the Chief Information Officer as essential for the position to be effective as an executive officer at the organization-wide level. These roles are strategic planner, change agent, proactivist, politician, integrator, information controller, staff professional, manager, and futurist. The roles were confirmed in studies of the Chief Information Officer in the business sector by Passino and Severance (1988), Brumm (1989), and Adler and Ferdows (1990). In addition to identifying the prevalence of these role characteristics, these authors further agreed that the CIO is an executive officer with institution-wide decision-making authority.

The research instrument was configured to help identify whether the Chief Information Officer in higher education carries out responsibilities identified by Synnott and Gruber (1981) for the CIO in the business sector. The Chief Information Officers who received the research instrument were asked to indicate the level of Synnott and Gruber's (1981) roles as being incorporated into their responsibilities. Of the nine roles only three are "always" present: manager (74.5%), futurist (61.4%), and strategic planner (54.2%). Synnott and Gruber (1981) claimed that for the Chief Information Officer to be effective as an executive officer involved with the management of the entire organization, all nine roles must operate at the "always" level. The respondents indicated the remaining six roles (change agent, proactivist, politician, integrator, information controller, staff professional) are less than "always" present.

Chief Information Officers in higher education do not consistently carry out two-thirds of the roles identified by Synnott and Gruber (1981) as being necessary to be effective in that position. Since Synnott and Gruber (1981) argued that their roles were a necessary facet of the executive-level role, and of the identification of organization-wide responsibility, the conclusion can be drawn that the Chief Information Officer in higher education is not an executive officer and does not have institution-wide responsibilities. This conclusion is consistent with the responses that indicate that the Chief Information Officer in higher education does not refer to himself or herself as a Chief Information Officer, does not have an executive-level title, does not consider himself or herself to be an executive officer, is not involved in making executive decisions, and does not have responsibility for most units associated with information management (see prior discussion).

In summary, Chief Information Officers in higher education, as represented by respondents in the current study, emulate the CIO in the business sector in that they are strategic planners, managers, and futurists. They do not, however, carry out the remaining six roles identified by Synnott and Gruber (1981) as necessary to be effective as an executive officer of the organization. The conclusion is consequently drawn that most of the respondents to the current study do not emulate the CIO in the business sector, and, as concluded earlier, do not function as executive officers.

The Transformation Process and the Role of the Chief Information Officer

Several authors (Hopper, 1990; McFarlan, 1990; Penrod & Dolence, 1990,1991; Peterson, 1990) argued that the Chief Information Officer position in both the business sector and higher education is exemplary of the transformation process. Theorists of organizational structure and change (Kanter, 1983, Morgan, 1989; 1989; Peters, 1987; Waterman, 1987) referred to the period of time during which the Chief Information Officer position was created in the business sector as the era of transformation. The characteristics needed for success in transformation are similar to the roles required of the Chief Information Officer as identified by Synnott and Gruber (1981).

Nolan (1990) and Penrod and Dolence (1991) stated that transformation must take place in higher education institutions. They emphasized, as did Hopper (1990) and Hammer (1990), that information technology as directed by a Chief Information Officer, is the driving force behind the transformation process. They contended that transformation cannot take place without the application of information technologies. Morgan (1989), Kanter (1983, 1989), Peters (1987), and Waterman (1987) contended that the organization must be entrepreneurial, incorporate transformation into its overall organizational goals, and conduct change through the transformation process for positions like the Chief Information Officer to be effective.

The research instrument obtained perceptions about the level of transformation taking place at the institutions represented by the respondents. To obtain information on the level of transformation taking place at institutions of higher education, Chief Information Officers receiving the research instrument were asked to identify the stage of progress which best depicted their institution's movement toward transformation. Five stages, based on the continuum of achievement developed by Rogers (1971), were defined for respondents. These stages are: "awareness," having knowledge of transformation; "interest," actively seeking additional information; "evaluation," deciding whether or not to implement transformation; "trial," applying transformation on a small scale for analysis purposes; and "adoption," applying transformation throughout the institution as a matter of policy.

Respondents were first directed to apply this continuum to define the stage of transformation taking place at their institution. The definition of transformation, "new ways of perceiving, thinking, and behaving by all members of the organization," was based on the definition of corporate transformation compiled by Kilmann and Covin (1988). Respondents' reports indicated that the transformation process is not dominant at any stage along the continuum from "awareness" through "adoption". The responses also indicated a bimodal distribution in that 47% of the respondents are at the early stages of "awareness" and "interest" and that 42% are at the advanced stages of "trial" and "adoption."

Within the definition of transformation, Beckhard (1988) identified four types of activities that are transformational. These are change from a product-driven mission to a market-driven mission; change from a centralized to a decentralized management structure; change from low-technology to high-technology approaches to accomplishing responsibilities; and changes in organizational culture from traditional to creative structures. Respondents to the research instrument indicated at what stage, using Rogers' (1971) continuum, their institutions were with each transformation activity. The responses are similar to those received concerning the stage of achievement for the definition of transformation. No stage, "awareness" through "adoption," reached the majority level (50.0% or higher) for any of the four transformation activities. There was no commonly identified stage along the continuum for the transformation activities concerning mission and management structure. In fact, the range of percentage from the top rated stage to the lowest was only 12.5% for mission and 9.1% for management structure. The responses for those two transformation activities were spread somewhat evenly across the stages of progression.

This is not the case, however, in changes concerning technology and organizational culture. "Adoption," the most advanced level of achievement along the continuum, was the most prevalent stage (48.3%) in the change from low- to high-technology approaches to accomplishing responsibilities. "Awareness," the first stage of transformation, was the most prevalent (40.5%) in the movement from traditional to creative organizational structures. These higher education institutions appear to be at an advanced point in only one area of transformation activity (technology) identified by Beckhard (1988).

Respondents were also asked to indicate which one of six decision-making/communication processes best described his/her institution. The six processes, or models, were originally identified by Morgan (1989). He contended that organizations in the process of transformation were migrating from Model 1 to Model 6. Respondents would consequently provide a good indication of their institution's progress in the transformation process by indicating which model was prevalent.

In the progression from Model 1 toward Model 6, respondents indicated that the common models are the second and third. Manager to subordinates with the flexibility of being authoritarian or participative was identified most often (40.5%). The involvement of project teams with decisions still made at the top of the organization received the second highest number of responses (30.0%). The remaining four models, or processes, were not identified frequently (ranging from 16.3% to 0.0%). The indication here is that the decision-making/communication process still reflects a high level of bureaucracy in that decisions are still made at the top of the organization. This conclusion is consistent with the responses received concerning the definition of transformation and the level of achievement in transformational activities. The institutions represented by the respondents appear not to be actively involved in the process of transformation.

Types of Institutions

An exception to the general conclusion that that the Chief Information Officer is not an executive officer, does not emulate the CIO in the business sector and is not involved in management processes that support the transformation proces appears to be the private undergraduate institutions. Respondents from those institutions have the second highest frequency of reported executive officer status (50.0%), the highest frequency of reported board meeting attendance (62.5%) at the "always" level, the highest frequency of reported attendance at board meetings as an active participant (37.5%), and the highest frequency of reported participation in executive decisions (75%) at the "always" and "often" levels. Within the executive decision-making process, they have the highest frequency of reported participation in every category: planning (87.5%), budgeting (87.5%), academic issues (50.0%), human resources (50.0%), facilities (87.5%), and curriculum issues (25.0%). They also have the highest frequency of reported responsibility in areas associated with information management: copying/reprographic services (37.5%), mail services (37.5%), institutional research (62.5%), planning (50%), and printing services (25.0%).

The private undergraduate respondents come closest to emulating the business sector CIO. They most often reported Synnott and Gruber's (1981) role characteristics at the "always" and "often" levels for change agent (100.0%), proactivist (100.0%), politician (100.0%), integrator (100.0%), information controller (75.0%), and staff professional (75.0%). More respondents on a percentage basis from the private undergraduate institutions (37.5%) reached the fourth level (project teams with leaders involved in final decisions) of Morgan's (1989) models of decision-making/communication processes, than from any other type of institution.

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Strategies for Data Management Leadership:

Why, Who, What, and How

Lore A. Balkan, Gerry W. McLaughlin, and Richard D. Howard

The critical issue is not one of tools and systems but involvement in the quality efforts of the business units.[1]

Overview

A recent advertising campaign for IBM calls for "new ideas for new challenges". This has three elements of relevant to those of us who work with information. First there is a strong theme of change. *New* is the norm and *change* is the standard. The second theme is that of survival in the face of challenges. The way we do everything is subject to question because our world has changed and promises to change at an even greater rate in the future. This theme acknowledges the ever present threat that if we fail to adjust, we and our services will become obsolete. The third theme is less apparent, but provides the keys to open new doors as we close the old. It is quite simply one of creating new vision from ideas generated at all levels of our organizations. Unlike days gone by when demonstrated knowledge and skill were required before ideas were solicited, today we ask the people at the pulse of every activity to interact and generate innovative ideas. The necessity and the ability to acquire new knowledge and skills is accepted as the rule. The road to success is paved with ideas. These ideas are then molded into plans and .esources are reallocated to support training on the new and improved practices and products.

The key challenge for organizations is to make better decisions and provide better support for their stake-holders. Information support must enable: 1) recognition of the need to make a decision, 2) identification of alternatives, 3) a call to act, and 4) the ability to verify and defend the action. The successful use of information to this end depends on an information support structure that assures the quality and availability of relevant data and that restructures the data for the decision makers. Not surprisingly, the old ways of doing information support cannot support our new ways of doing business. The disappearance of the middle management of the down-sized organization, the advent of intelligent devices, and the refinement of strategic management, all are the components of the new challenge. To meet this new challenge, we need new

[1] Radding, Alan, Quality is Job #1. In *Datamation*, October 1, 1992, p. 100.

ideas about providing information support for the entirety of our organizations.

Current Culture

The last several years have seen rapid changes in the technology with which we manage our organizational data. Complementary changes now need to occur in our organizations and in our concepts about information systems. We are witnessing a simultaneous push by technology and pull by management to deliver useful information. It is naive to assume that all of the required management information in fact resides in our historical legacy systems, and that the challenge is to simply implement new technology to deliver data on demand to an expanding clientele. What is too often overlooked is that management's requirements are driven by new needs to perform analyses related to both long-term and short-term decisions and then to evaluate the results of those decisions. The operational systems that perform the day-to-day transactions have not been designed to support this activity and quite likely do not contain sufficiently standardized or normalized data for the integrated, re-combined, and longitudinal views required for analysis.

Existing internal and external reporting functions often use informal procedures to obtain data and to interpret the variables. There is not a predominance of historical files, or census files, or standardized data. Furthermore, there is often no formal assignment of responsibility for data management, nor policies governing the process by which those involved with the operational systems capture, store, define, secure, or provide the data to management or do reports for distributed decision makers. Typically when a management call for information fans out to a variety of operational areas each responds by providing data from the perspective of its functional activity. The result is that 1) the executive will be drowning in data with no options to apply analysis and transform the data to useful information, 2) the executive will receive multiple, biased, and conflicting informational answers from a variety of functional areas, 3) the information provided will be based on incomplete assumptions about the desired analysis and incomplete data in terms of integration with other functional areas, and 4) the failure to properly obtain the information will produce organizational overhead and require extra resources for unnecessary complexity. Nevertheless, we see several trends that offset this rather gloomy picture and set the stage for creating a data management culture that can effectively respond to management information requirements.

The first trend is a focused movement in our organizations toward greater efficiency and competitiveness. With this comes a willingness to consider a variety of strategic alternatives. These strategies include changes in support structures, processes, and responsibilities and often produce a rational analysis of data needs. Second, most business and institutions are undergoing migrations of at least some of their major data bases to new operational systems, often moving to increasingly distributed modes of operation. New development tools, as well as off-the-shelf software, include structured methodology for clarifying an enterprise's data architecture, data definitions, and standard code usage. Since these methodologies provide the foundation for any executive information system, the migration projects present the opportunity to consider management's information requirements as part of the analysis. Third, there is recognition by small and large firms alike that there is a need for more participative management.[2] This compounds the numbers of managers who need to access and use data from across the organization. Thus, we see a momentum to also reach into other operational systems that are not immediate candidates for re-engineering. All of this leads to a realization that there are on-going data management activities that must be done to assure the availability of high quality information from all operational systems to support pro-active decision making.

There is much discussion in trade magazines and journals that couch these trends with such labels as re-engineering, right-sizing, and total quality management. While each of these movements points toward improvement of the information support functions and spurs an interest in what can be done to quicken and maintain progress, the lack of a structured process for coordinating the various data management activities and relationships across the organization limits and jeopardizes the excitement and potential momentum. Still, there remains a multitude of potent opportunities within the existing culture to use traditional relationships and friendships to develop prototypes that push management's "hot buttons" and thereby create support for ongoing quality data management work. Since culture is dynamic and changing, it is imperative to proceed with a sense of urgency to produce quick results that demonstrate value to those who can benefit within the current culture. By producing relevant prototype examples that address real current needs, there is increased likelihood that quality data management issues and projects will be included as part of other evolving organizational changes, thus, formalizing the data management function. This paper presents paradigm for a new data management culture and then presents a leadership strategy for achieving that culture.

A Data Management Paradigm

There are three key roles in a data management paradigm that work together to create an organization's data management process. One role, located at the data source point, is the **supplier**. This role is generally played by a variety of functional offices such as finance or human resources, which have operational responsibility for segregated sets of organizational activities. Suppliers are the essential actors insuring the reliability of the data. They must control the random influences in the capture and storage of the

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[2] Harper, Stephen C., Ph.D. The Challenges Facing CEOs: Past, Present, and Future, In *The Executive*, Vol. VI, No. 3, August 1992, pp. 10-11.

data which can destroy the consistency, the stability, and the objective nature of attributes being captured. They are also responsible for documenting the capture and storage. Finally, the supplier must apply standardized recoding as part of creating cyclic extracts of the operational data for inclusion in the organization-wide repository, or data warehouse. These data custodial responsibilities are part of managing the functional area and are frequently delegated to designated system support stewards within the functional area. These distributed data administration activities are the basis of an organization's data management function.

Next is the work of specifying standards that will allow integration from the various functional areas and will support data restructuring and delivery of entities as required by the numerous data users. This coordination is done by a central data management function, which plays the role of **producer** of management information. The producer is typically the custodian of a central data repository which contains important parts of the organizational data extracted cyclically and stored in a standardized form. In general, the central function is a bridging activity and this activity often includes running the organizational data warehouse with varying levels of responsibility for distribution. The person responsible for the producer functions may be referred to as the Data Administrator where there is a very limited distribution responsibility, or the Data Manager where the transformation of data into distributed information is also included. With the restructuring of data in a warehouse and the distribution of information comes responsibility for the internal validity of the data. This is the ability to interpret what the data mean and what the information created via analysis means. To the extent that delivery of information is included as part of the central function, the producers must also have the analytical ability to integrate qualitative and quantitative data and to determine likelihood of events. This may also involve manipulating the data to move it toward the format of the business rules for the customer to use in distributed decision making. Consequently, the producer is involved in quality assurance and implements checking mechanisms to determine consistency of business rules across supplier systems.

The third role of user, or **customer**, involves using the information in some manner to identify the need to make a decision, select and evaluate alternatives, describe the situation, or defend and advocate previous decisions. The customer may want a sub-set of the organizational data selected based on pre-defined or newly identified key indicators. The level of flexibility that can be offered to the customer will depend on the sufficiency, relevancy, and timeliness of the organizational data warehouse. It is imperative that the customer be trained and learn how to evaluate the provided data in terms of sufficiency (some factors may need to be applied from external sources), relevancy (criteria for selecting sub-sets must be carefully determined), and timeliness (a determination must be made whether to use current data or trend data). These skills for interpreting and effectively using data are necessary for users to fulfill their data management responsibility, that of assuring the external validity. This represents the degree to which the data and information can be appropriately generalized to the specific situation. Since the specific situation, as well as the elements of the decision, are known only to the user, it is clear that the user or customer must carry this responsibility. Similarly, the user is responsible for monitoring and measuring the value of the information. This is often referred to as the construct validity of the data and consideration of the degree to which "as-is" is becoming "to-be." In this regard, it is usually the user who is in the best position to identify changes in business rules that must be reflected by the organization's data. The user also needs to educate the supplier as to the true needs for data and the uses. This empowers the supplier to capture and store the most appropriate data.

It is important to note that each of the three roles (supplier, producer, and customer) bring a different and necessary perspective to data management. The suppliers must be primarily concerned with a specific decentralized function. They have little reason to consider data requirements beyond those that directly support the function unless required to do so by cultural norms or rules. The customers' views may be somewhat generalized in terms of the subject matter of interest, but are most often as narrow as the most recent requirement for information. Customers function in distributed mode and generally interact with others only as necessary. They have limited views of the needs of other customers. The producer's view is of the organization as a whole. Producers cannot effectively assess either the "as-is" or "to-be" infrastructures without significant interfaces with both the suppliers and the customers. Therefore, they must be central and accessible to both the suppliers and the customers. The producers are the central data management function. They coordinate and facilitate between suppliers and customers. Furthermore, they are the interpreters, providing translations to enable communication and transformation to relay understanding.

Characteristics of Decision Making

Information which reduces the uncertainty of the decision making or planning process is the goal of a successful data management function. In order to accomplish this, consideration has to be given as to what the information will be used for, the philosophy within which the information will be used, how the information is generated or created, who are the major players; and, finally, the current state of the campuses competing environment. Peter Ewell[3] identified five primary uses of information. Understanding the potential use of information is important as one creates information to help the decision maker reduce

[3] Ewell, P. T., 1989., Enhancing Information Use in Decision Making, *NDIR*, No. 64, Jossey-Bass

uncertainty of the decision. These five uses of information--rational decision making, problem identification, context setting, inducing action, and selling decisions--each require a different approach to the may in which the decision maker is supported. It follows then that the decision maker should be involved in the creation of this information. There are four primary decision making philosophies that we can anticipate being represented.

The first is the **political** philosophy where the primary concern is with others' perceptions. In general, this philosophy is found most often with the CEO or president of your institution. His or her primary concerns are often centered around political forces external to the institution (legislatures, other external governing boards, or other community groups), or internal groups (deans, students, or faculty senate). This person usually has many demands on his/her time and will require a very discrete data elements focused on a specific topic. In other words, if meeting the need, a single number is preferable to a detailed accounting of all components making up that number.

The implication is that the CEO has confidence in the decision support system and people to create reliable statistics. Again, as discussed below it will be important to involve him/her in initial discussions about the design of the data management environment.

A second decision making philosophy is known as **autocratic**. In this case, the decision maker is primarily concerned with a specific and often personal agenda. Information requirements are characterized by a continuous flow of information that is focused on specific issues. In other words, the usefulness of the information you provide to this type of decision maker may be compromised if more than one topic is addressed in a single report. On a university campus, the person that most likely reflects this decision making philosophy is the dean. The dean typically does not have direct responsibility for an academic program or research effort. The primary role is to build a college along an agenda he or she has set.

The **managerial** decision making philosophy is centered around the multitude of characteristics related to the specific program. The department head or chair typically reflects this type of decision making. In this case, the decision maker is interested in a continuous flow of information about any and all topics that are relevant to the programs in the department.

The final decision making philosophy is known an **collegial**. In this philosophy, the context of primary concern is that of correctness of process. Typically, the faculty senate will reflect this type of decision making when working through an issue. The problem will be studied from every angle and analysis often conducted because of personal interest rather than from a notion that it would provide direct information to guide decision making. The type of information they require is often discrete but covering a broad range of topics.

While in the above certain types of individuals on the campus have been identified as reflecting specific decision making philosophies, it should be remembered that at any given time a president could in fact use a collegial philosophy or any of the others if it suit a particular situation. Decision support must recognize the decision making philosophy that is in play in order to maximize the usefulness of their decision support information.

Data Management Leadership

Successful data management is dependent on advocacy and leadership spread across the roles of supplier, producer, and user/customer. It is predicated on nurturing new working relationships between people who previously did not communicate or were adversaries. Furthermore, there must be input representing all four of the decision making philosophies: political, autocratic, managerial, and collegial. What follows is a discussion of a strategy as a four step cycle (Plan, Do, Check, Act) that can begin to increase the robustness of data quality improvement in the current structure while establishing the foundation for the new formal and informal structures needed to deliver quality information. These steps amount to a strategy for "growing" a data management culture.

Plan

A critical step is to conduct a systematic evaluation of current data management and information support and develop a strategic plan for fortifying the process by which data are managed. Given the "new paradigm for management that encourages highly dispersed decision making,"[4] it would seem that one means for this activity to occur is to bring together the individuals involved in the development, analysis, and use of the data and to work them through a group process. Breaking the process into parts and involving individuals from various organizational units and perspectives is effective for quickly building consensus on immediate action steps. First, individuals in the group each identify issues. Small groups then cluster these issues, and barriers begin to surface. The next step is to focus on the root problems among the barriers, selecting one as a situation to address. This situation is then described as completely as possible and objectives and strategies to accomplish the objectives are formulated. Using such a process on a periodic basis accomplishes

[4] Quote by Don Tapscott, author of *Paradigm Shift* (1992, McGraw-Hill., New York).

several things: 1) Awareness of problems and solutions increases and pervades the organization; 2) Do-able tasks can be selected to improve information support and data quality; 3) Cross-functional commitment and accountability are established; 4) Preceding successes are spotlighted in successive group processes. All of this means that incremental improvements are more likely to be sustained and resources allocated to make more progress. The plan must anticipate changing locations of decision making to refocus the type of information as well as the location of delivery.

Do

Actions taken to address the problems that become priorities as a result of the group process should be considered prototypes. This allows pre-established boundaries to be crossed as solutions are proposed. What works well can, and will, become accepted standard operating procedure. What doesn't work so well can be re-worked with a greater chance of success given the new knowledge gained from the prototype.

Although cross-functional support and participation is key to the success of any innovation to improve information support, responsibility for coordination must still be clearly designated. Again, developing a prototype data management function is a good way to begin. For a select sub-set of the organization's data, develop a process to support: 1) reliable data capture and storage at the operational level; 2) internally valid data, extracted and integrated in a central data warehouse; and 3) externally valid data delivered to meet the needs of distributed management. Under the umbrella of centrally coordinated data management are the following functions and tasks which they must either do or coordinate.

1. **Information Planning**
   a. Work with operational area managers or custodians, system support stewards, and distributed users to maintain and share a model of data elements and their attributes important to the organization.
   b. Help anticipate and respond to users' changing information needs.
   c. Coordinate appropriate policies for population and use of the data warehouse.
2. **Standards Administration**
   a. Develop and coordinate implementation of standards for data warehouse data elements and codes.
   b. Work with distributed users, operational area managers, and information technology personnel in the establishment and implementation of appropriate policies for data management.
   c. Provide standards and appropriate documents for use by EDP audits.
   d. Maintain inventory of official definitions of codes and values for standardized data.
3. **Operational System Management Support**
   a. Assist managers of operational systems in extracting, standardizing, and providing data for the data

warehouse.

b. Assist managers of operational systems in developing and maintaining data elements and definitions.

c. Provide limited training and advice to operational managers on developing and preparing individuals for data-management.

d. Help operational managers create and coordinate user groups.

4. **Team Building**

a. Coordinate identification of issues and strategies for dealing with data and information management.

b. Support a quality development process with a baseline of standards and measures of improvement.

c. Organize and provide administrative support to an information policy steering group which includes personnel from the information technology function, the central data management function, operational area managers, system support stewards, and distributed decision makers or users.

d. Organize and provide training and administrative support to a group of distributed decision makers who use the data warehouse.

e. Lead focused cross-functional projects on data quality improvement.

5. **Data Administration**

a. Manage the data warehouse, serving as custodian and system steward.

b. Support creation of a consistent and usable set of data warehouse data elements.

c. Where necessary, mediate user and operational area custodial concerns on codes and data definitions consistent with organizational authorities.

d. Distribute information about the data warehouse and its use.

e. Insure proper archiving and protection of historical data warehouse data.

f. Act as the official source for the audit trail of changing codes and data element descriptions for elements in the data warehouse.

g. Maintain currency of all policies on information management.

6. **End User Support**

a. Provide examples of using the data warehouse to address concerns and problems across the organization.

b. Help communicate user's information requirements to management and to the operational areas.

c. Support user integration of local data with the organizational data in the data warehouse.

d. Assist with migration of users' local data to the data warehouse when it is relevant to activities, analysis, or reporting that cross functional boundaries.

7. **Technical Development**

a. Work with operational area managers or custodians, system support stewards, and end users to clarify technical needs.

b. Support the information technology department in development, purchase, and use of prototype tools and products for managing and delivering data.

c. Act as a clearing-house for data management tools and related technology.

Check

For information support and data quality improvements to be sustained, it is critical that on-going stewardship be executed by operational staff in the functional areas. It follows that there must be a mechanism for checking and verifying the adequacy of this stewardship. This amounts to assigned accountability for the following functions as a minimum:

1. **Data standards and documentation.** Work with the central data management function and others to develop and implement standards for selection, compatibility, integration and accessibility of organization-wide data. Incorporate and document implementation of these standards.
2. **Data capture and storage.** Assure reliable data capture, maintain list of allowable values, and archive data at standard cycles.
3. **Data validation and correction.** Implement and document validity checks and documentation in applications that capture, update, or report critical data. Develop and measure data quality and respond to problems by repairing the erroneous data, adjusting the processes that created erroneous data, and notifying impacted users of the corrections.
4. **Data security.** Implement and document access procedures that provide adequate protection as determined by management and monitor violations. Implement back-up and recovery procedures that protect against threats to data integrity from system failure, faulty manipulation, or other disasters.
5. **Data availability.** Provide accessible, meaningful and timely machine readable data which clearly identifies capture and modification dates. Work with central data management to provide training and consulting on data use and solicit input for improving data quality and delivery.

Act

The work of the cross-functional groups and the refinement of prototypes as a result of use and feed-back continually nudge and encourage a data management culture. As pockets of support and commitment began to gel, the time is ripe to pour a firm foundation for data management. It is time to act....to formalize the coordinated data management function. Management of data and information support can become a critical part of the strategic core of the enterprise and those who are involved in these areas can becometeachers and leaders for others. The leaders will specify the people, activities, data, and tools that have potential to impact all facets of an organization and its outcomes. Some of the basics include:

1. Develop a data management policy.
2. Develop a criteria for selecting data required by distributed decision makers for inclusion in a data warehouse.
3. Follow the organization's lead, focusing on data from systems or processes that are targeted for re-engineering.
4. Develop a standard for data definitions and descriptions for data warehouse data.
5. Select data management tools such as a data base system for the data warehouse, a complimentary data dictionary, guided user interfaces, report writers, etc.
6. Develop criteria, procedure, and process for refreshing and archiving data warehouse data and definitions.
7. Create cross-functional teams from system migration work-groups to continually address data requirements and quality issues. These groups should include individuals who support and who use the operational transaction systems, individuals who work with data from these operational systems to provide it to decision makers, and individuals who use data provided for analysis and decision making.
8. Create a map of the information management structure with names and job descriptions on the various functions.
9. Develop training at all levels of the information management structure (operational area managers, system stewards, users) on the data management functions, procedures, and tools.
10. Initiate a program of professional development for those involved in data management and information support that sharpens project management, team leadership, and communication skills.
11. Create an environment and structure so the act of integrating improvement identifies the next set of activities where one can plan new ways to remove waste, scrap, and rework.

Culture in Transition

Progress in evolving a data management function or "growing" a data management culture will not always be readily apparent or easy to point out. Behaviors must change before the continuous improvement of data quality becomes a recognized organizational goal. The changes are subtle and incremental. A relevant model for the response of an individual to change is the Kubler-Ross sequence for grieving, i.e., denial, hostility, bargaining, depression, and acceptance.[5] This model is pertinent because it recognizes that change is first and foremost the loss of the "way we have always done it," and it is always traumatic because comfort zones are threatened. If we do not witness some of the behaviors in this sequence, it is likely that nothing is changing.

[5] Kubler-Ross, F., 1974. *Questions and Answers on Death and Dying*, Macmillan

There are several cultural indicators we should observe during transition that can alert us to the areas that require particular attention. These indicators can also help us assess whether we have truly evolved to a changed culture, or in the case in point, to a new data management culture.

1. *Affective Orientation* - Do people openly acknowledge and value working relationships with individuals across the organization?
2. *Orientation to Causality* - Do people claim ownership for problems as opposed to blaming others or the system?
3. *Orientation to Hierarchy* - Do people accept working with others at levels above and below them within the organization's hierarchy?
4. *Orientation to Change* - Are people willing to take risks and embark on new ventures?
5. *Orientation to Collaboration* - Are people receptive to others, seeking input and considering a variety of perspectives?
6. *Orientation to Pluralism* - Do people who represent different interest groups make an effort to make contact and communicate with each other?[6]

To the extent that we can answer "yes" to each of the above questions, we are well positioned to evolve a data management culture that indeed embraces "new ideas for new challenges". We must remember that change is a process and subtle attitude changes signal progress. These include shifts from managing to leading, from control to coaching, from quantity to quality, from opinion to information, from resistant-to-change to open-to-change, from people-as-commodities to people-as-resources, from suspicion to trust, from compliance to commitment, from internal focus to customer focus, from individual to team, from detection to prevention.[7] All of these transitions are part of growing a data management culture. It is important to watch for these transitions and recognize them as gains in terms of awareness and commitment. They signal emerging pockets of support and fertile ground for adjusting priorities and strategy to use new allies as a re-investment in the desired data management culture. Data management can no longer be relegated as a technical issue. There will need to be changes in our organizations. Matrix organizations and cross functional teams focused on specific tasks or problems must become common place. This places the data users and those who need information in direct contact with the operational sources of data. Those who produce information for decision

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[6] Kuh, George D., and Elizabeth j. Whitt, 1988. *The Invisible Tapestry: Culture in american Colleges and Universities. ASHE-ERIC Higher Education Report No.1. Washington, D.C.: Association for the Study of Higher Education. pp. 104-105.*

[7] Plice, Samuel J. Changing the Culture: Implementing TQM in an IT Organization. In *CAUSE/EFFECT*, Summer 1992, p. 23.

making must shift from the roles of manipulating and analyzing data to roles of facilitator and trainer. Furthermore, those at the operational level will need training on the use of data and tools relevant to the new set of data stewardship activities which they will be expected to perform.

The organization which tries to distribute data without data administration to define it and document it will fail. The organization which does not support the distributed data management function to push out the data and transform it into information will fall behind its more progressive competitors. The organization which does not restructure to be consistent with a revised decision structure will frustrate its employees and produce feudal turf battles. The organization which does not continually train its employees to manage and use information will make questionable decisions.

We must step forward and nurture a data management culture. Deal and Kennedy suggest we must resist the temptation to roll up our sleeves and wade directly into the resolution of the problem as traditional managers if we truly want to encourage lasting change or transformation to a new culture. They suggest as an alternative the notion of a "symbolic manager" who recognizes "that the longer-lasting solution is to rely on the culture to meander its way to a solution of the problem."[8]

"New ideas for new challenges" amounts to creating a web of intelligence from the ideas and vision we have today. The web of intelligence is the new data management culture. It must be anchored by trained and empowered **people** who perform relevant and timely **activities** using sophisticated navigational and analytical **tools** on properly integrated quality **data** from both internal and external sources. "New ideas for new challenges" means change and the first change is at our own doorstep.

[8] Deal, Torrence E., and Allen A. Kennedy. *Corporate Cultures: The Rites and Rituals of Corporate Life*, 1982. Addison-Wesley Publishing Co., Inc. p. 154.

A Model for Change

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This presentation will cover management principles and organizational structures with specific strategies which are both applied and untried to create an IT provider capable of change.

One principle is to take those tasks which have been traditionally assigned to the IT provider and distribute to the user community. For example, a specific strategy is to share the process of technology implementation which is demonstrated, documented and encouraged by the user community. An educated user community which can carefully articulate their needs into report or processing specifications can be achieved through cooperation of provider and user. Users will become familiar with the concepts of files, fields, directories, reports, break points, sorting and filtering. The user community will actually write a large percentage of their own reports.

Introduction

This paper and presentation is intended to present a model for change. This model covers management principles and organization structure to facilitate the implementation of change. As each concept is introduced, actual strategies are described. Some strategies have been used and a discussion of their success follows. Others are untried and it is hoped to implement them in the future.

The following management principles and their specific application are discussed.

1. Work Groups
   Specify, Code & Test
   Individual Reports

2. Distributed Training/Support
   Computer Trainer & Computer Training Group
   E-mail SUPPORT

3. Flatter Organizational Structure
   Management Team & Technical Pool

4. Functional Specification by the User Community
   New Projects initiated with a specification

5. Operational Responsibility Transition
   Technology Implementation
   Human Resources creates/maintains user accounts
   Facilities trained on the cable plant and equipment moves

6. Sharing the Resource Allocation Decision
   The Automation Planning Committee and the request queue

Some of these techniques have been used at Regents College in Albany, New York. The College required a structure capable of embracing change as technology introduction had been essentially on hold for 12 years. During the last two and a half years, the College went from having a single person responsible for technology to a staff of 12. During that time, the College went from having approximately 30 stand alone personal computer to 200 in a network configuration and its own administrative data processing system using a commercial product.

Work Groups

Work groups can be utilized in a variety of ways. One involves the production of services. A second use of work groups is in the reporting and task assignment.

All projects, tasks and delivery of services can be completed within the framework of the work group. The minimum size of this work group is two. Consider the creation of a new screen to enter applications from students who already posses significant college level credit. The initial conceptual discussion and final product are all accomplished within the framework of a work group.

In the conceptual discussion, the team approach utilizes a dialogue between the head of a program, the advisors to prospective students and a representative from the computer services department where an outline of the basic functionality is covered. Contrast this approach to the traditional hierarchial structure where the program director indicates the screen requirements in a separate discussion to the representative from computer services in the absence of others.

In the team discussion, the staff from computer services are able listen to the operational needs as outlined by the staff on the front lines. The program director can react and provide feedback on the larger operational issues. The staff from computer services are able to comment on the functionality which can be provided and the relative costs thereof. The program director can react to the costs of different functions and features and judge the benefits with feedback from those on the front lines.

In a traditional hierarchial approach, this same information will need to be communicated and will take about the same total amount of staff time but will occur over a longer period of time. For example, the program director will work with the front line staff to create a rough functional specification. A separate discussion will then be held between the program director and computing staff. The task will be outlined with little opportunity for any cost benefit analysis of functionality. The computing staff will then begin a specification and subsequent coding. Any questions which arise during the coding will be presented to the director of the program and will require further consultation with the front line staff to resolve.

Once the application has been coded, a team approach will require that testing be performed by another member of the computing staff. This accomplishes several things. The application becomes familiar to at least two people on the technical staff. The testing by someone who did not write the application ensures a higher quality product and also provides some redundancy for support of said application. Additionally, a formal program review of one person's code by another ensures that new programming techniques are shared and a sense of consistency is continually refined.

Using a work group in the delivery of services shortens the product life cycle and improves quality.

This technique of sharing the development of new applications has been used very successfully at Regents College. It has resulted in higher quality and increased sophistication of the applications.

The reporting and task assignment in a work group means that all members of the group will be aware of the activities of each other. An actual strategy can take the form of individual reports at staff meetings of the tasks since the last meeting and those planned until the next one. This has the benefit of drawing upon the different experiences and talents of all members of the group as plans are developed. It has been my personal experience that these meetings often result in a new better course of action. People must be encouraged to freely comment without personal bias on the work of others. This is perhaps the most difficult to achieve when personnel are at different levels.

It has taken several years for this sort of communication to develop and flow freely. Success in this area will only come in the long term.

Distributed Training/Support

Training can be accomplished in a distributed fashion by having both a dedicated computer trainer and a computer training group. The computer training group are staff from throughout the organization who are interested in computer training. They serve on a committee responsible for developing and providing training. Distributing training among a group accomplishes several things.

As large projects come to completion, a sizable group of trainers is available to bring even larger groups of people on line. The computer trainer can act as an expert providing guidelines and standards to facilitate a structured guided learning process. The amount of training which can be completed over a short period of time is increased. The demand for training will cycle as the IT providers alternate between development and delivery. For example, it may take several months to bring a new application into production. If it is a large application, the demand for training will be great. The period of time to accomplish this training will be shortened by having a large pool of trainers available.

The computer training group will also serve to critic new lessons as instruction is developed. This process has been termed piloting. It is assumed the computer training group will assist both the dedicated computer trainer and other trainers in the group when piloting new material.

Equally important to distributing training is feedback on the quality of instruction given. Each lesson will require written surveys covering the quality of instruction and relative value of content to expectations.

Flatter Organizational Structure

In computer services, Regents College has managed to flatten the organizational structure. There are 12 positions within the office. Of the twelve, ten are professional staff. The interaction and supervision of professional staff requires significantly more time as the decisions and day to day work are more complex than the route tasks usually assigned to support staff.

The flattening of the organizational structure has been achieved by supervising work on a project by project basis. The director and associate director divide the supervision and the pool of technical staff to work on these projects. Rather than having individuals report on rigid lines of communication, reporting is accomplished on the individual project. Upon completion of the project, the portion of time dedicated to a particular project is put back into the pool and the next task is begun.

On a weekly basis, the director and associate director meet to update one another on each other's progress and to critic and comment. It is assumed communication is complete and sufficient to allow either to assume the other's role.

Functional Specification by the User Community

It has happened where new applications are begun with nothing more than a thumb nail sketch on a napkin over lunch. The project is described as very straight forward and easily completed in several days. The actual result takes many weeks and encompasses issues which were never considered in the initial discussion. There is little appreciation for the issues which arise during the application life cycle. The solution is to require a complete function specification be completed by the user community.

It used to be that concepts such as top down or bottom up design were terms used solely by systems analysts. Today, it is common for people to understand some fundamental design techniques and functional requirements. Training should not only encompass the use of applications but the specifying thereof.

Users are becoming increasingly familiar with terms such as files, fields, directories, reports, break points, sorting and filtering. Several levels of end user functional description can be put to use. For example, IT providers may in fact write the process description and merely require that decision makers within the end user community sign off on the deliverable. This will have mixed results. Some will read in details the proposed system and others will not even glance at the description and place their signature at the bottom. I have found a direct correlation in demand for services and the depth of review. The most sophisticated users will completely describe an entire system and deliverable. This will allow those involved in application development to concentrate their skills on producing deliverables.

Many are wanting to have ad-hoc query tools placed in their own hands. The writing of reports by end users serves to make information more accessible and give a greater appreciation for the work of IT providers.

Regents College has achieved mixed results in these areas. The level of participation is really left to each unit manager. Those who have chosen to become very involved will ask for the most sophisticated application. Additionally, those who are quite involved also require the least re-work as the application is put to use.

Operational Responsibility Transition

Operational responsibility transition involves taking those tasks which have traditionally resided in the IT domain and distributing them to the user community. Examples of this include technology implementation, system account management and hardware relocation.

The implementation of technology has usually fallen on the shoulders of IT providers. The real work in providing technology is to articulate a particular solution and build consensus. This does not require the skills and capabilities of a seasoned data processing individual. On the other hand, it is not a realistic expectation to call upon the end user to fully articulate a solution without some prior experience.

Partnerships between IT providers and end users will be formed through the successful completion of projects. This will give the end users a better grasp of the steps required to introduce technology. The process will become clear and the role of introduction can transfer from IT provider to end user. The final result will be that the IT provider can concentrate on creating and supplying new technology in concert with the end user community.

It has been the norm for decades that only IT providers could be entrusted with the task system account maintenance. This requires that Human Resources and/or the hiring program notify the IT providers of new employees. The notification requires communication and overhead for a task which is route and can be best accomplished by Human Resources. In other words, have Human Resources create the new accounts on the various systems.

The hiring of new employees always involves providing a physical space. Either facilities or office management are called upon ensure such space is provided. Increasingly, this space will involve a work station of some form as the "PC on every desk" is the norm. Physical facilities would then deliver and install the PC or equivalent to the desk top. Any cross-connection at an intermediate distribution frame or main distribution frame would be handled by facilities as well.

The maintenance of accounts and providing of desk top computers are just two examples where responsibility for providing technology can shift. It is a case of making a single entity responsible for servicing the new and exiting employees.

Sharing the Resource Allocation Decision

The decision of which projects to work on next when provided with a limited amount of resources is best shared among those expecting service. A high level committee entitled the Automation Planning Committee could be charged with examining the projects and determine what is to be done next.

This process would not divide the resources equally based on some pre determined budgeted charge back system. Instead, it would be the committee's charge to prioritize projects in the order which would give the institution the most benefit overall.

The request queue and its handling by a committee has had mixed success. Some new initiatives and programs are started without regard for needing computer support. The automation of the initiative then bypasses the queue and receives immediate and rushed attention. At the time of this writing, I am trying to create a system which would be responsive to the needs of all and fair in the distribution of services.

I have found the most difficult challenge in creating a model for change is to determine which project will be worked on next. Those who receive attention from the IT providers will consistently use the queue mechanism. Those who do not receive service based on the committee's decisions will seek alternate providers whether they integrate into the developing information systems or not.

The task of actually deciding within the framework of a committee is not easy by any means. Each member of the committee will view the projects wich different returns and costs. Some members may require several lists in different categories while others will prefer to work in a single format. As I said earlier, this is one of the biggest challenges in creating a model for change.

Conclusion

I hope that you enjoyed the presentation and this paper. I would be most interested in any comments you may have. I am particularly interested in any techniques which I have not mentioned which facilitate the introduction of changing technology.

The paper is geared towards creating a core of highly capable people within IT to provide services and relying on many operational aspects from the user community. It is most useful when organizations need to play catchup. It is not meant to be utilized when organizations are wanting to down size and consolidate.

Implementing Distributed Computing at Cornell University

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CAUSE 93

Abstract

This paper describes the approach used at Cornell University to enable information technologists and user staff to develop client-server applications. The lofty design principles of open architecture, standards, reusability, scalability, and portability were constrained by limited budgets, legacy data, time to market, security, performance, and the cost of training. Considerable experimentation with prototypes led to the decision to invest in two areas:

(1) creating a developer tool kit – an integrated set of applications, tools, protocols, and procedures; and
(2) implementing several key system infrastructure services.

The project that created the tool kit and implemented the infrastructure services was called Project Mandarin. This effort has resulted in an environment that facilitates the rapid creation of client-server applications.

The intent of this paper is to share our experiences. I will explain why we chose the approach we did, briefly describe the Mandarin environment, and describe our experiences implementing several projects using Mandarin technology. These brief case studies will be used to discuss some of the problems, required cultural changes, costs, and benefits of our approach.

Background

In April 1990 Cornell University, with support from Apple Computer, launched a two and a half year project to provide end-user access to data stored in enterprise database systems. Pennsylvania State University and Massachusetts Institute of Technology served on the Steering Committee and have assisted with development. This effort was named Project Mandarin. The original project, Mandarin Release 1.0, is now complete. Mandarin Technology is being used at Cornell to create an ever increasing number of services which are delivering information to students, faculty, and staff. Mandarin technology has empowered colleges and departments to create innovative solutions to their business problems. It also has created many new and in some cases unexpected challenges.

The Business Case

The only justification for any Information Technology (IT) project should be to service the business in some way. Part of the mission of Cornell Information Technologies (CIT) is *to empower people to get the information they need, where, when, and how they need it.* Project Mandarin's role is to provide a technical environment which will enable the rapid development of applications which support this vision. Working from the mission we identified the following business objectives:

Business Objectives

Local empowerment–is embodied in such initiatives as total quality management, legendary service, and self-managed teams. We are moving from hierarchical decision making to distributed decision making. This calls for changes to our traditional information systems and changes in who we consider our customers. Information is power, to support local empowerment we must provide access to information to a large segment of the university community that we have not traditionally considered our customers.

Supporting the "new" information technologies user–is critical to the continued existence of an IT organization. We used to consider a dozen central offices as our users. The definition of user now has changed to include all members of the university community. At Cornell this changes our customer base from a hundred or so central office users to over 20,000 members of the university community. These new customers are not using IT systems every day. They are what we refer to as casual users; users that interact with information systems once a week or maybe a few times a year. They demand high levels of integration and consistent, intuitive interfaces.

Delighting the real customers–is the only way to survive in days of severe fiscal constraints. Cornell University is committed to improving the service provided to its students. We see this initiative as an opportunity to use information technology to assist students in dealing with the administrative requirements of university life. We have the same opportunities with faculty and staff. However, these new customers are not tolerant of time to market measured in years. Their experience with micros has led them to expect instant gratification. They are looking to information technology to reduce the time spent waiting in lines, cut down on paper work, and in general, improve their ability to accomplish their goals.

Saving money–is a very popular objective. Given the reality of today's financial situation, every activity needs to scrutinized in terms of costs and benefits. For infrastructure and tool building projects such as Mandarin, this is a particularly challenging area. We believe that Mandarin will give us the ability to leverage development across institutions resulting in significant savings in development costs. Distributed technology will allow us to make use of low cost RISC based hardware reducing the ever increasing load on our mainframe. The high level of shareability will reduce the cost of development for any one system and also reduce the maintenance cost for all systems.

Working from the business objectives, we arrived at a set of goals and design principles for the project. The goals set the general direction for the project and the design principles describe in a very general way how we planned on getting there.

Project Goals

Provide access to central, departmental, and local information–One of the most frequent and loudly voiced complaints about Information Technologies organizations is that they do not provide timely and friendly access to information. Once the political hurdles are passed, we must not allow technology to be the excuse for not delivering information to our customers.

Engineer the illusion of simplicity–We cannot expect our new customers to learn arcane rituals to access information. The complexity of the underlying systems must be hidden. We also need to provide a way for data, from several heterogeneous sources, to be displayed to the user as a single data source. We do not have the funds or the desire to convert all of our legacy systems into intuitive user-friendly systems at this time. What we need to do is provide a simple way for people to access information without having to replace our existing systems.

Build infrastructure and develop tools–The key to controlling costs is to create a development and run-time environment in which most of the functions that need to be accomplished are available as services. This allows developers to concentrate on the unique parts of the application and not recreate functionality that already exists in other applications. Using tools to develop applications allows staff to move into distributed computing without extensive retraining; development time is reduced; and a level of consistency is introduced into applications.

Object oriented, modular design–We believe that object orientation is the way to achieve the flexibility and shareability required to accomplish our other goals. We do not see Mandarin as a one-size-fits-all solution. It is, rather, a kit of objects that can be used alone or combined in various ways appropriate to the target institution.

Design Principles

Open Architecture–The architecture provides a framework for assembling various objects into a distributed computing environment. The architecture must not lock us into any one vendor or technology. We must allow for the same functionality to be implemented in different ways.

Standards–The adherence to standards is closely bound to implementing an open architecture. The protocols, interfaces, data encoding, and object definitions must not preclude the use of existing and future vendor supplied products.

Shareability–The key to reducing development time and maintenance costs is the ability to implement a function once and have multiple applications access that functionality. The real win is to isolate common functions, implement them once, and allow objects to access them as needed. This is what we mean by shareability.

Scalability–Solutions must function at various levels. Some applications will have an audience which numbers in the tens of thousands while others my have ten users. We need to support department and office level applications as well as campus and multi-campus applications.

Portability–We are not trying to build a solution for Cornell University. Our intent is to build something that will be useful to other institutions. By focusing on portability we will avoid the trap of relying on some Cornell specific technology which would limit our future options.

Reality Check

After setting our goals and identifying our design principles we reviewed the situation at our institution. This reality check led us to the following conclusions:

Legacy Data–The university has made a major investment in creating and maintaining operational databases. A lot of the information contained in these databases would be of interest to our customers if they could access it conveniently. The problem in providing access is that the databases were not created with ad hoc query or end-user access as design criterion.

Time to market–Time to market is an area where IT organizations are under a lot of pressure. Systems development times are measured in years. By the time a system is implemented, the original requester is no longer in control of the area and the business requirements have changed. It should be no surprise that the delivered system is not perceived as a great success.

Security–The replacement of terminals with microcomputers running terminal emulation programs has resulted in a general reduction of security. The microcomputers are typically connected to a network. Passwords and data are flowing in clear text over the network. To the user, the situation does not seem to have changed from the days when they were using a terminal hard-wired to the mainframe, but in truth security is significantly lower.

Performance–We are running out of capacity on our mainframe. Assuming that demand continues to grow at historical levels and mainframe cost/performance does not radically change, the cost to provide mainframe computing power will be probative. Our users are clamoring for distributed implementations making use of RISC based hardware.

Staff training–Clearly the move to distributed computing will require the retraining of the IT staff. We still have all of our operational responsibilities. The need to cut paychecks, register students, or solicit alumni support will not stop and allow us to focus on a retraining program. Staff are currently being pushed to the limit just to keep up with their workload and stay current with evolutionary changes in technology.

User training–Our new definition of customer could result in the requirement to train thousands of users. Clearly this is going to be very expensive and time consuming. We need to design new applications in such a way that they do not require extensive user training.

Client-Server Investigation

We surveyed the state of client-server computing at the start of the project. In 1990 we found very few examples of successful implementations of distributed computing. The ones we did find had several common characteristics:

Use Relational DBMS and SQL–The most common implementations involved the creation of a data warehouse utilizing a relations DBMS. Access was implemented by the use of SQL or SQL based tools.

Use Shadow Database–Data was extracted from operational systems and loaded into the warehouse.

Put Emphasis On Decision Support–Most of the system were oriented towards decision support.

Retrain Staff–Extensive retraining of the development staff seemed to be common.

Throw Money at it–Most projects involved the purchases of a relational DBMS and SQL based tools. When the cost of staff and user training is added in we were getting estimated total costs measured in the millions of dollars.

Mandarin Choices

This approach did not seem to fit our goals and design principles. In addition to not addressing our immediate concerns, it would cost more money than we had available. As a result we chose to go against the trends. We felt the need to demonstrate some quick wins with as little expense as possible. This led us to the following choices:

Support a variety of database technologies–We did not want to be locked into one vendor's DBMS. We decided not to incur the expense of implementing a new DBMS, but rather, design an architecture which will allow us to support our existing systems and give us the flexibility to access other DBMSs at the same time. We have a staff trained in the use of Natural, a 4GL, and experienced in working with our ADABAS DBMS. We wanted to make use of this expertise. We also wanted to support the hot relational products such as Oracle and Sybase.

Use Operational Data–Although there are many cases where the data warehouse concept is appropriate, we decided to provide access to our operational databases. Since the data which most of our customers are interested in is contained in our these databases we decided to provide direct access to this information.

Provide Real Time Access–We wanted to provide real time access to this data. We saw an opportunity to improve the quality of our operational data by allowing direct update of demographic information by end-users.

Isolate the DBMS from the client applications–We view the client/DBMS interaction as the client invoking a host-based service rather that simply calling a DBMS procedure. Because the operational databases were not designed for end-user access, we need to provide the ability to interpret the high level service request and then access and process the data required to provide the requested information. The use of a Data Access Service isolates the client applications from the DBMS.

Use existing skill where possible–Implementing the servers in the 4GL, which the staff already knew, significantly reduced the training requirement. Using the shareable services concept hides most of the distributed computing aspects and allows the staff to simply extract the data from the database, a task that they know how to accomplish. Providing a graphically oriented client builder minimizes the need for technical training for client developers.

Just Do It–We will try to avoid the temptation to design elegant solutions that cater to the technicians' egos more than the users' needs. We accept the fact that we are not going to get it right the first time. We see the development of distributed computing as an evolutionary process. The most important thing is to get something in place and learn from the successes and failures.

Adopting a Technical Architecture

A technical architecture is a description of design objectives and principles for systems construction and operation. It describes how applications should be constructed and how they are linked to data and services. The adoption of a standard technical architecture is critical in implementing distributed computing. Applications must be able to access system infrastructure services. The services must be able to communicate with other services and various data stores. This type of communication and shareability cannot occur without an overriding technical architecture.

Early in the project, we made an unsuccessful attempt to define a technical architecture. We then decided to construct some prototype applications. After gaining experience building and supporting prototypes, we at least knew what we did not know. Object based design, client-server design, and distributed architectures are not things that are easy to get right the first time. It is necessary to try them a few times to understand the problems that need to be solved. At this point we encountered the VITAL technical architecture.

We found Apple's VITAL (Virtually Integrated Technical Architecture Lifecycle) to be of great value in evaluating our current architecture and planning for our next release. VITAL is the result of thousands of hours dedicated to developing a plan for implementing distributed computing. A basic premise of VITAL is that custom systems need to be constructed of generalized modules that can be reused and shared. This is clearly consistent with our project goals. When we reviewed the VITAL design principles we found a 100% congruence with our design principles. It was comforting to see that our architecture fit within the VITAL framework.

We are building Mandarin using VITAL as a road map, or building code, to help us avoid costly mistakes. Our goal is not to implement VITAL. However, as we evolve Mandarin, VITAL will play a key role in defining our directions. Our product will be consistent with VITAL not because we have mandated the use of VITAL but rather because VITAL makes sense.

Key Services and Tools

Our experience with prototypes convinced us of the necessity to invest in the development of several critical systems infrastructure services. A service is a basic unit of shareability. It is called upon by other applications or other services to perform some action. A service is usually implemented by a process (a server) which may require access to data or metadata and a desktop integration component.

VITAL defines several dozen services. We identified the minimum set of services we needed to implement the functionality required by our first group of users. (It is important to differentiate these services from network-based services such as electronic mail, Gopher servers, or library catalogs.) We selected the following set of services to support our first generation of client applications:

- **Directory Interface**
- **Authentication**
- **Version Control**
- **Software Distribution**
- **Authorization**
- **Authorization Aliasing**
- **Database Access**

The Data Access Service will talk to any authenticated and authorized client application. We have implemented clients in 4th Dimension, HyperCard, and C++. However, to facilitate the rapid development of client applications we created a simple but powerful application creator and associated run-time environment. The application creator is called **ProbeMaker** and the run-time environment is called **ProbeLauncher**.

Case Studies

This section describes some of our experiences using Mandarin technology to solve business problems. Before looking at specific projects it is useful to briefly discuss the criteria for selecting the projects used to introduce this technology.

Picking the projects

The combination of the client building tool and the infrastructure services has resulted in a development environment which allows the rapid creation of client-server applications. These tools are not appropriate for solving every problem. We developed some general guidelines for selecting good candidates for first projects:

- **Project Champion**
- **Quick Win**
- **Not Mission Critical**
- **Accommodating Users**
- **Visibility**
- **Limited Complexity**

Just the Facts

Just the Facts (JTF) was the first application built with Mandarin technology. The project was initiated by senior university management asking us if we could use technology to reduce lines in the student services areas. In our surveying, we found that a high percentage of student inquiries were about academic records (course information, schedules, grades); financial information (CornellCard, bursar bill, financial aid information); and personal information (address, phone number changes). The retrieval and display of this type of information is an ideal application of Mandarin Middleware.

This was clearly not a mission critical application, the students could always go back to waiting in lines. On the other hand, it was definitely a high visibility system. We found the students to be a very accommodating user group.

Just the Facts was developed by a team made up of staff from the VP for Academic Programs office, Project Mandarin, and the programmers who had responsibility for the legacy systems. The result of this project is that Cornell students can check their transcripts and bursar accounts without going to our administrative building and waiting in line for a clerk. Now they can get this and other information from Just The Facts by using their Network ID. When they type in their Network ID and password in the main menu, Just The Facts displays their grades, bursar accounts status, CornellCard status, and addresses on file with Cornell. Just The Facts also lets them view their current course schedule and update most address information. Additionally, they can communicate with the bursar and registrar via e-mail from within Just The Facts.

We learned that technology was only one of the requirements for making distributed computing happen. Cultural changes must occur at all levels in both the user and IT communities. We were fortunate that the time was ripe for change. The university was investing resources in the "total quality improvement" process. Shrinking resources prompted inquiries into how the university could deliver better services for less money.

Organizational structures inhibit change. In many cases the organizational structure is so rigid that any change or innovation will meet resistance, the "If it ain't broke, don't fix it" mentality. An example of this was our attempt to allow students to directly update their own address information. There was much concern that the students would "mess up" the data. This has not proved to be the case. JTF has cut in half the number of manual entry address changes that staff must make (10,000 reduced to 5,000 changes annually). It also reduced the number of errors because the students are inputting their own addresses. The percentage of students who make their own changes continues to increase.

Administrators were generally pleased. JTF greatly reduced the long lines and allowed them to devote more of their time to addressing more significant problems and issues. The number of requests for printed grade reports and transcripts has significantly decreased because students can now access the information themselves and see the information on screens in front of them.

Students were thrilled. In the first ten months, 11,072 unique students accessed JTF in 37,585 sessions. We made it very easy for the students to comment on the services. They have been particularly enthusiastic about the ability to access the information at their convenience as opposed to being limited to when the administrative offices are open. We are constantly getting feedback about their needs, concerns, and wishes. The Mandarin technology allows us to be responsive to their comments (the system is now in its third generation after only two years of being up and running).

Change breeds more change, and change never ends. The first JTF was a prototype - we had no intent of creating anything more. But that quickly changed after its introduction. Students loved it. Don't start anything unless you think you can see it through. If you raise students' level of expectation about service delivery, it is very hard to go back. Once the waiting lines are gone, students are very reluctant to stand in them again.

Bear Access

Bear Access is a CIT sponsored project that provides a consistent interface into a suite of network-based service offerings. These applications provide access to a variety of services over the campus Internet. In addition to providing a common access point for a heterogeneous collection of services, we wanted to be able to administer a group of general university services centrally. We needed to allow for other groupings of services to be managed at department or college level. We also needed to be sure that the software we provided was always current.

We used the Mandarin LaunchPad, Version Control, and Software Distribution services to meet these requirements. Problems arose about who was responsible for what services. There should be some services that are supported centrally and are subject to installation cycles and support requirements. It is equally important to allow the community to readily create and distribute new services. We must educate the users to go to the service owner for support. We also must enhance the Mandarin infrastructure so that it provides the users with information whether a problem is with a service offering or with the infrastructure supporting the service.

Faculty Advisor

The College of Human Ecology, the Office of the Vice President for Academic Programs, and CIT are sponsoring a project to provide the faculty with immediate access to current student data. Faculty members saw JTF and were very interested in being able to have access to information in a similar fashion. But they needed different kinds of information (primarily academic records) and in a slightly different format. This prototype gives faculty information about a student so they can give better service to the student. This project demonstrates the high degree of reusability possible with Mandarin technology.

Just the Facts, Bear Access, and Faculty Advisor are examples of using Mandarin technology to deliver information to the university community. Mandarin technology has allowed these services to be developed very quickly, typically in a matter of weeks. These products are sharing the infrastructure created by Project Mandarin. Each new service does not have to be built from scratch. It can be put together from reusable building blocks. This ability to leverage existing effort is critical in delivering cost effective solutions. We have seen a high level of reusability on these projects which contributed to faster development than we experienced with other technologies.

TRACK II

LEVERAGING PEOPLE WITH TECHNOLOGY

Coordinator: James H. Porter

Making our people and organizations more effective has always been—and continues to be—the ultimate promise of information technology. Expectations for IT in colleges and universities, where the transfer of information is at the heart of the enterprise, are especially high. How can IT help people on campus do their jobs better?

Implementing a Culture of Change
The Five Year Transformation of The George Washington University

by Walter M. Bortz
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Introduction/Lead-in:

For Centuries, people believed that Aristotle was right when he said that the heavier an object, the faster it would fall to earth. Since he was regarded as the greatest thinker of all times, he surely could not be wrong - and no one challenged his concept for almost 2000 years. In 1589 Galileo disproved that theory with his famous experiment at the leaning Tower of Pisa -- but the power of belief in conventional wisdom was so strong that professors denied what they had seen. They continued to say Aristotle was right, reinforcing the observation of Niccolò Machiavelli that, "There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success than to take the lead in the introduction of a new order of things."

The George Washington University:

In 1988, the then 163 year old George Washington University announced the appointment of its fourteenth president. With that appointment, the forty-three acre campus, but two blocks from the White House, began what can only be called a rebirth, as reassessment and reinvention began to occur in every corner of the institution. Nothing was sacred -and nothing too small or too large - to escape some focus. Long held at bay, the winds of change - driven by ubiquitous information technology - were blowing across all facets of our organizational life.

Leadership For Change

It should come as no surprise that one of the areas receiving unusual scrutiny would be the institution's business practices, especially the processes and procedures emanating from its policies. Consider a scenario where major segments of the institution are attempting to make day to day decisions using different data from different sources -- the results are guaranteed to be less than satisfactory. To put it another way, if a university with a budget in excess of six hundred million dollars has units that cannot agree on enrollment figures, the number of funded positions, a given semester's financial aid commitments, or any other such fundamental information, then all the traditional collegial models of problem solving and participatory governance are but window dressing.

While I do not propose that college or university presidents need to understand the finer points of TQM or re-engineering methodologies ... I do know that they will not accept excuses why something cannot be done. Those of us whose responsibilities include information collection and dissemination must meet the challenge of large scale transformations which span entire organizations and tax the limits of both our technological and human resources. We must be prepared to integrate our information systems into those changing organizations, to reengineer processes, absorb new technologies, in other words to facilitate the formation of a cohesive institution capable of delivering quality, innovation and customer satisfaction. And all of this usually means a fundamental change in how we meld computing and communication resources to create an integrated enterprise. We must seek synergy of technology and organizational process. But merely pursuing technological change is not enough -- we must *implement a culture of change* if we are to be successful in that transformation.

Unfortunately, as we are all too painfully aware, change in general is not welcomed by most of our colleagues in the Academy. Those with long staff tenure embrace well entrenched, standing practices -- often with pride of ownership and authorship. It is that resistance to change, complicated by unaccommodating or unwieldy infrastructures, pressing financial necessity, and the ever present rhythm of the academic calendar that so challenge those who advocate and champion change.

Recognizing the Need for Change

I do not wish to suggest that prior to the current administration's arrival, former staff at The George Washington University had been sitting on their hands, ignoring the changing circumstance of technology and related data management. In fact, a student information system had been created in-house during the 80's, though by 1988 it had limited flexibility in addressing the growing needs of the community. The system was not distributed to users, though reports were readily available. Originally, it had been anticipated that an entire information system would be constructed using the student system as the backbone. A quick review of a possible timetable for this task - using past experience as prologue -suggested a completion date somewhere just shy of the University's 200th anniversary in 2021! Had the institution pursued this option, it was suggested that we might want to create a profit center, in the form of a museum of 20th Century higher education administrative system software. A fitting tribute for so heroic an effort.

As you might imagine, proliferation of systems was rampant during the time the University was creating its student system. A mainframe based alumni and development software package had been purchased. The financial affairs folks were taking the better part of a decade to implement a finance software package. None of these systems addressed enrollment management needs, or financial aid packaging and modeling requirements, or procurement, or grants and contracts, or a host of other administrative systems ... all basic to the successful day-to-day operation of the University. Our systems - even payroll - were independent of one another and therefore filled with redundant data. They all required regular updates, as well as dumps from one to another. Furthermore, this potpourri of challenges was compounded by the verification that some costly upgrades to the systems mainframe hardware were but twelve months away. To add insult to injury, these upgrades were projected to be interim solutions at best -- they did not address the issues of integration nor improve access to information. It was clear, therefore, as the new administration took stock of its environment in 1988-89, that a decision was imminent to redirect the University's effort in information management. Our intention was to move as far ahead in the utilization of new technology as possible -- setting a pace commensurate with the rate at which we felt the institution could absorb the change --while implementing organizational diagnosis to assess the underlying processes, and the gaps between actual and desired work dynamics.

As with all such major decisions in large and complex organizations, there is some distance between the lip and the cup in declaring new policy and obtaining buy-in from the community. At the time of the decision, it was apparent that the institution could be faced with severe economic contractions as we addressed a host of issues concerning the quality of the student body and the faculty. More importantly, even though *everyone* would have a vested interest in our direction, we could not -- would not -- accommodate to *everyone's* individual satisfaction.

Setting the Stage for Change

The keystone of our plan was the creation of an "infostructure" designed to support the mission and goals of The George Washington University. Our first step: the development of a Computing Technology Master Plan. Its purpose: to provide a foundation and set the direction for the future of administrative computing, as well as to address the issues surrounding academic computing support, especially mainframe support. The process that eventually produced the Master Plan was time consuming but as participatory as possible. No segment of the community was ignored. It was important to have as many "creators" as possible for the new directions that would come forth from this document. A quick review of the table of contents of this more than 200 page product will attest to its thoroughness. Both voice and data were explored in depth, and networking issues along with other telecommunication challenges addressed.

Because of this exercise, it became clear to the campus at large that it would not be enough to simply acquire new technology. Our university community was going to have to study and learn how the application of technology, in whatever form, could and would be used to transform, to reengineer if you will, the various administrative delivery systems of the institution. Success in such an undertaking can be benchmarked in a variety of ways: the ability to recruit and retain a desired quality of student, faculty and staff; a capability to provide the appropriate level of service to these constituents; the effectiveness of productivity improvements and their impact on the economic performance of the university; and finally - in the grander scheme - whether we have furthered the stature of the institution in its accreditations, ratings and rankings.

In order to accomplish these objectives, a clear vision of computing at The George Washington University had to be presented, and a commitment to revisiting and updating that vision also had to be made. That represents a significant challenge when the pieces of administrative machinery - particularly those responsible for computing and telecommunications - reside in various vice president's portfolios. Therefore, following the recommendations of the Computing Technology Master Plan unveiled in early 1990, Telecommunications, the Center for Computing and Information Management (including both administrative and academic support elements), and the Computer Information and Resource Center/User Services (the faculty and student support unit), were placed under the direction of one vice president. This consolidation, and the recommendations of the study in which the entire community had participated, created the foundations and set the stage for significant change.

Even as we set that stage, it was clear that the University should not exceed the current level of resources devoted to administrative computing. In fact, the University clearly wanted to rewrite the formulas to direct more of its resources away from administrative computing to academic computing. It was under such parameters that we began our search for a solution.

Implementing Change: Creation of an Information Infrastructure

One of the first orders of business was to make the long range, long term commitment to administrative software. In particular, the community needed to decide if the institution would "build or buy". Four primary issues drove the decision, all with financial import. First: the period of time we estimated it would take to achieve consensus on system functionality. Second: a consensus on the current level of IS staff proficiency and the training required to bring the resident analysts and programmers up to speed. Third: the need to rethink administrative processes and the challenging "pride-of-authorship" inherent to that exercise. And fourth: the reality that the last two systems the institution had implemented, finance and student, had taken a combined effort in excess of fifteen years -- and both were showing signs of instability.

It was this last issue which drove a strenuous review of our "buy" options, and the resultant investigation of available providers of full range administrative systems. We desired a "partner", one who would consider bundling a package of services, systems, and hardware enhancements in a long term relationship at an attractive and predictable cost. To this was added the bottom line requirement that since The George Washington University was already spending too much for administrative computing, the annual expenditure for this transformation to new technology had to be less than our then current budget.

A small GW group went to the market and reviewed the status and future directions of four higher education software vendors. The institution's ongoing experience and senior management's previous experience with Systems & Computer Technology Corporation (SCT) of Malvern, Pennsylvania, focused attention on them.

It was the institution's desire to have a real-time distributed system, coupled with our perception of both what SCT's BANNER software was and would become along with BANNER's hardware independence as well as SCT's willingness to contract it's installation, modification and implementation to GW's standards. After months of contract negotiations, and both rigorous and vigorous internal discussion, a seven year, multi-million dollar per year outsourcing contract was signed in May 1991. The 123 page contract committed the institution to purchase the current version of the administrative software, and laid out an aggressive modification and implementation schedule. A comprehensive relationship was formed that laid the foundation and made possible the institution's transformation to an integrated data, open systems architecture, distributed computing technology. In addition, the annual 7 year level payments of the contract resulted in an immediate and continuing savings to the University's bottom line. Thus we met the challenge of investing, while spending less.

The implementation of the financial aid module began immediately. On it's heels followed the Student Information System, Alumni/Development System and the Human Resource System. A decision on the Finance System was postponed for two reasons, number one: the newly arrived vice president for finance needed some time to become familiar with the landscape; and number two: the financial system software then in use had to be "stabilized". A delayed decision also allowed the financial affairs staff to carefully review their processes and procedures, and determine appropriate protocol in a distributed, rather than a highly centralized environment.

Redefining the Business Approach Through Technology

The results of that decision in 1990 and 1991 are obvious in 1993: The George Washington University is transforming itself. Perhaps the most significant outcome of the change to date is that decisions no longer equate to independent action. Student accounts, financial aid, registration, housing and a host of other operations having myriad processes are now inextricably linked in an integrated information system dependent upon and owned by all.

No doubt you will not be surprised to learn that the process of transformation has not been easy nor trouble free. Large scale organizational transformations of culture, resources, and strategy seldom are. Should you visit the campus or otherwise have contact with any of the hundreds of staff and faculty who have been involved with the activity, you will find various levels of enthusiasm for the software, the manner in which the "plan" has been implemented, and the speed with which the process has been accomplished.

What you *will* find is a community with more information available to them than ever before and still in the midst of struggling with the learning curve of new software. You will also discover an institution that is actively *redefining* the way it approaches its clients and how it chooses to do business with them. Unfortunately, the fundamental synergy of new technologies and processes are sometimes lost on a host of middle managers who would rather remind us of the list of yet-to-be-accomplished tasks!

But I can report to you that the majority of the campus now recognizes that the change accomplished, and that which is still underway, is worth the thousands of hours of staff time. More and more, users are willing to accede that they -- and our clients -- are enjoying vastly improved service levels and information access. Immediate access to information, on both individuals and transactions, has caused us to rethink *how* we collect the original information used to populate those data bases. An entire user subculture has arisen that spends time researching direct data entry. They search for methods that allow students, applicants, and prospective employees (as well as a host of others) to provide information directly to the system. Students now use touch-tone telephones to register. They obtain copies of their class schedule from information kiosks located around campus (called "GWiz") and they meet with faculty who can advise them on their academic histories with up to the nano-second accuracy.

At the end of the 1989 fiscal year, seven hundred users were connected to the data systems of the University. Last week, we connected our three thousandth user as we also announced a major effort to seek a partner for a significant telecommunications project, one that we anticipate will permit the institution to take a giant step in connectivity, and in the distribution of data, voice and video both on campus and throughout the world as we press the boundaries of the envelope outward to further explore interactive long distance learning and the administrative's challenges it presents.

Summary: A Culture of Change

I am satisfied that we have successfully influenced our culture within many areas of the University. We have done it through the establishment of strong links between the enabling technology, organizational processes, and our human resources. Today, every campus renovation carries a connectivity budget and includes input from a committee charged with technical enhancements. All new construction enjoys representation on planning committees from both telecommunications and academic computing support. E-mail abounds, software site-licenses are proliferating. The institution *is now* in the enviable position of trying to keep up with an accelerating campus learning curve and demand.

More and more, The George Washington University recognizes technology as an integral part of the infrastructure rather than an added benefit of "automation". We are beginning to see a return on investment. Fewer letters of complaint from students and parents on registration, financial aid processing, or student accounts is a welcome sign that the business operations are receding into the background -- where they belong! There is every reason to believe that future implementations (the Human Resource System later this academic year and the Finance System during the next two years), will be gentler transitions and provide even more significant benefits to a growing list. In the midst of the institution's "coming of age", in an era of enterprise integration, the general population is becoming more computer savvy. Anticipating future directions, The University is spending more of its resources to address the convergence of communications and computing technologies. High speed networking, off-campus network access, on-line library enhancements, networked software depositories and expansion of faculty access to additional learning based technologies and training are receiving more and more of our attention and resources. New faculty and staff arrive on campus each year with more computer sophistication. Computer literacy and training will begin to fade as a resource issue as new elements replace them. Bringing the entire community along in this enterprise is much like the task that the school teacher faces with a classroom of multiple intelligences and abilities. Holding everyone's attention and maintaining support campus-wide will continue to challenge us into the foreseeable future.

I look forward to reporting to you again in two years when, if our calendar has not failed us, we will be able to share with you additional good news of how we have further learned to leverage people with technology.

EMPOWERING THE USER

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ABSTRACT

This presentation describes how Cincinnati Technical College organized its efforts to meet the following challenges:

1. The use of PCs and automated systems was expanding rapidly with little or no thought given to integrating the systems.

2. Users of MIS were demanding more access to the computer-based data and faster response on system problems and on development of new systems.

3. The MIS department was being seen more and more as a barrier to progress rather than as a facilitator and servicer for progress.

The GOALS of this presentation are to describe:

1. The PLAN which was prepared to meet the challenges.

2. The STRATEGIES which were designed to implement the PLAN.

3. The INNOVATION which was necessary to break away from old habits and ways of thinking.

4. The EVANGELISM which was invoked to give leadership to the PLAN.

EMPOWERING THE USER

INTRODUCTION

Cincinnati Technical College (CTC) is a two-year, publicly-assisted technical college which offers fifty different certificates and associate degrees through four separate academic divisions--Business Technologies, Health Technologies, Engineering Technologies, and Humanities and Sciences. Approximately 5,500 students are in attendance at any time during the five academic terms, with about 3,100 FTEs. The special emphasis of the College is cooperative education for which it has been recognized nationally. Most recently, such recognition occurred on the front page of the Wall Street Journal[1] and on the ABC World News Tonight With Peter Jennings.[2]

Like many other two-year colleges, Cincinnati Technical College experienced significant but rather steady enrollment increases in the 1980s despite the decreasing number of high school graduates. In 1990 a new president was installed, James P. Long. Subsequently, enrollment jumped 10 percent and 11 percent in the first two years of his administration. His goal was to lead the College to become a community college. He recognized that additional growth was being jeopardized by outdated and outmoded administrative computing systems. He directed that a complete review of those systems be accomplished. To assist with the review, the College hired a consulting firm. The results of the study and the process which was used to plan and implement the new administrative information system is described below.

REVIEW OF FORCES AT WORK

There were three major forces at work at Cincinnati Technical College in the world of information systems in 1991.

1. Expanding Use of PCs and Non-Integrated Systems

   PCs were becoming ubiquitous. Some were connected to the larger computers in use (IBM 4361 mainframe for student systems, IBM System/36 for Financial Systems), but more and more were in use for stand-alone systems which made little, if any, use of data already in computer systems at CTC. Often, in fact, the data being processed were data which already existed in the large computers but which had been separately entered into the PC. Separate PC-based systems were used to re-enter data from computer reports in order to prepare reports required for the Ohio Board of Regents. Many analytical reports were also prepared using LOTUS 123 for different financial purposes using data which already existed in the System/36 financial systems.

2. Users Demanding More Access to Data and More Integration of the Systems

   The use of second-generation software had provided some basic integration of some parts of the student services systems, but there was only very incomplete integration

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1 Ralph T. King, Jr. "Real Help: Job Retraining Linked Closely to Employers Works in Cincinnati," Wall Street Journal, 19 March 1993, pp. 1, A9.

2 "American Agenda," ABC World News Tonight With Peter Jennings, 15 April 1993.

with the financial systems. Also, the Financial Aid process was manual and completely separate from the automated systems. The maintenance of the automated systems was extremely difficult because of poor documentation and because of relatively high turnover in the MIS department.

The MIS department was in a Catch-22 situation. When it attempted to respond to the user-demanded changes to the current systems, it often introduced additional reporting problems which exacerbated the difficulties and resulted in increased user dissatisfaction. The users had seen enough of the level of integration and data access which were available with fully-integrated systems to become much more demanding in calling for those capabilities at CTC.

The mainframe in use was being used to full capacity and response time was not acceptable at registration for a new term. Since CTC has five terms each year and five registration periods each year, the complaints about poor response time had become almost a drumbeat. The poor response time from the mainframe systems and the poor response from the MIS Department when system changes were required built a user perception of an MIS Department which provided poor service overall.

3. MIS Being Seen More and More as a Bottleneck

Because of the central role that the MIS department played in the operation and maintenance of the automated systems, MIS was blamed more and more for problems which affected student service, preparation of accurate reports, and the ability to respond to regulatory changes. This third challenge was particularly worrisome because the solution to the first two challenges clearly depended on effective leadership and teamwork from the MIS department. The longer MIS was seen as "part of the problem" the more difficult it would be for MIS to be seen as "part of the solution."

Over time, the user community came to accept the MIS department's poor performance as a fact. There was at least one benefit to the users from this fact. Whether it was true or not, it was relatively simple to blame the MIS system for any and all problems which occurred. This finger-pointing was a convenient cover for other problems and became a part of the culture. Everyone knew that the MIS systems were unreliable and set their expectations and attitudes to reflect that knowledge. The MIS personnel realized that they were being blamed for problems which pre-dated their employment at CTC and that their role was not regarded as valuable and supportive. This realization contributed to the morale problems within the department and an adversarial relationship with the users. Both of these factors contributed to a high rate of turnover in the MIS department.

PLAN TO ADDRESS THE THREE CHALLENGES

CTC decided to attack all three challenges at once with a team approach. The design of this team approach was based on the work done at Sinclair Community College[3] and at

3 Stephen Jonas and others, "Selecting an Information System for The '90s--Can a User Driven Process Work?" Presentation at the 1990 Annual Conference of the League for Innovation in the Community College, October 21-24, 1990, p. 3.

Georgia Tech[4]. The team would include both the users and the MIS personnel with the users providing the overall leadership to the effort and having the final responsibility for the major decisions. It would include both management and workers, from the user departments and from MIS, with input regularly gathered from all. It would include both the academic and the administrative areas because it was clearly seen that a key part of integrating the automated systems was integrating the ability to access the functions and data those integrated systems would provide. This integration had to cross all lines of the organization through the use of systems for which all parts of the organization felt responsibility.

A task force was formed which included representatives from all departments, all areas, and all levels of the organization. This Task Force was asked to be a sounding board and a generator of ideas for the overall project. It continued to meet periodically throughout the planning and the implementation stages of the project.

An approach to project management was designed which would use the organizational structure which was already in existence to populate three levels of project effort.

Top Level - Executive Systems Review Board (ESRB)

The Executive Systems Review Board (ESRB) included the academic deans; the vice presidents for student services, finance, and administrative services; the dean of admissions and counseling; and the director of human resources; with the director of MIS as an ex-officio member. An organizational chart appears below in Figure 1.

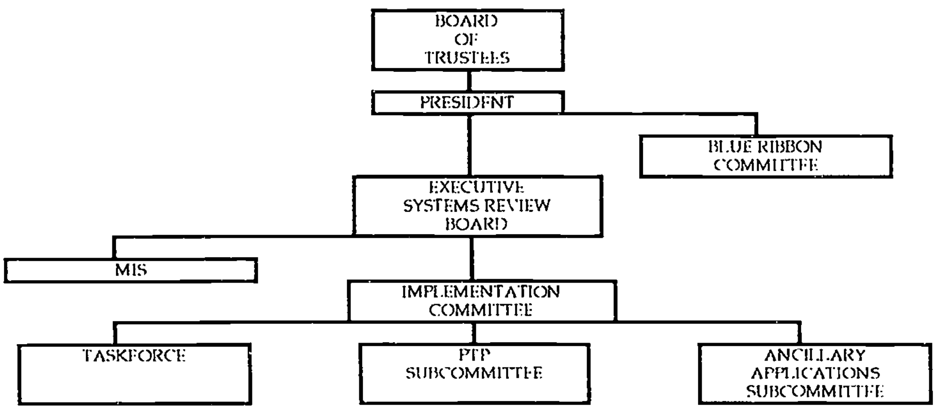

Figure 1: Organizational Chart for the Update '93 Project

The ESRB was charged with the responsibility for setting overall policy for the project and for making the major decisions concerning computer software, hardware, and personnel assignments. It guided the development of a Request For Proposal (RFP) and led the selection process to evaluate and choose software and hardware vendors. The process included in-depth interviews with all members of the Task Force concerning their areas' current systems, system problems, and needs for the future. These interviews resulted in written statements of needs which were consolidated into the RFP.

4 Linda Martinson, "Scrapping Patched Computing Systems: Integrated Data Processing for Information Management," NACUBO Business Officer, June 1991, p. 35.

The project to upgrade the Administrative MIS to meet the requirements stated in the RFP was named UPDATE '93. The acronym stands for User Planned Data Access Toward Empowerment. The name intended to identify not only the process of upgrading the systems but also the teamwork approach being used.

The specific goals which were set for the UPDATE '93 project were the following.

1. Use of a relational database management system to support data integration, easy access, and powerful reporting tools.

2. The ability to communicate from any PC or terminal in the College to any other PC or terminal in the College.

3. The ability to download selected data from the central database to department PCs for further analysis.

4. Fast access to the data to improve service to the students in all interactions with the College.

5. The ability to add new features and functions (E-Mail, telephone registration, INTERNET access, etc.) without major changes to the basic system.

6. The ability to greatly expand the number of students served without a major expense to upgrade the hardware or software.

To advise him on the contents of the RFP and the criteria for the selection of the new system software and hardware, the president recruited a Blue Ribbon Committee of data processing executives from the business community. These vice presidents of major insurance, banking, and information systems firms met with the president and representatives of the ESRB to provide feedback, direction, and confirmation of the approach used. When the president took the recommendation for the purchase of a major new system to the Board of Trustees, he had not only the selection of the internal committee but also the concurrence of an independent outside panel with many years of experience in purchasing and designing software solutions.

Second Level - Implementation Committee

Once the selection of software and hardware had been made, an operating committee was established. It was called the Implementation Committee. It had the responsibility for making the decisions necessary to make the project happen. Those key executives in whose areas the new system would be installed were included, namely the registrar, controller, and the dean of admissions and counseling. In order to maintain a balance of academic and administrative viewpoints, the dean of health technologies, the senior academic dean at CTC, was also included. The director of MIS was made an ex-officio member. The selection of these members was made purposely to include two members of the ESRB in order to provide clear communication paths horizontally as well as vertically within the organization.

The Implementation Committee decided to set up sub-committees which would be populated with members of the Task Force and MIS department people.

Third Level - Sub-Committees

Four sub-committees were formed initially. The subcommittees were composed of midlevel managers and staff who would be ultimately responsible for working with the new system on a day-to-day basis. The subcommittees provided leadership opportunities and decision-making authority to persons who were not used to having these roles within the organization.

1. DATA MANAGEMENT AND SECURITY - to plan what data needed to be converted and what security needed to be applied to the system.

2. TRAINING - to plan and guide the training required.

3. CONVERSION - to develop and recommend the conversion sequence to be followed.

4. ANCILLARY APPLICATIONS - to make sure that any current needs for automated systems which were not included in the packaged software were addressed during the life of the project.

The four subcommittees met regularly for several months. Through their input, they laid the foundation for the implementation of the new system. The subcommittees crossed departmental lines and initiated the team building efforts. Subsequently, when the conversion became the primary focus, the Data Management and Security, the Training, and the Conversion subcommittees were combined into a single group called the Planning-Training-Problem Identification (PTP) subcommittee. PTP included all of the key supervisors from the user departments and all of their MIS teammates.

NEW STRATEGIES DEVELOPED

From the experiences gained by site visits during the selection process, the project leadership realized that the implementation phase would provide the greatest test of the teamwork approach. In order to help assure success, several strategies were developed.

1. Users who have PCs but do not understand them well must be made more computer-literate. Training classes on PC Fundamentals and DOS were developed and implemented using a "train the trainer" approach in order to institutionalize the knowledge. The training was conducted by a team made up of user personnel and MIS personnel. It included representatives from the academic areas as well as the administrative areas. A new E-Mail system was selected and installed on the new administrative network to help solidify the knowledge which was gained in the PC training.

2. Users must be provided better access to data through an integrated software system. This system is built on a Relational Database Management System (RDBMS) in order to provide the tools needed to effectively manage the database and to support ad hoc access (QUERY) to the database. To build on the training done earlier, the software vendor was brought in to CTC to conduct focused on-site training on the software modules. This system software module training involved both user and MIS personnel and was accomplished again using the "train the trainer" approach. Doing the training on-site allowed a much more focused effort. All questions and concerns were CTC's questions and concerns. All examples and solutions were

CTC examples and solutions. Training on the QUERY capability was provided to key personnel in all departments, not just to MIS personnel. User personnel were involved in helping to deliver the QUERY training to other units.

CTC recognized that empowerment of the users depended on three separate ingredients, computer literacy, integrated systems, and the Query capability. (See Figure 2.) Each of these ingredients needed to be acquired over a period of time, in an integrated manner.

TOTAL EMPOWERMENT

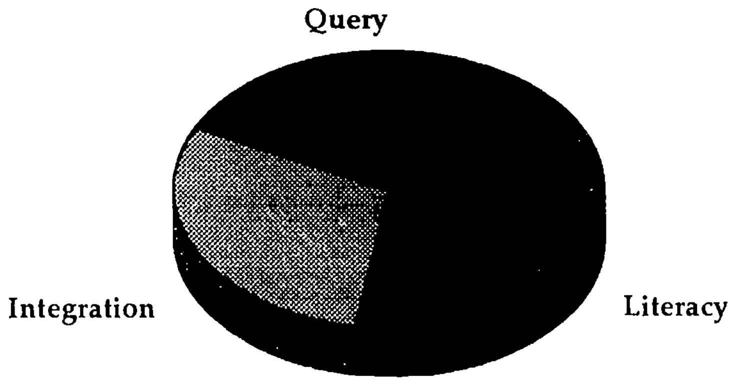

Figure 2: Computer Literacy + Integrated Systems + Query = Total Empowerment

3. MIS personnel must be reoriented to a user-service point of view. This change of attitude was accomplished through the identification and development of leadership within the MIS personnel, through the team-building previously described, and through assigning MIS personnel to specific teams with user personnel. User managers were regularly asked for input concerning how well the MIS personnel were supporting the efforts of the team. Problems which were identified were addressed immediately. In addition, MIS personnel were regularly asked for input concerning the cooperation being shown by the user personnel. Problems identified with those relationships were also immediately addressed.

   The modus operandi for addressing teamwork problems, from whatever source, was to meet with the personnel involved to review the problem and to develop a solution to which all parties agreed. If necessary, the next higher level of management was involved in the discussion in order to reach a consensus on the problem definition and on a solution. Since all of the departments involved in the project already had key executives on the different teams, it was relatively simple to gather the necessary personnel together and focus their attention on a common definition of the problem. In a few cases, it was necessary to raise the problem to the level of the ESRB in order to achieve the necessary level of cooperation. With all parties generally knowledgeable concerning the overall project, it was not necessary to prove problems existed so much as it was necessary simply to identify the problem and to show how it was interfering with effective progress. In addition, it was stated as policy that UPDATE '93 was to be user-driven with all major decisions made by the users.

INNOVATIONS IMPLEMENTED IN IDEAS AND IN ACTIONS

The project leadership introduced a number of innovative ideas within the implementation phase. First, teamwork was stressed as essential, not just a good idea. Good teamwork was recognized and rewarded with special recognition during meetings. Poor teamwork was also recognized, and appropriate corrective actions were taken. The previous adversarial relationships and attitudes were weeded out through joint successes and through recognition of the essential need for the full participation of all those involved. Second, decisions were not allowed to be made by single individuals, whether the individuals were department managers or vice presidents. All decisions had to be joint (integrated) decisions in order to successfully implement the new integrated system. Third, MIS personnel were not separate from the team effort. They were expected to be team contributors, not remote gurus or gofers to be ordered about. Fourth, the new system was not an end in itself, but the first stage of a process which would be continuously reviewed and improved. The Total Quality Management[5] approach, with the general recognition for effectiveness it has received in industry, was most helpful in this effort to convince the staff that change is part of the new way of operating.

In addition to the innovative ideas, a number of new actions were introduced. First, team assignments were announced publicly, and team performance was recognized publicly. Second, inter-department training was made standard. The Admissions personnel, once they had learned their module, were expected to train other departments on how that module worked. This approach solidified their understanding of their module's functions and contributed to teamwork and improved communications. Third, quick identification of problems became the order of the day. Anyone who did not identify problems of which they were aware became "part of the problem." Fourth, recognition and celebration of good performance and of successes became a regular part of the weekly meetings of the different working groups.

EVANGELISM

To break through the barriers which the culture at CTC presented, the project leadership continually stressed the inadequacies of the current situation, the benefits of the new system, and the essential need to implement the new system in order to prepare CTC for the future.

This evangelism took several forms. First, the Board of Trustees and the president confirmed the goals to be achieved with the new system. This confirmation was invoked to help add force and credibility to the need to assign all necessary resources to complete the tasks. Second, management stressed the total inadequacy of the current system and the essential need for change. Third, MIS personnel continually sold the excellent benefits to be achieved through the empowerment of the users. Fourth, several boosters of the new system were identified and encouraged to speak out positively among their peers and their staff about the benefits of the system, the importance of moving forward, and the need to meet project deadlines.

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5 W. Edwards Demming, Out of the Crisis, Massachusetts Institute of Technology, Center for Advanced Engineering Study, Cambridge, Massachusets 1986, p. 4.

RESULTS ACHIEVED

As a result of the successful implementation of these plans and strategies, these positive results have been achieved.

1. The computer-literacy of the organization has been upgraded.
2. The users and the MIS personnel have a deeper understanding of the essential value which each group brings to the work.
3. The automated systems are fully integrated and provide a solid basis on which to improve service to the students and to upgrade overall efficiency.
4. The installed network enables all employees to access the data they need to fulfill their assigned responsibilities.
5. Communication between and among all employees is faster, more actionable, more accurate and less-paper dependent than before as a result of the use of E-Mail.
6. The future developments in computer systems are now options which are available to CTC. There are no artificial barriers in the way to the use of telephone registration, access to INTERNET, electronic exchange of data files, or other new developments.
7. Users have access to the data on the central system and can download a copy of selected data to their PC for further analysis.

The system configuration has been altered dramatically. Figure 3 is a visual representation of the automated systems before the conversion.

CTC Network In 1991

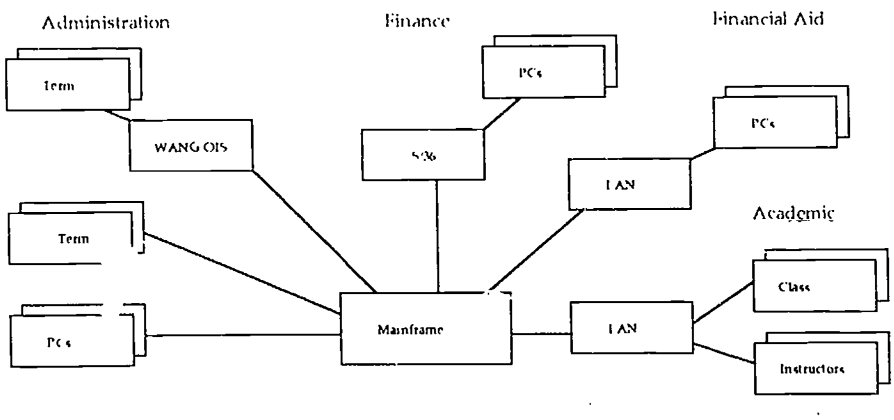

Figure 3: CTC Information Systems Before Update '93

The new Information Network eliminates the hardware variety and network complexity which existed in 1991 and provides simple, direct access to all network services. (See Figure 4.) In summary, the new CTC Information Network provides a solid basis for future growth in the use of the database and in communication across the network. Users are now truly empowered.

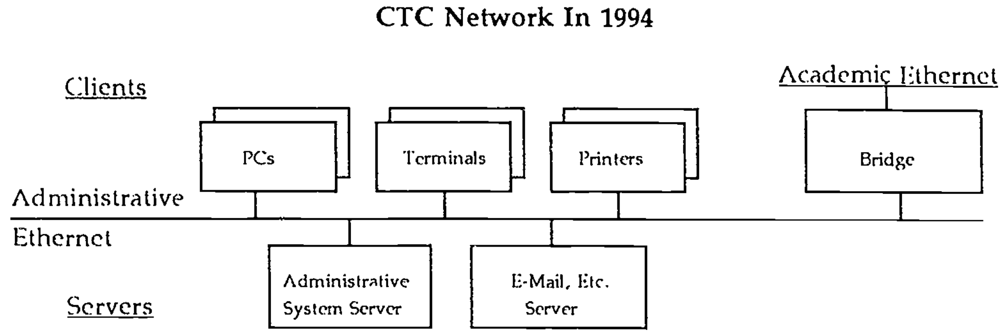

Figure 4. CTC Information Systems After Update '93.

USER-DRIVEN TRAINING -- A STRATEGY FOR SUPPORT

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Spokane
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Abstract

Investment in information technology on the campuses of small colleges and universities has been a high priority in recent years. One important area which seems to get less attention in this rush to attain technological adequacy is the investment in the training and support of our human resources.

At Whitworth College we are implementing a training program based on a strategy for training and support that places the focus of attention on user-identified needs. It is a strategy that identifies the users as the central figures in identifying, defining, and organizing their own training and support needs.

INTRODUCTION

As Whitworth College embarked on a major computer system upgrade which included administrative hardware and software, networking and facilities enhancement, it was clear that the user support services would need to be enhanced. Historically, investment in hardware and software, although not excessive or easily attained, far outweighed our investment in the personnel who would be required to use the equipment and software.

Training and Support...

What Users Need
When They Need It
Where They Want It

As we considered the significant investment that was being made, it was clear that unless commitment was made to training and support, we risked jeopardizing the effective use of upgrades and enhancements. Worse yet, we jeopardized the potential benefits of the new systems.

This program is a response to these concerns. It is based on the desire to gain the most from our investments, and to establish an environment of professional development among our employees with regard to the use of technology.

STATEMENT OF PURPOSE

The training in technology program was designed to establish and nurture an ongoing **atmosphere of training and support** for computer technology on the Whitworth College campus that meets the growing needs of the faculty, staff, and administration of the College. This "atmosphere of training and support" relies on the end user as the central point of focus. The program has created a **USER-DRIVEN** training and support environment that encourages end users to be involved in directing their own professional development. Users play a major role in setting the schedules, identifying topics, establishing training groups, and the identification of training and support needs. The underlying strategy supporting the defined program is dependent upon the continued input from the participating employees.

By asking employees to analyze their own training needs, to consider those who they might be trained with, and to request the style of training they prefer, the resulting training sessions can be both meaningful to the employee and beneficial to the institution. To accomplish this task, a variety of methods and training approaches are required. This program has formalized these ideas which are critical to the success of any training effort implemented at Whitworth.

PROGRAM OBJECTIVES

1. Enhance, encourage, and direct the appropriate use of the College's technological resources through the training and support of our human resources

2. Enhance the skills, knowledge, and technological understanding of campus technology users, enabling them to better accomplish institutional objectives

3. Establish a user-directed system of support and training that provides job related professional development opportunities for the employees

TRAINING STYLES

- **Classroom Training**
- **Workshop Training**
- **Workplace Training**
- **Individualized/Self-Paced Training**

Classroom Training

Classroom training involves the use of formal training sessions which are held in a classroom or lab with both lecture and hands-on training. This traditional format is useful in supplying training for general needs and foundational knowledge. Introductory courses in a variety of topics are well served by this approach.

Classroom training sessions are targeted as one-hour training sessions with 40 to 45 minutes maximum for actual instruction and the remaining time reserved for questions, comments, and discussion.

Workplace Training

Workplace training provides training that is specific to a particular "workplace". The needs of one department are sometimes unique in specific areas of a given application. This type of training takes place in the departments at the actual workplace of the employee(s) receiving the training. By conducting the training in the departments, focus and attention can be given to the specific needs of those being trained. For many employees, this style of training best meets their needs. However, care must be given to protect the training time from potential interruptions common to the workplace.

Workplace training session time schedules are held to one-hour when appropriate. The end-users help to establish the time that is allotted for each specific session.

Workshop Training

Workshop training consists of a concentrated series of training sessions to cover a topic in greater depth. Sessions vary in duration and number of meetings depending on the topic. This type of training may take place outside of normal office hours utilizing evenings and/or weekends. User input is welcomed in helping to identify topics, time schedules, and possible incentive programs and options.

Workshop training sessions may include the use of off-campus personnel and organizations to provide the training. Issues of cost and associated fees necessary to bring in outside services are assessed for each identified need. User input is critical in making this type of training effective.

Individualized/Self-Paced Training
Individualized training allows for employees to receive training either on an individual basis or as self-paced training. Materials used in providing this form of training include internally developed tutorial workbooks, published workbooks, and audio and video training tapes.

The development and/or purchase of the training materials necessary to support this form of training is important to the success of this style of training. The materials must be thorough and generally available for access by employees.

Although the bulk of this training is self-paced or independent study, some individualized one-on-one training is required. A variety of personnel are involved in providing individualized support for other employees, including peer-to-peer training sessions. Much of this type of training is informal and occurs "naturally" within the daily activities of the job. Use of peer-to-peer training helps to support the growing needs in this area. As personnel are trained in areas of need, they are very willing to share this knowledge with others. In this process, employees learn more about both technology and about each other and the jobs they perform.

TRAINING GROUPS

- **General Training Groups**
- **Departmental Training Groups**
- **Positional Training Groups**
- **Specialized Training Groups**

General Training Groups
This group includes any employee of the College interested in the training being offered. Topics offered to this group are general in nature and provide an introduction to software packages and applications. General training groups are limited in size only by the facility limitations or by the instructor's request.

Departmental Training Groups
This group includes employees who work in the same department. Use of this group configuration allows for meaningful dialogue and discussion during the individual training sessions. It provides a natural environment for departmental cross-training as employees participate in training together. Questions asked during a given training

session are of greater interest to the group. The topics covered with this group type vary and include intermediate and advanced application training. Departments may decide to develop multiple training groups within the department to achieve the most effective training possible.

Positional Training Groups
These groups consist of employees of like appointment and position within the College with similar responsibilities and needs. In most cases they do not work in the same department or even in the same division of the College. Groups of support staff employees, faculty members, administrators, department managers, and professional and technical employees are some examples. Training topics for this group are relatively specific to the job performed. Topics are determined by the needs of the group.

Specialized Training Groups
This group may consist of a variety of campus employees and are formed as a result of an identified special need. These needs may include topics such as use of specific hardware and/or software. Topics covered may become fairly advanced in nature and may be very specific to a given discipline or department, or simply of interest and need to a specific group of individuals.

TRAINING TOPICS

- **Introductory and Foundational Topics**
- **Features and Functions Topics**
- **User Job-Related Topics**
- **Brown-Bag Lunch Topics**

Introductory and Foundational Topics
Topics covered under this category include introductory training for a variety of software packages and technological awareness. These topics cover the basic operations of a given package and provide the user with the skills necessary to operate the software at an elementary level. Other non-application specific topics include file management and data organization, basic hardware maintenance and problem resolution, printer operations, and others.

User Job-Related Topics
As discussed previously, the end users play a major role in directing the training and support services offered. A significant component of the user's role is in providing feedback and suggesting topics for training sessions. In identifying training topics, users are encouraged to provide suggestions based on their job-related needs. Specific functions from a variety of applications may be necessary. No topic is considered to be too minor, too specific, or too elementary.

This approach to topic selection is designed to accomplish at least three significant objectives; 1) Users will be participating in training that addresses their specific needs, 2) users will become more conscious of their training needs and the definition of those needs, and 3) users will be more likely to experiment and try new functions if they know they can request training.

Features and Functions Topics
Topics from this category include specific functions of various software packages that are beyond the introductory level of operation. These topics are offered on an as requested basis and are open to general, departmental, and positional training groups. Some topics require a sequence of sessions in order to achieve the training objectives. Employees are encouraged to participate in appropriate levels of training based on their experience, expertise, and needs.

Features and functions topics are offered in classroom, workplace, and workshop styles of training. The specific style is dependent upon the specific topic(s) to be covered, and the desires of the group and the instructor.

Brown-Bag Lunch Topics
On a regularly scheduled basis, "brown-bag" lunch sessions are held to discuss a variety of technologically related topics. Topics to be discussed are determined through user input and suggestions as well as topics selected by training staff. Computer services staff members coordinate the lunches and provide input (along with attending users) into the topic of choice. Topics range from specific problems with hardware and/or software to issues of policy.

Lunch sessions provide ideas for formal training sessions that are developed and scheduled for training. These sessions provide a consistent resource of meaningful training topics and serve as a mechanism for end user feed back, comments and suggestions.

TRAINING FACILITIES

- **Training Center**
- **Campus Classrooms & Conference Rooms**
- **Computer Labs**
- **Office Work Areas**

Training Center
The training center is located in the computer services area of the library. The facility is utilized for a variety of training sessions and is equipped with 6 networked computers. Formal training sessions with a maximum of 12 participants may be conducted in the center. In addition to formal training sessions, the training center is used for individualized or self-paced training. Users may schedule the training center for a

variety of training sessions. Scheduling of the center is managed by the User Support Specialist.

Computer Labs
Both the Macintosh and the PC computer labs located in the library are available for training sessions. Due to the heavy use of the labs by students and for classes, scheduling is coordinated with academic computing. Training of larger groups (10 or more) may be conducted in the labs when appropriate. The labs can be used for a variety of training topics and styles and offer an ideal environment for training that requires hands-on access.

Campus Classrooms & Conference Rooms
In certain cases, training does not require hands-on experience. At such times, training may take place in lecture classrooms and/or conference rooms throughout the campus.

Office Work Areas
In addition to the use of the formal training facilities, the use of office work areas is also beneficial. Depending upon the style of training taking place, it is often useful to utilize the specific work area of the individual or group receiving the training. This has proven to be especially useful in the training of employees in the use of network printers located in their individual buildings.

TRAINING PERSONNEL

- **User Support Specialist**
- **Department Personnel**
- **Computer Services Personnel**
- **Applications Specialists**

User Support Specialist
The User Support Specialist position supports the ongoing user training and support efforts of the College. It is clear that the potential benefit of the new technologies being implemented throughout the College can only be reached if we provide ongoing training and support for the end-users.

The User Support Specialist is responsible for the coordination of user support services and training programs. This includes the scheduling of training sessions, conducting needs assessment surveys, development and purchase of training materials, and conducting training sessions.

Although conducting training sessions is a significant part of this position's responsibilities, a wide variety of training resource personnel are necessary to provide the desired level of support. The User Support Specialist coordinates the use of faculty and staff instructors to meet the training needs of the campus.

Computer Services Personnel

The members of the computer services organization of the College participate in conducting training sessions in a variety of software and hardware applications. The expertise of the department members is used to provide training and support to the campus users.

Department Personnel

There are a number of employees who have the expertise, skills, and ability to teach a variety of topics. We encourage these individuals to participate in the training program as instructors or tutors. Some train others in their departments, while some become involved in campus-wide training sessions. It is certain that the success of the training and support program relies on the expertise of experienced employees who are willing to share heavily in the training of others.

This program provides the opportunity for employees to support the efforts of their fellow department members and co-workers campus wide. These opportunities provide unique experiences for employees outside of their normal work responsibilities and duties, enhancing their understanding of the needs and responsibilities of others. A resource survey form is used to identify employees interested in training others.

Application Specialists

In certain situations, it may be beneficial to enlist the services of a software application specialist to conduct training sessions on campus. A number of organizations, vendors, and consultants offer this type of on-site training in a variety of applications.

TRAINING MATERIALS LIBRARY

We are in the process of establishing a training and support library that will be available to the employees. When completed, this library will include a variety of self-paced and individualized training materials. Users will be able to use the materials on campus and at home for the purpose of software training.

Training materials will be available in the training center and through the Audio Visual department. These materials will include video training tapes, audio training tapes, reference manuals, self-paced work books, quick reference guides, and other resources.

PROCEDURES FOR REQUESTING TRAINING

Application of the USER-DRIVEN training and support environment relies heavily upon input from the end users. This input is collected in a variety of ways. Use of user surveys, questionnaires, training request forms, and open comments and suggestions are vital to the success of the program. All information and requests are processed by the User Support Specialist who directs the implementation of the requested training.

The users are asked to complete a Training Request Form that details the desired training topic, the preferred training style, a suggested time schedule and date, and the training group that will participate in the training. In addition, the requestor s supervisor is asked to approve or validate the user's request before it is submitted. Each training topic is submitted on an individual request form. Users are encouraged to submit as many requests as are necessary to meet their training needs. The only limits are those created by scheduling conflicts and the time allotted within departments for training.

The purpose for gaining a supervisor's approval is to ensure that the training being conducted is appropriate for the specific job responsibilities of the employee making the request. Our intent is to provide the necessary training and support to meet the institutional needs of our users.

Once a user has completed a Training Request Form, it is submitted to the User Support Specialist for scheduling. Verification of the scheduled time and date of the training are sent to the requesting party and members of the specified training group (if applicable). In some cases, announcement of the scheduled training is made to the general campus.

Every effort is made to meet all of the approved training requests. Scheduling conflicts do arise and are resolved based on our desire and ability to maximize our training efforts.

PROGRAM EVALUATION AND REVISION

Every training session is evaluated by the users. They are asked to provide input on the usefulness of the information covered and to provide suggestions for further study and training. This evaluation is intended to provide immediate feedback to the instructor and direction for future training. The evaluation form is quite simple and requires very little time to complete.

In addition to the written evaluation, conversations with participating employees as to the value of the training programs offered has proven to be very beneficial. Taking the time to talk with the users regarding their training needs and experiences is time well spent. These conversations can take place over lunch, in passing conversations, or through electronic communications.

THEORY INTO PRACTICE

Planning and design for this program began in February, 1993. Due to fiscal timing, the User Support Specialist was not hired until August, 1993. Formal implementation of the program was initiated at the beginning of the Fall 1993 term.

Presentations of the training strategy and program operation were made to three major personnel groups on campus; support staff, professional staff, and the faculty. Introduction of the User Support Specialist and the proposed operational procedures were made during these presentations. The concept of the program was well received by the entire campus and some began making their requests immediately.

However, we soon realized that some of our assumptions were a bit optimistic. A number of employees had difficulty defining their training needs, particularly when attempting to identify specific needs. They recognized their need for training but found it difficult to accurately define those needs. There are probably several reasons for this but two seemed to be quite clear.

First, many users simply were unable to identify specific training needs related to specific software. They recognized the need for training in a given area, but were uncomfortable with the terminology. Therefore, they were not sure how to define their requests. As a result, we began to encourage users to define their needs in terms of what they did at their job. We encouraged them to describe their needs in non-technical terms by simply describing their daily tasks. Then we would work with them to match the activities of the job with appropriate training in specific software packages. Using this approach, users can more easily define "what they do", and get support in defining how technology can play a role in supporting their needs.

A second reason seems to be more historical in nature. With a history of not providing adequate training for our users, it is taking them some time to get accustomed to the idea that they can request training as needed. The idea of taking an active role in the directing of their own training required some adjustment. We continue to educate our users as to the purpose and operation of the program emphasizing the important role they play in the success of this program.

As is the case with most strategies and/or theories, they are much easier to develop than they are to implement. We continue to learn from the implementation process and use this experience and knowledge to review and modify the program. As we review and revise our program, the strategy of a "user-driven" training and support environment has been maintained. The users remain at the center of the program and continue to guide our efforts of training in technology.

The End-user's Desktop: New Center of the Computing Universe

CAUSE93

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I. Introduction

Our current approach to end-user support is directed at achieving computer literacy. For the most part we provide our administrators, faculty and students with classroom training in the use of desktop applications running on their personal computer (PC). Little effort is expended on assisting the end-user integrate the PC, the network and the task at hand, whether that be managing a department, recording student grades or researching and writing a paper. As a result, many—and some would argue most—of our PCs are serving as typewriter replacements.

Needless to say, with our PCs serving as typewriter replacements, little of the reduced costs and increased organizational effectiveness expected by many from desktop computing is being realized. Indeed, it could be argued that since we tolerate non-use and our organizations incur the cost of duplicate administrative and communication systems, PCs have contributed to increasing costs rather than reducing costs. For example, we do not require all faculty, staff and students to use electronic mail and we do not require all administrators to use only electronic transactions to submit, say, a purchasing requisition.[1] There is always the option to use a paper form, fax, paper memo, messenger or telephone.

This is rapidly changing. The option to use, or not use, the desktop computer will soon disappear. The end-user's personal computer will soon cease being a typewriter replacement and will become the end-user's only window to the university's administrative applications, electronic mail, analysis tools, information servers and collaborative work. Empowered users will accomplish all work and most communication and information exchange through their networked personal computers. The end-user's desktop will be the new center of the computing universe.[2] Soon, our administrators, faculty, staff and students who do not understand and use their networked desktop computer in accomplishing their university role will become isolated, separated from the administrative and educational mainstream.

Our end-users, our organizations and our technological infrastructures are not ready for this rapidly approaching computer-mediated future. Our users are struggling to master the computers already on their desks. Our support organizations are struggling to train these end-users.[3]

This paper addresses the importance of the end-user's desktop by:

- looking at the university administrator's work environment and how it is changing
- reviewing various user-support and training models
- expanding the definition of end-user to include faculty and students as well as administrators
- reviewing user-services experiences at The University of Chicago
- proposing possible user-services models and organizations

This is a complex subject involving cultural, sociological, organizational and technological issues. A short paper such as this can only explore one or two thoughts in any depth. There is some interesting work being done in the private sector on this theme. Hopefully, others will take these ideas and use them to help us better understand how to build, support and utilize the human and technological infrastructures in our universities.

II. Administrators and Their Work

Outside of our central organizations and the larger academic units, our administrators are "Lone Rangers,"—one person tending to most administrative matters such as purchasing, personnel administration, budget management and report preparation. We have observed that these administrators are generally interrupt driven in that they must deal with the current demand or crisis crossing their desk.[4] The administrators are isolated in that they are the only person in their unit with such responsibilities.[5] Since these administrators report up through their organization, there is little reason to talk to peers in other units—so cross training is limited. We have also observed that these administrators have no forums in which to share common problems and have no champions to advance their agenda.

The administrative work environment has been relatively stable for many years. With the introduction of PCs and networks, the technological knowledge and skill required to perform as an administrator have increased—but individual administrators have not yet fully incorporated networked PCs into their daily work. Since our administrative systems are paper- or mainframe-based, there is limited organizational or peer pressure to master networked desktop computing. In addition, the required network and PC resources are not in place and the required organizational support and direction is not available.

In our work with campus organizations, we have loosely identified three general categories of PC user: the early adapters, the laggards who will never be able to, or will not, adapt and the remaining 'adapt as required' majority.[6] This majority will use technology if they can see that it adds value, if they are trained and if there is an organizational expectation for its use.[7] The early adapters, on the other hand, are the ones who love technology for its own sake. Given the rapid change we will be experiencing, a challenge facing user-services is to adequately train the 'adapt as required' majority and to somehow leverage the talent, enthusiasm and knowledge of the early adapters. More on this later.

III. Rapid Change

The administrator's world is rapidly changing. Figure 1 presents a model of the administrator's environment today while Figure 2 gives a comparable view of tomorrow's environment.

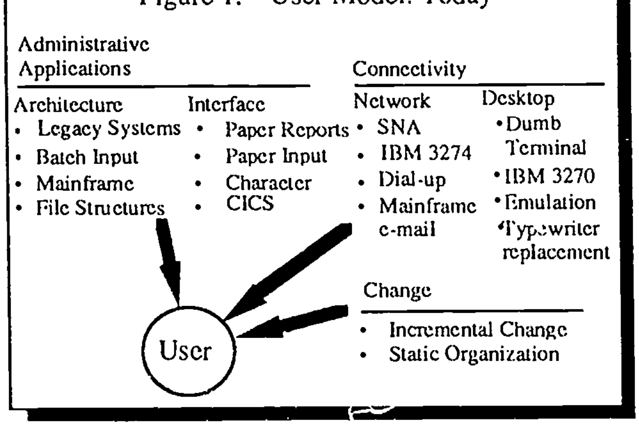

Figure 1. User Model: Today

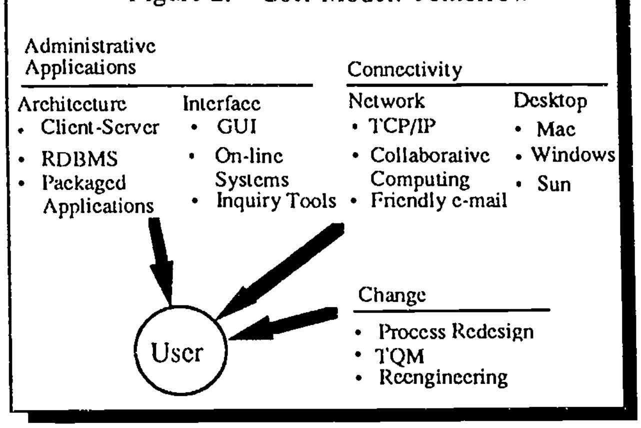

Figure 2. User Model: Tomorrow

Many of the change elements in the 'tomorrow model' are already here. To me, these change models support the idea that, like it or not, we are moving toward an electronic community where we will work, communicate, teach and learn through our desktop. Our organization's effectiveness will depend upon successful interaction through the desktop. Today the desktop is inconsequential. In the rapidly approaching future, the end-user's desktop is critical.

IV. Disappearing Applications and New Organizational Structures

An interesting phenomenon is taking place. Our central applications are losing their identity to the end-users. Today, with our mainframe-based legacy systems, we log into, say, the purchasing system to initiate a purchasing transaction. Likewise, we take specific steps to log into a different system to inquire about a personnel matter.

With the current commercial client-server applications available for the higher education market—which are based upon integrated relational database management systems—end-users log in through the network and select the transactions they need and are authorized to use. The movement between the various traditional systems, such as the accounting, personnel and student systems, is seamless. To the end-user (in this example a departmental administrator) there is one administrative system. The accounting, personnel or other central office that today 'owns' the application and data and processes the paper transactions may, over time, become blurred into one central support office in the minds of the end-users.[8]

Needless to say, the disappearing applications phenomenon has some important implications for user-services, which will be discussed below.

V. What Skills are Required?

How do we prepare our end-users for the electronic organization of the future? Will our current employees make the transition? Do we wait, as one of our administrators suggested, to introduce new computer-based systems until all the people who do not use computers have retired? How can we train the thousands of future system users?

What is required can be better understood if we consider the technical skills used by administrators over the years to record basic business transactions. As indicated in Figure 3, we started off centuries ago with pen and ink and then moved to typewriters early in this century. In this simplified history, we moved to mechanical punched card systems in the 1940s, to electro-mechanical ledger card systems in the 1950s and to mainframe based systems in the 1960s and 70s. Each of these changes required retraining and resulted in new organizational structures to take advantage of the new technologies.

For example, most of the initial mainframe applications concentrated on eliminating manual clerical operations with a resulting organizational structure that concentrated data-entry personnel into relatively low-skilled units.[9]

PCs were introduced in the early 1980s; however, they had little impact on the typical organization because they were not networked, they were used to emulate dumb terminals, the users were not trained and the PC was not integrated into daily business activities.[10] Later in the 1980s, networked personal computers were introduced. Application systems designed to take advantage of networked desktop computing power are being developed and installed in some organizations. Figure 3 suggests that the administrators need to master a well-defined, achievable set of skills to work successfully with networked PCs.

This analysis implies that if we can bring our employees up to a knowledge and skill level adequate to work in the existing networked PC environment and ensure that this skill and knowledge level is maintained, then our end-users will be prepared to successfully handle the additional technical and non-technical skills required as new organizations, redesigned procedures and new systems are introduced. In other words, if we are to successfully change our organization to take advantage of the enabling power of the new networked PC-based technological infrastructure, we must develop our human infrastructure.

Year Introduced	Technology	Representative Required Administrator Skills	Remarks
Centuries ago	Pen & ink	General penmanship	
1900s	Typewriter	Typing	
1940s	Punched cards	Typing	New low-skill backroom activity evolves
1950s	Ledger card machines	Typing	Some ledger card activity moves from backroom to administrative offices
1960s	Mainframe computers	Typing, Some data entry and inquiry through dumb terminals	New organizations created: data entry, programming, computer operations
1980s	Personal computers	Typing, word processing, spreadsheets, Some data entry and inquiry through dumb terminal emulation	PC used as a personal tool.
Late 1980s	Networked personal computers	Word-processing, spreadsheets, on-line transaction submission, inquiry, reporting, e-mail, network navigation, collaborative work	Changing organizations. New communications structures.

Figure 3. Representative Required Administrative Skills

Once our end-users are functioning adequately in the networked PC environment, what additional technologies will they be required to master? Keeping in mind that predictions are difficult, especially about the future, I suggest that possibilities include multimedia, personal digital assistants and virtual reality. Multimedia and digital assistants can be considered an outgrowth of PCs and adequately qualified PC users should be able to master either or both as the need arises. Virtual reality will probably remain in the entertainment realm for the next few years. Anyway, most of our administrators have sufficient real reality to be bothered with the virtual kind.

VI. Who are the End-Users?

At The University of Chicago I would estimate that there are from 700 to 900 or so users of our corporate administrative systems—with a user defined as one who prepares transactions for submission or has on-line access to the corporate systems for transaction entry or inquiry. There are, of course, many more account managers, researchers, faculty and others who have account management or other responsibilities and receive periodic paper reports but have no direct interface with the systems themselves since this is typically handled by the departmental or other administrator as described above under "Administrators and Their Work."

This is rapidly changing. With the new administrative systems we will eventually purchase or possibly build and the administrative procedures and processes we will reengineer:

- account managers will have on-line access to their accounts and can initiate transactions directly
- researchers will have direct access to information on their sponsored research accounts and can, if they wish, initiate transactions

- faculty will have on-line access to appropriate class and student records as well as access to their accounts and the ability to initiate transactions
- employees will have some type of direct access to their own personnel records
- students will have on-line access to their own academic and financial records and will be able to update, on-line, certain information such as their various addresses

Eventually, virtually every employee and student will have some type of access to our corporate administrative systems or to portions of the data. As these new users are given access we will move from hundreds of users to thousands. For The University of Chicago, with 11,000 or so students and approximately 10,000 employees, there is a potential of having up to 21,000 end-users.

VII. Required End-user Desktop Resources

If we consider the networked PCs in place today, we will find that e-mail, remote information access and desktop PC applications are a common denominator among most end-users. What today seems to set faculty, staff and students apart as far as PC usage is concerned is that some administrators have access to corporate administrative systems or other function specific systems, some faculty use computers in the classroom and in their research and students are special because they are students.

If we set aside sociological issues (such as faculty generally not wanting to attend classroom training and staff being reluctant to sit in a classroom with sharp, eager students), I believe that this division of faculty, researchers, staff and students, however defined, into separate groups for PC support is inappropriate. A different model, especially if we accept that over time virtually everyone will have access to and will use the corporate administrative systems, is to consider that all faculty, researchers, staff and students have a common core of PC resources that they must know and use to be productive members of the University community. This core includes access to a networked PC, access to a basic set of desktop applications, access to electronic-mail, access to various networked information sources and services, and appropriate access to the corporate administrative systems. Implied is the required knowledge and skill to adequately utilize these core resources, the organizational and peer expectations that the core resources will be used by everyone and an organizational commitment that the core resources will be made available.

In addition to the core resources there exist at least two special areas of PC usage: computers in the classroom and computers used in research. It seems that support for classroom and research related computer usage are special areas that will be best addressed on an as requested basis. This does not preclude having information technology specialists proselytizing the use of computers in the classroom; however, computers will be widely used in the classroom only when the push comes from the faculty themselves. That push will grow very rapidly once a critical mass of computing skill and knowledge is in place—when all faculty and students are actively using the core PC resources.

VIII. End-user Support Requirements

This paper, so far, has proposed that in our rapidly changing environment:

- We have thousands of end-users that must become proficient in a reasonably well-defined set of core resources
- All faculty, staff and students will work with about the same set of core resources

- Once the core resources are mastered, the end-users are prepared to cope with the evolving networked PC-based technological infrastructure until some new future breakthrough occurs

Bringing thousands of users up to an acceptable level of proficiency with the core resources and maintaining that proficiency is, needless to say, a challenge and requires a bold new approach. I propose that we look beyond the technology and recognize that we are really introducing organizational and cultural change—and then proceed appropriately.

At The University of Chicago we have been very successful in moving entire groups into new technological environments. Examples include our President's Office[7] and the Publications, International Affairs, College Admissions and Special Events Offices. Our methodology puts great emphasis on individual, one-on-one coaching, relating the technology to the individual's work and establishing group expectations for system use. Traditional classroom training, when used in these change efforts, has been less successful than we would have liked.

We have not been very successful in assisting isolated individuals to adapt to new technologies, especially administrators in remote academic departments. For example, we have installed e-mail and other network-based applications for such academic departmental administrators and they aren't used. We believe that the administrator's isolation, the difficulty in setting expectations for use and the lack of a critical mass of PC-based functionality havee contributed to this lack of success.

The installation of electronic mail is a good example of our group approach. We always recommend a micro-based e-mail package. (QuickMail—but other similar products would work as well.) Micro-based e-mail is feature-rich, easy to use and is locally maintained on the front end within the group. Generally, everyone gets their e-mail connection and personal training in its use at the same time, which helps to set group expectations for use. We have installed QuickMail for hundreds of users and have always been successful—where success is defined as everyone in a group using e-mail on an on-going basis.

We have not yet had an entire client group begin to use e-mail where pop-mail, mainframe-based e-mail or other non-micro-based e-mail was used. We believe the individual focus of these e-mail applications, when compared with micro-based e-mail, has contributed to this lack of success.

Our directions and experiences have been substantiated by the literature, including:

- Local, focused, just-in-time assistance is the most effective end-user support. The support person must provide business-related, context-sensitive coaching and training[11]
- Most learning takes place on-the-job, classroom training is typically not effective[12]
- We must change our organizational structures to accommodate and exploit what is valuable in information technology if we are to bring about the information technology revolution[13]

IX. One User-support Model

One approach to providing the required desktop PC support to end-users is to recognize that there are two very different tasks to be accomplished:

I. Bringing end-users up to an acceptable level of proficiency with the core resources

II. Providing on-going support to end-users to maintain and increase proficiency

Task I is best accomplished in natural groups—such as all faculty and staff in a department or all staff in an administrative unit. Bringing together selected administrators from many different academic departments, providing training to one person from a unit and similar splintered approaches will not be successful due partially to the absence of the group expectations and mutual support which exists when groups are "converted." If possible, the intervention to introduce new technology to a group should be timed to coincide with the group's connection to the network or other significant event.

Our experience indicates that the requirement for support when using the proposed Task I approach drops off rapidly after a short period of intense personal support.

The long-term Task II support can be provided several different ways. We provide a range of support, depending upon the requirements and resources of the unit. For example, we provide on-call support for individuals and small units while larger units have resident experts whom we have trained to provide front-line, just-in-time support, with our organization providing backup. We do have a problem that needs to be addressed: the contribution by our resident experts, who tend to be regular staff with job pressures like everyone else, are not officially recognized in their job descriptions or by the University—and occasionally not by their bosses.

Staffing for end-user support organizations must have an information technology background, understand the university's business processes, know the organization and have excellent people skills. According to the literature, most traditional classroom training and hot-line support personnel lack the educational and business experience to be successful in this newly-defined user-support role.[14]

X. Summary

After years of spending $millions on PCs and related technology with no pay back, we are poised for a breakthrough. This breakthrough will be driven by our institutions achieving a critical mass of networked PCs and the implementation of new processes and organizations to take advantage of the potential these new technological and strengthened human infrastructures provide. The technical infrastructure to achieve this breakthrough is, for the most part, available and could be purchased today, given sufficient funding. The human infrastructure required to achieve this breakthrough is a different matter. For years we have dropped PCs on end-users desks and assumed that somehow they would learn to use them. For years we have treated the introduction of PCs, networks and related technology as if it were another office tool, like a typewriter. For years we have skimped on training and support, forcing our end-users to learn from one-another and support themselves. For years we have tolerated non-use of technology. As a result, our end-users and our organizations are not prepared for the future. Many are struggling to get by with today's technological demands.

The challenge to our universities is not technological. It is a human challenge. We must take bold steps to prepare the entire organization for the future. An initial step is to focus on building the human infrastructure. A first step in building this human infrastructure is proposed by this paper: do whatever is necessary to bring the end-users up to an acceptable level of proficiency with the core resources. And since we are really dealing with organizational change and the setting of organizational expectations, we need to approach this initial task by "converting" groups rather than individuals.

Ongoing support is also very important. If we are successful in getting the core resources into use by all end-users, we will create a tremendous demand for help in mastering new tools and doing new things in addition to assistance in solving routine problems.

The possibilities are exciting. If we are successful in getting an entire university to use at least the core resources, we will build a synergy that has never existed before. Imagine the faculty, students, and staff linked together electronically, supported by new administrative and other support organizations. This will lead, over time, to new approaches in education, research and administration with tremendous benefits to us all.

Notes:

1 Many of our electronic transaction systems are actually mainframe-based legacy systems with the desktop computer substituting for a 'dumb terminal'. For this paper such systems are considered in the same light as the typewriter. They have served their organizations well and will continue to do what they were designed to do; however, such systems are not part of the end-user desktop environment this paper is addressing.

2 The phrase "...new center of the computing universe." first appeared in John P. Halloran's and Brian S. Pappas's article titled "Micro Management" in the April 15, 1993 issue of *CIO* magazine. Halloran and Pappas are affiliated with Nolan Norton & Co.

3 A major theme of discussions in the User Services Special Interest Group meeting at CAUSE93 was that our user services organizations are underfunded, understaffed and that our organizations do not understand the importance of end-user support.

4 This discussion focuses on the 'business' administrator. In academic units there is usually a 'student affairs' administrator who faces similar isolation issues.

5 For a discussion of administrative organizational issues see Therese Nelson and James Porter's article, "Desktop Computing Power: Issues and Opportunities" in the Summer 1991 issue of *CAUSE/EFFECT*.

6 Halloran and Pappas, in the article mentioned above in Note 2, suggest that the early adapter category is 20%. Chris Pickering, in his December 1992 article in *CIO* magazine, "Preparedness Training," suggests that laggards make up 16% of our employees.

7 In "Introducing Technology to Senior Executives: Theory and Practice—a Case Study" (*CAUSE92 Proceedings*) James H. Porter suggested that desktop computers will be used by executives and other senior managers when the applications are easy to use, are meaningful to the executive, and a "critical mass" of functionality is available such that the executive turns on the computer first thing in the morning and uses it throughout the day.

8 If our end-users are empowered through on-line, integrated systems into which have been embedded the university's policies, processing rules, edit and audit rules and legal requirements, will this result in major changes to the traditional roles and organization of our central administration? Do our administrative processes have to be supported by systems broken into the traditional financial, student, human resources and fund-raising modules?

9 This reduction of clerical personnel was offset by the new data-entry, computer operations and computer programming organizations. The apparent savings in clerical costs were used by our systems organizations to justify new and improved systems. Unfortunately, using computers to reduce clerical costs is still expected by many of us while the major benefits from computing are in improving organizational effectiveness and enabling new organizational structures.

10 The typical PC in our organization is used for word-processing and spreadsheet applications. Some use the PC to access information on our legacy systems over the telephone lines or via the campus network. A growing number use electronic-mail as their primary communications medium. However, none of these activities are yet fully integrated into the way an administrator works.

11 John Halloran & Brian Pappas in the article referenced in Note 2 above. Also, "Wanted, MBAs for the Help Desk" in *Information Week*, October 18, 1993.

12 Kavin Moody of the Bank of Boston in *I/S Analyzer*, September, 1992

13 From *What Presidents Need to Know* published by CAUSE, 1993

14 Naomi Kartin in "Mind Your Own Business" published in *Strategies for End-user Computing*: QED Information Sciences, Wellesly, MA, 1990

Architecture and re-engineering: Partnership for change at the University of Pennsylvania

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Abstract. The University of Pennsylvania is one of the first universities to link the re-engineering of business processes and the development of an architectural foundation for information and systems. The presentation explores that linkage, focusing on planning for flexibility in a fast-moving world, aligning information technology with business goals, and negotiating consensus in a radically decentralized institution such as Penn.

The presentation draws on lessons learned in a multi-year effort by Penn's Division of Finance and Office of Information Systems and Computing. The two partners are leading an effort to make Penn's business processes faster, less expensive, and more flexible; develop an information technology architecture of principles, models, and standards; and acquire a new generation of business systems, beginning with a new financial system.

Architecture and re-engineering: Partnership for change at the University of Pennsylvania

Penn believes that finding new ways to manage the institution is critical to the success of the academic mission. With costs growing faster than revenues, demographics shifting, and Federal grants in shorter supply, the belt has to be tightened *somewhere.* The University of Pennsylvania is committed to cutting costs and boosting quality on the administrative side in order to redirect funds to research and instruction. We've started an approach we call "Project Cornerstone." It brings together three related efforts—Total Quality Management, business process re-engineering, and information re-engineering.

The partnership. A many threaded partnership is at work. The organizational partnership links Penn's Division of Finance and the Office of Information Systems and Computing. Their methodologies are also linked. The Division of Finance is redesigning broadly conceived business processes to make them faster, less expensive, and more flexible. Information Systems and Computing is developing the principles, architectures, and standards for a new generation of systems that will support the new processes. James Martin and Company serve as consultants.

Progress to date. Penn has finished its first re-engineering effort in procurement and disbursement and its second in compensation. We have "completed" the principles and architectures, recognizing that they are living, ongoing efforts. We are deep into negotiation with vendors to provide an integrated set of business systems that will support the new ways of doing business. The first system will be financial and the first application will be procurement/ disbursement.

In this paper. This paper focuses on business re-engineering at Penn and on Penn's information technology principles and architectures. The paper pursues three themes—aligning information technology to the business, planning for flexibility, and negotiating consensus. (Penn is radically decentralized; we have twelve schools with substantial independence. Consensus is part of our organizational culture.) We offer you our experiences and the lessons we've learned.

The machinery

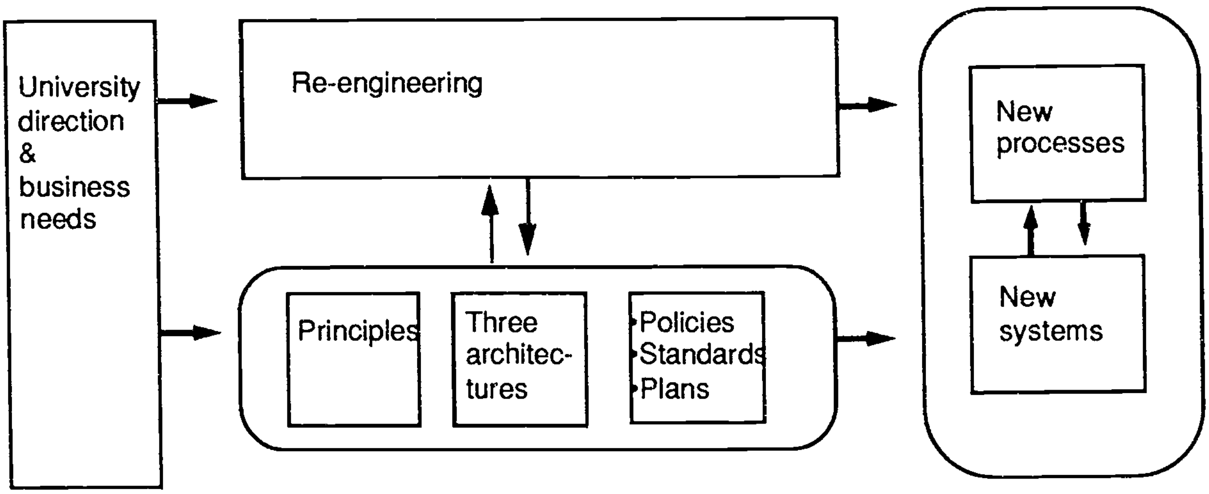
Business re-engineering. *Business process re-engineering* is the fundamental, start-from-scratch, redesign of business activities. Processes are conceived broadly, across organizational boundaries. They start with a customer and are not complete until that customer is satisfied.

Total Quality Management. *Total Quality Management* is a more incremental approach to continuous improvement, also focused directly on the customer.

Information engineering. *Information engineering* is a set of tools and techniques to create a common basis of decision-making for business people and information technologists. Information engineering is based on principles, or basic beliefs about how the institution uses information technology, and on architectures, or frameworks for that technology. There are three of these architectures—information, business systems, and technical infrastructure. On that foundation are built policies, standards, plans, and, finally, systems that work together and share data.

Technology in supporting role. Information technology is seen as a facilitator, an enabler, of the improvements identified in business re-engineering. Technology cannot substitute for organizational and cultural change. It can, however, create an infrastructure for data sharing, flexibility, and ongoing measurement of quality. A new mix of technologies and techniques are required. If we want business processes that are flexible and responsive, our technology processes must be equally flexible and responsive. We will have to meet the challenge of constant change as we develop and maintain the new systems.

The chart shows the interdependencies that are the focus of this paper. It shows the driving force of University direction and business needs and the intimate linking of business process re-engineering and information engineering. The goal is new ways of working, supported by new information systems.



Business re-engineering

Re-engineering isn't warm, friendly TQM. How do you get people to play when the stakes are so high?

How high ARE the stakes? Many groups at Penn have launched Total Quality Management projects to improve specific problems. Project Cornerstone has depended heavily on the TQM teams' analysis of existing processes and has benefited from the discipline and cohesiveness that TQM teams bring to an institution.

Re-engineering, however, is a very different approach. You try to rethink the process, the business, from scratch. You have to nurture absolutely outrageous ideas and make people comfortable exploring the unexplored. For real improvements, you have to tackle processes that are broad enough to have significant impact, which means crossing organizational boundaries. Crossing these boundaries is *very* threatening. You have to negotiate ownership and new roles.

Re-engineering requires much more than changing the flow of work. To change a process successfully you also have to change people's jobs, skills, rewards, tools, organizational structures, and to some extent, their values and beliefs.

Watching ourselves change. The rest of the campus was grateful at first "it's not me." The rest of the Executive Vice President's organizations were glad they weren't the first to try re-engineering, and the schools were convinced it was the central organization that needed to change. In the Division of Finance, we were not happy to be the first in the barrel. We knew, however, that if we didn't take control of our future, someone would do it for us.

The core team had to push itself and others to define the first process broadly enough. We were accustomed to thinking of two central offices, "Purchasing" and "Accounts Payable," when, in fact, the procurement/disbursement process occurs across the entire campus, in schools, departments, and other offices.

We had to blow the roof off our own expectations. Our first estimates were nowhere near the 40% staff reductions and 25% budget cuts we now believe can be achieved in procurement/ disbursement.

Most striking, the Division of Finance has a new conception of its place at Penn. We eventually found ourselves willing to say, "Look, our finance function happens every day out in the schools and centers. And, frankly, our notion of being in the compliance business, double and triple checking, doesn't add a lot of value." We've designed a "paperless" procurement/ disbursement process that lets the people in the local units buy things, receipt the goods, and release payment. The central organization can now focus on identifying the best vendors and negotiating the best prices.

The energizing force. As we changed organizationally, we saw ourselves changing personally. We believe, in fact, that this is the energizing force that gets people excited about re-engineering. We saw changes in our management styles, our focus, and our personal interactions with each other and with our customers. The energy comes also from marshalling forces. We began pulling together alliances of people who like a challenge and have the nerve to do something about it. We sought out people who can deal with uncertainly, as we experimented our way through a methodology new to us—to a result none of us could predict. We also needed people who were willing to take hits from the Penn community, who let us know in no uncertain terms when we were not communicating clearly or inclusively enough.

We tried hard to eliminate the fear of failure within the core teams. We tried to recognize movement toward our goal, not just achievement of the goal. We believe we built trust, respect, and commitment. Penn operates slowly, by consensus—but within the core teams we succeeded in agreeing to disagree. The nature of re-engineering—nurturing the outrageous in search of new ways of doing things—runs counter, in fact, to a culture of consensus. An outside facilitator was key to making all this happen. He encouraged us, kept us on track, and kept pushing us past our own assumptions about the way things have to be done.

Getting it done. We constantly walked the line between Penn's consensus style of drawing others in, inviting them to join teams, paying courtesy calls—and just moving forward with what we knew we had to do. We targeted key people and systematically argued the case that they were part of a broader business process than they were accustomed to considering themselves part of. We demonstrated the links with the process diagrams from the architecture effort. The diagrams are a two-edged sword. On the one hand, they depersonalize the business process, so you can talk about it without getting immediately into questions of turf. On the other hand, they are *so* impersonal that you have to reanimate the process, give it a human face.

We insisted on having fun. One of us had second thoughts, though, when we told a large and very solemn group that we didn't need a new payroll/benefits system; we could all be bar-coded and pass by proximity readers in the morning—and no one laughed.

Information technology principles

I'm delighted when people throw the principles in my face.

What do the principles do? The quote is from co-author Robin Beck, wearing her Director of Applications Development hat. She finds, to her uncomfortable pleasure, that people throw the principles at her when they want something done or want it done differently. The principles have become a rallying cry in some quarters at Penn.

The principles state Penn's beliefs about using information technology to solve business problems. We came up with twenty-six principles, in five categories: data, applications, infrastructure, organization, and an overarching general category. Here's an example of a general principle (see appendix for the entire set):

> **Cost effectiveness.** *Information technology must be cost effective from the perspective of the University as a whole.*

For each principle, a rationale is stated and specific implications listed. One implication of this principle is that you have to take the entire life cycle into account, not just the cost of buying the technology in the first place.

The principles are a link, a bridge, between the business people and the technologists. They attempt to make assumptions explicit, which helps both sides identify points of conflict and perhaps start resolving them. The principles are the foundation on which the architectures, policies, standards, plans, and systems are built. They're a stable base that lets those other components be as flexible as they need to be.

Finding the sweet spot on the bat. The principles were the first component of information engineering to which the larger Penn community was exposed. We encountered a great deal of thrashing and negotiating of expectations as we unveiled the draft set of principles and began seeking feedback and ratification. We had to keep telling people what the principles *aren't.* They aren't standards, aren't policies, aren't plans. Until people saw real evidence that these additional components would fall into place, they told us the principles were "not useful." We also had to keep reminding people that the principles are meant to be used in combinations, not separately. People would focus on an individual principle and tell us it's "not useful." The organization principles turned out to be the hardest. They were the hardest for us to develop and they stirred up the most passionate critique in the community. We believe we were running into the fact that organization is far more complex than technology.

When is enough enough? A piece of advice: Don't set yourself up. Don't let substantial discussion with a variety of groups count for nothing because in the end not everyone ratifies every principle. You have to be inclusive. You have to seek both formal and informal feedback. You have to really listen. That's your part of the bargain. But the feedback process itself won't come to a logical end. At some point the sponsor has to step in and say, "Thank you, that's enough."

Language. Another piece of advice: Avoid high-sounding, cover-all-the-bases language. If you want people to use the principles, you have to write them so they can be remembered and repeated. They need to be short and sweet, almost slogans. (We confess we fail this test.) And don't let the committee writing show. Work hard to keep the group effort from obscuring the voice of the document and diluting the power of the message.

Building on the principles. The information engineering methodology guarantees tight links between the principles and the next component, the architectural models. We checked and rechecked the principles against the evolving architectures—to make sure the architectures were true to the principles, but also to make sure the principles held up. It's necessary however, to *communicate* that connection to the larger public. Again to our uncomfortable delight, the community demanded to *see* the links between the lofty principles and the down-on-the-ground architectural models.

Now that the architectures are complete, the process becomes far more public and diffuse. We are making an effort to recruit key people and seed key efforts. We target planners, for example. We want them to post the principles on the wall on big sheets of paper and invent exercises that take the principles into account. We try to draw in advisory groups. The first order of business for our brand new Data Policy Committee, for example, is to build a living structure for the data stewardship principle:

> **Data stewards.** *Data stewards are responsible for ensuring the appropriate documentation, collection, storage, and use of the administrative data within their purview.*

Architectures

> *An information technology architecture isn't a product. It's a process.*
>
> —*Gartner Group*

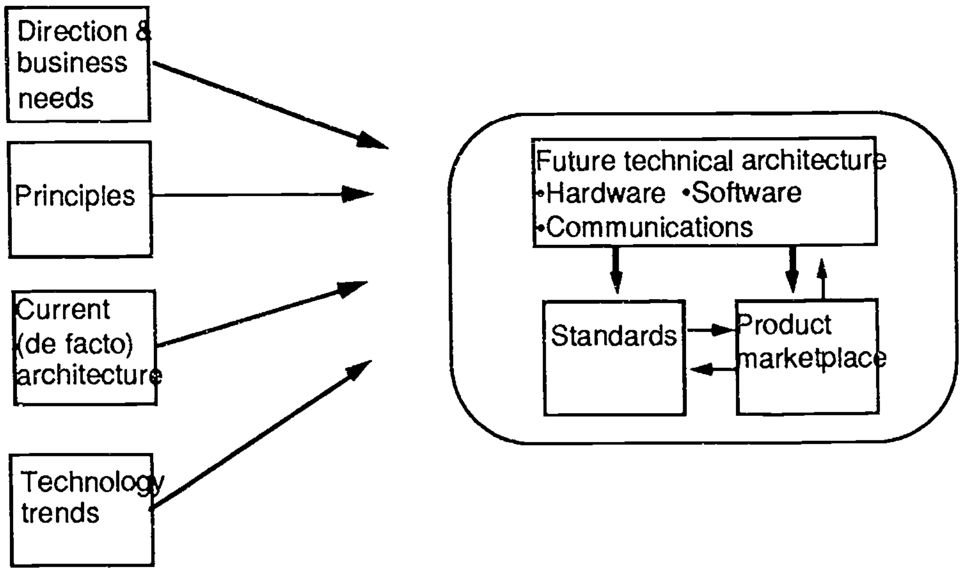
Three architectures. As with the principles, it's important to say what the architectures *aren't*. They aren't a pulpit to preach a particular planning methodology. They aren't a vehicle for technology for its own sake. They have one overriding objective—to improve the performance of the business. They spring from business purpose and are refined with one or two business themes such as faster turn-around or better service.

Penn has developed three architectures—information, business systems, and technical infrastructure. All three are models, or frameworks, from which will flow policies, standards, plans, and systems. The architectures themselves flow one from the other:

- The *information architecture* includes an enterprise-wide data model to help Penn understand what data it needs. That's mapped against an enterprise-wide process, or activity, model that helps us understand what the organization is doing. Reconciling the two ensures that actions will be supported by the right data.
- The *business systems architecture* lays out the comprehensive set of information systems and data stores that are needed to carry out Penn's specific business processes. The systems are identified without regard for what's already in place or how the pie is currently sliced.
- The *technical architecture* is a blueprint of the hardware, software, and communications components that will be necessary to implement the first two architectures. It's not a buy list, but a model from which standards and products can be derived.

Focus on the technical architecture. The diagram delves more deeply into the technical architecture. It illustrates four of the streams that feed the architecture. University direction and business needs are paramount. The principles are the second stream. Penn's current, de-facto, architecture—the third stream—greatly affects our migration strategy, so we did a systematic inventory of the current Penn environment. To research the fourth stream, technology trends, we hosted a campus-wide series of forecasting forums, drew heavily on our Gartner Group membership, and visited a number of software and hardware vendors for non-disclosure briefings. From this raw material we crafted three architectural alternatives: a conservative one, an aggressive one, and one that falls between.

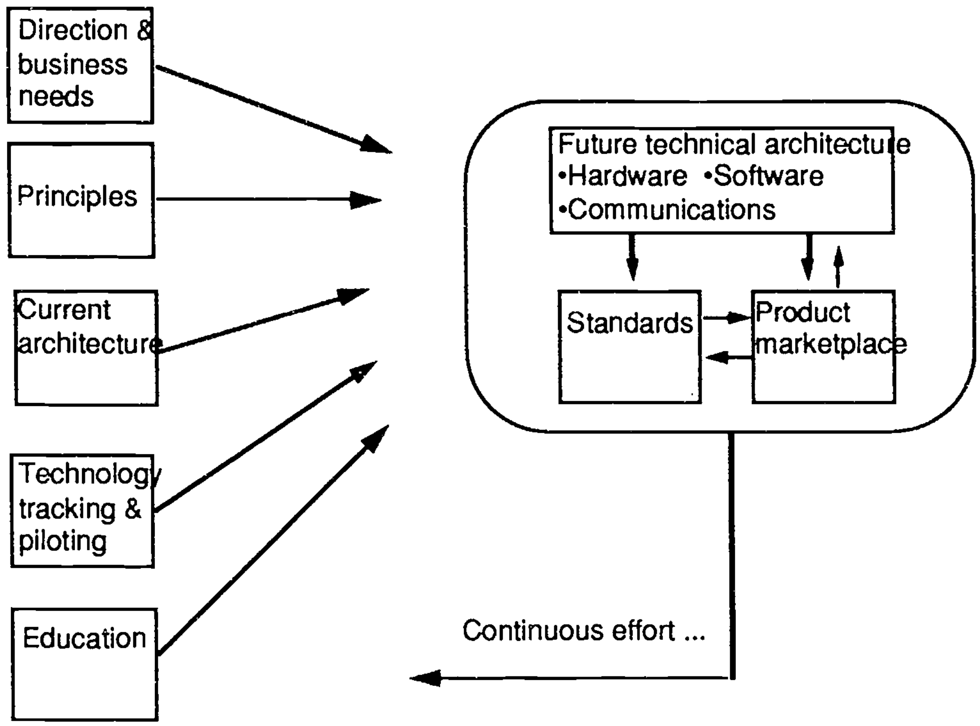
Technical architecture— blueprint for technology choices



Where to start? To avoid paralysis, we fixed some components while we moved the rest around. In our case, the campus-wide network was already stable and in place and we quickly fixed the type of database we wanted. Our consultant greatly simplified our job. He convinced us there's a fairly small set of basic architectural alternatives. Our job was to see which ones make sense for Penn. Place holders were another way we kept things manageable. We recognized there were areas of the architecture (networking and office systems, for example) that required a more detailed approach, a more participatory approach, or an approach that took academic needs more explicitly into account. The core team dealt with these at a high level and then handed them off to other groups.

Planning for flexibility. It's feedback loops that permit flexibility and nimbleness. As the diagram below suggests, we expect the principles to remain relatively stable. The architectures and business needs are less stable, since the environment is constantly changing. It's necessary to track and pilot emerging technology. Penn has no advanced technology group, but Information Systems and Computing makes an effort to coordinate and share the fruits of campus-wide pilot efforts. The ongoing technology forecasting forums are another centrally-facilitated effort. A strong education campaign is also required to build excitement and awareness.

Planning for flexibility



Breathing life into the architectures. Architecture—arcane at worst, cryptic and jargon-ridden at best—is a tough sell. To capture hearts and minds, you constantly have to make the business case—service, productivity, costs. Penn's senior management are fortunately taking the realistic approach that exact numbers can't be known at this point, but orders of magnitude *can* be known and must be demonstrated.

It's useful to have a short, compelling article to hand out. We use Davenport, et al., "How Executives Can Shape their Company's Information Systems," Harvard Business Review, Mar/April 1989.

We've learned that some people respond to images and some to text, so we've tried to communicate the architectures both ways. Our Executive Vice President, brand new to the job, found our highest-level, one-page process diagram of Penn helpful as she tried to understand her new organization. She cut quickly to the chase: These particular functions have huge numbers of inputs and outputs; I should look for opportunities there. And if there are so few inputs and outputs to this function, why are so many people working there?

We're sitting on a treasure trove of data—and need to make more effective communal use of the vast store of diagrams and inventories. They could save other people a lot of work, and could become an important shared lexicon at Penn.

Wrap-up

Keeping the partnership alive. For the partnership to thrive, the Division of Finance and the Office of Information Systems and Computing must understand each other. The technologists need to understand what business Penn is in. The business people need to understand why and when Penn should invest in information technology. Both sides have invested blood, sweat, and tears to understand each other well enough to get to this point. Both are concerned that their own side will treat the effort as a project with an end point and wrap party rather than an ongoing new relationship. Both sides are working hard to institutionalize some of the formal and informal communication channels that have sprung up. A particularly difficult problem is how to maintain the hard-won kernel of knowledge of each other's fields, which won't stay current long in today's fast changing environment. And what's "enough" to know?

A role for CAUSE. Both CAUSE and its business counterpart, the National Association of College and University Business Officers (NACUBO), could be helpful to the growing number of partnerships like this one. CAUSE could go much further than it does to help information technologists teach themselves about business and education trends and stay current on what's happening in Washington. NACUBO could return the favor.

For more information. For more information about Project Cornerstone, contact Janet Gordon or Robin Beck. For a copy of Information Systems and Computing's long-range direction statement, which is based in large part on Project Cornerstone, contact Linda May.

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Appendix: Information Technology Principles

General

1. **University assets.** Information technology infrastructure, business applications, and data must be managed as University assets.
2. **Functional requirements.** University priorities and business functionality determine investments in administrative information technology.
3. **Cost-effectiveness.** 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.
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 business 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.

Business 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 business 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.** Hardware and software for administrative use 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 business applications that ensure the quality and cost-effectiveness of specific business 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.

Successful Planning from the Bottom-Up

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Abstract

Most universities generate strategic computer plans from the top down, both conceptually and administratively. The process is instigated by high level administrators and begins with the general institutional mission and environment. Weber State planning goes in the opposite direction. Faculty are asked to describe their particular needs for computer and communication support and from the resulting list are abstracted common objectives and sharing procedures aiming at overall goals. This approach has produced a very practical, useable document; has evoked rapid change; and has increased cooperation across campus. The process is evolving into a potentially revolutionary departure from normal top-down management.

University planning in general, and computer planning in particular, are regarded as explicit, self-conscious acts, initiated by senior administrators, derived from fundamental institutional priorities and effecting high-level policy decisions. Strategic Plans are awarded capital letters by university presidents. At Weber State University (WSU) we have experienced a different phenomenon. Without pretensions of anything more than immediate efficiency and common sense, a series of tactical decisions by faculty committees and administrators have accumulated into a document and a process which serves the institution as a strategic computer plan. "The Plan" was in effect before senior administrators knew of its existence. Comparison of the two approaches affords insights into the nature and benefits of the variety of acts which are called planning.

Top-Down Planning

Computer planning has generally been viewed as coming from above. In a recent paper concerning the adaptation of information technology to challenges facing higher education the authors state, "Information Technology planning needs to be integrated fully into an institution-wide strategic planning and management process ... Senior leadership needs to be involved continuously ..." (Rosser, Kunselman & Penrod, 1992.) Coughlin, in a survey of colleges and small universities, found that major computer resource and policy decisions were made by senior administrators on more than half the campuses, and by high level coordinating committees, such as a President's Council on more than 25% (1986). Faculty committees were used in less than 5% of the responding institutions.

Planning can be top-down both administratively and logically. Administrative top-down procedures are rationalized by arguing that the broad participation necessary for implementation requires directives and incentives which come from the top. The first "lesson" listed as a guide to planning efforts at Rensselaer Polytechnic is "Top administrative commitment and participation are essential to obtain the cooperation of varied elements on campus and to arrive at decisions acceptable to these various groups," (Moss, 1982; p. 140).

Logic based top-down planning consists of deriving computer needs from the fundamental goals of the institution. As Falduto, Golden, Beyer, Conley and Detweiler describe it, "...planning begins with the institution's mission, followed by identification of strengths and weaknesses, development of assumptions about the future, development of a vision of the future and goals consistent with the institutional mission, development of a timeline for achieving these goals, ... and a provision for assessment and feedback ...(1993, p. 19). Such logical development is meant to produce a plan which has general academic validity, which is coordinated with other components of the institution and which is adaptive to institutional challenges and opportunities.

From the high level, mission-based vision successively specific sub-goals and actions are derived as the process moves down. Implementation of the plan occurs as these specific projects are finally accomplished.

The recent planning effort at the University of Montana is a typical example a top-down effort. It was initiated by President George M. Dennison with the explicit goal of a "long range strategic information technology plan", (University of Montana, 1992). After some preliminary work by separate constituency groups, a single task force, representing the widest range of university interests was formed to prepare the plan. Co-chaired by the Dean of the College of Education and the Vice President for Administration and Finance, the task force included 30 people: deans, directors, students and six faculty representatives. A critical first step in the work of this group was to develop a vision with maximum temporal and institutional scope. Perceived immediate needs of particular departments were purposely deferred in the interests of achieving this fundamental encompassing vision. After six months of effort the task force produced a long range "Information Technology Plan" with six major goals for computer development and support administration. Goals are described briefly and are accompanied by few curricular, budgetary or implementation details. In true top-down spirit, various constituent groups have been filling out the Plan with these particulars over the last year.[1]
1

The Weber State Experience

Wandering in the wilderness. By 1982 WSU had recognized the value of common goals and operational coherence in computer development, and thus the Coordinator for Academic Computing was charged with developing a campus plan. In collaboration with an *ad hoc* faculty committee the plan was written and disseminated in 1983. The plan was provided to all department chairs, was reviewed and blessed by the Dean's Council, and was approved by the Academic Vice President.

The document, however, had no discernible effect on the campus and within three months of completion, fewer than ten people remembered that it existed. Curricular, budgetary and personnel decisions concerning computers continued to be based on departmental considerations without any institution-wide reference. A second plan was written in the following year with similar results. In hindsight these failures are easy to understand. The plan came from the Department of Academic Computing which had neither money nor authority to implement it.

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[1] We appreciate the assistance of James E. Todd, Vice President for Administration and Finance, University of Montana, in helping us understand the planning process used at Montana.

Coherence and coordination in computer development was effected through informal discussions between individuals and departments, sometimes expedited through Academic Computing. The written plans appeared to be of no assistance in these efforts in consensus building, and general suspicion of high-level, comprehensive planning developed.

Infusion One. In 1985 a special state appropriation of $700,000 was made available for general academic computing upgrades. Instead of dividing the money among the several colleges, the president and academic vice president appointed a special faculty committee to develop recommendations for how it could be best used. This committee solicited ideas from the faculty and was overwhelmed. It was clear that the majority of faculty desires for computer support could not be met and some hard decisions would be necessary. After sometimes rancorous discussion the committee arrived at a spending plan which excluded many particular requests but which was academically valid and reasonably coherent.

Although the plan had many detractors, the general opinion was that it was an effective compromise. Independence from established departmental and college administrative structures did not appear to have handicapped the process, and some felt that such independence had encouraged rational discussion over political bargaining.

Infusion Two. In 1986 a large, permanent budget increase was provided for unspecified improvements in educational computing. Again the academic vice president chose to allocate the money through a faculty group, outside the regular governance structure of departments and colleges, in this case the newly established Faculty Senate Computer committee.

Following the model of a research grant board, this committee requested proposals from faculty for computer projects, with the initial expectation of simply reviewing these proposals and funding the most educationally meritorious. When the proposals arrived, however, the committee quickly realized that separate implementation of projects, as proposed, would be wasteful and ineffective.

Redundancy abounded. For example, 15 departments (more than a third of the campus total) requested funding for the establishment of new personal computer labs. From one department came two separate proposals for labs from two faculty, apparently unaware of each other's requests. Several departments requested mini-computers, none of which provided additional service beyond that already available on campus.

Many of the proposals were technically incomplete and unworkable. Hardware was requested with no applications software. For many projects no provision for installation, power conditioning, remodelling, system maintenance, or other essentials were made. Many good projects risked early demise, because there was no space to house them, or funds to keep them in operation, or technical expertise to maintain them. At a more subtle level, it was apparent that inappropriate hardware or software was being requested for otherwise, valuable projects.

Instead of a simple reactive role of funding some projects and not others, the committee decided to get actively involved in using the money to improve computing on campus. The goal became the efficient, workable implementation of the good ideas contained in the proposals. In other words, the committee redefined its role from one of funding computers to one of implementing curriculum improvements. Proposers were asked to provide more explicit and complete descriptions of the educational value of their projects. From these discussions the committee was able to forge a coherent development strategy.

Where common values could be ascertained, it was possible to propose facility sharing, e. g. a single pc facility to support history, social sciences and English for common data analysis, CAI and word-processing needs. In cases where such sharing could be agreed upon, the committee negotiated with Deans and support departments to obtain space, remodelling funds and operational support which would be necessary for success and which had not been adequately accommodated in the original proposals. The value of these larger, shared projects which helped several departments and thousands of students was easy to demonstrate to Deans, and their budgetary and personnel support greatly extended the original monetary allocation.

Discussion of educational intent revealed a natural temporal ordering which allowed priority setting and valid scheduling of projects. Some curricula were not ready for the requested projects, and the committee found it possible to concentrate funds on those areas where there would be an immediate impact. And, of course, some projects did not merit funding and the focus on educational goals helped emphasize their shortcomings.

Using the proposals as a starting point for discussion and negotiation, then, the committee developed its own comprehensive design intended to accomplish, as much as possible, what the faculty had desired in the first place. Through several iterations the design was discussed and refined by the original project proposers and finally adopted and implemented.

Discovering a plan. The campus computer design which emerged from this allocation process became, of necessity, a long term commitment. The new VAX, the large new pc labs acquired through the allocation were major investments which would focus expenditures and activities for several years. The committee also became committed to the procedure which had been established for allocating the yearly budget: request proposals, integrate proposals into a coherent design, implement the design. Although the system was founded on academic priorities, encouraged campus-wide cooperation, reduced redundancy and moved toward long-term stability and commitment, the terms 'strategic' or 'plan' were never used.

Finally, in 1990 the concept of a strategic plan for computing was explicitly introduced in a request from the President's Council. The Council sought some guiding principle for resolving the chronic, and sometimes impassioned, funding requests for student record systems, financial record systems, *and* academic computing. Vice presidents for Business, Student Affairs and Academic Affairs were each asked to develop long-term computing plans. Responsibility for creating the academic plan was accepted by the Faculty Senate Committee, and they approached the task by simply modifying the well-established fund allocation process.

Questionnaires were sent to all faculty asking them to state their specific needs for computer support. Departments were asked to meet to discuss these questionnaires and individual responses to it to prepare departmental statements of need. These department reports were reviewed by College committees in the preparation of College reports on computer needs, which in turn were passed on to the faculty senate committee. Areas of University-wide interest, networking, mathematical and graphics processing, word-processing, computer-based-instruction and student labs, were identified in the initial survey results and groups of interested faculty were asked to develop coherent plans for meeting these needs.

The completed Plan described 61 major projects in 6 general university-wide categories and within each of the 7 colleges. In addition many smaller scale projects were described within individual departments. A total of $6 million and a permanent budget increase of about $600,000 would have been necessary to fund the entire Plan, (Weber State University, 1991).

Like the designs for fund allocation from earlier years the "Plan" was founded on very specific, concrete projects proposed for particular courses, educational programs or research projects, e. g. three DOS pc's with laboratory interface boards to be used by the 25 students enrolled each quarter in Psychology 343, Experimental Design. Also like the annual fund allocation designs, cooperative projects, broad goals, campus priorities were all abstracted from the specifics, rather than specified at the start. It was a bottom-up plan.

Where the Plan differed from the fund allocation process was in its scope. Fund allocation designs were limited to the annual $200,000 budget at the Committee's disposal. The Plan, on the other hand, attempted to show how *all* computer money over three years, real and potential (and perhaps even imaginary), ought to be spent to optimize the academic program. Execution of the Plan would require budgetary support from Dean's and Department Chairs, and fund-raising support from the President and Vice Presidents, even though none of these administrators had had a direct role in the Plan's creation.

Operating with the Plan. The initial Plan was adopted by the Faculty Senate in the Spring of 1991. The Plan was revised in 1993, (Weber State University, 1993) and is undergoing revision again this year. Currency through yearly revision is a goal of the Computer Committee.

The Plan has been used in three arenas. First, it has been used by the Computer Committee to allocate its yearly budget. Second, deans and department chairs, voluntarily and selectively, have based their own budgetary decisions on it. Finally, it has been the key rationale in appeals for increased funding. Nearly $.5 million has been allocated by the President's Council from University contingency funds in the last two years toward Plan implementation, and an appeal for a special legislative appropriation for some aspects of the Plan is under discussion in the Board of Regents. A review of implementation during the first academic year indicated that of the 61 major Plan projects, substantial progress was made on 17, some progress was made on another 17 and no progress was made on the remaining 27.

Contrast

Using a top-down approach, the President of the University of Montana directs an institution-wide group with a majority of administrators to develop a strategic computer plan. Through consideration of long term trends, basic institutional options and fundamental, common purposes, this group identifies major institutional goals. And finally, implementation details for accomplishing these goals are derived by user groups.

WSU moves in the opposite direction. Implementation decisions involving a single faculty group coalesce into a planning process and ultimately an explicit plan. The process arises from a set of specific faculty projects, and grows to encompass academic computer development in general. No special support, prior to plan creation, is offered by Deans, Vice Presidents or the President. Can strategic direction emerge from such informal mechanisms? How does faculty grown organization differ from that mandated by administrators?

A Closer Look

Top-down planning is meant to integrate computer development within fundamental institutional goals by deriving particular projects from basic, mission-derived goals. Such derivation, however, is not rule bound, or even very constrained. Consider how a reasonably high level goal, such as "Instill in students an understanding of computing and computing applications," might be translated into specific actions. A new course offered by the Computer Science Department in fundamental computer theory and architecture might be developed and equipped. The College of Business might expand its offerings in applications software: databases, spreadsheets, and so on. Each department might be encouraged and supported in the development of computer learning experiences appropriate for its field. Even with strong consensus on the higher goal, there could be deep and genuine educational disagreements on the best way to achieve it. The philosophical disputes would be exacerbated by budgetary competition and facility rivalry. Mission statements, by design, are an institution's common ground and therefore not very controversial. Disagreement increases with specificity.

This problem can be attacked directly in the planning process. Arguments can be aired, disagreements resolved and specific decisions to do one thing and not another can be made--Computer Science gets the course, the other departments do not. For a plan of major scope there will be many losers as specifics are worked out and these losers may easily become disaffected from the plan and its implementation.

Alternatively these disagreements can be avoided by not forcing the process into specifics, by leaving the plan at the level of broad goals meant to guide decision-making informally. Given the putative goal of increasing computer understanding, deans, curriculum committees and others would do what they could to improve students' computer concepts as opportunities arose. Vague statements of goals with little clear impact on institutional decision-making, however, can be platitudinous and irrelevant to the real needs of faculty.

If the plan develops top-down administratively, that is, is encouraged and supported by the president and vice presidents then the cooperation of faculty may be more likely, but it is not certain. As a matter of fact, the top-down approach contravenes the traditional role of the faculty as masters of the academic program. Faculty are hired and tenured as independent, responsible professionals whose job it is to set curricular and research goals. Generally they have developed their own ideas about the nature of computing support for academic work and may have little patience for a planning process which they perceive to be detrimental, irrelevant or slow and bureaucratic. Beltrametti in a somewhat different computing context recently used a bottom-up approach at the University of Alberta because of the delays and staff resistance which can accompany top-down, manager-directed planning, (1993).

WSU's bottom-up approach avoids some of these problems. Being based on present curricular needs as stated by the responsible faculty it has immediacy and relevance. Since the process begins, rather than terminates, with concrete project descriptions, the elapsed time from funding approval to complete implementation is very short (typically no more than six months). With the narrow, curriculum-specific focus, the projects are very low-risk. Nearly all of the projects are implemented successfully, and have immediate demonstrable academic benefits.

The process is open and collegial, and therefore engenders a high level of trust among faculty. One remarkable consequence of this trust is a *reduction* in total funding amounts of the Plan and its precursors over the last 3 years. Apparently participants feel less inclined to exaggerate needs and pad budgets, since the real needs will be perceived and sympathetically viewed by colleagues. Decision making on funds has become concomitantly more difficult, however, since automatic rejection or trimming of bloated projects is no longer possible.

The discussion of specific projects within a broad faculty forum has helped individuals discover and appreciate the work of others, and has thereby fostered cooperation and inter-departmental sharing. Software standards have been established for faculty and student use. Coordination of hypermedia projects has begun under the auspices of the Instructional Technology Office. An intra-departmental effort has been initiated to combine and upgrade UNIX systems. Five of the largest student labs have combined into a joint administration. The basic design for the universal campus network was initiated and implemented through the academic planning process.

This is not to say that a miracle of selfless sharing has been wrought. There remain individualistic faculty and departments that have gone their own way. The experience at WSU, however, does show that coordinated projects aimed at general institutional goals can emerge from faculty deliberations on immediate curricular needs. Higher administrative direction is not a necessary condition for strategic thinking.

A clear disadvantage of WSU's planning tactic is that its limited scope tends to discourage innovation. Departments and colleges focus on immediate, short or near-term computing needs and do not take risks to innovate for more far-reaching results. While individual faculty may design an innovative computer-related project, there is no incentive to implement a university-wide change. The collaboration and cooperation across departments and colleges fostered by the bottom-up planning process seems to encourage short-term and immediate sharing of resources. The Faculty Computer Committee chair has suggested that some portion of funding be set aside for higher risk projects, but this met with negative feedback from the Committee that specifically wanted to let individual colleges determine where the plan, and consequently the funding, would focus.

The strengths of bottom-up planning are its immediacy, relevance and concreteness. A crucial condition for relevance at WSU was the budgetary allocation given directly to the Computer Committee starting in 1986. People were motivated to work at the process because it made a real difference in the accomplishment of particular projects. Probably no planning effort, up, down or sideways, can be sustained very long unless it has a clear impact on resource allocation. Given the responsibility to allocate too few funds to implement too many good ideas, the Faculty Computer Committee began to explore issues of academic priority and organizational efficiency, in other words began to plan strategically. It is similar resource allocation constraints which motivate presidents to initiate top-down planning efforts. Perhaps the logical problem of optimizing limited resources should be the key concern. Whether the problem is attacked by a president, top-down, or a faculty group, bottom-up, is less important than the logical and political quality of the solution. If the plan and its implementation improves the institution and is supported by the community then its origin is unimportant.

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THE ART AND POLITICS OF RE-ENGINEERING UNDER CRISIS CONDITIONS

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Re-engineering an entire college administration can be daunting -- wholesale change is intimidating and unwelcome to many. Common wisdom from the literature suggests that re-engineering should take place in times of stability and good fortune. In practice, there may be little motivation short of crisis for even launching an encompassing re-engineering project. This paper describes how Bryant College got started on such a project, the crisis conditions under which the project is proceeding, and the lessons we have learned to date.

MIS Project Background

In early 1991, Bryant College's administrative information system (IS) consisted of a set of independent modules for major functions, each with its own internally defined, flat data files. Most had come originally from a package purchased in 1986, but had been extensively modified. Custom linkages had been built between modules to copy data from one area to another. People were reasonably satisfied with existing functions, but requests for changes and enhancements were being met very slowly, or not at all for lower priority offices. In fact, the combined backlog of requests and necessary systems maintenance was estimated in excess of 200 days of programmer/analyst effort.

New leadership in the Development, Alumni, and External Affairs Division found the available IS functions to be inadequate for a proposed major fund-raising campaign. Their inquiry about possibilities for improving existing or acquiring new systems provided the impetus for a College-wide review of administrative IS needs. The Executive Director for Information Technology (EDIT) asked Vice Presidents to name representatives from major administrative offices to an Administrative Systems Advisory Committee (ASAC). The ASAC, which was first charged with articulating needs, became an important forum where members learned from each other about how the College did its business and how similar many of their needs were.

The EDIT then involved ASAC in development of a Request for Proposal to replace the existing administrative systems with a comprehensive set of applications built on an underlying, integrated database. Pricing was requested for initial purchase of Alumni/Development support alone, and for acquisition of a complete system to handle student information and services, and College financial support functions as well. By the time they completed functional evaluation of the candidates, ASAC members concluded that enrollment management might benefit from a new system as much as, or even more than, Alumni/Development. Consequently, ASAC recommended acquisition of a complete new administrative management information system (MIS), and the EDIT proposed it to senior management. The proposal was endorsed by the Board of Trustees in May 1992, a contract was negotiated, and system implementation got underway. Admission and Development, the two sources of College revenue, were targeted for first implementation.

College Context: Crisis and Opportunity

In addition to declining demographics, for which we had been planning, Bryant has also been faced with a Northeast regional economic slump and a significant, unexpected loss of student interest in undergraduate business majors, our academic specialty. Much of the motivation for the new MIS came from interest in acquiring better tools to support improvements for the Admission and Financial Aid Departments in marketing and recruitment of new students, key activities in our consolidated approach to enrollment management. We also expected to contribute to retention by improving the timeliness of, and enhancing services to, continuing students.

During the fall of 1992, following budget cuts and administrative staff reductions, the College faced growing organizational unrest among its faculty and staff. While the EDIT had always intended for the MIS project to provide an "excuse" to foster examination of business processes, College economics and politics made that more important and more difficult at the same time. The pressure was on all areas of the College to cut costs, increase revenues, and generally do more and better with fewer people. In retrospect, it is easier to see that most participants did not appreciate the time or effort involved in shaping and learning a new system, much less in re-engineering our business. We continue to be faced with constraints on staff time and resources, needing to run up the learning curve and maintain business operations both, in offices already feeling overwhelmed by short staffing.

Project Approach and Major Players

The Executive Vice President (EVP), with primary responsibility for enrollment management and particular focus on recruiting, became the senior-level project champion. The EDIT took overall responsibility for project success, beginning with hiring a Project Manager to be responsible for the team of programmers and analysts. This person was selected by a search committee composed of two IT staff and three ASAC members who would be users of the new system. The EDIT also requested full-time assignment of a Team Leader from user ranks to guide users in shaping the student information system. We described the roles of these latter three as: chief politician, chief technical expert, and chief user advocate. Together they formed a management triad for project direction and execution, picking up leadership for the project from the ASAC.

Because she had chaired ASAC through that activity, the Team Leader easily carried forward the collaborative and educational advantages of ASAC's participation in the MIS selection. Her first task was to fill all the code tables that tell the software package how Bryant wants to work. She drew representatives from every administrative office involved with students to form a Coding Committee. Together they examined and agreed on values for over 100 system tables, while the EDIT had ASAC went on to formulate policy recommendations for who would have access to what data for what purposes.

Guided by the software vendor, all administrative offices participated in an overall project schedule planning exercise. Discussions of work breakdown into tasks and relative timing were later held by the Project Manager with individual offices. The schedule was then adjusted to fit work around periods of peak office activity. The order of implementation reflected expectations for benefit or internal software linkages, e.g., we put admissions first and the group of financial aid, accounts receivable, residence life, and registration second. One thing we failed to do, however, was incorporate the process review and analysis activities overtly into the project schedule -- not even as placeholders for time or staff assignments.

Getting Started -- Admissions and Financial Aid

With our eyes on the potential benefits of making new tools and capabilities available to people responsible for ninety percent of College revenues, we jumped into implementation of the admissions module for the full-time undergraduate Admission department. The first target date, to capture data and generate correspondence for prospective applicants, was missed by three months, primarily due to late delivery, installation, and debugging the setup of hardware. Beyond this, IT did not fully understand, until the module went into live operation, that Admission staff expected to get exactly the same reports (content and format) from the new system as came from the old one. We did discover that management commitment to process review was inconsistent across departments, however, as soon as the EDIT convened a group to assess alternative approaches to data entry. No commitment to consider or implement change was generated. At the time, the perspective from the Director of Admission was that people could not appreciate how different the new system might allow things to be until they had "put their hands on the keyboard" to gain experience. This tended to drive us to take an incremental, rather than a synoptic, approach.

While software implementation activities were focused on undergraduate admissions, we took a different approach with Financial Aid. A faculty member from the Computer Information Systems department offered and was encouraged by the EDIT to begin from a process review perspective. He interviewed Fin-aid staff and documented their existing operational procedures, data flows, and decision processes, and fostered discussions about what improvements they would like to make in their services. People concluded that improvement would be more likely if changes crossed departmental boundaries instead of being confined within Financial Aid. By this time, however, pressure on IT to address Admission's issues was so great that no forum was provided to extend the Fin-aid discussions to the related departments. All IT support for Financial Aid became focused on adapting to the new federal rules under the Higher Ed reauthorization.

In an attempt to consolidate articulation and understanding of Admission's expectations, the EVP was eventually called on to moderate development of a "contract" between Admission and IT that listed functions and reports required to make the software implementation "successful." All available programming resources, including an outside contractor, were then assigned to Admission to clean up outstanding items. A new schedule was proposed, naming a new target for complete live operation by Admission and, after discussions with other departments, dropping the next modules back about six months. The EDIT suggested separating Admission, as Phase I, from the next modules, as Phase II, to formalize what had been learned into a different model for project leadership and management.

Toward the end of the period of intensive focus on Admission, the EVP and EDIT agreed on a quick review by an independent consultant of the project status and recommended schedule and management changes. Interviews were arranged, recommendations received, and proposed changes endorsed. The consultant assisted us to focus and articulate what we had learned so that it could be captured and put to use for the remainder of the project.

Lessons Learned

Probably the most basic lesson we have learned is:

(1) effective re-engineering is difficult to accomplish as a byproduct or side effect of another project.

The level of commitment for time and resources must come from the top down and be consistent across the College. Our financial concerns made the dollar investment in acquiring the IS hardware and software paramount in most minds, focusing staff time and energy on opportunities for cost recovery or revenue enhancement rather than service or business improvements. It is critical to set the context and project philosophy to emphasize customer service enhancement and job effectiveness, NOT the information technology tools. Today this seems rather obvious, but when we started, little practical guidance was available in the literature.

The most important lesson we have learned to date is:

(2) there is a huge difference between user participation and user control.

User departments at Bryant were accustomed to asking IT for data or functions, having IT go away and make it happen. Previous system conversions had been done over a week-end and were largely transparent to user operations. The EDIT's inclusion of ASAC, not just in evaluating candidate systems, but in making the final selection, can now be seen to fit a familiar pattern of user control, although the process was quite different. The departures came when control transferred to the project management team, and substantial user participation was required, first for coding and then for implementation tasks (such as training each other, learning the query language, documenting procedures, etc. -- things that had been done for them by IT in the past). In retrospect, we had gone from one extreme to another, from complete user control and little participation, to little user control with major requirements for participation.

We've found that an important companion to control is:

(3) users need to be accountable to each other for system decisions that affect overall project implementation schedules.

We really caught ourselves on this one -- with IT, particularly the programmer/analysts, taking all the heat for missed target dates, when users had actually been expanding their expectations and functional demands as they learned more about the new software capabilities. The more energy IT invested in Admission, for example, the less time was available to prepare for the next set of modules. IT staff became incredibly discouraged at not being able to finish things on time, Admission got no nearer to completion, and other users began to lose interest, feeling we would never get to them or would not be able to meet their needs either.

A lesson it has taken us some time to appreciate is:

(4) our vendor did not understand what was involved in, or assume adequate responsibility for, ensuring the success of our project.

Phase II -- What We Plan to Do Differently

After more than one year's work on Admission, the EVP has reconvened the ASAC with a longer-range charge to advise the EDIT on administrative technology needs, serve as a clearinghouse for information related to campus-wide administrative computing, and keep the EDIT apprised of issues. For the duration of the MIS implementation, a subcommittee of the ASAC, called the MIS Steering Committee, will be responsible for guiding the project by defining the scope of activities, setting priorities, and monitoring progress. Membership on the Steering Committee includes a representative from completed modules, to provide insight from experience, and representatives of the modules currently being implemented. The Committee will be chaired by the Dean of Administration; the IT Project Manager and the vendor account representative will provide resources. We thus return control of the project to the first-line users, giving them back responsibility, and matching that with accountability, for project decisions.

The first task for the reconvened ASAC is to review and finish documenting their policy recommendations for data access, privacy, and security. The EDIT will also ask ASAC to consider the questions raised by senior management about how much process review and design the College can "afford" right now. Our impression is that only a grassroots commitment could rekindle enough enthusiasm to carry the re-engineering effort forward. My concern is that, while necessary, it may not be sufficient so long as a crisis attitude prevails. Every office needs to continue operating with fewer staff, making project time difficult to carve out of routine office duties. This is the new reality, however, and we must learn to cope with it better. Upper level management commitment for any re-engineering is vital; it remains to be seen whether ASAC can generate it. This is another, although possibly local, lesson:

(5) it is difficult, if not inappropriate, for re-engineering leadership to come from IT.

On the other hand, upper management support is clearly necessary, as demonstrated by the success of a process review completely separate from the MIS implementation. A registration process study group was charged by the EVP to examine the various ways and places we perform student registration (full-time undergraduate, part-time undergraduate, graduate, continuing/ professional) and to recommend appropriate consolidations for economy of operation and improvements in service. The MIS Project Manager was a member of the committee, but served only as a consultant on how the new MIS might support any changes under consideration. This group's work was incorporated into a recent restructuring of the Academic Affairs division, but has not been used to advantage as a prototype for other process review activities.

For phase II then, the EDIT will try to focus IT's attention on serving customers with the software implementation. We need to capitalize on what we learned with Admission, including creating more formal "contracts" to specify functions and reports that will constitute "successful" implementation. These will be developed under the supervision of the MIS Steering Committee to ensure College objectives and schedules are met and that required resources (IT and administrative staff) are available or can be obtained. In addition, IT needs to pay more attention to the time required for users to develop a level of comfort in understanding the new system capabilities before certain decisions about the suitability of functions and operations can be made.

During phase II, IT must:

1. <u>Focus on the user</u> by: placing early attention on user needs and expectations; finding ways to build credibility and forge alliances within each user department; paying attention to user business requirements and perspective.

2. <u>Stay grounded in reality</u> by: pairing up visionaries with detailed pragmatists ensuring that planned changes are realistic (e.g., in Admissions, we assisted with redesigning their application form so that data on the form matched the order of items in the new data entry screens).

3. <u>Build user investment</u> by: putting their hands on the system as soon as possible, and guiding them to see it as part of the solution rather than a new problem.

4. <u>Find ways to bring underlying assumptions to the surface</u> by: writing things down (the "contracts"), working beside users in their environment, and checking, checking, checking with those users.

5. <u>Keep things moving</u> by: involving users continuously, building on project momentum, and especially enlisting and encouraging user "champions."

6. <u>Capitalize on user strengths</u> by: encouraging and harnessing user enthusiasm and creativity, making a concerted effort to "see it their way."

7. <u>Encourage the celebration of victories</u> by acknowledging the effort, investments, and progress made by all involved with aspects of the project.

Meanwhile, the Steering Committee will be intimately involved with the detailed progress of the MIS implementation. They will report to ASAC at least quarterly, creating a vehicle to communicate that progress widely. We hope that users of modules still to be implemented will develop a better sense of what it takes to achieve, and the likelihood of, success for their areas. Each will serve on the Steering Committee as we move to their module in the implementation plan. The Steering Committee will also report to the EVP quarterly so that progress can be communicated to the rest of senior management. We expect to use broader communication of objectives, responsibilities, target dates, and progress to focus the community on the MIS implementation as a College-wide, not an IT, project.

A Parallel Implementation

One of the reasons we are disappointed with our progress on the student services and information side is the contrast with our Alumni/Development experience. This area has a much smaller, more tightly knit group of people (consisting of only two rather than twenty department/offices), who were coming from old software that provided separate files for alumni, donors, and giving history, along with some transaction processing. Little customization or enhancement had been done because there had not been consistent leadership in the division for long enough periods. We used a parallel project approach with a team leader for implementation and a user committee to specify the necessary code values.

In working with Alumni/Development staff, we found that the size of the gap between an inadequate old system and a very sophisticated new one was a definite bonus. Reviewing and changing how they did their business became an integral part of discovering how to set up and use new capabilities to advantage. User expectations about the learning time and energy required were more realistic from the beginning, and there was no history of having IT "do it for them." The software modules require outside linkage only to the General Ledger; otherwise they are self-contained. Because this mirrors our organizational structure, it was easy for users to accept -- they did not have to coordinate with formerly independent offices to make the system effective. Successful implementation of very sophisticated functions was achieved in less than one year.

Major benefits of the process and system are quickly being demonstrated. Although key users left the College during the implementation period (the team leader and several directors), we have restructured and combined staff functions from previously distinct areas to reduce the total number of positions and still operate better than ever before. Our first supported phonathon is currently in progress.

Conclusions -- While They May Seem Obvious...

To re-engineer successfully, we now understand better that one must:

1. Emphasize enhancement of customer service and improvements in job effectiveness -- not the information and technology.

2. Get users invested in designing and becoming part of the solutions -- instead of allowing them to wallow in the problems.

3. Coach IT staff into a user-based, customer-service perspective -- instead of allowing them to concentrate on installation of technology.

4. Formalize the process of discovering assumptions, articulating expectations, and building shared vision -- instead of assuming that everyone is moving in the same direction toward the same goals.

5. Create formal, public user stakes in the project.

6. Find ways to create <u>early</u> successes, even if small, and publicize, publicize, celebrate -- don't assume that successes are obvious or that everyone notices them.

7. Make sure that project management is handled by a team with a strong, consistent vision, operating with a single philosophy, and communicating clearly among themselves and with others -- not simply a group of people cooperating during a project term.

8. Set goals realistic for both the people and the institutional setting, and try to establish metrics for assessing benefits to be achieved. Don't allow the vendor to set goals, and don't follow someone else's plan -- it is rare for sister institutions to have similar enough characteristics.

9. Have everyone who is affected by the changes participate -- even if they argue that their contribution will be minor.

10. Recognize the enormity of the effort: the time, energy, people, and physical resources required -- there is no "free lunch."

Above all, expect that re-engineering will be a complex, often bewildering, and typically threatening "change process" for both IT and users. We've found that the management key to successful re-engineering is to reduce the associated personal, process, and organizational uncertainties. We should manage the risks and let the participants design and manage the processes.

Doing More With Less: A Pragmatic Approach to Getting the Work Done

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Abstract

As most higher education institutions in the country are facing budget and staffing cuts, administrators are looking at less staff-intensive methods to accomplish administrative tasks. This paper describes how the University of Delaware's Office Systems group addressed this reduction in staffing issue by identifying it as a new challenge for cost-effective use of Information Technology. The Office Systems group helps departments and colleges face the challenge of implementing automated systems. We guide users through a process of analysis, system design, integration, funding, documentation, and implementation. The approach is one of offering solutions rather than technology. We present our recommendations in a comprehensive package that also includes practical considerations such as physical office space requirements, or the appropriateness of the building's existing electric and telephone wiring. The Office of the Dean of Students project will be presented as a case study to illustrate our approach.

Doing More With Less:
A Pragmatic Approach to Getting the Work Done

The Concepts

From Information Center to Office Systems - Beyond Word Processing

The University of Delaware is a multi-campus university system. It enrolls more than 20,000 students and employs nearly 1,000 faculty and over 2,300 professional and salaried staff members[1]. In late 1984, the University of Delaware's MIS department established a service within its management structure to provide office automation for the administrative branch of the University. The Information Center (IC) was created to conduct needs analyses, document studies, and cost projections for secretarial staff office automation. A task force was established to select a word processing standard, and a plan was laid out to bring the affected staff up to par in terms of computing. Three staff and a manager were hired to start the process, and in the Spring of 1985, the conversion to word processing was started.

Since then, the Information Center has continued its crusade for computer literacy of the University's staff by providing support for the mission-critical mainframe data as well as the many user-developed, microcomputer-based systems that were popping up in the administrative offices as a result of a mainframe system development backlog.

Today, the IC no longer exists; instead, it has been superceded by a new support team for administrative computing called Office Systems (OS). The goal of this new team is to help administrators cope with the significant cutbacks in staff and funding that have resulted from budget reductions over the last four years. Our mission now reaches far beyond simple word processing, and our users are more knowledgeable and computer literate.

Facing a Better Trained Workforce

Desktop computing was introduced in 1984 when office automation began on campus for the administrative offices, and a University grant was established to provide the faculty and professional staff with an opportunity to purchase a personal computer at low cost. Nine years later, this investment has paid off: we now have a well-trained workforce and a good level of computer literacy among faculty and professionals.

From Hand-Holding to Think-Tanking

No longer does the Office Systems staff have to show users the benefits of word processing or electronic record keeping. Our users have experienced the many benefits first hand. Now they want more, and they create their own think-tanks within their departments to come up with new ways to do their daily work. The Office Systems staff helps them put their ideas into a form that is usable within their department without too steep a cost or learning curve. We also try to make the new systems fit into existing ones without too much redevelopment or investment in new software and hardware. Cost-effectiveness and staff productivity are our primary goals.

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[1] Source: Office of Institutional Research, University of Delaware.

Are We There Yet? Planning For Solutions Yet To Come

While we help our users with their automation goals, we also teach them how to plan for new solutions that the University's Computing and Network Services department is envisioning for the future. For example, CNS is currently in the process of wiring our campus for Ethernet. Most of the administrative staff have been working in an SNA environment for more than ten years, and are reluctant to accept the change. They are unaware of the many applications and wealth of information available to them via access to the Internet. It has therefore been the goal of CNS to provide the users with this knowledge and to make them aware of the benefits by creating real-life solutions otherwise not available to them. Other emerging technologies are being implemented on our campus such as electronic forms, kiosks, voice-mail, cable TV and digital technology to all dorm rooms and offices.

Increasing Productivity Within Budget Constraints: The Ultimate Challenge

Because of the continuing price reductions in computing equipment, it has been possible for the Office Systems group to increase productivity in various offices on campus while still maintaining the continuing level of budget reductions required by upper management. Often, this has presented some real challenges and required some very creative suggestions from both users and Office Systems staff. For example, at the time when the staff of the University Secretary was cut in half, a decision was made by the Board of Trustees to significantly increase the number of advisory committees to the Board. This resulted in a tremendous scheduling problem for the staff member in charge of organizing the committee and board meetings. The Office Systems staff provided the staff member with a turnkey system that practically runs the whole process. The new systems selects committee members, prints invitations, creates meeting minutes, interacts with food services and schedules transportation for committee members. What used to take several staff days to do by hand is now done in minutes by one operator.

How Did Office Systems Know You Were Shorthanded? THEY ASKED!

As in the Paine-Webber TV commercial, the Office Systems staff planned for the constraints users' offices were experiencing when faced with staff and budget cuts. We asked our users how they planned to cope with less staff, yet perform the same amount or more tasks with a leaner budget. Many offices were so short-handed that they simply hadn't even thought of how they would cope. Many were so backlogged that they would not even want to hear about changing their work habits or learning new technologies that would help them cope with their workloads. We helped them realize that they needed to streamline their systems and become more efficient in the use of their staff. We also helped them realize that by using the technologies available to them, they might at first see a decrease in productivity because of learning curves, but would soon see a tremendous gain in productivity that would allow them to structure their offices and task assignments in a more effective way. And we gave them our unconditional support and help through the learning period.

Overcoming the Daily Routines: Leaving Room for Planning

One of the biggest obstacles we encountered when helping our users plan for better office systems was the remark "I just don't have time to talk to you right now!" And they didn't! We could see firsthand how overworked some of these people were. In the Dean of Student's Office, for example, we found that we could not speak to anybody for longer than 1 minute before being interrupted by telephone calls. Soon we realized that most of these telephone calls were redirected to the Registrar's Office or to the Admissions Office. So the first suggestion we made was to put an answering machine on the telephone to screen these calls. IT WORKED! Even though they did not quite get an answering machine, they did purchase new telephones with features capable of rerouting calls. This interim solution was preferred while waiting for the campus-wide implementation of voice mail for administrative use during fiscal year 1994.

Involving our Buddy: The CRP

We have a network of "buddies" in place on our campus. They are our departmental contacts and we refer to them as the department's Computer Resource Person (CRP). The CRPs are trained thoroughly in computing applications and receive preferential treatment from CNS in terms of support. In turn, they provide CNS with a resource to funnel information for dissemination to the users and back to CNS. Since the CRP knows the business environment of the department, we work through the CRPs to find systems suitable for automation. They are present during all meetings with the department and are the channel through which we report progress to the department.

Asking the Right Questions and Getting the Right Answers

When thinking about office automation, it is imperative that the Office Systems staff know how to receive correct information from the users. Asking the right questions is therefore key. We make a concerted effort to avoid using computer jargon and to talk business rather than technology. Using this approach has given us many opportunities for opening communications with other departments on campus and often puts two people together to solve issues without our help. For instance, when we interviewed the CRP of our College of Engineering, we learned that one of the secretaries rekeyed into a word processor all the recruitment information received from the Admissions Office about minority students. We spoke with the Admissions Office and asked if this information could be obtained in electronic format. The answer was "certainly."

Is Management Support Necessary?

Attempts to obtain management support for our automation projects have been successful in varying degrees. We found that the degree of departmental management involvement is correlated to the project's successful implementation. Even though most requests come to us from the clerical staff, our most successful projects have been those in which we have involved management from the very beginning. If management is not sold on the process, the projects will not be successful, and a lot of time and energy will be wasted.

What About Funding?

Office Systems staff do not help departments obtain funding for automation projects. We do suggest avenues for the department to pursue to obtain support and funding. One alternative may be to spread implementation cost over more than one fiscal year. Another option may involve requests for grant money matched with department funds. We found that once a department believes in the benefits of the automation project, they will find the funding for it. It is the duty of Office Systems to provide the department with a complete and realistic cost analysis for the project, and to make sure there are no financial surprises during its implementation.

Don't Forget to Implement the Project: Doing It As You Go

As a rule, we take care of tasks not requiring funding during the project analysis period. This "instant gratification" approach encourages the department to continue the project and see it through to completion. Once funding is obtained and the project implementation stage has been reached, we find that we need to make sure implementation goes smoothly and as planned. We monitor progress through the CRP and provide the department with our assistance if deadlines are not met. All too often, departments "forget" implementation deadlines when workloads peak periodically during the semester. While we accommodate these peaks in our project plan, we find that users forget to pick up where they left off after the peaks have passed. We make sure that they continue implementation by offering our help during these periods.

The Process

Background

Before Office Systems begins working on an office automation project, we have a staff meeting and brainstorming session to decide how to approach the project(s). Our objective is to make recommendations for improving office functionality and promoting usage of the facilities and information available to the departments on the central mainframes. We use the following steps as a guide for conducting a successful needs analysis.

Steps Involved in Accomplishing the Objectives

Step 1: Interview all staff members.

Before the project begins, a letter is sent to the CRP (the computer resource person within the department), along with a list of questions we plan to ask. The CRP is instructed to give a copy of the questions to each staff member. The CRP is also involved in scheduling the interviews and may attend each interview, if desired. A sample of the questions we ask is provided in your handout materials.

Step 2: Write preliminary report.

Our findings are compiled during the next month or so, and a preliminary report is written. The report is returned to the CRP to verify that we made an accurate depiction of their office procedures.

Step 3: Perform walk-through with selected CNS staff.

The walk-through is an informal meeting with members of the Computing and Network Services staff. During the walk-through, we review the preliminary report openly and brainstorm alternatives to our recommendations. Members of CNS provide information on what data is available on the central mainframes, and how the department can utilize it effectively. Connectivity issues are also discussed, if necessary. This walk-through helps assure that our recommendations are in line with CNS's long-term strategy.

Step 4: Conduct interviews with departments interacting with the College or Department.

Commonly, the department being analyzed interacts with one or more outside departments on a regular basis. In this step, we meet with staff member(s) in the other departments so we can determine solutions that will be in the best interest of all departments involved.

Step 5: Include recommendations and cost analysis in the report.

In this step, we revise the preliminary report, considering the findings from the walk-through and notes from the outside departments. Also, new equipment recommendations and connectivity needs are included. Finally, we determine the approximate cost of the project.

Step 6: Submit final report and implementation plan to the Dean or Department Head.

The final report is submitted for approval to the Dean or Department Head. If they agree with the plan, then implementation can begin.

Step 7: Find funding sources and obtain funding.

Most departments don't have the money readily available to fund these improvements. So, in these instances, we present our recommendations to the Department Head, who can use it as justification to request funding from their superiors or other suggested sources. Sometimes the Provost's office agrees to fund a portion of the project.

Step 8: Implementation.

This includes everything from ordering new equipment to submitting work orders for data line installation, to installing software and training the users. The time frame for this step is entirely dependent on what needs to be done. It can sometimes take over a year to complete. Finally, a turnover letter is sent to the department to mark the project end.

The Case Study

Overview

The Dean of Students Office (DOSO) consists of four professional staff members, one non-professional support staff member, and two secretaries. The office provides numerous services to students at the University and is also responsible for handling judicial matters. When the new Assistant Dean of Students joined the staff in 1990, she noticed the large amount of manual work that was involved in tracking a judicial referral through "due process" and thought that there must be an easier way to do it. She also found it difficult, if not impossible, to gather statistics on current cases for her regular meetings with the Judicial Council. Then after losing one of her support staff members, she called on the Office Systems group to take a look at how her office conducts business.

Observations

The following is a list of the major responsibilities of the Dean of Students Office:

- Track Judicial referrals and due process
  Includes scheduling pre-hearings, hearings and related appointments, and preparing *ad hoc* reports and end-of-year statistics
- Track off-campus tickets issued against students
- Process student withdrawals
- Track crisis data
- Maintain office staff sick and vacation records
- Answer telephones and direct calls

We found that most of these functions are performed manually, with an over-abundance of forms and paperwork shuffled within the office and to other departments. The specifics of our research and our recommendations are described below.

Tracking judicial referrals through the "due process" cycle is perhaps the largest and most time-consuming function of the Dean of Students Office. The office receives official complaints which are hand-recorded on a Judicial Referral Form. The referrals usually come from Public Safety (our university police) or Housing and Residence Life, but can be initiated by anyone. Once a complaint is recorded, due process begins.

Each step of due process is tracked manually using the Judicial System Tracking Form. The office staff are using a database to a limited extent to record information, but an application has not been implemented to track the status of a case as it progresses. Approximately thirteen yearly statistical reports and at least one monthly report of current cases are manually prepared (hand-counted).

The Office of Housing and Residence Life (HRL) works in cooperation with the Dean of Students Office. If a case is referred to the DOSO by Housing, it is tracked by both offices. Although the official file resides with DOSO, HRL keeps a photocopy of the file contents for their own records. If a case is referred to DOSO from another source, then Housing does not keep a record of it. This communication gap sometimes results in a student being issued a sanction by the DOSO without HRL's knowledge (behavioral history is an important consideration when issuing subsequent sanctions). HRL uses a simple database on their own Local Area Network to record case information, but no electronic means exists for the departments to share data. Student files are hand-delivered daily between the two offices.

When a student is charged with an offense by off-campus police, the DOSO is also notified. The DOSO retains a copy of the ticket and sends a notification letter to the student. About 200 off-campus tickets per semester are recorded using a WordPerfect file. However, WordPerfect's full features (*i.e.* Sort and Search) are not utilized when reports are generated, and the data is not organized in any logical order. Crisis situation data is also kept in a WordPerfect document, and, like the off-campus charge data, reports are compiled manually and unsorted.

Student withdrawals are also handled by the Dean of Students Office. When students want to withdraw from the University, they must fill out a form at the DOSO. Then they are advised to personally notify Financial Aid, HRL, and some other departments of their intent to withdraw. An eight-part Withdrawal Notification form is then manually typed by the secretary and distributed to the following: the student, DOSO, Records and Registration, Accounts Receivable, the Academic Dean, HRL, Financial Aid, and Dining Services. A monthly list of all withdrawn students is prepared manually and distributed to eighteen departments.

Miscellaneous office duties of the secretaries include answering telephones and directing calls. The office has eight phone lines. The phones are extremely busy, and many of the calls are directed to another appropriate department. One secretary is also in charge of maintaining the vacation and sick leave records for the staff members. These are kept on handwritten charts -- one per employee.

The secretaries are also responsible for scheduling pre-hearings, hearings, and appellate hearings with the Dean and Assistant Deans. This is all done via paper calendars. Individual calendars are typed up daily for the Dean and Assistant Deans.

Each staff member has a PC with mainframe access; however, these machines are not used to their best capabilities. The Dean, for instance, was using an IBM Model 55sx for electronic mail access only, while his secretary uses an IBM Model 30 for word processing and spreadsheets. The oldest of their equipment was an IBM XT, which is used by the staff assistant.

Recommendations and Justification

We recommended the following be done to help automate the Dean of Students Office procedures:

Provide each member of the Dean of Students staff with a desktop computer with LAN and mainframe access.

Develop a LAN database application to track judicial referrals using R:Base 3.1. This includes developing an official information policy between DOSO and HRL to determine who has the right to access information handled by DOSO and HRL.

Develop a means of tracking off-campus tickets and crisis data using R:Base.

Develop an automated means of notifying the necessary departments of a student withdrawal.

Purchase WordPerfect 5.1 for office staff for use with VASS (Vacation and Sick System) to track staff vacation and sick leave.

Purchase R:Base 3.1 LAN 5-pack.

Evaluate an automated telephone answering system to direct calls.

Provide training to the staff members.

Since each member of the DOSO staff already had a PC with mainframe access, it was not necessary to make major hardware purchases. There was already a Banyan network in place in the DOSO's building (and HRL owns their own Banyan server), so the PC's only required token ring cards to connect to it. There was, of course, a connectivity charge for this. The only system that needed to be completely replaced was the oldest PC/XT, which was incapable of running the latest R:Base version efficiently. Other PC's would be swapped around the office to make the most of their functionality.

We also recommended they purchase WordPerfect 5.1 and R:Base 3.1. Our campus has been somewhat standardized on these vendors for many years now. The Office Systems group developed a macro, using WordPerfect 5.1's Table feature, to track employees vacation and sick leave. Since the DOSO and HRL already had data in older versions of R:Base, we recommended they continue using that product to develop the new and improved judicial tracking database, which would also include the off-campus offenses. The crisis data, which was already kept in a WordPerfect file, could be easily imported into a separate database, also within R:Base.

The electronic mail package that is most widely used by the administrative users on campus resides on our IBM mainframe and runs under TSO. This package includes a calendaring system, bulletin boards, conferences, and the ability to use electronic forms. Thus, two of the DOSO problem areas could be addressed by simply utilizing the tools already available on the mainframe. By granting the secretaries access to the appropriate person's e-mail account, they could easily schedule appointments and print daily calendars on the fly. We recommended that an electronic form be developed to notify the necessary departments via e-mail of a student's intent to withdraw from the University.

We also recommended that an automated telephone answering system be evaluated so most calls could be directed without secretarial input.

Implementation

The first step of implementation was to obtain the necessary funding. We presented our report to the Dean of Students stating our findings and recommendations, as above. The Dean used our report as justification to ask his Vice President for the funds. His Vice President agreed.

Once funding was acquired, Office Systems prepared the requisitions to order the hardware and prepared the work orders for the Data Communications group to do the wiring. Upon delivery, we set up the equipment, loaded software and swapped machines among users. We conducted one-on-one training sessions to get the users familiar with the Banyan environment. We also provided a custom R:Base training course for the DOSO staff members, which incorporated their own data into the class exercises.

Office Systems supplied a development team to design the new judicial database system. This new system has been in use for about two years now. The Dean of Students staff members have taken enthusiastically to it and strongly depend on it. As the staff members have become more familiar with R:Base, they are able to create their own *ad hoc* queries and reports quite painlessly. Office Systems provides support, along with some updates and enhancements.

Once the judicial database was fully functional, HRL was granted access to the DOSO server to query the data. Although HRL has not developed their own shadow system of the data, they have on several occasions exercised their new query privileges.

Office Systems also developed an automated fill-in form, which is used to notify departments and colleges of a student's intent to withdraw from the university. The electronic form is sent to 24 recipients, and only one hardcopy record is maintained in the DOSO files. This new procedure has drastically reduced the paper flow between offices, and each office is responsible for keeping its own records of withdrawals.

After some preliminary research, our recommendation for an automated telephone answering system was ruled out because of its extensive cost. As an alternative, new phone sets were installed in the office which offered more features than a standard push-button phone. We are awaiting implementation of a voice-mail system, which the University plans on making available to staff and departments sometime this fiscal year.

Conclusion

The Dean of Students Office is only one of the several projects that has been successfully implemented by the Office Systems group during the past two years. Other departments served are the College of Physical Education, the College of Education and the Department of Music. As the news of our successes spreads across campus, we have been approached by more users who require automated solutions for both big and small projects.

TRACK III

THE IMPACT OF QUALITY

Coordinator: Constance F. Towler

Total Quality Management, in one form or another, is being adopted by many IT organizations today. The impact of this process can cause a dramatic change in the way we manage our organizations. How will we handle these changes?

The Impact of TQM on an IT Organization: The First Eighteen Months

Paul Morris
Tufts University
12/6/93

1. Institutional Background of Tufts

- Private university, research and teaching
- Decentralized: 7 Schools plus Central Administration
- 4,300 undergraduate; 3,000 graduate
- Budget: $270 million
- Central IT budget: $9.5 million, staff of 80
- Academic, MIS, data communications, telephone

2. Problems needing solution, which led us to consider new alternatives such as TQM:

- Declining real budgets
- Increasing demands for IT services
- TCCS not well perceived by users
- Staff under stress, felt unappreciated

3. My expectations of TQM as I started TCCS down that road

- Improve customer orientation
- Means of motivating staff
- Way of developing priorities
- Empowerment of staff through participation in decision-making about their jobs
- Set of tools for focusing on customer needs

4. Self-preparation before getting started

- Attended GOAL/QPC conference (12/91) (a local research, training and consulting organization)
- Read Walton's "Deming Management Method" (but did not adopt the Deming set of issues)
- Attended 3-day course at GOAL/QPC
- Attended 6-day course at CQM (Center for Quality Management: information-sharing consortium of local corporations using TQM)
- Joined CQM University Affiliates, which provided networking with other local universities and industry practioners

- (after a year) taught course in TQM

5. First TCCS (Tufts Computing & Communications Services) activities

- Started talking to TCCS managers about TQM
- Tried using some policy-level tools - failed, due to inadequate training of myself and managers. Should have started with something simpler (like KJ's)
- Focus Groups to analyze Voice of Customer (9/92)
- Used KJ analysis to identify major themes
- Analysis done by 14 TCCS managers and supervisors - to build their sense of ownership, and develop some faith in TQM tools

6. What the VOC analysis told us

- Not meeting customers' expectations for service
- TCCS does not understand customer needs
- TCCS does not understand customer environment
- Eight major themes for improvement (next topic)

7. Eight Task Forces

The mission of these are:

- Develop senior University-wide commitment
- Inform customers of services provided
- Establish feedback channels for customers
- Develop desktop support strategy
- Develop service-level agreements with customers
- Improve customers' access to transactions data
- Improve Help Desk/Customer Service Center
- Broaden skill set of staff

To illustrate the sorts of things we have been doing, I shall discuss the Desktop strategy group:

8. "Desktop Support" - the Problem

- Taskforce: 4 senior managers (this was not a multi-level TQM-style group, because the initial issues were policy-related rather than operations-related)
- Identified key customer complaints
  - who to call
  - do not like talking to a machine

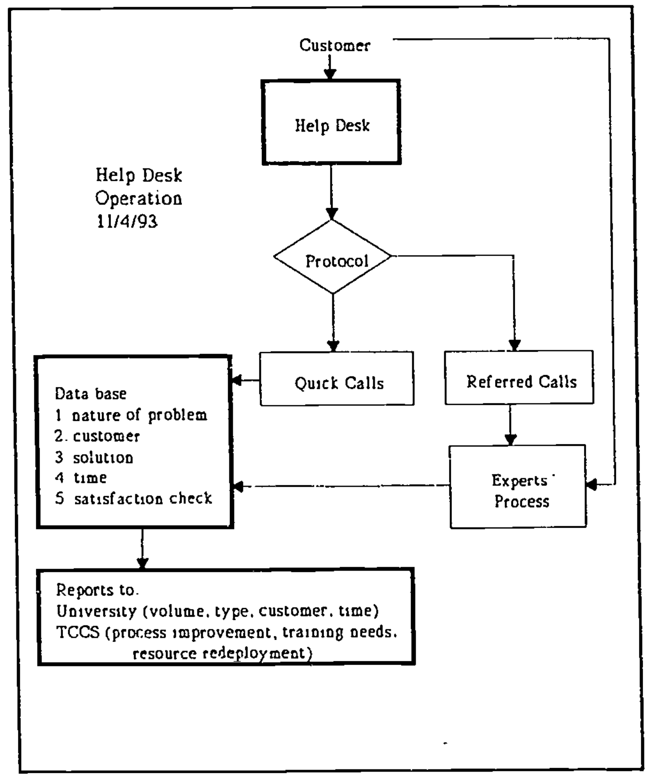
- o takes too many, different people to solve problem
- o service unreliable, takes too long
- o poor communication about what is going on

9. "Desktop Support" - Progress

- Developed process based on existing Help Desk
- Data collection
- Problem tracking
- Performance reporting

10. Help Desk

We have focussed on, and strengthened, the staffing, training and processes of the Help Desk:



- Transferred, trained staff from other areas
- Implemented Automatic Call Distribution - feature of telephone system
- System "knows" who is available (staff "log in")
- Data on volume, times, etc. automatically collected
- Made better use of existing tracking system (running on VMS now, will move to LAN)
- Monitoring and Reporting features now being used more actively
- Weekly management review of trends, unsolved problems.

11. "Desktop Support" - Issues Still to be Addressed

- Still no agreed list of "Things We Don't Do"
- Need FAQ list, solutions database as part of Help Desk resources
- Desirability of same process for all experts?
- We expect "Continuous Improvement", so we will always be looking for ways to do things better.

12. Central Administration's TQM Program

TCCS's TQM program is happening at a time when Central Administration (of which it is part) is also experimenting. Its program is named "TQ3" for its three objectives:

- Continuous improvement of services to customers
- Improve the way Central Admin operates (greater efficiency)
- Improve skill levels and job satisfaction for all levels of staff

13. TQ3 activities

The TQ3 Steering Committee has devloped a plan, and launched a number of initial activities within Central Administration:

- Senior management training
- Middle management training
- Communication via TQ3 Newsletter
- QI Team training
- QI pilot projects

14. TQ3 Pilot Projects

To test our ideas, and in particular the Seven Step Problem Solving method, a number of Pilots have been launched, one in each Division of Central Administration, and the last one in the Vet School:

- Reduce cycle time to generate P.O. from requisition
- Reduce cost of purchased vehicles by buying them used
- Reduce cycle time for hiring research assistants
- Reduce time required to answer payroll inquiries
- Reduce number of lost or incomplete records in Animal Hospital

15. Process for QI Teams

The QI teams are using the CQM methodology, assisted by Joiner's "Team Handbook":

- Seven Step Problem Solving
- currently at Steps 2 & 3: Data analysis, Causal analysis
- KJ analysis - qualitative data, focus on identifying underlying weaknesses

16. Results so far?

In TCCS:

- Customer needs now the official touchstone
- Projects, priorities try to reflect customer needs
- Help Desk project making encouraging progress
- Internal Training Committee making progress (on broadening staff's skill set)
- Management-by-fact making progress
- Still a long way to go

TQ3 Pilot Projects:

- Enthusiasm on QI Teams so far
- Results in January

Lessons Learned:
Warning: Anecdotal Evidence, sample size 1!

17. Cultural Change depends on New Processes

Talking about TQM, and asking for attitude change, will not work unless you give staff new processes to work with:

- If existing processes are not producing customer satisfaction, it really is management's fault
- Don't expect staff to provide better customer service without working with them to improve processes
- Focus on processes, not on individuals
- Listen to staff about why they are not meeting customer expectations
- Using the tools, and seeing them work, is critical to cultural change

18. Control IT Staff's Expectations

- TQM is not a panacea
- Change will happen slowly, over several years
- Stress "participation in deciding how to do your job"
- Stress **not** "participation in policy-making"
- Staff participation means some loss of control for managers
- Must tolerate other depatments who are not implementing TQM

19. Beware of Strangers

In trying to interest people in TQM, I have made the following observations:

- Very few people want to hear about the Japanese
- Japanese-style jargon offers an excuse for rejection
- Very few people want to hear about corporate successes
- Corporate-style justifications offer an excuse for rejection
- Most people want to hear that a school just like yours solved all their problems with TQM successfully, quickly and with no pain

19. A University-wide TQM Program Needs:

Based on a year's experience with the senior Central Administration managers, TQM needs:

- an agreed vision by top managers
- agreed expectations and objectives by top managers
- a link to local industrial practitioners (to be used discreetly)
- plenty of time and patience
- a variety of perspectives and expertises
- a balance of analytical tools and human relations skills

20. Difficulty of Bringing about Change

The following are obvious, but I have encountered all of them in the past year:

- Avoid unrealistic expectations on results, time, effort
- Expect progress to be S-L-O-W
- Constant re-inforcement needed
- Words, attitudes and actions must all be embody what you preach
- Not everyone will share your vision
- Not everyone will trust your motives

21. An Act of Faith: TQM is Worth Doing!

STRATEGIC PLANNING AND BUDGETING FOR INFORMATION TECHNOLOGY

prepared by:

Charles R. Thomas and Dennis P. Jones

INTRODUCTION

Strategic planning can enable an institution to take advantage of new and different opportunities in the future while minimizing the negative impact of unexpected challenges along the way. In this time of rapid technological change, strategic planning can also provide great opportunities in the use of information technology to support the mission and goals of colleges and universities. The planning effort must, however, be conducted within the framework of the institutional planning process and must consider the institutional culture, history and resources.

While many institutions engage in strategic planning activities at the campus level, few have extended those activities to the information technology units, and even fewer have linked them to budgeting and operations. The strategic planning process described in this paper is not revolutionary, in fact it has been used by dozens of institutions. The unique addition is the integration of *budgeting* at the strategic level. The purpose of this paper is to present a detailed framework for the implementation of a strategic planning and budgeting *process* for information technology that ensures policy level attention to the resources required to achieve strategic objectives. This approach involves close work with the appropriate institutional policy committee supported by staff work from the information technology unit. It is important to note that while outside assistance can bring a broad perspective and knowledgeable opinions to the process, and an outsider can serve as a catalyst to keep the process moving, the strategic planning process must be "owned" by the institution.

DIMENSIONS OF STRATEGIC PLANNING

The strategic planning part of the process described is based in part on "*Strategic Planning for Computing and Communications*[1] by Penrod and West, and generally follows the model developed by Dr. Robert Shirley[2]. The following important dimensions of planning for information technology cited by Penrod and West are based on a list compiled by John Moynihan.[3] and modified to fit the higher education environment. Planning for information technology should:

1. be a *formal continuous process*, have the support of senior administrators, use up-to-date planning methods, and result in documented output publicized to the institutional community;

2. be *eclectic,* choosing the best features from a diverse set of resources;

3. include a *review of the mission and the organization* of academic computing, administrative information systems, and telecommunications;

4. be *broad but bounded* in scope by economically and technically feasible solutions;

5. *involve* senior administrators, representatives of major client departments, and information technology staff members;

6. involve the identification of potentially *important technologogical developments* and recognize when those developments make the transition from "state of the art" to "state of the market";

7. address the *technical and managerial assets* of the information technology units through an analysis of strengths and weaknesses;

8. formalize an *organizational architecture* that addresses all departmental levels of the institution;

9. formulate an organization-wide *information architecture* on which all institutional application systems are based; and,

10. result in an organization-wide *technical architecture* that includes hardware and software platforms for voice, data, and image networks;

11. develop a collegial process for selecting an *organization-wide tool set* for both academic computing and administrative application systems development.

12. be *driven by institutional problems and opportunities* and by *client office needs* rather than by technological developments;

THE PLAN TO PLAN

Before undertaking to develop a strategic planning process for information technology, it is important to have the commitment and support of the institutional leaders. The best way to achieve this is to have a very understandable *Plan To Plan*, to communicate that plan to the appropriate individuals on the campus, and then encourage participation in the process. In the collegial environment, the involvement of the right people in the right processes at the right time can do much to ensure success.

An effective planning process should be consciously and formally organized. Both the administrators and the support staff should have formally assigned planning responsibilities[4]. To this end, a well thought out *plan to plan* can enable an institution to reach consensus on a planning process with a minimum number of false starts. In the follow paragraphs present a suggested set of activities for the plan to plan.

1. Conduct an on-campus workshop on strategic planning for top administrators and advisory committee members. The purpose is to establish a base set of knowledge about the state of information technology and strategic planning efforts at other colleges and universities. This workshop should follow the general model for strategic planning and emphasize the linking of strategic planning for information technology with the institutional planning process. The workshop should cover the basic concepts of *data versus information; the array of managerial actions; decisionmaking styles and the differing roles of information; and the application of a strategic planning model to a unit within an institution.* Other areas such as the external environment, both technical and non-technical should be covered, as well as the major strategic planning issues.

2. Gather strategic plans for information technology from other appropriate institutions to serve as examples.

3. Develop and summarize an overview of the strategic planning and budgeting process and the steps appropriate for the institution.

4. Develop a policy and advisory committee structure for information technology, including:

    a. Committees and specific charters. Gather and consider example committee charters from other institutions.

b. Determine committee chairs and representatives based on examples from other institutions of comparable complexity and size.

c. Develop committee appointment and operating procedures within the structure of existing institutional committee guidelines. Clearly document these procedures.

5. Develop an academic computing seminar agenda appropriate for the institutional culture, then identify topics for discussion, moderators, and participants.

6. Develop an administrative computing seminar agenda, then identify topics, moderators, and participants.

It should be obvious, but be sure to obtain approval for the *Plan to Plan* from the appropriate institutional administrators before proceeding with the orchestration of the full planning process.

THE STRATEGIC PLANNING PROCESS

The following paragraphs suggest the steps necessary to develop an ongoing strategic planning process for information technology for the institution. Institutional documentation and procedures for the process should be prepared in cooperation with institutional staff who will be responsible for accomplishing them.

1. *Establish the planning parameters.* This process determines who does what and how the planning process for information technology will relate to the institutional strategic planning process.

2. *Assess the external and internal environments.* Since these assessments may be conducted at varying levels of detail, it is important to determine the level of effort for appropriate the institutional culture. Analysis of the external environment should identify and assess major forces in the economic, social, technological, political and legal, demographic, and competitive areas that will present specific opportunities, threats, and constraints to the institution. Assessment of the internal environment includes identifying the strengths and weaknesses of the organizational resources such as human, physical, technological, and financial.

3. *Determine institutional and constituency values.* Include solicitation and documentation of perceptions of and expectations for both academic and administrative computing in the planning for this step. Conduct campus interviews with all of the major technology clients and document their opinions.

4. *Identify areas for strategic decisions.* The specific areas typically addressed in this step are: organizational mission, clientele, goals and outcomes, service mix, service areas, and, comparative advantage. Discuss the strategic decision areas in the planning committees, then review staff descriptions of alternatives in each of the six areas. Address alternative organizational structures, as well as the institutional hardware and software environments and the academic and administrative applications portfolios.

5. *Develop functional and operational strategies.* This step deals with how each of the strategic information technology issues will be addressed, by whom, and through what processes. Base discussion and suggestions for descriptions of the functional and operational strategies on successful models from other institutions. Develop and document specific action plans for each of the major information technology organizational units.

6. *Develop strategic objectives for the planning year.* The final step of the strategic planning process is to come to agreement on a set of strategic objectives for the planning year. These objectives include development and/or acquisitions of new information technology products and services as well as maintaining and improving existing systems. It is important to allow for iteration in the planning process, since many times other institutional units develop objectives that create information technology objectives that may well be unbeknownst to the information technology unit.

THE STRATEGIC BUDGETING PROCESS

Executive and top level policy committee involvement with the typical strategic planning process ends at the point of agreement upon objectives, leaving operational units to accomplish what they can within limited or reduced resources. Responsibility for achieving the objectives then shifts entirely to the operational managers

While it may seem relatively simple and somewhat mechanistic, this strategic budgeting process explicitly focuses executive attention on the activities and resources necessary to successfully meet the objectives. This is accomplished by using a series of steps that relate resources required for operational activities to agreed-upon objectives. The process allows value judgments on resource allocation and trade-off decisions to be made at a strategic level before operational projects are undertaken rather than being forced to make costly mid-stream adjustments when resources will not stretch to cover over-optimistic objectives, or when in-process operational failures occur.

The first step in the process is to briefly describe and identify all of the agreed-upon strategic objectives for the planning year. These objectives are then listed across the top of a standard spreadsheet. After agreement upon the objectives, all information technology activities required to achieve those objectives, as well as all on-going activities, are briefly described and identified, then listed down the side of the Objective-Activity Matrix. After constructing the basic matrix, a "1" is then placed in the spreadsheet cell under each objective supported by each activity as shown in Figure 1. The first pass at this exercise can be completed by information technology staff, then reviewed by the appropriate strategic planning committees.

	Objective-1	Objective-2	Objective-3	Objective-n	Total
Activity-1	1		1		
Activity-2	1			1	
Activity-3			1		
Activity-4					
Activity-n	1		1	1	
Total					

Figure 1: Objective Activity Matrix 1a

After all objectives and activities have been entered in the spreadsheet, the Objective-Activity Matrix is then summed vertically and the bottom line checked for totals of zero as shown in Figure 2 below. Any objective indicating zero supporting activities obviously cannot be achieved, so must either be eliminated, or have supporting activities added to the list.

	Objective-1	Objective-2	Objective-3	Objective-n	Total
Activity-1	1		1		
Activity-2	1			1	
Activity-3			1		
Activity-4					
Activity-n	1		1	1	
Total	3		3	2	

Figure 2: Objective-Activity Matrix #1b

After all zeros on the bottom total line have been eliminated, the Objective-Activity Matrix is then summed horizontally as shown in Figure 3 below. If any activity indicates zero objectives supported, either there is an unlisted objective, or there is some question why that activity exists. In most cases, an ongoing objective has been overlooked.

	Objective-1	Objective-2	Objective-3	Objective-n	Total
Activity-1	1		1		2
Activity-2	1			1	2
Activity-3		1	1		1
Activity-4					
Activity-n	1		1	1	3
Total	3	1	3	2	

Figure 3: Objective-Activity Matrix #1c

Once all zero totals have been resolved, the resources required for each activity are identified, both dollars and full-time-equivalent (fte) staff. Allocation percentages for activity resources are then estimated and entered for each objective supported as illustrated in Figure 4. These two exercises are usually accomplished by information technology staff, then reviewed by senior administrators and the information technology policy committee.

	Objective-1	Objective-2	Objective-3	Objective-n	Total
Activity-1					$ fte
Activity-2					$ fte
Activity-3					$ fte
Activity-4					$ fte
Activity-n					$ fte
Total					

Figure 4: Objective-Activity Matrix #2a

After resources are allocated and summed vertically, the estimated costs for each objective are displayed as shown in Figure 5 below. Value judgments can then be made by the information technology policy committee as to the costs and benefit of each objective. If the estimated costs shown in the lower right hand corner of the Objective-Activity Matrix exceed those available, value judgments can also be made as to which objectives should be modified, postponed, or dropped.

	Objective-1	Objective-2	Objective-3	Objective-n	Total
Activity-1	$ fte		$ fte		
Activity-2	$ fte			$ fte	
Activity-3		$ fte	$ fte		
Activity-4		$ fte		$ fte	
A\ctivity-n	$ fte		$ fte	$ fte	
Total	$ fte	$ fte	$ fte	$ fte	$ fte

Figure 5: Objective-Activity Matrix #2b

CONCLUSION

Recent technological developments in both computing hardware and software present dramatic opportunities for colleges and universities, but planning and preparation are required to capitalize on those opportunities. The current industry emphasis on campus-wide networking, client-server computing, and the graphic user interface require major changes in traditional institutional computing and communications environments, but these changes will not happen without executive involvement and leadership. The process of strategic planning and budgeting described in this paper can focus institutional attention on the appropriate institutional issues, and with institution-wide involvement, formulate a common vision for information technology.

Footnotes:

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3. John Moynihan, "Propositions for Building an Effective Process," *Journal of Information Systems Management* 5, no. 2 (Spring 1988): pp. 61-64.

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IMPLEMENTING A NEW SYSTEM ON TIME IN BAD TIMES

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Abstract

In 1991, the Student Information area of the University of Connecticut Computer Center faced many problems. There was very little documentation, many jobs were not in production and being run as 'test' jobs from programmers' machines, and the staff had no overall knowledge of the projects under development. In addition, bad economic times had resulted in the loss of many knowledgeable personnel.

In the midst of these difficulties, the student information group was assigned the task to implement a university-wide touch-tone registration system.

In order to cope, we restructured our group to insure rapid development and first-time perfect operation of the new system. This paper will discuss our new standards and procedures, the problems we have encountered, and the progress we have made toward achieving the goal of installing a touch-tone registration system which would work perfectly the first time.

IMPLEMENTING A NEW SYSTEM ON TIME IN BAD TIMES

INTRODUCTION

In the Fall of 1991, in an effort to cut down on payroll expenses to the State of Connecticut, University of Connecticut employees were encouraged to take early retirements and voluntary layoffs rather than face mass firings.

The loss of staff within the University community resulted in greater demands on the computer center for additional computerization of University office functions to increase University efficiency; the loss of highly knowledgeable staff within the computer center made meeting these demands more difficult. Since there was no possibility of replacing lost positions for the foreseeable future, Administrative Services decided to consider the possibility of restructuring its staff in the hope of becoming more efficient.

In December, 1991 Administrative Services was restructured to consist of 3 teams of programmers each headed by a Team Leader. Each team would be responsible for multiple projects and team members would move from project to project within the team, depending on need. Team 1 was assigned student and academic applications, including the student information system, the auditing/advising system, and the new (yet to be programmed) touch-tone registration system. The team consisted of 2 senior programmer analysts (one of which was made team leader), 3 programmer analysts, and 1 programmer (transferred from production support).

Although the main impetus for using the team approach was the need to restructure due to the loss of personnel, Team 1 viewed this change as an opportunity to improve the overall student information system. Over the years, many of the team members had voiced concern about some of the ways we operated. With the formation of this team we decided to review the concerns we had, rank them and develop a plan for improving the way we worked.

CURRENT SYSTEM PROBLEMS

In meeting with the team, three main areas of concern were identified: personnel concerns, current system concerns and new system concerns.

The loss of 3 key members involved with student information systems in November, 1991, meant a loss of 60 years of combined experience. The manager who left had written many of the original student record systems programs which were still part of the newer system. His loss meant that any problems with or changes to these programs would create a problem for the computer center staff. The project leader who left was a trusted member of the University community. She served as a primary interface with the various departments, and was very knowledgeable in their needs. The primary analyst who left was the person involved with maintenance of the files, and who oversaw grade processing. Also, he was the person who had investigated the purchase of a voice response system for the new registration application.

By November, 1991, the morale of Team 1 was at an all time low. Not only did they have to deal with the added stress of increased work loads, frozen salaries, and lack of certainty about the future, but they also had to deal with the fear of failure due to lack of knowledge (regarding both specific tasks, and a general overview of the entire system).

Because of the prior stability of staff and the number of staff members involved in the student/academic systems, the computer center had allowed itself the luxury of permitting specialization. The staff member who was initially involved in a particular programming task was later the person to be involved with any modifications or problems dealing with that program(s). In short, we had permitted 'ownership' of information. This practice was beneficial in enabling us to do tasks quickly, but the lack of cross-training backfired when we lost programmers involved in some of the major areas. Given that there was no hope for new staff, and that no current staff member was familiar with the overall student record system, it was time for us to require a broader knowledge base of the staff, and to begin a program of cross-training.

In our team meeting discussions several major problems emerged. The first problem that we noted was that not all jobs were in production. (Only production jobs are scheduled by the user through the scheduling office.) Some jobs were still in the 'test' library and were being scheduled by a programmer at the request of a user. Other jobs were being run by programmers from a programmer's machine at a user's request. Also, many "errors" were being corrected "on the fly" without being logged in via a service request. This practice permitted undocumented modifications on user demand without factoring in other requests for programmers' time.

The second problem we encountered was the lack of documentation (or minimal documentation) of the system (jobs/programs/interfaces). This meant that anyone other than the programmer who was initially involved with the job/program/interface would have difficulty determining the nature of any problem and method for proceeding when a problem developed.

The third concern with the current system involved grade processing. This had always been a major effort by the computer center. It had been handled by two of the members of the staff who had recently left, and required all night overseeing by them. It was a process which rarely (if ever) ran smoothly, although the specifics of what went wrong were not known, as the procedures involved had not been documented. Grade processing was next scheduled for December 30, 1991 (1 month away from the time of re-organization), and would require the team's immediate attention.

Despite the financial problems at the University, the administration continued to maintain its strong commitment to the need for a touch-tone registration system. The then current system of processing pre-registration requests using a batch system and handling over 7000 students at add/drop using punched cards was no longer considered acceptable. Although some online capability already existed for the regional campuses and the continuing education office, this capability was not available at the Storrs campus. In addition, a 'promise' had been made by staff members who had since left that it was feasible to have a new registration system up and running by August, 1993. There was not a single computer center staff member remaining who had been involved with the touch-tone project. Although a general plan existed, no detailed analysis of any of the 'subfunctions' of the system was available.

To have any chance of meeting this new challenge, it was necessary to move immediately to ascertain what needed to be done, what could be done, and the resources required to get it done.

IMPLEMENTING THE TEAM CONCEPT (ASSESSMENT)

In December, 1991, a detailed analysis and plan were prepared for submission to the Touch-Tone Steering committee (consisting of the Associate Provost, members of the Registrar's office, associate deans from several colleges, and computer center staff). The analysis showed all of the tasks required to meet the goal of the original project plan, and a time estimate (in hours) for each task. By reviewing the amount of time team members had spent on previous projects, it was estimated that the team could (at best) devote 70% of its productive time to this new project, and still manage its other functions. Using this information, it was clear that we could not provide all of the functions requested by August, 1993. However, a plan was proposed which called for a phased-in approach to introducing touch-tone registration. The plan called for an online method for handling add/drop for August, 1993, which would eliminate the need for punched cards and reduce the lines of students waiting to change courses. Also, the plan called for a touch-tone tone registration system to be available for add/drop with limited functionality for January, 1994, and a fully functional system available for January, 1995 which could handle not only the add and drop period but also the pre-registration period. It was imperative that the touch-tone registration system be operational within this new time frame; because of the high visibility of the project, it would have to work perfectly the first time.

To address the concerns of the team involving personnel issues, current system issues, and new system issues, and insure the success of the new registration system, the team decided that it would be beneficial to hold frequent working sessions to determine how we would proceed and to keep everyone informed of what was happening.

IMPLEMENTING THE TEAM CONCEPT (GRADE PROCESSING)

We began by reviewing the current schedule submitted by the system administrator from the Registrar's office and the schedule from the computer center scheduling office which showed dependencies and run times for each job. We decided that since we were sufficiently unfamiliar with the process, we would carefully monitor grade processing in December to insure that any problems would be detected as early as possible (hopefully prior to the printing of grade mailers and transcripts).

We determined potential places for failure within the process and decided to back up our files before the running of these jobs as a safety measure. We also discussed how we could know that a particular job was producing the correct results when the job ran successfully. For many of our jobs, summary reports were produced. However no one was looking at the reports until the following day, when the entire grade processing had been completed. These jobs would now be flagged to indicate that the process was not to continue until the reports were read and approved. Jobs which were not producing 'readable' reports were modified to provide better information.

In reviewing the current grade processing schedule we noticed that processing jobs and printing jobs were interspersed, so that jobs which required checking by the user might occur at 2:00 a.m. The schedule was revised to do the processing first and the printing of transcripts, mailers and letters later in the evening, with the expectation that if all the processing was correct then the outputs would also be correct.

Before running the grades, the team did a walk-through of the process and discussed how we would recover if a problem occurred at any stage of grade processing. These recovery procedures and the additional jobs needed for recovery were then documented.

Although we felt we had done a good job in improving grade processing the team decided to be available during our first trial. With pizza donated by our director to fortify us, we watched as job after job ran successfully. We checked all the output summaries, verifying the information reported and all outputs, giving special attention to grade mailers, probation and dismissal letters and transcripts.

The December running of grades was the fastest and best grade processing the University ever experienced. Our future goal was to have grade processing run smoothly without the need for the computer center programming staff overseeing the process. This goal was accomplished the next time we ran the grade schedule, in May, 1992.

Once grade processing was no longer a major concern to the team, we decided to tackle the problem of the current Student Records system. We realized that we could not undertake a major new project if we were going to be constantly pulled away to handle 'problems'. Therefore we needed to put together a plan for minimizing 'problems' so that we could focus on new tasks. It was important to insure that we would in fact devote 70% of our productive time to the new registration system, if we were to meet the deadline that was set.

IMPLEMENTING THE TEAM CONCEPT (OTHER PROBLEMS)

The first item in our plan was to continue our group meetings to discuss problems, issues and overall design objectives. We decided to schedule regular weekly two hour meetings to discuss general issues and to schedule other meetings as needed. The team set the agenda for each meeting, including any questions or concerns they had, and the agenda was distributed prior to the meeting. In addition, a running task list was maintained by the team leader and at the beginning of each meeting outstanding tasks were reviewed to determine their status. New tasks were added to this list as they were assigned to the team members.

We decided that our next priority would be to review every job that was part of the current system, and put all non-production jobs to production status. This review included jobs which were on programmers' machines, test jobs in the test library and pre-production jobs in the test library. During this review we found that in some cases we had several versions of a job. In the past this had created problems when we went to change the wrong version of a job. As a group we determined which was the correct version and deleted all other versions from either a programmer's machine or from one of the libraries. By May, 1993, we had cleaned up the test library and put all our jobs to production status. As part of the process of putting jobs to production status the team re-instated a policy of creating programmer and user documentation to accompany all production jobs. Also, a policy was established that all team members were required to spend 10% of their time creating documentation for 'old' jobs. We decided that this documentation would reside on a special machine to which we all had access, and that all job and program documentation would follow a specified format that we created. One of the team members was assigned the job of insuring that new documentation adhered to the standards and creating an index to the documentation. By July, 1993, we had created 400 pages of new documentation.

Several programmers had noted that they had created 'special' jobs/procedures for handling problems that they had to deal with. These jobs were located on their own machine. To improve the technical competence level of the team we decided that the procedures would be documented and the jobs would be put in the 'test' library. We came up with a naming convention for identifying these jobs and distinguishing them from test jobs which would eventually go to production. Ultimately, this permitted flexibility in assigning 'problem' tasks to programmers. If the documentation was well written and the job/program was available then anyone could solve the problem without the need to 'reinvent the wheel'. Each time documentation needed to be used team members were provided an opportunity to reassess the usefulness and accuracy of the documentation. A programmer who did not feel the documentation was sufficient for his/her needs went back to the programmer who initially wrote the documentation and asked for improvement. In several instances programmers would ask another programmer to review their documentation before it was finalized, rather than have to redo it later. Although the team members initially balked at the tedium of having to create documentation, they have been relieved at knowing that they are now no longer the only people who can handle a given problem.

Another technique used to increase the versatility of the team members was to have one programmer work with another, more knowledgeable programmer on a particular problem. Team members were more willing to take criticism from their fellow team members than from the team leader who would be responsible for evaluating them. This process also promoted the team concept.

IMPLEMENTING THE NEW SYSTEM

In March, 1992, the team began tackling the new tasks for the registration system. Each month we monitored our progress, by using an in-house reporting system called Time Track. Much to our dismay, we discovered that we were not spending 70% of our time on the registration system as we had planned. In analyzing the data we learned two things. First, programmers were spending considerable time responding to *ad hoc* (telephone) requests from users. We also learned that the written service requests from the Registrar's office that were being submitted were not being ranked in priority order. Not only was the time we spent on other tasks affecting our ability to work on the new system, but the constant telephone interruptions from users were causing the programmers to lose concentration when they were working on the new system. Although we had improved our efficiency through proper documentation, cross-training and improved procedures, we now needed to improve the work habits of both the programming staff and users to meet our ultimate goal.

In meeting with the team, several problem areas were identified.

1. Users were interrupting the programming staff with telephone calls which were in fact service requests.

2. Programmers found it difficult to say 'no' to *ad hoc* requests which only took a 'couple of hours' of their time.

3. Because there was no paper trail for many of these *ad hoc* requests, specifications were not finalized prior to programming and therefore what a programmer initially thought would be a two hour task could actually take several days.

4. Usually service requests were not being properly prioritized by the users, so that a 'nice-to-have' enhancement would be sent in with a vital 'must-have', without being distinguished.

Team members felt that while the current system was negatively impacting their productivity, they did not feel comfortable with denying users *ad hoc* requests, even though it was the policy of the computer center to require written requests. The programming staff had worked closely with many of these users, and a good rapport had been established. They felt that it was important to preserve these relationships, and they felt that by denying any request they would jeopardize the good relationships. A suggestion of having all telephone calls go through a central number so that they could be screened was overwhelming rejected by the team. Since many of the team members had young children, they felt it was important to have direct outside phone lines. It was decided that we first needed to educate the users about our policies and how they would be implemented, before we could expect the programming staff to adhere to the policies. The following policies were restated and agreed to by the administration and Registrar's office staff.

1. Telephone calls to programmers would be limited to those required for the implementation of an already assigned service request. The users were informed that programmers would no longer be permitted to spend their time servicing undocumented requests.

2. All requests for service would be handled via a written service request. Any emergencies, which required immediate attention and could not wait for submission of a service request would go though the team leader. (Even emergencies were required to ultimately have a service request submitted and a number assigned to the task for auditing purposes).

3. Until we felt comfortable that we could meet the time line developed, we would only handle vital (emergencies and mandates) requests. Any other service request demanding our attention would require the signature of the Associate Provost before it would be done. This practice would insure even-handedness for the users.

At first the users were unhappy with the rigor that was being imposed, but as time went on, and the quality of our service improved, more and more users directed their call to the team leader and submitted proper written service requests.

ACHIEVING OUR GOALS - A PROGRESS REPORT

As we continued to develop the new registration system we implemented several new techniques which in retrospect were crucial to our initial success.

First, we kept a paper trail of all communication concerning the new system. This was a carryover from requiring a written service request. For the touch-tone project we decided to request sign-off of written design specifications for each subtask, be it a new directory of classes, extended security, development of a scheme for creating access time blocks for students to call, or developing an administrative online add/drop program. Programming did not begin until all of the specifications were determined for that subtask and we had a written sign-off. We wanted our programs to be of first quality and the only way we knew to achieve that goal was to avoid modifications to the original programs once implementation had started. What we offered to the users was our analytic skills in developing good specifications, clear documentation on the specifications, and a walk-through to insure that the programs (once developed) would serve their needs. In return, we demanded from the users full attention to the analysis and walk-through, as well as written acceptance of the specifications.

We never rushed the users to accept specifications before they were ready to do so, but the users knew that programming would not begin until they gave the 'go ahead'. In addition, the users were responsible for final testing and acceptance of the program as meeting the specification agreed upon. We agreed that unless the program did not meet the specifications, or there were policy changes which affected the program, we would not alter a program. Of course we would always make modifications due to programming errors, but we believed that these situations would be minimal once we received written acceptance.

Because our goal was to have a product which would be perfect the first time it was used in production, the team decided that it was important to provide for a large safety window for testing. This meant that at times we needed to 'perfect' the basic system before adding enhancements. Our programs were written with sufficient flexibility to allow other functions to be added in the future.

Not only did we require behavior modification from our users but the team underwent its own kind of behavior modification. The old attitude that it was all right to make mistakes as long as you were available to correct the problem when it was discovered was no longer acceptable. Not only could we not afford the time to correct programs, but too many mistakes had hurt the respect and trust from the user community. We began to improve our own testing techniques. For batch programs this meant running the production JCL with the minimum number of changes possible, and including the output from the test with the production run book (which contained the JCL, message library and programmer and user documentation and was available to the scheduling and operations areas). The team leader would not sign off on any production run book without the inclusion of the output from a test. For online programs, programmers, after doing their own testing, might enlist help from fellow team members. The same documentation that would be turned over to the user was given to a team member and the team member was requested to try out the software. Feedback from the testing was discussed at our weekly meetings, and any necessary changes were made prior to turning over the software to the user for testing.

One of our main concerns in using an online add/drop program, in which over 60 terminals would be available for add/drop and a larger number of terminals would be available to access the Master Schedule to provide student with information on the availability of classes, was that our system would not be able to handle the additional number of I/Os expected without severe degradation to the entire CICS system. To deal with this potential problem the team included Systems personnel in the early stages of planning performance testing. Not only did they take part in file design analysis and assist us in developing a test plan, but they also carefully monitored the CICS system during testing and after the programs had been put to production. The reports that they produced for us provided us with the information needed to define our VSAM files in the most efficient way possible and decide where to put files to minimize contention.

One of the contributing factors to the success of both the online administrative add/drop application and later the touch-tone registration application could be that in designing the requested applications the team also took into account user procedures. Often it was the team that first recognized that current procedures were no longer compatible with a new computer system. This was exemplified when we went from a punched card system for add/drop to a computerized system and the team recognized that a mechanism for advising the student of cancelled courses and courses which no longer had seats left would need to be developed, as the presence or absence of cards in a box would no longer provide this information. As a result the team developed a public access program to the Master Schedule which students could use. Since the Registrar's office and other administrative personnel already had online access to the Master Schedule, the importance of this addition to the project was not fully appreciated by the administration until add/drop was underway.

By March, 1993, we had completed the programming for the administrative online add/drop system. The documentation for the system was complete; key administrative personnel had been trained; testing had been done by both the team and the Registrar's office; and we had received a sign-off by the Registrar's office indicating that the system we had met all specifications to their satisfaction. We were now ready to devote more of our attention to the online application which would support the new telephone registration system.

The new touch-tone registration system (TTR) project provided the team with a wonderful opportunity to work in a new and better way. First, we decided that since TTR would be a separate system, we would abandon the standards developed by Sigma Corporation and used in all of our online student record system programs so far. These programs contained many lines of code which was not needed for our installation, and which many of our programmers did not understand. We decided that the programs would be written in COBOL 2 and make extensive use of the temporary storage queue capability. By making this decision we committed ourselves to being pioneers, since we were the only programmers within administrative services to use COBOL 2. Since we would be treading into some new territory, we decided to make all technical decisions as a team.

The team leader, acting as lead analyst for the project, worked with the Touch-Tone Steering committee to develop clear specifications. Most of these specifications (in broad terms) had already been determined when we put together the project plan. However, details were now needed. Once we had sufficient detail from the committee, the team reviewed the information to determine if additional information was needed which might affect the way we designed the system. These questions were documented and sent to the Registrar's office personnel for response. With the information we had, we began to develop an overall design of the system. This design, expressed both in words and as a flow diagram, was then submitted to the committee for review. The committee met, discussed the overall plan, and gave their permission for us to proceed. The team then proceeded to expand the overall plan into more detailed specifications. Since the voice response application would be written by an outside vendor, it was important to have clear documentation of the system, not only for ourselves but also for the vendor. The textual documentation was expanded first, and reviewed by several members of the team. This plan was then translated into a flow diagram by another team member. Meanwhile, other team members used the plan to develop screens and to begin programming the mainframe application. It was always necessary to keep consistency between the textual plan, the flow diagram and the programs. As the textual documentation became more and more detailed, so did the flow diagram and the programs. During this detailed design phase the Touch-Tone Steering committee was unavailable for meetings because of scheduling problems.

Before the beginning of the programming phase, the team made several design decisions, to insure consistency from one program to another. Several different members of the team were assigned different parts of the programming effort. While this meant that we needed to meet more frequently (now twice per week), the team felt that the time spent during these meetings was beneficial.

Once the programming was complete, it was time to begin testing - not only that the programs worked, but that they worked based on the documentation and flow diagrams that were developed. Each member of the team was given a part of the system to test which was different from that part of the system that he/she had programmed. Since we were sure that errors had to exist, the goal was to uncover as many of them as possible before we turned the system over to the user and the vendor. Rather than be embarrassed by errors which were uncovered, team members would thank each other for discovering an error.

For three months the team tested and simultaneously modified documentation, flow diagrams and programs. Although errors were uncovered, none of the corrections required a change to the basic design of the system. On September 21, 1993, the Touch-Tone Steering committee was given a demonstration of the mainframe application with simulated voice response, which would be used in the TTR system. It would have been nice to be able to report that the committee was completely satisfied with the new system. Unfortunately, although the system performed to specifications, the committee demanded changes that would affect the design of the system. This failing is clearly a result of the different time scales which the user community and computer center community operate. Users are embedded in their day to day concerns while giving only partial attention to specific fragmentary questions of design while the programmers and analysts are completely stymied by questions which are either not answered or answered insufficiently. The users on the Touch-Tone Steering committee who were expected to act as consultants to the project were not released from any of their normal obligations; therefore they had very limited time to devote to the project. Critically reading detailed documentation and finding time to meet regularly as a group proved impossible. In our case when the users finally gave their full attention to the Touch-Tone project they discovered that assumptions made by the programmers and analysts although workable were not to their liking and they demanded changes. This particular problem is one that deserves consideration by the administration for future large scale projects.

CONCLUSION

At the time of finalizing this manuscript, we have not yet implemented the touch-tone registration system, which is scheduled to take place in January, 1994. But whether or not we make the deadline the team feels that it has learned several important lessons, which have permanently changed the way we work, the way we interact with each other and the way we deal with the user community.

We recognize and have gotten the computer center management to understand the importance morale plays in our performance. Whenever possible we encourage users to write notes of appreciation. As a team we celebrate our successes, and we have come to realize that our individual successes are in fact team successes. Although the monetary resources of a state institution are limited, management has tried to implement reclassification in a more timely manner to insure that the staff is working at its potential.

In reflecting over the past two years, our team has come to appreciate how far we have come in improving our own work habits to provide better products and better service to our users. We turned a difficult situation into a window of opportunity to review our past practice, and explore innovative changes in methodology. Although meeting as a team is time consuming, we find that the time is well spent. The ability to discuss problems, issues and overall design objectives has cut down on possible errors, and has caused each of us to feel part of every project. Having clear documentation centrally located has enabled us to support one another and ultimately give better service to the users, who no longer have to wait for the availability of a specific programmer. Each of us, in one way or another has increased our technical competence, either through formal training, through workshops given by our colleagues, or through self-teaching. Each member of the team has a clearer understanding of the overall student information system.

We have made strides in improving our communication with the users by maintaining a paper trail of requests, specifications and desired enhancements. By requiring a sign-off of written specifications before programming and after job acceptance, we have increased the likelihood that we understand what the users wants and the users understand what they have been given.

As a team we have worked to install a new system, beginning with a needs analysis and progressing to a description of the system, flow charts, top-down design, programming and thorough testing of the system. We feel that as a result of the rigid standards which we agreed to adhere to, we were able to create a first-class product.

Team 1 wishes to acknowledge that the success they have achieved could not have come about without the support and backing of its management, for which we are grateful.

Quality Software ... But by Whose Definition.

Is the End-user King?

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Introduction

Software is playing an ever-increasing role in critical business processes. Yet software quality has not received the attention needed for such an important company asset.

Current software quality levels in the US result in software with approximately 4.5 defects per 1000 lines of executable code. This is an unacceptable level of quality. Japan is doing 3-fold better with 1.5 defects per 1000 lines. Motorola and IBM have launched quality programs striving for six sigma quality in software, or 4.3 defects per million lines of code. This may be excessive and addressing the wrong problem. How bad is the problem? A 1988 US Government Accounting Office surveyed the success, or otherwise, of software projects for their division and found that of a 6.8 million software budget the results were:

Software Projects for US Governmental Accounting Office 1988
47% (3.2 million) software delivered but never used
29% (2.0 million) software paid for but not delivered
19% (1.3 million) software abandoned or reworked
3% (0.2 million) software used after changed
2% (0.1 million) software used as delivered

Total quality management, quality improvement programs are common place in most industries, particularly manufacturing, and in most industries the payback has been incredible. The word quality is used in everyday speech to describe the degree of excellence of a product or service. But in the interum quality programs for software have been allusive. The first problem is a definition of software quality. There is confusion about what is meant by the term software quality. Part of this confusion may be caused by the different perceptions of software quality existing between people; software developers vs traditional quality assurance people vs end-users. There are different dimensions of quality which are important when considering the quality of a software product: performance and features, reliability, conformance, durability, serviceability, aesthetics, perceived quality, etc, It seems clear that quality is not easily defined, except arbitrarily, and that there are a number of dimensions to it.

This paper would like to present the software quality challenge. It starts with the important definition of what is the meaning of quality software to your institution and more importantly those who ultimately stand in judgement of IT (Information Technology) products and services, the end-users. Then how does a company organize a Information Technology quality improvement effort? What is the process for addressing quality trade-offs? What role does the customer play in all this? What is their definition of quality? What software and system attributes are important and to whom and how do we measure them? What tools or processes or ideals to use and follow will improve the quality of our software? Finally, how do we evaluate if our efforts are successful... worthwhile?

Misconceptions and ...

The first misconception about software quality is that IT management and staff know what quality is. When problems occur or customers become dissatisfied, it becomes immediately obvious that the software is of poor quality. Yet the IT response to the quality question remains essentially reactive rather than focused on searching for ways to build quality into software and services.

Second misconception, quality can be related to an "acceptable" level of failure. An old IBM advertising campaign asked: "if your failure rate is one in a million, what do you say to that one customer?" Unfortunately, all too often we are measured by our failures.

Third misconception, quality is an expensive luxury. The cost of quality in software is the cost incurred by delivering faulty systems. These costs encompass not only the cost of correcting the fault, but the costs incurred by the business due to the fault such as, lost orders, uncollected tuition, dissatisfied customers. The cost of detecting and repairing software failures after they have occurred usually far outweighs the cost of preventing them.

Fourth misconception, quality is free. Quality improvement efforts are by no means free. There are costs to efforts required to prevent mistakes, appraise work done, correct defects. However as long as these costs are less than the resulting benefits, they are worthwhile. The problem is that quality efforts require an investment up front, and it takes time before the benefits show themselves and can be assessed.

Fifth misconception, lack of quality in software is caused by poor quality staff. In fact, most people prefer to do a good job, but will deliver the quality they think is expected of them. If people feel that no one cares whether they produce quality work, they won't.

Sixth misconception, one can *test* quality into software...unit test, integration test, systems test, acceptance test, and finally quality is achieved. Testing does improve quality, but it is costly and still you can miss the mark.

Truths

First truth, users do not weigh equally everything that is right with software against what is found to be wrong. Unfortunately, we get judge by our mistakes. Software that works well is taken for granted. Software that is wrong for whatever reason, is remembered... and often talked about.

Second truth, users do not distinguish between problems caused by the application software itself, and those which are caused by faults in the hardware, system or communication software.

Third truth, whatever is wrong with the software, not meeting requirements, buggy programming, bad communications environment, slow response time, does not interface with vendor purchased or other software applications, etc.,etc. is the software developer's problem. It may not be his/her responsibility, but it will be their problem. It should be noted, this is getting better with more business partnering between the IT function and other business functions within the organization and team work across department, divisional, and institutional organizational boundaries. Still it has a way to go.

Fourth truth, "the best you can do as a computer professional is defend yourself." (DeMarco, 1980)

Why is software quality important?

The crash of a Boeing 767 in May, 1991 was attributed to malfunction of software that caused the plane's engines to reverse thrust in midflight. I expect the people on the plane did not realize when they boarded the significance of that software, but without question the quality of that particular software was of paramount importance to their very well-being. Computers and the software they run from microcode to standard 4th generation programming languages touch every aspect of our life. For a university, the proper functioning and support of computer software makes sure we have an entering class, students get courses, students get tuition bills and financial aid, room assignments are made for classes, grades are recorded and tracked, and finally diplomas are issued. University software pays the bills (suppliers, employees), collects the revenue (tuition, outside support, alumni gifts), and even controls the heat in our buildings during our cold Ithaca winters. And yet software quality has not received the attention needed for such an important institutional asset. When facility building runs over budget, we cut moneys for parking to cover the loss. So software quality is the parking lots of many of our expensive high-rise system software development efforts. And yet because of hard financial times, institutions like Cornell must look to the strategic application of Information Technologies as a source of competitive advantage with other educational institutions in the future.

A high quality purchasing system will allow Cornell to pay bills in a more timely fashion and consolidate orders, thereby saving millions by taking advantage of volume and early payment discounts offered by vendors. Quality administrative systems free up not only staff but faculty, allowing the institution to save dollars in staff reductions and better utilization existing employees. Freeing up faculty time, allows them more time to go after grants and perform better research and teaching so more moneys flow to the school. Poor quality software or information technologies solutions COST BIG TIME. When an administrator says that they'd rather fill out a form than use the system, IT has a problem. When a faculty member calls, and complains they just wasted a day trying to send a document because of faulty communications software, IT has a problem. When 70% of your IT staff is spending all their time fixing bugs and maintaining software so it runs in production instead preparing for the new and future needs of the institution, IT better start looking for work in another field.

What is Quality? Quality Defined.

One of the early works to define quality resulted in Garvin's 5 approaches to defining quality. Garvin recognized that one approach to evaluating quality would not fit all situations. Consequently, the result was five approaches with the advice to follow the one that will most likely give you the result you seek. What you can see in computing is an evolution of the quality definition. Garvin's 5 approaches to quality include: the transcendent approach, the product based approach, the manufacturing approach, the user based approach, and the value based approach.

Transcendent approach is software is viewed as its innate excellence. In this case, the software would be viewed as a work of art: new, visionary, inventive. Quality is an unanalysable property. One can only evaluate on gut feel. Unfortunately, far too many computer professionals feel this way about their work. It is this path that has caused IT to find themselves in the predicament their in. For years, computer professionals were rewarded for reinventing the wheel. Now, there is just not enough time or money and there is far too much work, to encourage this behavior. Programming must stop being art, and be a business. If I have a print routine, writing another one that is unnecessary, is not excellence, it does not contribute to the quality of the IT function even if it is well written software. We very rarely have the resources to revisit the same problem or need twice. One step further, if I can purchase a print routine that meets the organization's needs for the optimal cost, then that is the quality thing to do. The transcendent approach may be how computer people judge each other, but is not an institutional approach to software quality. It was probably most applicable prior to the 1980's, when in fact computing was still in it's infancy and time of discovery.

1980's Quality Definition - Product and Manufacturing Approach

Product based approach is software quality is related to the presence or absence of some attributes or characteristics and that these attributes can be objectively measured and consequently so can the software's quality. The manufacturing approach equates quality with conformance to stated requirements. The combination of the two, software that contained code possessing the professionally accepted quality software attributes/ characteristics and conformed with stated requirements was the goal of the 80's. It represented what 1980 programming shops consider acceptable and quality product.

Those of us who got our computer training in the 80's, were brought up on attributes or software characteristics that were signs of quality programming.

Quality Software Attributes and Characteristics

What attributes or characteristics are relevant and traditionally have been considered when considering the quality of a software product? The software literature is full of the attributes such as: correctness, flexibility, efficiency, reliability, usability, extendability, portability, testability, understandability, re-usability, maintainability, interoperability, integrity, and survivability. Top of the list is performance and features.

Performance relates to the primary operation characteristics of the software.

Features refer to the secondary characteristics that supplements the software's basic functions. (NOTE: Both performance and features are measurable, but it does not follow that the user perceives differences between different software as significant in quality terms).

Efficiency ,the amount of computing resources and code required by a program to perform a function.

Usability ,the effort required to learn, operate, prepare input for, and interpret output of a program.

Reliability ,the extent to which a program can be expected to perform its intended function with required precision or the probability of a software product failing with in a specified period of time. Unlike a manufactured product, software is more difficult to evaluate on this front due to the fact it doesn't "physically deteriorate".

Extendability /flexibility ,the effort required to modify an operational program.

Portability ,the effort required to transfer a program from one hardware configuration or software system environment to another.

Testability ,the effort required to test a program to ensure it performs its intended function.

Understandability , the effort required to understand the code and what it is doing.

Re-usability ,the extent to which a program can be used in other applications, related to the packaging and scope of the functions that the programs perform.

Maintainability ,the effort required to locate and fix an error in an operational program.

Serviceability ,the ease with which the supplier of the software accepts responsibility and rectifies.

Interoperability ,the effort required to couple one system with another.

Integrity ,the extent to which access to software or data by unauthorized individuals can be controlled.

Conformance, the extent to which the software meets the specification. (This must be measured before and after acceptance of the software by the customer. Deviations may become apparent only after the software has gone into service.)

Correctness ,the extent to which a program satisfies its specifications and fulfills the user's mission objectives.

Durability/survivability, the measure of the length of time that software can be used before replacement.

Aesthetics, yes software can be beautiful.

Perceived quality , the user opinion of the quality and usefulness of the software. This may in fact be the most important. Individuals may not have full information to judge by, but judge they will. Their judgement may also include price and reputation of the software supplier.

As one can see there are many characteristics that contribute to the quality of software, and this list is certainly not exhaustive. These actual represent high-level attributes that can be shown to depend on other characteristics. For instance, if a piece of software is to be maintainable it must be understandable, testable, and modifiable. Given the state of the art in software engineering, growing the the tree in this way until the characteristics at its leaves are objectively measurable may not yet be possible but it is a necessary goal if software quality assurance is to develop. In 1987, Kaposi and Kitchenham proposed a quality profile model as a way of structuring the analysis of the quality of a piece of software. The quality profile of the software is specific to an individual and the application, but has the advantage of separating quantifiable and non-quantifiable factors. It provides a good basis for an explanation of why different people can simultaneously hold different views about the quality of the same piece of software. The quality profile categorization follows:

Quality Profile for a Person,Application

Transcendental Properties (Non-quantifiable)

Quality Factors (Objectively measurable)
- Quality Metrics (Quantifiable)
- Quality Attributes (Indicate presence or absence of a property)

Merit Indices (Subjectively measurable)
- Quality Ratings (Quantification of value judgement)

It should be noted that some of these characteristics are mutually exclusive. Quality is a trade-off. Which attributes should be emphasized?

Quality is a Trade-Off

In addition to identifying the "quality" characteristics there is a problem with conflicts between the quality attributes. After quality attributes of software for an application have been defined, the next major concern is determining which of the quality attributes to emphasize. It is impossible to optimize all quality attributes because of conflicts between the quality factors such as, maintainability being at odds with speed of execution or minimization of storage. A system that is easy to use requires easy access and system openness. By contrast, high integrity requires limited access and a closed system. In a trade-off environment, one must decide whether to emphasize the correctness characteristics (internal controls, data entry, and validation) or the maintainability characteristics (user documentation and simplicity of design). It is important to emphasize the qualities appropriate for the application.

To add to the difficulty, is the issue of cost. People say quality is free. That's not exactly true. Total quality-related costs are often subdivided into four groups: 1)prevention costs (quality planning, employee training, supplier education, etc), 2) appraisal costs (reviews, walkthroughs and other forms of testing), 3) costs of correcting defects discovered before acceptance,and 4) costs of correcting defects discovered after acceptance which have to be borne by the developer. This complicates the cost of quality issue because the cost of quality assurance activities such as appraisal and prevention are more easily estimated than the expected savings.

Over the years, depending on the software and its application some attributes have taken a back seat to others. For example, in the 80's portability was of little importance. Most administrative shops were running large mainframe applications. There was little thought to moving the applications to other platforms. Now with hardware cost plummaging, micro- and mini-computers competing with mainframes on raw computing power, and communications software and networks propagating and improving in reliability, portability is a very desirable software attribute. The type of application effects the ranking of relative priority of the characteristics. An application used by hundreds of decentralized users will place more importance on the quality of useability and nice GUIs, than a system used by a well-trained few.

Motivation to undertake quality assurance activities may be to produce a good product, but usually not. More usual reasons include cost effectiveness or good customer relations or marketing. And despite the definition of quality characteristics and their prioritization, quality software and systems alludes us. What is missing from our definition?

1990's Definition of Quality

In Garvin's user-based approach and value-based approach we may find a definition of quality that we can successful apply in the 90's and next century. User-based approach where quality is related to its fitness for use in a particular application. Quality is related to the software user's satisfaction. Value-based approach combines quality, which is a measure of excellence, with value, which is a measure of worth, by defining a quality product as one which provides performance at an acceptable price or conformance at an acceptable cost.

Sample definitions reflecting this philosophy...

"The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs (ISO 8402 standard)."

"The totality of features and characteristics of a product or service that bear on its ability to satisfy a given need (BSI 1979)."

"The degree to which the attributes of the software enable it to perform its specified end item use (DOD 1985)."

What is not present in these widely accepted standards is the acceptability of cost. Now with finances being tight, acceptable cost must be added to the definition.

Organizing for Quality

Now we know what it is, how do we achieve it? First there must be management commitment. This can not be over-emphasized. Few things are more damaging to quality initiatives than a stated quality policy which is immediately contradicted by short-term imperatives and unrealistic deadlines. Without a highly visible commitment to software quality from management, no quality program will succeed.

A separate functional group with responsibility for quality should be created within the IT function, being careful to make sure the achievement of quality remains the responsibility of every person involved in the delivery of software products and services. The quality group is to advise on procedures, techniques and tools, and provide external, objective quality assurance. The quality specialists must be viewed in a support role of assisting staff in the achievement of quality, rather than a policing role. Management must be the police, so the seriousness of this quality initiative is reenforced. The quality function should aim to prevent problems before they occur through education, and the introduction and support of appropriate procedures, standards, techniques, tools, and training. One of the key functions of this group is to take the customer's satisfaction pulse regularly.

A second group will be needed to spearhead the quality improvement effort. This group would be comprised of members representing different roles in the IT function: business modelists, front-line consultants, analysts, designers, programmers, technical support staff, and operators. Their responsibility should be part-time, and a rotation through this group is advised. These people will define and plan the quality improvement effort, represent their concerns to the quality team, and the quality team to their function. They will be instrumental in the implementation of quality initiatives within their function.

Metrics

It will be difficult to register any improvements in quality unless some measures of quality are established. "You cannot control what you cannot measure" (DeMarco, 1982). The identification of suitable measure, and the assessment of the actual values of each of these measures, is an essential component of any effort to improve quality. One must be careful when selecting measurements. Selecting the wrong measurement could give undesired results. For example, measuring lines of code could result in the illusion of increase productivity, but more likely it will result in extraneous, inefficient code and reduce use of reuseable modules. Measurements might include:

* number of problem reports, change requests received per period of time
* problems or change requests outstanding at the end of each month
* time taken to respond to problems
* number of errors detected and type design, specification, misstated or misunderstood requirement

There are numerous possibilities that should be limited only by imagination, need, and resources.

It is important to implement the right measurements. Common sense and monitoring the results will tell you if you are measuring the right things to get the desired outcome. Secondly, it is important not to select too many measurement (5-6 is sufficient). Remember quality improvement is an iterative process and a long-term commitment. Too many measurements will distract and confuse the direction of the quality effort and be overly costly. Pick largest problem areas first.

It may be difficult to obtain measurements. Inability to take needed measurements in itself is a quality problem, and should be attacked as such. The second step in a quality effort may be developing the means to collect needed metrics after identifying what metrics are needed. Whatever means is used, keep it as simple and unobtrusive as possible!

You'd be surprise how much development and maintenance records you are probably already keeping can tell you. For example, the costs of development efforts is usually readily accessible information. Currently, 79% of all development efforts are viewed as going significantly over dollar and/or time budgets. System usage records are also usually readily accessible due to IT's need to account for machine usage. Currently national usage statics show 45% of all systems never get used. During development: track costs, milestones, the success of unit testing, the amount of reusable code exercised, track record for user acceptance testing. The effectiveness of your systems/software development life cycle methodology can be seen in the number of changes made at each development stage to: the business model after its acceptance, the logical design after its acceptance, the physical design after its acceptance, file changes after physical design, and program changes after unit testing during user testing.

Maintenance Metrics

Maintenance tells you an incredible amount about the quality of existing software. Maintenance can fall under 4 categories: corrective, adaptive, perfective, and preventative. If your organization is doing a great deal of corrective maintenance, fixing bugs, etc. then it is a good indication your IT function needs better systems development cycle methodologies, or modeling tools, or programming standards, or testing procedures. Adaptive maintenance is due to a changing user or computing environment. Some of it is inevitable, but too much is again an indication that user requirements were not defined adequately during systems development. The user requirements required the ability to change and the specifications analysis lacked the quality to anticipate this need resulting in undesirable system inflexibility. Perfective maintenance is often referred to at Cornell as enhancements. Often, our enhancement list is longer than the original specifications. This is a combination of user not recognizing needs and analyst not discovering all user needs prior to software release. It is often a sign of an unrealistic implementation schedule, that was too rushed. Finally, preventative maintenance which is the periodic review of the system to uncover or anticipate problems. If your shop is doing mostly preventative maintenance you are probably running a quality environment and have control of your computing.

Maintenance will tell you alot about the quality of the IT work. Track maintenance costs by system, by program, by programmer. Measure to number of failures per program. Calculate number of hours spent on maintenance and whether it was corrective, adaptive, perfective, or preventative in nature and emergency, urgent, or routine. Develop a profile of the most common maintenance requests and problems encountered. Look to correct these first in the development process. Quality improvement is incremental improvement.

Tools

The clear statement of quality requirements in the requirements specification is a major step towards the production of good quality software. Software developers must plan and implement software development projects with the objective of building in quality. A desire to produce a high-quality product must be supported with a willingness to commit resources to the three disciplines needed for the activity: development disciplines (such as analysis, design, and unit testing), product assurance disciplines (such as quality assurance, test and evaluation), and management disciplines (such as project and general management). It seems to be generally agreed that this involves activities in the following areas:

1. Establishment and maintenance of a requirements specification. This also serves for the basis for acceptance tests.

2. Establishment and implementation of a process for developing the software. This would include shop design and programming standards. A methodology.

3. Establishment and maintenance of an evaluation process. This involves the production of standards defining what must be done to complete a task successfully and also how the work should be done.

Fifth truth, the biggest single problem encountered in the computing industry is the specification of requirements. Organizations seem to find it exceedly difficult to express what they want in clear and unambiguous terms. The fuzziness particularly is evident where a institution's own administrative function and information are concerned. If the business has problems in this area, computerization is often seen as the way forward. In such cases computerization only succeeds in producing more convincing chaos, not sense. The evidence for this lies in the hundreds of abandoned projects throughout the industry.

If the goal or definition of quality is meeting the user's needs than IT will have to more closely align itself with the customer. Cornell has implemented Business Modeling to separate the software development process from the business analysis. Business modeling has help at Cornell better synchronize IT with the business and in many cases better synchronize the user's with their own business. Business modeling involves everyone who has a part to play in an elemental function that is being studied. It breaks down the function to its smallest parts. With everyone having a solid understanding of the business, it is a wonderful opportunity for reengineering and doing a critical study on where and what kind of support information technologies can best provide. The advantage of this, is time is taken to identify what IS the business. It is an opportunity to reengineer and optimize necessary activities and obliterate worthless activities. All this is done prior to thinking about computerization.

Quality is in the eyes of the user. To understand what the user values, IT function has to move closer to the business philosophically to understand what's important. Computer people know what they value in a quality system, robustness, maintainability, etc. What they don't know is what the user values. To find this out the user should be asked. A simple software characteristic evaluation form filled out by the user will help communicate user defined quality. Early on communication is key, if for no other quality goal than a satisfactory user perception.

Communication must be viewed as a key tool to insuring quality software. Business modeling assists that communication. Early survey sheets from users on what they are seeking and postmortem user survey sheets on satisfaction on prior software products move communication forward. Taking up residence with the user community is also appropriate. Communication is unfortunately often an under utilized tool. Aides to communication such as surveys, e-mail, structured modeling tools (DFD,ER diagrams) are invaluable to the quality effort.

An important tool to system/software development is structured development approach. Often referred to as system development life cycle or SDLC or system development methodology. At Cornell, we have our Systems Development Methodology. This methodology describes:

* the phases of the system life cycle,
* the purpose and goals of each phase,
* the items to be delivered and for each deliverable item, who is to prepare it, what it consists of, some idea of the methods and tools available to create it, and the review process by which the item is accepted,
* the approval process for each phase, how we know it is completed.

Tools to assist this process include modeling tools: data flow diagrams, entity relations diagrams, structure charts, and business function diagrams. These provide several benefits. First they act along with the methodology guidelines as a communication tool between IT and the customer. In many cases these days, automated modeling tools can serve to check for consistency and completeness of the model. And finally, the model serves as documentation.

A glossary or data dictionary of terms for data elements and other items in the system is a must. Redundant and and inconsistent data definitions may exist throughout an organization's procedure manuals, source program documentation, data files, and in the minds of those in the organization. Ambiguity of what things mean is the makings of software disaster. One can not hope to build quality software, or purchase it, when there is ambiguity of the meaning of the data in the system and how it is used.

Standards are of utmost importance to insuring quality. Well trained software specialists know the best practices for analysis, design, programming, implementation, documentation, and maintenance. Quality demands consistency. Consistency is insure by standards. Many systems development groups operate without standards or have standards they do not use. The most common reason for a lack of standards or not following them (though often not admitted to) is that standards inhibit creativity. I haven't met a systems analyst or programmer yet who did not believe they could determine a better way to do a task than the process proposed by the standards manual. When computer professionals are allowed to do this they have performed two jobs instead of one. They have develop the process that they follow AND follow that process to solve the user's needs. Waste.

Programming standards come in all shapes and forms. Not everyone with a 4 year computer science degree knows how to program well. Standards can help teach good programming techniques. Modular design and reuseable code allows one to create the best code possibly and use in multiple places.

Invest in new automation techniques. Case tools can be used not only to increase programmer productivity, but to institute shop programming standards. CASE generates code faster and reduces code variability. The biggest problem with CASE is sometimes getting IT staff to use it. Most of them got into this business because they enjoyed programming. The other problem though not as obvious, is customers wanting their own signature systems. With CASE tools you get a standard interface. The resulting purchasing system looks like the resulting budget system, etc. Many users through years of IT lacking standards, have gotten as use to creating their own world as the supporting IT staff have. Both sides of the house must be sensitized to the cost of individual interfaces built for functional area preference vs a common interface for the institution.

One of the best tools, though often overlooked,for improving quality is staff training. Proper training in quality, programming, analysis and design, modeling, software tools, and communication skills is invaluable.

Variability is the enemy. The obvious problem with variability is that the user and other IT staff never know what to expect. Each system operates differently. Maintenance may be easy in one system and difficult in another. It makes user training and new IT staff training a nightmare. And with variability, visible and invisible to the customer, IT credibility for knowing what they are doing suffers.

Testing does improve quality, but it is a costly method of accomplishing the quality objective. Testing procedures should exist for all levels of testing: unit, module, integration, systems, and acceptance. It is important to have a good test environment, that mimics the production as closely as possible. All project plans must include adequate testing time.

Post- Review and Evaluation are Important Tools

The only tangible that matters is dollars. Does the system save more money than it cost to develop (or purchase), maintain, and run. The only intangible that matters is customer satisfaction.

Though these are simply they encompass a world of sins. Money, where it is spent, how much is received, or how well it is utilized is just not that easy to track down. But scrutiny of the business, it's inputs and outputs, and an honest look will show you. Taking an honest look however is not easy. Pet projects, pet agendas, and business processes steep in tradition and sometimes mysticism stand in the way. It is IMPORTANT to quantify as many savings and costs as possible. Look for signs.

* Staff working less/more hours or Staff reductions/increases
* Reduction in costs or budgets
* Reduction in identifiable waste
* Reduction in paper
* Fewer reports or sources of information without completeness or sufficiency of information suffering
* Lower stress or anxiety levels among staff and service receivers
* More business or higher quality business. In a university that might mean more and better applicants to admission, larger alumni gifts, better faculty.

Customer satisfaction is also allusive. Customers sometimes do not know what they want until they see it. They almost always know what they do not want. And alot of the satisfaction depends on the expectation. It is important in addition to systems project management that the IT management manages customer expectations. Customers must be kept abreast of progress all along the way and be the center of system development. This is sometimes difficult. It is not always obvious who the customer is: is it the sponsor, who may never use it such as a VP of Finance, the heads of the function the system serves, such as the heads of budget for a budget system, or is it the clerk who actually USES the software. This is where business partnering becomes the key. Ultimately the clerk is the customer, but it should be kept in mind the VP and functional head has a broader picture of what is trying to be achieved. Both needs must be reconciled for success. This sometimes requires the administration to align their goals across the organization. But this is not a topic for this paper.

To determine customer satisfaction...ASK THEM often, repeatedly.

Quality of Outsourcing Service

With many of our organizations seeking to cut costs by outsourcing all or part of the IT function, I feel a need to make a comment on outsourcing quality. For many of us the outsourced pieces of IT will become an integral thread of our institution's IT function. The same quality guidelines apply. The quality of products and services, cost-effectiveness, timeliness of deliverables, reliability of performance, flexibility, and responsiveness to the customer, and customer needs being met to their satisfaction is still the measures of quality. Project deadlines must be met or penalties imposed. Measures of performance reflecting customer priorities are part of the contract. In short, the quality guidelines of the IT function should apply to vendor supplied software.

Software Quality is Only Part of Information Technologies Quality

Software does not run in a vacuum nor do customers judge it solely on it's own merits. Unfortunately, this is truly a case of one bad apple can spoil the bushel. Software that runs in a poor quality communications environment is worthless. Bad response time or machine downtime reflects poorly and causes customer dissatisfaction no matter how good the software is. To insure Information Technologies quality one must look at the entire IT picture. Diane Wilson (MIT,1988) identified seven IT assessment methods to evaluate the IT function:

Productivity. Efficiency of expenditure of IT resources.
User utility. Customer satisfaction and perceived value of IT services.
Value chain.. Impact of IT on functional goals.
Competitive performance. Comparison against competition with respect to infrastructure components of business measures.
Business alignment. Criticality of the organization's operating systems and portfolio of applications to business strategy.
Investment targeting. Impact of IT investment on business cost structure, revenue structure, or investment base.
Management vision. Senior management's understanding of the strategic value of IT and ability to provide direction for future action.

In her research, it was discovered only a third of the organizations studied measured the business value or strategic impact of information technology on the business. The dominant measures were ones of cost reduction, increased productivity, and reduced head count. Although more than 70% of the organizations use surveys to determine user needs, about one-third used formal procedures to assess user satisfaction with IT services.

Measurements are also needed to evaluate the value of the system/software in relation to it's performance. What is the strategic value of the software to the business? How does it contribute to the institution's competitiveness? Finally what may be the best expression of the two previous questions, is how satisfied is the end-user? These are the harder, but more important questions. How can these attributes be measured?

IT Quality Assessment

Attribute	Instrument or Metric
Organization satisfaction	End-User Surveys
Meeting Business needs/priorities	End-User Surveys
Contributions to Business Competitiveness	Revenues Gross margin Reduced costs Improved productivity Improved cash flow Cost avoidance-Be careful of this one Improved transaction response time Improved receivables payment Improved departmental performance Impact on end customer (students,etc) Return-on-investment calculations Return-on-asset calculations Impact on products and services
Strategic Value to Business	Establish competitive barrier Create defendable market position Improve service level Introduce technology-based products Introduce technology-based services

Summary

I contend quality is simply meeting the user's requirements both expressed and implied for an acceptable cost. It is not an intangible or subjective factor of rightness or good design. IT IS directly measurable through the user's perceived satisfaction with the product or service, and its tangible costs and benefits can be calculated. The wider context of the service offered by the information technology function should be part of the formula, the majority of users do not distinguish between problems cased by the application software, and those which are caused by faults in the hardware or system software. What we need to aspire to is tight performance measurement linked directly to important business consequences.

Quality is, above all, about people: a continuing commitment to produce quality software and provide a quality service is needed from people at all levels and in all parts of the IT organization. End-users perceive quality in software products and services which most meet their requirements and continue to do so. Techniques, tools, and procedures can improve software quality, but only if they are deployed in an environment which encourages every person to make a long-term commitment to the achievement of that quality as part of a team committed to quality performance. Of all tools, communication is the most valuable. If communication with users is poor, then the perceived quality is likely to be low. The bottom line. The user will judge the quality of the software, the system, the Information Technologies function.

GUERRILLA TQM OR HOW TO INFILTRATE TQM INTO YOUR INSTITUTION

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ABSTRACT

Various models for pursuing TQM are emerging on college and university campuses. Most models and TQM gurus insist on a top down approach for TQM to succeed in transforming an organization. This paper explores the experiences in an organization in which TQM devotees pursue the principles and concepts in their own sphere of influence but without official sanction or resistance from the top. Information technology is part of the guerrilla movement.

Almost by definition, information technology (IT) organizations are accustomed to being change agents in their institutions since they constantly cope with changing and improved technology. Since most all units in an educational institution are touched by information technology whether it be computing, telephones, or other services, IT can play a key role in transforming an institution into a total quality environment. This paper shares experiences of an IT organization and how it demonstrates the possibilities of TQM through customer focus and reliable, responsive services.

GUERRILLA TQM OR HOW TO INFILTRATE TQM INTO YOUR INSTITUTION

Various models for pursuing Total Quality Management (TQM) are emerging on college and university campuses. Most models and TQM gurus insist on a top down approach for TQM to succeed in transforming an organization. This paper explores the experiences in an organization in which TQM devotees pursue the principles and concepts in their own sphere of influence but without official sanction or resistance from the top.

The key principles of TQM and three models for adopting TQM in higher education are presented. The *guerrilla* model for pursuing TQM at the University of Kansas is discussed and is followed by a case study from the Department of Telecommunications.

KEY CONCEPTS OF TQM

Total Quality Management is a managerial philosophy with many names--continuous quality improvement, statistical process control, statistical quality control, among others. Regardless of the label you choose, the key concepts that underlie the *quality* philosophy include:

- focus on customers,
- focus on process,
- use of scientific method to continuously improve processes,
- employee/staff involvement.

Many other issues are involved for an organization interested in adopting TQM principles but are not discussed in this paper.

TQM places a premium on customers and recognizes their central role in determining quality. The satisfaction of an organization's customers--both those external to the organization and those within the organization--is a key driver of TQM. An understanding of who the external customers are and what they need is critical to carrying out the organization's mission.

The customers internal to an organization are partners in accomplishing the organizational mission. In particularly complex organizations like higher education institutions, many subunits of the organization serve one another and receive service from one another as internal customers. For example, the department of telecommunications exists to provide voice, data, and video communications needs within the university. The internal customers--the departments and offices to which they provide services--will determine or judge the quality of those services.

To provide quality services, TQM focuses on the activities by which we do our work--*processes*. To accomplish a goal or perform a task, the means are processes. Telecommunications has processes to provide new communication services (install a phone), to relocate existing services (to move a phone), to upgrade or expand services (to add voice mail), to provide data communication services (install local area networks), to bill for services, to train departmental and office personnel in use of various communication features (e.g., voice mail), among a host of other processes.

To improve these service-oriented processes, we use *systematic analysis*. TQM has an array of tools and techniques to help understand how processes function and to develop alternatives to improve them. "Controlled" experiments are used to test alternatives and to evaluate the success of suggested changes. This scientific method to improve processes is also known as the Shewhart cycle, named for W.A. Shewhart who applied statistical quality control techniques to manufacturing processes in the 1930s while associated with Western Electric (AT&T) Bell Laboratories. The steps of the scientific method or plan-do-check-act (PDCA) cycle include (Sherr and Lozier, 1991, p. 8):

Plan: Identify a process in need of improvement, analyze the problems, and develop a proposal for change that will cause some type of improvement.

Do: Run an experiment with the proposed change.

Check: Collect data to determine whether the experiment produced the desired change.

Act: If the experiment is successful, implement the idea more broadly; if not, learn from the mistake and try an alternative.

Processes targeted for improvement are systematically studied using the PDCA cycle and data collected about the process is used to determine the viability of proposed changes to the process.

Who recommends process improvement changes? Those most closely associated with the process, often referred to as the "owners" of the process, are in the best position to suggest improvements. TQM recognizes the critical human element in the execution of processes and involves staff in the improvement of those processes. It is the owners of the process who best understand how a process *actually* operates. This knowledge is critical to the improvement cycle since the focus is on how a process actually works, not how someone removed from the process thinks it works. How a process could work better is the outcome of the process improvement effort.

The role of management changes from being directive to coaching as it "empowers" staff to assume greater responsibility for how their work is executed. Staff development is essential to prepare staff for these expanded responsibilities. An understanding of organizational mission, knowledge of customers served, and an understanding of tools and techniques to improve processes are a part of necessary staff development. Furthermore, a sharing of responsibility and credit for the improvement of organizational processes is an obligation of management in a TQM organization.

This synopsis of some of the key tenets of TQM provides a backdrop for the ensuing discussion for an organization adopting TQM principles and concepts. For a more extensive discussion of TQM foundations in a higher education setting read "Six Foundations of Total Quality Management" by Lozier and Teeter (1993).

ORGANIZATIONAL MODELS FOR PURSUING TQM

TQM gurus and industry leaders pursuing TQM in their own organizations insist there is only one model for adopting TQM and that is "top down." While many early adopters in higher education have heeded that advice, there is evidence of other models of pursuit. It is too early to determine their ultimate success but important to note them.

In 1991, Seymour and Collett reported the results of a survey of twenty-two institutions with a TQM initiative. They found three distinct models for adopting TQM:

- cascade model,
- infection, and
- loose-tight or combination of top down/bottom up.

Each model is briefly described below.

The cascade model (or trickle down) involves master planning from the "top down." The senior officers of the organization study TQM principles and tools; the leadership develops a vision for the organization and a three or five-year plan for implementing TQM; education and training are provided; and pilot studies are initiated.

In the infection model (or bubble up) there is top level involvement but not necessarily commitment; the implementation takes place through voluntary pilot programs whose successes generate interest and are used to garner interest throughout the organization.

In the loose-tight model, institutional leaders need not be zealous nor have a sharply-defined five-year plan; there is some involvement at the executive level and some general map of where the journey is headed with a loosely-developed plan; local champions pursue fundamental transformation of their unit or area; the pilot projects not only focus on the improvement of a targeted process but also a basic change in the unit's culture.

The focus of this paper is on a fourth model--the guerrilla model--with attributes of both the infection and loose-tight model.

GUERRILLA MODEL FOR PURSUING TQM AT THE UNIVERSITY OF KANSAS

Interest in TQM at the University of Kansas (KU) was spurred by faculty teaching quality concepts in the School of Business. In the fall of 1988, two senior administrators in the financial area attended a five-day professional development program on TQM that the business faculty present each semester for business and industry leaders. As a result of this experience, a pilot project to improve the payroll process was undertaken that resulted in the elimination of signatures (other than the appointing department) on student appointments under $6 an hour. This reduced the complexity of the process, reduced errors, and improved timely payment for hours worked.

In May 1989, all senior administrators attended a session on the principles, concepts, tools, and techniques of TQM conducted by Lawrence A. Sherr, Chancellors Club Teaching Professor and Professor of Business Administration. Sherr conducted an expanded version of that session in 1990 first for the directors and then the staff reporting to the University Director of Information Resources (academic and administrative computing, human resources, institutional research, and telecommunications). A pilot project in telecommunications was initiated. During 1991 Sherr presented several seminars on TQM for the Unclassified Professional Staff Association.

After several years of presentations on TQM to a variety of administrators and staff, there was no top level "push" to formally adopt these principles. Changes in administrative leadership and other issues diverted the attention of the senior management of the institution.

But the grass roots involvement in the pilot payroll project and subsequent seminars for mid-level managers and staff who found the TQM principles and concepts appealing provided the real impetus for pursuing quality concepts. The guerrilla movement began to form in 1991 as individuals who shared an interest in pursuing TQM concepts in their own spheres of influence began meeting to learn more about TQM concepts and to consider how to pursue the practice of these principles in their own organizations. They referred to themselves as the Ad Hoc TQM group and included the following:

- Associate Vice Chancellor for Administration and Finance,
- the directors of facilities operations, telecommunications, and facilities planning,
- the director and assistant director of institutional research and planning, and
- associate director of human resources.

The group has expanded to include other directors committed to pursuing these concepts. The group does not formally report to any university officer; the group was not appointed by anyone and is not formally accountable to anyone.

The ad hoc group was motivated to pursue these principles by the simple desire to be more customer-friendly, provide higher quality services, and be more efficient through the adoption and practice of quality principles. This common interest in pursuing shared goals galvanized the TQM Ad Hoc Group to develop plans and devise strategies to make TQM an operating philosophy.

Initially the TQM Ad Hoc Group recognized that an investment in training was essential if the principles of TQM were to become an operating philosophy. The group sponsored training of prospective team members, team leaders, team facilitators, and team sponsors that built upon introductory sessions presented by Sherr. These first efforts were funded by members of the ad hoc committee from their departmental budgets, a real demonstration of commitment in a time of constrained resources.

The guerrilla movement advanced with the formation of six teams in 1992 to improve administrative processes. This action step signaled that the movement was beginning to realize the goals that brought together the members of the TQM Ad Hoc Group. The teams reported on their activities in March 1993 to the senior management.

While these teams worked, interest in TQM grew. Training in the principles and concepts is now conducted by members of the ad hoc group. Over 300 staff and faculty have been introduced formally to TQM principles and as the interest in TQM expanded, the effort to coordinate and support the formation of teams grew beyond the volunteer capacity of the ad hoc group. Subsequent to the presentation to the senior management about the activities of initial teams, funds were identified to support a full-time coordinator/trainer. This support has enabled the effort to grow by expanding the training and by providing assistance to units to help identify processes for improvement and to form more teams to address new issues.

The vision of the early proponents of TQM was that through championing the principles within their own organizations, their successes would capture the interest and attention of others. The strategy that developed from this vision bears a strong resemblance to those used by political movements (Goodwyn, 1978); the activities may be considered as guerrilla tactics. The five phases to the strategy are:

- Movement Forming - Create awareness of and interest in a new managerial philosophy that recognizes that the pursuit of quality is customer focused, data driven, process oriented, and empowers faculty and staff.
- Movement Recruiting - Form an ad hoc group which shares an interest in furthering the principles espoused by the new managerial philosophy.
- Movement Educating - Educate faculty and staff about the principles, concepts, values, tools, and techniques of the new managerial philosophy.
- Movement Activated/Embraced - Create a mechanism for the pursuit of these new principles, concepts, and values utilizing the tools and techniques, e.g., teams.
- Movement Realized - Integrate these concepts, principles, and values into the daily work life of faculty and staff.

The objective of this five-phase strategy is to transform the university into a quality-driven, customer-focused institution in all aspects of the organization.

In summary, the principles and concepts of TQM are intrinsically appealing to those desiring to provide high quality services and the tools and techniques provide a means. The challenge is in the pursuit of the philosophy. Initially senior management was neither a supporter nor a barrier. The proponents took it upon themselves to pursue these principles in their spheres of influence. As experience grows and interest builds, other units of the university are targeted to "join the movement." The expansion process is slow but deliberate. With limited resources, the ad hoc group wants to be sure newcomers are adequately trained and supported. The effort is still in its infancy (ad hoc) with the hope of becoming institutionalized over time--the movement fully realized.

DEPARTMENT OF TELECOMMUNICATIONS IS INFECTED WITH TQM AND BEGINS THE TRANSFORMATION PROCESS

The Department of Telecommunications is a key player in the guerrilla TQM movement at KU for several reasons. At the time the guerrilla movement was forming, the department was undergoing considerable growing pains and suffered a variety of image problems that TQM could help address. There were many opportunities for improvement. Additionally, since all units in the university use telephones, if the telecommunications department successfully practices quality principles, it has the potential of impacting most all units in the institution and could spur interest in TQM. Furthermore, information technology (IT) organizations are accustomed to being change agents in their institutions since they constantly cope with changing and improved technology. The following case highlights how telecommunications became a part of the guerrilla TQM movement and describes the transformation process and its various impacts in the evolution of telecommunications into a quality organization.

Background

The Department of Telecommunications is one of the newest departments at the university. Once a service provided by facilities operations (physical plant), telecommunications became a department reporting to the senior officer of information resources in 1986. During this period, the university was in the final stages of wiring the campus, installing the new PBX, providing new phone sets, and hiring staff. Processes multiplied and became extremely complex in response to human, technical, or system failures/needs/regulations.

Exasperation, frustration, and dissatisfaction multiplied in the client community. Life--in terms of telephone service--had once been simple: if a department wanted to add a phone, move a phone, or disconnect a phone, they had only to call the local Ma Bell to take care of everything. Now the client was faced with new forms to complete, people to deal with who were not telephone experts, new rules, and higher costs.

At the same time, staff in the telecommunications department were faced with hostile, frustrated clients who yelled at them; had trouble finding information in the files; did not fully understand how the PBX worked; and did not know how to pass information to one another in a meaningful way. In response to this chaos and uncertainty, the staff sought to gain some control by creating new processes, modifying old processes (sometimes combining the processes), adding new forms, and attempting to document the ever-changing procedures.

The Beginning of the Transformation...

Informal and sporadic discussions about TQM occurred between the coauthors of this paper for over a year, but interest and commitment were undeveloped until 1990 when the annual retreat of the Information Resources units was devoted to an introduction to Total Quality Management principles presented by Sherr. The telecommunications department director left that session with a commitment to explore the possibility of using TQM to evaluate some of the processes that appeared to be badly broken or in need of a "fix."

Continuing discussions between the coauthors ended with our agreement to put together a pilot TQM team in telecommunications--the first since the guerrilla movement began. We established meeting dates and times and met for several months in the fall 1990/spring 1991 before cancelling the project. Why? In short, we did not yet have the tools or training to properly deploy a team.

The meeting format was no different than the format established for a staff meeting. Too many people were involved; the staff had no idea of what we were trying to do or what their role should be; the director controlled the meeting and had specific outcomes in mind; the staff had no stake in the outcomes; and, particularly important, the staff was intimidated by the director's presence and the majority were extremely reluctant to participate. It became apparent that this process was not working. Training in leading and facilitating teams and how to approach process improvement was needed. Contrary to the advice of some to "Just Do It," we learned we did not know enough to "Just Do It."

Next Phase

The commitment to TQM, however, remained. And, fortunately, the TQM Ad Hoc Group arranged for team leader/facilitator training in January 1992. Shortly after this training, six teams formed from units represented on the TQM Ad Hoc Group. One of the teams was from the telecommunications department; the director was the sponsor and one of the department's assistant directors was named team leader. Both had participated in the team leader/facilitator training. The team was charged to improve the telephone work order process.

Maintaining Momentum

What helped maintain and sustain the telecommunications director's interest in TQM as well as reinforcing support of the departmental team, was the regular meetings of and discussions with the TQM Ad Hoc Group. These meetings reinforced the TQM principles that:

- the university is a collection of processes;
- units are responsible for the creation and maintenance of many of its processes--they are not imposed by others;
- the unit must ask how they perform a specific process, who performs specific tasks in the process, and why;
- the unit must not only be willing to change or delete specific processes, but also to continuously evaluate the changed process to maintain gains or seek further improvements.

The critical element is that process analysis, change recommendations, change implementation, and change evaluation are conducted *by the individuals who perform the tasks in a process or who are responsible for the complete process.*

TQM Impact on Staff

The work order team was comprised of staff from accounting, purchasing, billing, customer services, operations, and management. The facilitator was from another campus department. The team scheduled weekly meetings and established attendance, format, and general behavioral guidelines. The team completed their initial task in seventeen weeks and, one year later, has regrouped to analyze the original changes and determine corollary processes that are candidates for improvements.

Three team members enthusiastically wrote an article about their experience for the *ACUTA News* (Association for College and University Telecommunications Administrators). Published in spring 1993, the article begins:

> "This year, the department had the opportunity to apply Total Quality Management techniques to the improvement of the telephone work order process. It found that by employing the TQM philosophy--by coordinating all departmental areas and drawing on the insights and talents of all staff--it was able to isolate problems and to create effective solutions."

The article ends:

> "Our most obvious benefit from our TQM process is the new work order.
>
> Another benefit is a greater sense of teamwork, as each area within our department communicated and worked with others. Through TQM, Telecommunications staff gained a greater understanding of our department and an increased appreciation of how we can pool our abilities to improve the way we do business.
>
> Another benefit was that it placed the decision-making process on the level of the users of the form--both internal and external."

From their initial team formation, through completion of the initial team effort, and team reformation, significant, but often subtle changes have occurred. For example, the majority of the team initially expressed skepticism regarding the process and concern that their "real" work would be delayed. It took approximately four meetings before they began to work together, setting aside their work group identities (i.e., accounting, purchasing). Correspondingly, they began to look forward to their weekly meeting as an opportunity to complete work.

Team cohesiveness really took shape after an intensive three-week effort on form design. Feeling quite good about the work they had completed and the changes to be made, they looked forward to finalizing the format of the new work order. The facilitator, perhaps frustrated with the lengthy team struggle, on his own devised a format outside the meeting and presented it to the team. Reportedly, very few members commented and the meeting ended. The team informally regrouped and sent the team leader to discuss with the sponsor their reaction--demoralized, undermined, devastated, and frustrated. At the next meeting (after a one-week cool down period), the team successfully confronted the facilitator. The result: the team members drew closer, with a stronger commitment to function as a team.

Impact on Management

TQM poses many challenges to management. Management is charged with the maintenance and creation of processes and some may view the examination of processes as a challenge to their authority. Furthermore, it can be difficult to relinquish to the staff the authority and autonomy to change processes. The staff must recognize that when they have been provided with the authority and autonomy to improve processes, they also assume the responsibility for the success or failure of the processes they are empowered to change. As the boundaries for management and staff change, everyone needs to understand the implications of those changes. This is an educational process and, in some cases, a struggle for all that requires constant monitoring.

Management must recognize that not every staff member may fully understand a process even though they may be a critical player. For example, mail delivery/pickup in telecommunications has historically posed problems. To clarify the process, instructions were written and are continually modified to simplify the process. For example, a list of technical reading material with the designated recipient of each has been posted at the receptionist's desk. Yet, month after month the director's "in-box" was filled with material that should have been directed to others. Frustrated with the failure to follow guidelines, I (Jan Weller) went to the front desk and, self-righteously holding up the misdelivered magazine, asked the receptionist if she had instructions on where this magazine should be delivered. She paused and then said brightly, "Oh yes, but I thought YOU might like to see it before I sent it on to the right person." If individuals don't understand the process of which they are a part, they may, with the very best of intentions, feel free to change the process.

Impact on Customers

We do know that the customers in the external work order focus group like the changed form. A 62% reduction in call backs indicates success. The number of clients involved with this process, however, are less than 3% of the total faculty and staff at the University.

Internal customers, however, indicate that problems exist with the new form in terms of billing and cable plant database updates. While we do have some informal feedback, telecommunications does recognize the need to systematically collect data to assess the impact of changes on all customers. In collaboration with the Office of Institutional Research and Planning, an assessment tool is being developed.

Parting Thoughts...

The principles and practices of TQM are driving the staff to become more customer focused. Staff now see themselves as clients and know what they want and how they want to be treated. The staff are beginning to practice thinking about what they would expect as a client of telecommunications. The "we" versus "them" mindset is shifting as demonstrated by conscious effort by customer services staff to view irritable clients as a challenge. Recently, the manager said she timed how long it took to turn around a client from negative to positive (or at least neutral).

The staff is looking at what we do and how we do it as a series of interconnected processes. They are asking whether they should look at a specific process and, if so, should the evaluation process be formal or "quick and clean." The degree of perceived process complexity and the time to formally study the process are the determinants. Some process issues can be addressed informally using TQM principles and tools rather than a formal team process.

Learning about and practicing TQM opens us to new ways of doing old things. At every opportunity we are asking our technical and administrative colleagues how they perform tasks, why, and the results. This, perhaps as much as anything, is what infects the staff. There is excitement that tools exist that allow us to look at old tasks in fresh, new ways--and the staff will be the ones who will assess whether a new way can or will work.

TQM is inclusive if staff is provided with basic training in the principles and practices. It is essential for management to articulate why it is important to incorporate TQM into everyday work habits and visibly practice tenets of TQM. Staff who are not trained in TQM basics, or who have not had the opportunity to develop a TQM mindset through participation on a team or other reinforcing activities, can inadvertently subvert a unit's pursuits of being a quality organization.

TQM is not a panacea and it is not easy to practice. To learn new ways of thinking and doing can be daunting, and it may seem easier to return to the old way of doing business. But doing things the old way is what drew us to TQM.

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Change in the Trenches: Continuous Improvement of Service Processes

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CAUSE '93

Getting Started

Over the past three years of implementation of the Quality Process at Harvard, we have worked with managers, supervisors, and staff to help them understand the concepts of TQM and how they might apply at Harvard University. This work began in the Office for Information Technology (OIT). We have put some of these techniques in place and many problem-solving teams have been successful in improving productivity and saving money. We were, therefore, able to build on this positive experience with key managers in the organization and when we were ready to launch the Service Process Improvement program, they were ready and, in some cases, waiting for this next step in our journey.

OIT began its training component of implementing TQM with a basic Problem-Solving Team Training module. Added to that in the following year and one-half were Team Facilitator training, a workshop on Benchmarking, and Customer Service training modules for front-line staff and management staff.

A module on Service Process Improvement was added this year. This module, unlike Problem-Solving Team Training, was designed using the concepts of JIT (just-in-time) training, with participants working on actual processes. While the pilot program was quite successful in that the teams achieved their goals or at least made significant progress, they were mixed in their reactions to the training. Some felt that the pressure to meet the training deadlines inhibited them in their process improvement. They wanted to work at their own pace and not on a schedule determined by others. Accustomed as we are to listening and reacting to our customers, we re-designed the program to use a case study in the training instead of actual processes.

What is Service Process Improvement (SPI)?

We chose the title ***Service*** Process Improvement to emphasize that all processes are driven by customer satisfaction. In this program, teams of participants learn how to identify and specify their customers' requirements and how to determine their customers' current satisfaction levels. These customers might be internal or external to the organization.

The program emphasizes Service ***Process*** Improvement which requires that participants understand:

1. processes and systems,
2. how to map or flow chart them, and
3. how to measure them, not only in terms of results, but in terms of key variables upstream from the results.

The aim is to teach people to build quality into the process, which eliminates the waste of rework and ensures customer satisfaction.

Problem-Solving Team Training, a Pre-Requisite:

Problem solving is a part of any service process improvement. So that we would not have to stop the flow of the work once we started the process improvement, we made Problem-Solving Team Training a pre-requisite to the Service Process Improvement Training.

Included in the Problem-Solving Team Training is practical application, using a case study, of many of the basic quality tools: Pareto, histogram, fishbone, force field analysis, et cetera. Some refresher might be necessary as we proceed with process improvement, depending on the length of time between these two programs; however, it would probably not be a significant delay. By making the Problem-Solving Team Training a pre-requisite, we also avoided a facilitator's worst nightmare of some people having had the basic training and some not.

Objectives of the Program

As teams began the Service Process Improvement program we established these objectives:

At the end of the program the teams will have **improved the effectiveness of one work process** and will have learned:

- how to identify and flowchart a work process
- how to measure the capability of a process
- how to obtain customer requirements and to specify them
- how to measure customer satisfaction with the output of the process being improved
- the interaction between service process improvement and problem solving
- re-learned the importance of creating a high performance team through the use of good interaction skills, good meeting management, and consensus decision making

Selecting a Team to Attend SPI Training

To help managers understand the selection process they might use to identify who should attend this program, we formed the following guidelines.

Guidelines for Selecting a Team to Attend SPI Training

The team you select to send to SPI training might be formed by thinking about the work process or processes you would like to see improved. You want to include people on the team who have ownership and responsibility for a process or set of processes. You are empowering your team to document a process, to discover how it does and does not work, and you are asking them to interact with the customer to discover the customer's current level of satisfaction and exact requirements for the output of the process. The team should have 4 to 6 members.

We are using as a resource for the training a booklet by Richard Chang called "Continuous Process Improvement." Chang suggests the following guidelines for choosing a work process to improve.

"Processes selected for improvement should typically be considered critical to the organization, ones where customers are not satisfied with the specific outputs being produced. In addition, some or all of the following process characteristics may exist:

- Problems experienced by external and/or internal customers
- Complaints received from external or internal customers
- High degree of non-value-added effort involved
- High maintenance costs, i.e., too complex, too many people and/or functional areas involved, requires ongoing fixes
- More advanced technology available than is currently being used.

"To increase your chance of success, select a process that:

- The customer benefits from or cares about
- You have a moderate to high level of control over
- Is important to the ongoing performance of the organization
- Is stable enough to analyze, measure, and improve.

"In addition, the organization should be able to dedicate the appropriate financial, and human resources for improving this process."

You may want to pick a team that has responsibility for several processes, giving them the freedom to choose a process to improve. We will be asking teams to keep managers informed at each step of the improvement process.

The Original Design

This module began using the concepts of JIT (just in time) training, with participants working on actual processes from their every-day work life. The teams were given time between sessions to collect data from the customer and perform tasks required in the process improvement effort. The outline for our first training effort looked like this:

First Design
Service Process Improvement Training
Program Schedule

Session 1 - 3 hours

Overview of SPI
Review of processes chosen by teams
Methods for identifying customer requirements and levels of satisfaction
Teams plan to identify requirements and satisfaction level

2-1/2 week break

Session II - 4 hours

Reports on requirements and satisfaction
Flowcharting the process
Identifying strengths and weaknesses of the process
Measuring the process

2-1/2 week break

Session III - 2 hours

Reports on process performance
Review of process improvement methods and problem-solving process
Write "as is" and "desired state" statements

3 week break

Session IV - 2 hours

Reports on solution(s) chosen, plans for implementing, tracking, and evaluating
Standardizing the improved process

4 week break

Session V - 2 hours

Reports on results and standardization
Evaluation of training and application process
Graduation and celebration

Program Re-Design

The re-designed program is different in the following ways:

• Length of the program:

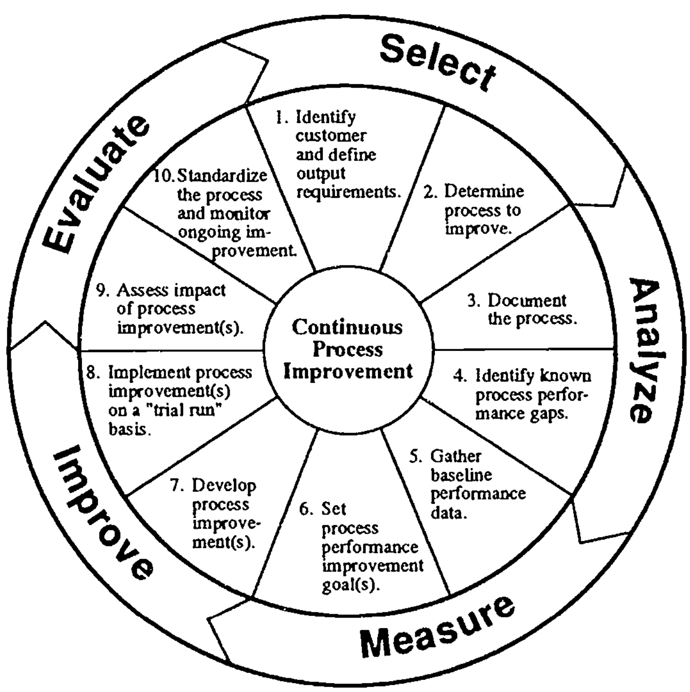
The program is shorter: the training time for the original program was 12 hours, the new program is 9 hours. The program is also more compact: instead of spreading the program out over 12 weeks, we now conduct SPI training in 3 half days spread over 3 weeks.

• Approach

We are using a case study in the re-designed program, not real processes. This, again, was a request from the participants in our pilot training program.

Re-Design
Service Process Improvement
Session I - 3 1/2 hours

• Conceptual overview of SPI
  SAMIE (Select, Analyze, Measure, Improve Evaluate) model and its relation to Problem Solving



• Program Objectives
• Simulation of Process Improvement
  - Collating Exercise
• Review of key concepts and practices in TQM as they relate to SPI
• Introduction to the case study
• Team Meeting 1 SAMIE steps 1 and 2
  - Case--Part 1: the organization or department, its context and situation, services provided, customers and identification of something about the process that will be the focus of the case.
• Questions for the team:
  - Who is the customer(s)?
  - What is the service provided?

- What is the process to be improved, its boundaries--inputs and outputs?
- Who is the process owner? Is this a process that is a candidate for the SPI approach? How will you find out the customer's requirements and the current level of customer satisfaction?
- Clarify concepts covered:
    1. a process--its owner, its boundaries
    2. SPI and processes
    3. services provided
    4. customer(s)

• Presentation on how one identifies customer requirements, and how these are translated into the work unit's specifications. Measuring customer satisfaction. The basics of flow charting.
• Team meeting 2 SAMIE steps 1, 3 and 4
  - Case--Part 2: Results of interviews with customers and a focus group. Results of a customer survey.
• Questions:
  - What are the customer's requirements? Work unit specifications?
  - What is the current level of satisfaction? Is it worth improving the process?
  - Case--Part 3: The current process in narrative form. Task for the team:
    - Create a flow chart of the process.
    - Identify any known performance gaps (ways in which customers requirements are not being met.)
• Clarify concepts: - customer requirements and departmental specifications
  - Flow charting
• Assignment on measuring

Session II - 3 1/2 hours

• Team Meeting 3 SAMIE step 5
• Questions:
  - How will you measure output?
  - What measures could you create upstream in the process?
• Presentation: Brief review of the problem solving process.
• Team Meeting 4 SAMIE step 6
  - Case--Part 4: Baseline performance data.
• Questions: Are there performance gaps? If so, where in the process?
• Tasks: List performance gaps. Choose one gap as a problem to be solved. Write AS IS and Desired State statements. Fishbone potential causes of the problem.
• Team Meeting 5 SAMIE step 7
  - Case--Part 5: Data on causes.
• Question: What are the key causes of the problem?
• Team Meeting 6 SAMIE step 7
  - Tasks: Brainstorm solutions. Clarify. Support and disagree. Bracket. Combine. Name the categories of solutions.

Session III - 2 hours

- Team Meeting 7 SAMIE step 7
  - Tasks: Select a solution using weighted voting, discussion and consensus.
    Plan the solution using a Gantt chart.
    Talk through implementation and evaluation--SAMIE steps 8 and 9
- Talk about standardization--SAMIE step 10.
- Summary and review of participant objectives.
- Teams meet with facilitators to plan their first meeting.

Results and Learnings

It has been stated above that the JIT aspect of the first SPI program did not work well. Teams working on improving real processes proceeded at very different paces. The training became a distraction. Teams felt that they had to stop the real work on the process to complete the training assignment for the next session.

Yet one team, the telecommunications team, felt that being asked to measure their process was the real breakthrough that took them beyond the problem-solving process. They never would have measured - because they felt that they knew what was wrong! The results of the measurements confirmed their hunches, but gave them confidence that they were on the right track. This team also felt that the constant emphasis on listening to the customer and applying what you hear leads to looking at things in a different way. The team began by asking: "how can we improve our voice mail system." With this focus the team bogged down. Listening to the customer opened up the possibility of doing away with the voice mail system except when it was needed to handle the large volume of calls in peak periods.

A team looking at the return policy at the Technology Product Center discovered that process improvement didn't apply very well to a discreet policy decision. Another team working on the maintenance system for the local area network in a particular building did not have a process in place on which to make improvements. The process had to be created. The training was only somewhat useful for this team. The learning here is: be careful to apply process improvement only where it is applicable and helpful.

One facilitator reported:

> "The quality process helped drill in the notion that we must be customer focused both individually and organizationally. SPI goes a step further and helps us to view what we do for customers--almost everything we do--as a process.
>
> "Recognizing that what we do in serving customers is a process is a very powerful new awareness. Reifying the process, making it an object that can be measured, studied, tweaked and gradually improved as we measure it, brings us to a very different mindset and into a very different relationship with our work. SPI gives us the knowledge along with the right tools for controlling our work processes, for changing them in ways that make a difference to us and to the customer. We become the subject instead of the object ... the actor instead of the acted upon.
>
> "Whereas before the job seemed like random human interactions that cannot be controlled or improved, SPI helps us to see it differently, to understand the inputs and the outputs, to focus on the process variation and to measure the resulting gulf between what we are providing and what the customer is really telling us she wants.

"As a facilitator, though, I learned that success does not come easily. If the suggested improvements were not made, participants ended up believing that SPI was just another training effort that in the final analysis could not make the bureaucracy adopt needed changes."

Teams reported that it was an obstacle to effective work together that some team members had been trained in problem solving, team interaction skills, and good meeting management practices -- and some had not. This situation makes it difficult for the facilitator and for the team members. And it takes more time for teams to make progress.

Summary

In summary:

- Process improvement training can have significant payoffs for teams and the organization.
- Use a case study of process improvement for the training.
- Flow charting and measuring processes are valuable skills for teams.
- Help managers choose appropriate processes to work on.
- Be sure that all team members have been trained in problem solving, team interaction, and meeting management skills.
- Be sure managers understand the importance of empowering teams to make improvements.

Primary Resources for Service Process Improvement

Leadership Through Quality: Concepts of Quality, Quality Improvement Process Reference Manual. Stamford, Connecticut: Xerox Corporation, 188.

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Establishing Trust and Building Relationships: Negotiating with Information Technology

by

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Establishing Trust and Building Relationships: Negotiating with Information Technology

The growth of information technology has advanced McLuhan's "global village" into a global community capable of communicating efficiently and rapidly across a large and heterogeneous landscape. Computers have played an tremendous role in transforming the life of citizens all over the world, as millions of people in more than 100 countries have been affected by the way in which they communicate, learn, govern, manage and make decisions (Stefanik, 1993).

Once universally available and operational, computer networks and other types of information technology: 800 numbers, videotapes, cellular phones, fax machines, electronic databases, cable and satellite television, talk radio/television, have minimized language and geographic barriers while providing the world's residents with the tools to learn from and communicate with each other (Stefanik, 1993).

Yet even without universal accessibility and utilization, information technology has a great capacity to serve as a catalyst for problem-solving and facilitating effective group communication (Stefanik, 1993). In fact, as leaders consider the use of total quality management techniques, the use of computers and other forms of information technology for qualitative and quantitative analysis require ethical and practical considerations on their respective utilization.

The challenges of management and decision making in today's political, business, health and education sectors demand dynamic negotiation perspectives. As such, effective negotiation and shared decision-making is built upon a communication foundation; as it is basciallly the *sine qua non* of negotiation. The entire process originates with the initial communication act. As the negotiation develops, options are presented and discussed, along with appropriate alternatives, all within a context of mutually agreed upon objective standards which imbue the process with trust, in the joint effort to reach a satisfactory and successful outcome while developing an effective ongoing relationship. Such an approach [shared decision-making] has been described in a*New York Times* (1992) editorial regarding its implication in health care as "something big -- big enough to change the way U.S. medicine is practiced."

The intent of this article is to apply a shared decision-making model to satisfy common goals and objectives, employing information technology to build relationships and establish trust between individuals in management and decision-making capacities.

The COAST Model

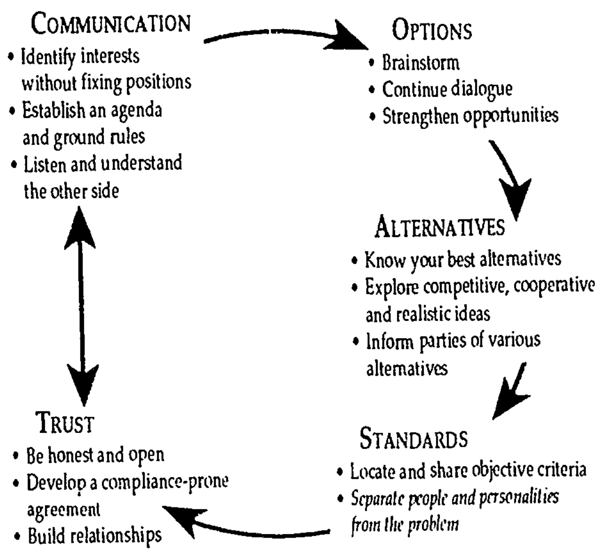
COAST -- Communication, Options, Alternative Standards, Trust -- is an approach to negotiation rooted in the essential elements of Aristotle's classical views on rhetoric. Accordingly, negotiation is a communication process based on shared similarities derived from ethical and caring relationships between people in pursuit of common goals. Its goal of identifying differences and facilitating optimal solutions among the alternatives is designed to forge an overall trusting relationship among participants necessary for long-term success in future encounters.

COAST suggests a dialectical approach, characterized by a replacement of the unidirectional flow and power relationship with a co-active encounter based on trust and a free flow of information employing various means of information exchange (e.g. interactive video, printed matter, computerized interactive databases, etc.).

To build upon agreed alternatives and enhanced trust, while advocating and implementing specific actions to improve the public good, is the abiding ethical goal of communication in the COAST model.

The COAST Model of Negotiation for management is rooted in an ethical and effective co-active *communication* process. The initial communication encounter involves parties who communicate particular management/decision-making interests. Subsequently, the brainstorming of all available *options* - regardless of the viability and effectiveness of those options. Following this important phase and through intensive communication acts, the focus of the encounter is to identify *alternatives*, agreed upon by involved parties, that could/should be employed in reaching a common goal. Such alternatives are selected based on application and analysis of the options to specific *standards*, objective criteria oftentimes defined by a third party, group or organization which has credibility among those involved in the encounter. The essential element of the COAST model, and an element that should be pervasive throughout its various phases is *trust*, the transactional product of open and honest sharing of information and credible, expected feedback among the involved parties. The degree to which trust exists within the encounter is a positive prediction of the degree of compliance with action plans and overall satisfaction of the parties involved.

Insert COAST Shared Decision-Making Model Card Here



Communication

Effective and ethical communication are key ingredients of any communication encounter. These include: *exploring/discussing the interests of each party; exercising effective listening skills; understanding personalities, cultures, backgrounds, attitudes, values, and beliefs; establishing an agreed upon agenda; setting ground rules; and asking/answering pertinent questions.*

Communication is information technology's main application with traditional and alternative means such as telephones, fax machines, computer networks among others which are designed to assist people in communicating and learning. Modern economic systems cannot compete in the global village without far-reaching telecommunications and global knowledge banks (Stefanik, 1993).

The opportunities that information technology holds for management and decision-making within the public or private sectors are great. One of information technology's greatest assets is its high reach: that it provides educators with the invaluable potential for reaching an enormous population, otherwise difficult to contact.(Arkin, 1990) This view is echoed in another researcher's report:

> "Worldwide, everyone is potentially connectable to everyone else through a newly evolved global web of interlinked telephone-computer networks. In theory at least, more abundant information communications technologies ... should create new opportunities for previously disconnected people ... to talk to each other, (and) exchange information."(Annis,1992, pp. 587-8)

Effective communication is based on the traditional communication act. Beginning with the foundation of oral and written communication , appropriate mediated communication can redefine the encounter especially if the ultimate joint decision opportunity is terminated due to issues of power and authority. Clearly, a communication-based negotiation model centers on a multi-agent decision -making approach determining the respective parties' best interests rather than employing a unilateral "substituted judgment" decision.

Although the agenda and ground rules often are impacted by constraints, the imprecision of language, the inability of parties to communicate clearly, prior attitudes, beliefs, role expectations and religious perspectives, those involved in a negotiation must make the effort to establish an open relationship, thereby ushering in a two-way process of decision-making (Quill, 1983). Without an active agenda objective within the communication component of COAST, participants in effective management decisiion-making will reduce the potential for the most effective outcome.

Options

Options, the second component of the COAST negotiation model, invites the participants to engage in generating and brainstorming potential solutions that could satisfy each parties' interests. At the onset, however, there must be an understanding that while working together, the first effort should be to create as many options as possible, without criticism or analysis of said options (Fisher & Ury, 1981). The advantage of the brainstorming process is that it provides a wider variety of options to be considered by the decision-makers that may not be considered in normal discussion. Furthermore, it results in a strong bond and identification with the decision, a product of a joint decision-making effort (Ballard-Reisch, 1990). It also increases satisfaction in the decision making process and hence increases compliance (Beisecker, 1990). The ability to generate ideas through dialogue, with inductive and deductive thinking of possibilities further enhances outcome potential. Inductive empiricist Francis Bacon (1625) stated, "a wise man makes more opportunity than he finds."

Options ahould be determined with the final goals of management and decision-making in mind, regardless of the viability of those options. Options tend to be more intangible, based for example, on values and beliefs. The options stage can be problematic if the step is not merely viewed as continuing the dialogue of parties' possible actions to address common interests. The risk is that parties often cannot withold judgment that often leads to participant withdrawal in the decision-making process.
The impersonal nature of information technology, demands an emphasis for the creation of options by all parties to be discussed and considered in the alternatives phase of the COAST model.

For example, in the field of medicine information technology assists in numerous ways; alternatives to oral communication between patient and physician such as artificial neural network systems, can be used to increase the number of options from which a physician and patient may choose. These systems analyze patterns in large data sets where computational answers are not useful but where decision making and problems solving can be enhanced by recognizing recurring patterns (Rootenberg, 1992).

Alternatives

During the decision-making process, one should protect against hasty selection of an inappropriate course of action. Alternatives, unlike options, tend to be more tangible, leading to actual actions that could realistically address the interests. Each party should consider viable and workable alternatives in the effort to strengthen the satisfaction level of those involved in the communication encounter. Frequently this includes conferral with family members, friends and colleagues. The major focus in this part of the negotiation is to continue the dynamic flow of communication among the dyadic participants. Employing traditional formal and informal decision analysis (probabilities, reasoning, heuristics, etc.) with frank discussion of advantages and disadvantages regarding each alternative can aid involved parties in eliminating weak alternatives and strengthening the ultimate appropriate decision.

During the negotiation procedure/act, it should be reaffirmed that there is nothing permanent nor obligatory in the communication encounter. If either party views the encounter from an unsatisfactory perspective, barring a resolution of the differences, potential termination of the relationship remains, however unpleasant, an alternative which could increase ultimate compliance with realistic/rational decisions.

Standards

Another pertinent component of the COAST model is *standards,* criteria by which alternatives are measured and assessed. The agreement on and use of standards -- objective criteria -- in the decision-making process is a crucial component in enhancing the efficacy of the communication encounter.

Over two thousand years ago, the Greeks identified a speaker's character to be of crucial importance in effective leadership. Today, amidst an array of technological capabilities that can instantaneously transmit an image throughout the globe, the bottom line for the effective leadership still remains unchanged -- credibility of the source and his or her ability to establish standards and to embody personally such principles in management.

Of course, there is room for compromise and acceptance; the key step is for both perspectives to be communicated and agreed upon. For example, a patient might be motivated by moral standards and a physician by professional standards. According to Fisher and Ury (1981), each must realize that "one standard of legitimacy does not preclude the existence of others." The consideration of appropriate standards from which to refer in the mediated encounters of great importance.

The realization of the importance of information technology in the immediate future in the United States and the world has led to partnerships in business and education. In 1989, the University of North Carolina at Chapel Hill and IBM entered into a partnership to further develop information technology development in higher education. The Institute for Academic Technology (IAT) was designed to create more technological classroom experiences and streamlined the ability to disseminate information within the university system. The program was estimated to have reached 40,000 academics this year through a system of shared seminars, workshops and planning sessions. Similar partnerships are appearing in the medical school community as well.

Eighteen schools in the United States and Canada participate in the Health Care Interactive Videodisc Consortium formed in 1987 in conjunction with IBM, which allows members to collectively produce course-ware for the field (Rootenberg, 1992) The Northeast Medical School Consortium's 11 participating schools shares resources via Apple Computer technology, and the Shared Decision-Making Foundation program at Dartmouth Medical School in Hanover, N.H. in conjunction with the Sony Corporation of America helps patients make more informed decisions about their own health through a totally mediated communication process with alternatives and standards (Rootenberg, 1992).

In the medical field, the growing number of collaborations between academic institutions and information technology vendors demands guidelines due to the fact that these partnerships often affect patient care (Rootenberg, 1992). The Integrated Academic Information Management Systems at the National Library of Medicine assists institutions that wish to participate in studying several different aspects of information technology management systems in the hope of meeting such standards (Rootenberg 1992).

Trust

Trust, one of the most important elements in the COAST Model, is a reciprocally enhanced product of each of the aforementioned areas. As open *communication* is encouraged, all possible *options* and *alternatives* discussed, and objective *standards* agreed upon, both parties already have begun the process of establishing an abiding *trust* - building an effective relationship in the dyadic encounter. Communication with disclosure of information further enhances *trust* and the relationship - (that part between the communication and trust in the model illustrated by a double arrow line).

The COAST paradigmatic dialectical design presents an added by product of disclosure by interested parties further deepening trust. If present, trust imbues the encounter with honest and open dialogue. (Bromberg, 1981; Deutsch, 1958; Jabusch & Littlejohn, 1990; Kremenyuk, 1991; Lindzey & Aronson, 1969).

With ethical communication leading to trust of both the source and the message, computer networks can enable the world's residents to communicate with and learn from each other (Stefanik, 1993). Information technology provides management and decision-makers with the tools to streamline the process and facilitate better decisions leading to more effective government, more productive business, and better-quality service. Because of its growing ubiquity, those involved in the use of information technology must ensure the accuracy and integrity of their data by properly learning how to use and manage the technology (Rootenberg, 1992)

Ultimately, the COAST model is merely a theory which builds *trust*, a necessary objective for its practical and efficient application transcending the initial encounter. Relationships are formed over time with trust built from disclosure and effective communication between parties (Silvestri, 1987). The relationship - the double arrow- is perhaps the unquantifiable resource employing the COAST negotiation model. With a strong relationship (communication and trust), future outcome efficacy of the management encounter is enhanced, adding positive human factors which often are the most important indicator to a plan's success (Fisher & Brown; 1988; Norfolk, 1990).

Applying COAST

Ironically, the importance of communication with information technology was so eloquently descibed some 65 years ago by John Dewey (1927):

> " The highest and most difficult kind of inquiry and a subtle, delicate, vivid and responsive art of communication must take possession of the physical machinery of transmission and circulation and breath life into it. When the machine age has thus perfected its machinery it will be a means of life and not its despotic master. Democracy will come into its own, for democracy is a name for life of free and enriching communion."

The idea of using all the available means of communicating -- appropriate media -- elicits unique options to expand the effectiveness of the encounter. However, the open communication of alternatives offers individuals the opportunity to apply different standards, whether scientific, religious beliefs or other areas deemed important to participants in the encounter. In place of the traditional communication patterns, the negotiation model clearly emphasizes the joint importance of mutual decision-making of target audiences through ethical and effective management and decision-making.

Overall, the application of COAST - Communication, Options, Alternatives, Standards and Trust - to messages with information technology can result in a win-win situation for all parties involved. The ethical application of the COAST model of negotiation by business leaders, health care educators, politicians, and such could potentiate the plight for appropriate social responses including individual behavior and attitude change as well as institutional and policy making to reach appropriate audiences adequately .

Within any communication and negotiation encounter, information must flow both ways. Rather than solely expounding information technology into a community and expecting the recipients to listen, understand and adopt the message, educators should take a more transactional, holistic approach. As the use of information technology grows and new generations learn to improve upon it; as its accessibility changes the face of politics and the mass media by giving individuals more access to information; as it encourages people to organize and become active within their respective communities and presents the option to learn about and communicate with other countries, we learn that other cultures have much to teach about managing, conflict resolution, negotiation and compromise (Stefanik, 1993).

The application of COAST --Communication, Options, Alternatives, Standards and Trust -- to messages with information technology synergistically enhance the information technology/interpersonal encounter with an advantageous by-product of a *relationship* with the message/messenger. Hence, a sense of public and private empowerment to be involved and responsible participants in attaining the goal becomes a welcomed qualitative benefit, resulting in a win-win situation for all parties involved.

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Assessing the Effectiveness of Information Technology

Susan F. Stager, James G. Williams, Polley Ann McClure, and John W. Smith

I. Evaluation Needs of Chief Information Officers

The time is past when information technology leaders could boldly promise that our solutions would cure all ills (if indeed there ever was such a time). Today college and university executives are more knowledgeable about the real promise of information technology; at the same time they are under serious budgetary pressure. This means it is increasingly important for us to be able to document authoritatively the outcomes of investments in information technology. We must also demonstrate that the benefits of those investments outweigh their costs. In the past we've done neither job well.

The benefits of information technology interventions should be evaluated in terms of their effects on the academic process. These can be direct effects, such as interventions aimed at improving student learning or enabling an analysis needed for important research. The effects can also be indirect, as when an intervention is intended to improve the efficiency of a support process or to improve some element of service to customers. It is important to tie indirect effects to academic outcomes, as, for example, when an improvement in efficiency of a support process enables funds or staff to be reallocated to the direct support of instruction and research. The most important failure, in my view, of efforts to evaluate information technology projects is that we evaluate the technology itself and whether people like it or use it, but we do not often enough take the next step—demonstrating that the project made a difference in academic outcomes for the institution.

Nor is it enough simply to demonstrate effectiveness in terms of academic outcomes. For example, a growing number of excellent software packages have been shown to improve some aspect of student learning. I know of no example, however, in which we have measured an improvement in academic outcomes per unit of cost of these packages. An important first step may be the collection of very expensive "boutique" applications that show some improvement in learning; but when our institutions look to us for help in improving productivity, we must begin to include the denominator of cost in our assessments.

A critical requirement for the type of assessment I think we need is some definition of measures of academic outcomes. Unfortunately we are dependent upon others—faculty and academic leaders—for these definitions. They will not be easily formulated. But until we have some agreement about the way to measure the numerator of the productivity term, our efforts to do so will always be subject to disagreement by way of definition. We need to challenge faculty and academic leaders to define the objectives for educational improvement initiatives in terms that can be measured. Then we need to use those definitions to assess the effectiveness of technology initiatives.

These efforts to evaluate the "bottom line" effectiveness of our activities are essential if information technology is to "grow up" and become a mature component of the higher education enterprise. Five or ten years ago we may have been able to promise the world at any cost (and many of us did). But today the very existence of our institutions may depend on whether or not we can deliver on the promise of improving academic productivity. Our obligation is to determine honestly where we can and can't do this, and to give evidence to support our case.

The purpose of this presentation is to review Program Evaluation techniques for acquiring data about technology innovations and to provide recommendations on the format for communicating these data to senior administrators in higher education and to state legislators.

II. Evaluation Tools and Techniques

> "When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind: it may be in the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science."
>
> William Thomson, Lord Kelvin
> Popular Lectures and Addresses (1891-1894)

The question any evaluation seeks to answer is: "Did the intervention or treatment have the desired effect? Did it cause a change? Did it make a difference?"

To begin an evaluation it is critical to determine exactly what was the intervention or treatment in question. Following that, we seek information on the effect. We must determine what the effect was and find ways to measure it. Even if an evaluation proceeds no further than this, thinking about these key points will lead to more effective programs and investments.

To provide some context, consider the following hypothetical intervention. In the past year, your university has invested $1 million in constructing a new network. You wonder if this has been a good investment. The questions above—about intervention, effect, and measurement—become real, and their difficulty becomes clear. What do you mean by "good investment?" How do you measure the effect of a $1 million investment versus, say, a $900,000 investment? To make any progress we will have to make this scenario more concrete.

Imagine that in the past year 1,200 faculty at your university have been connected to the network at a cost of $1 million. Has this intervention (the network connections) had any effect on:

- Faculty productivity as measured by the number of peer-reviewed articles they have published?
- Faculty satisfaction with the computing environment at the university?
- Faculty access to information (as measured by what?)?

To answer these questions we need information derived by either an experiment or an evaluation. We make the following distinction between these two sources of information:

- To control unknown effects (sources of variation), an experiment uses sampling, experimental design, and random assignment of subjects to treatments.
- An evaluation is usually non-random. Without the powerful effect of randomization, great care must be taken to attempt to control unknown sources of variation that could mask or exaggerate the intervention and lead to incorrect conclusions.

The primary issue in both experiments and evaluations is the appropriate assignment of unknown sources of variation.

To continue the case study, in an experiment you would assign faculty members at your university to a networked or non-networked group. After a reasonable period of time, you would compare the publication rates in the two groups. If the productivity of the networked group was significantly higher than that of the non-networked group, you might conclude that the intervention had had a positive effect. There might be other factors, such as department/discipline affiliation or length of tenure at the university, that could have an effect on number of publications. But, in theory, the random assignment of faculty to groups balances these effects.

In an evaluation you would have made no random assignment of faculty to groups. Ideally, faculty members would have been given connections to the network based on some non-random plan. To conduct an evaluation of productivity in this context, you would have to take into account all variables that could have affected the outcome of the experiment. For example, it would be reasonable to assume that faculty who demanded network connections immediately were more involved than others in collaborative research with their colleagues at other institutions. Such faculty might be inclined to publish more as a group, whether or not they had network connections. The key thought to keep in mind is that in an evaluation context, randomization does not control for these effects. The evaluation must take them into account, or risk drawing incorrect conclusions.

Given the non-random nature of evaluative studies, and understanding that uncontrolled, non-random variation is the chief source of ambiguity in evaluation results, what might we do to minimize the risk of error? Here are several possibilities:

- We can give careful thought to the types of variables that can cause unwanted effects. If we collect information on these variables, we can use statistical procedures to eliminate them from the analysis.
- We can analyze information collected on the key variable of interest before and after the intervention. But we must beware of the time effect—a variable can change simply through the passage of time, and not from the intervention.
- We can collect data on a similar, parallel group not exposed to the intervention. In effect, a control group can be identified and examined after the fact.

Revisiting our case study once more, we can apply some of these ideas. We know, for example, that it is standard university procedure to collect publication rates for faculty each year. We can examine the overall rates of publication from the year prior to the network installation and one year after installation. A significant difference would indicate the effect of our intervention, all other factors being equal.

In a similar evaluative procedure we could examine and compare to our own case information collected from a university that had not deployed a network in the past year, ensuring that the demographic characteristics of the two groups are matched as closely as possible (size and mission of the institution, departmental affiliations of the faculty studied, their years in the department, etc.).

III. Criteria for Evaluating Evaluations

Whether the intended audience for your evaluation is the faculty, other administrators, the university president, or board of trustees, that audience will make value judgements about the worth of the evaluation. The criteria for judging an evaluation study are the same criteria that administrators use daily when judging the value of any information presented to them: the information must be of high quality and must come from reliable sources. These evaluation criteria may never be verbalized, but they will be consciously applied. It is important, therefore, that you "think" like the audience and evaluate your own efforts during the planning stage when you can still modify the evaluation process.

Here is a list of criteria that represents both the professional and lay judgement of such efforts:

1. Was the evaluation carried out by a competent, trustworthy, objective staff?

   An eloquently written evaluation by a staff member with a history of inflating numbers, blaming mistakes on others, or falsifying information will not be taken seriously by your administration. An eloquent evaluation written by the project leader will carry less weight than one conducted by an external evaluator or an internal evaluator without a vested interest in the outcome of the project.

2. Were the relevant stakeholders involved in the evaluation?

   At the very least, an evaluation of a collaborative project is considered incomplete if one or more stakeholder units were not included in the design of the evaluation and review of the results. At worst, the evaluation may be suspect. The nature of the involvement of stakeholders is also an issue. Was involvement coerced or voluntary? Do the evaluators have supervisory responsibilities for some of the individuals participating in the study?

3. Did the evaluator take the context into consideration when reviewing the results?

   A document written from the perspective of the technology organization risks appearing naïve if it fails to account for factors operating within the higher education context. Technology programs are not implemented in isolation from factors such as the increase in nontraditional students, fiscal problems of higher education institutions generally, the distance education movement, and deferred maintenance problems.

4. Were reliable and valid measures used?

   In many respects, administrators are less concerned about the reliability and validity of the instrument used than in the other factors mentioned above. The reputation of the author of the document often colors administrators' judgement about its reliability and validity. Of special concern to any evaluator should be the accuracy with which s/he quotes faculty, students, and staff participating in the study.

IV. Case Study: University of Virginia School of Architecture

By the beginning of 1993 the School of Architecture at the University of Virginia was at a stage many organizations go through as they embrace information technology. The computing environment had been created and managed by a few interested faculty and administrators. Two key players had left within the last year, and the computing environment was in disarray. The administrative and academic areas were uncoordinated, reflecting the structure of the university computing organization. University and school administrators felt increasing internal and external pressure to significantly increase the use of information technology in instruction. Resources were extremely limited, with little money budgeted for information technology and no internal technology support staff.

The planning that had been done was too local and limited in scale to serve as a guide for the extensive, complex, networked environment that was evolving. The plans presented to the university administration had shifted significantly as the key people in the school changed. The provost wanted future investments to be guided by a more long-range and consistent plan. One of the university's responses to this problem was to commit an internal consultant to the school for an initial period of six months. This person had two primary charges:

- Bring the current computing environment to a reasonable level of reliability and service.
- Help the school create a set of strategic and tactical plans.

In both of these areas the dominant factor was extremely limited resources, both fiscal and personnel. The vision that was developing in the school would require an order of magnitude more resources than were currently available. It was clear that:

- There was very little margin for error—the technology had to work.
- All acquisitions and activities had to contribute to the future as well as the present.
- The technology expenditures had to maximally benefit architecture, not just technology.

To deal with these criteria the university had to develop a scheme that provided some assessment of the impact of a particular technology intervention upon the instruction and practice of architecture, as well as one that helped determine which interventions were most cost-effective.

Information technology has become so entwined with the practice and teaching of a discipline that people find it difficult to separate content from technology. When asked, "What is the problem?" the instructor's answer is likely to be "We need more memory," rather than "Our students need to be able to create clear and concise project proposals."

To deal with this, UVA devised an evaluation scheme to direct thinking into three distinct areas: discipline content, computer literacy, and infrastructure. This scheme provides a direct link from discipline requirements to infrastructure design and expenditures. For example, the discipline need "A landscape architect must be able to compose a clear layout plan for a site" links to a computer literacy requirement that "Students must be proficient in at least one computer-aided design and drafting program." This in turn leads to an infrastructure specification that "LAND CADD will be available on all workstations connected to the School of Architecture network."

The foundation of the scheme is a collection of knowledge statements. These statements can be converted into questions that can be used to establish a baseline, to set goals, and to measure progress. Examples of the different forms are shown in Figure 1. It is also possible to adjust the resolution of the question depending upon specific needs and the amount of effort the organization is willing to spend on the evaluation. They can be phrased to gather simple yes/no answers, choices from multiple alternatives, or precise numbers.

Statement: An architect should be able to write a clear and concise project description.

Baseline: What percentage of third-year students can create a clear and concise project description?
Goal: What percentage of third-year students should be able to create a clear and concise project description?
Progress: What percentage of third-year students have subsequently demonstrated an ability to create a clear and concise project description?

Figure 1. Knowledge Statement and Derived Questions

It is important to emphasize that this collection of statements is not meant to exhaustively define an area. It is impossible to get agreement on such a list. Such a focused statement is more like a null hypothesis: if a person does not understand the statement, most others would agree that that person is not knowledgeable in the area. For example, if a student can not "efficiently create accurate and detailed schematic drawings," that student is not competent to practice architecture. This relates to technology planning in the following way: if access to a CADD lab does not increase the number of students who satisfy this criterion, it may indicate that information technology is not a cost-effective solution to this particular problem. Or it may indicate that the facility is deficient.

Associated questions in the computer literacy and infrastructure areas can help determine if the problem is with the facility or instructional process, and can lead to corrective intervention.

The major effort in this method is the generation of the knowledge statements. People in the discipline must generate the content statements, although they often need coaching to keep them from drifting into the areas of computer literacy or even technology infrastructure. Technical staff should generate the infrastructure statements, and the collection of computer literacy statements is best generated by a combination of discipline and technical personnel.

For evaluation, the first step is the determination of the current knowledge of the target group (students in this example). A questionnaire, formulated as shown for the baseline statement in Figure 1, should be given to administrators, faculty, and students. The second step is to establish measurable goals. A rephrased questionnaire should be presented to administrators and faculty. The results of these two questionnaires should then be used to determine literacy requirements and as the basis for infrastructure design and development. There are four basic considerations for this stage:

- What are the most important goals?
- Where do we find the greatest discrepancies between the current state and the goal?
- In which areas will technology have the greatest impact?
- In which areas will technology have the lowest cost/benefit?

Additional questionnaires can be used to measure progress. These have limited utility, as will be explained in the conclusion.

This scheme is already producing useful results, though it has not been tested in its entirety. The process of generating the knowledge statements:

- Brings content issues to light so that they can be rationally examined.
- Enumerates the core content of the discipline as it relates to technology.
- Starts the process of establishing priorities.
- Indicates the areas where technology intervention is important.

The initial questionnaires have been used to generate a rational framework for the design of the technology environment and as a guide to optimize technology investment. Additional questionnaires can be used to measure progress toward goals. In reality, the rapid evolution of technology and the steepness of the assimilation curve are likely to cause the goals to change significantly during the time of the intervention. Thus, although it would be possible to conduct a summative evaluation, there would be little meaning in the results. As a formative tool, however, the technique addresses many of the special problems of technology planning. It provides a direct link between discipline requirements and technology interventions, offers guidance in setting priorities, and provides a rational basis for resource allocation decisions.

As with all such methodologies, this one is not the ultimate answer. It is one more tool to be shaped and applied by those of us trying to manage information technology in higher education.

V. Case Study: Evaluating Classroom Technology

Indiana University was concerned that freshmen were not fully engaging in freshmen-level courses. We undertook a project to help reinforce a "culture of learning" at Indiana University by targeting three large lecture courses and assisting their faculty as they worked to engage freshmen more fully in them. The courses were introductory psychology, 100-level mathematics, and business law.

A number of the innovations in these three courses had technology as their cores. In introductory psychology, students responded via computer to questions about course concepts, allowing the instructors to modify the next lecture to clarify the concepts. In addition, students completed computer-based quizzes that tested their understanding of readings and course materials. Students could re-take the quizzes until a 70% success rate was achieved. In mathematics, students independently completed practice problems using interactive software and modules prepared by the professor. In business law, lecture discussions were extended through e-mail, thus increasing faculty and student contact.

From the beginning, we were aware that there would be statistical limitations to the evaluation. Course assessment measures were by necessity non-intrusive. Each innovation was evaluated from three perspectives: the faculty member's perceptions; observations by external personnel; and student responses to tests, course evaluations, and focus groups. In the introductory psychology class, students scored significantly higher on a common final exam than their counterparts in six other sections. Typical comments included, "The course stimulated me to think in a better, different way." In mathematics, the students in the targeted section had higher median scores on both the midterm and final examinations, although the differences were not statistically significant. In business law, daily attendance reached the 93% mark.

The results of this evaluation were reported to four audiences. A technical report, written by the evaluation team, was distributed to the evaluation team and the participating faculty. A narrative description was distributed to the university board of trustees during its regularly scheduled meeting. An oral presentation of the project and evaluation were presented to the senior administrators of the university. There was a definite logic to this distribution plan. In each case, an effort was made to report the data of interest to the audience in a format that was comfortable for that audience, without compromising the integrity of the report.

Track IV

Managing in a Client/server Environment

Coordinator: John Sack

Open systems, interoperable systems, client/server systems ... these are not only changing the rules for hardware and software, they are changing the paradigm for management as well. The central question for IT managers on campus is how to minimize risks while optimizing rewards when developing systems for these new models.

Moving To Client/Server Application Development: Caveat Emptor for Management

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Client/server systems architecture is evolving to include a set of concepts and tools that range from many exemplary success stories to some intriguing but unresolved problems. Much of what is being called, or sold, as client/server is confounded by a substantial amount of confusion due to: still maturing designs, standards and tools; as well as vendor, consultant and colleague aggrandizement. This has resulted in a level of expectations about the benefits and appropriate use of client/server which is confused by many myths, misconceptions and incomplete information.

This paper presents: a summary of management considerations and recommendations involving moving to client/server application development; and an overview of two mature client/server applications developed and extensively used at Dartmouth College.

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Introduction

Caveat Emptor; let the buyer beware! Valuable consumer advice, whether a manager is faced with gold or snake-oil in the client/server marketplace.

The preferred architecture of computing applications is continuing to evolve. Made possible by advances in hardware, software and network technologies, the concepts of "Client/Server" computing represent an emerging technology which offers valuable design features worthy of immediate use for many applications. From a perspective of most mainframe modeled systems, moving to client/server represents a dramatic transition involving technological and organizational change that can often be far more complex and costly than many vendors or pioneers admit.

The client/server model is still evolving as a set of concepts and tools that range from proven success stories to some intriguing but unresolved application software and operating system problems. As with any change of the magnitude that some consider a "paradigm shift", most of what is being called, or sold, as client/server is confounded by a substantial amount of confusion due to: unresolved problems; still maturing designs and tools; as well as vendor, consultant and colleague aggrandizement. These problems are exacerbated due to the inexperience of computing professionals who are too busy for, or in some cases incapable of, successful training in this new model. This has resulted in a level of expectations about the benefits and appropriate use of client/server which is confused by many myths, misconceptions and incomplete information.

Resulting from an effort to sort through these issues in order to reach intelligent decisions on information systems investments, this paper presents: a summary of management considerations and recommendations involving moving to client/server application development; and an overview of two mature client/server applications developed and extensively used at Dartmouth College.

Why all the Client/Server Enthusiasm?

The attractiveness of Client/Server systems concepts may be associated with its compelling arguments which seek to better leverage desktop computing resources, further empower the independence of users, and take advantage of increased capacity and reliability of networks. Furthermore, the intriguing technical challenges of continuing advances towards achieving the goals of open systems in distributed or cooperative processing applications pose exciting, and frequently solvable system challenges. These factors, considered in contrast with the burdens and frustrations of many of our older legacy systems, may explain some of the initial apparent willingness of many computing professionals to so fervently embrace client/server as the long awaited promised land of information technology.

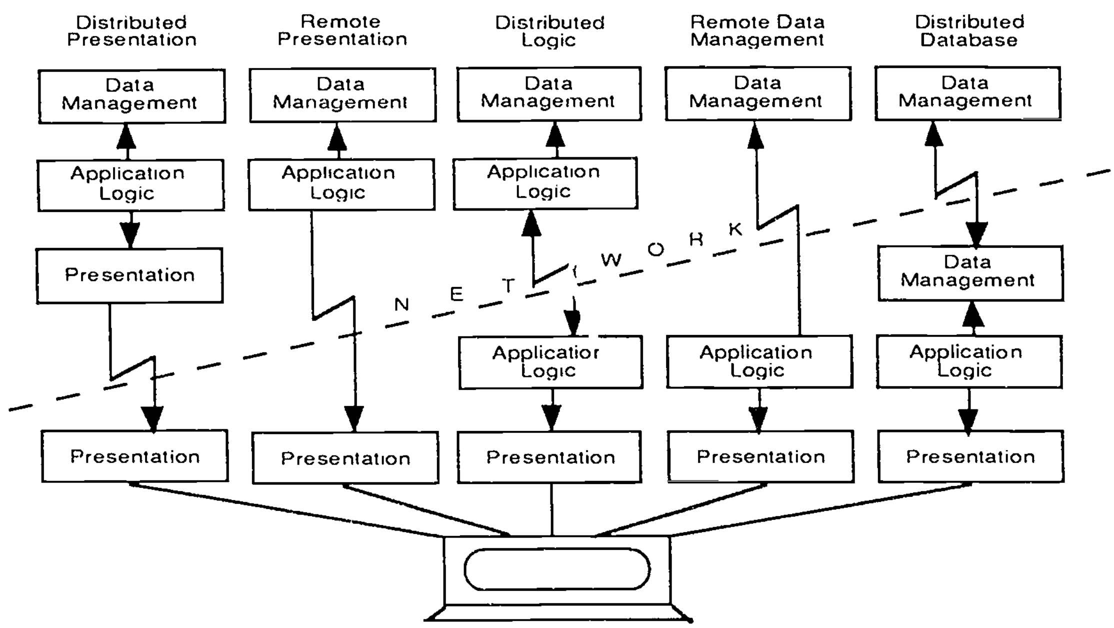
Management decisions involving information technology investments should be driven by prioritized needs, based upon a realistic assessment of costs and benefits. Considerations of the exciting promise of emerging technologies should factor in the wisdom gained from computing's history of exaggerated promises and panaceas. As the initial fervor of client/server enthusiasm has been tempered with experience, our industry has once again been reminded that still maturing technologies need to be approached carefully. Acknowledging that many emerging technologies are built upon compelling and in some cases attractive and thorough systems design principles; the current appropriateness of each of these technologies and trends needs to be judged according to a few criteria. These criteria include: the maturity and reliability of the technology; the costs of adoption; the benefits and tradeoffs relative to other approaches; the availability of enough sufficiently skilled staff; and the balance between a complementary fit with existing systems goals versus the timing of needs to embrace change in existing approaches.

Defining the Client/Server Model

"What does client/server mean? Is it merely a state of mind, a fashion, a philosophy, an attitude? No; not just. Reports coming back from the bleeding edge tell us that client/server is in fact a *technology;* tough, complex, incomplete, and not inexpensive. After several years of dynamism, the revolutionary fervor that has surrounded client/server is dissipating. Rather than a clear rational construct, client/server is a nest of new and interrelated challenges. As evidenced by its wide popularity... client/server crosses several (in fact, nearly all) technology boundaries: database, applications, networks, systems, and hardware. And perhaps most importantly, client/server implies dramatically new management approaches to gathering, accessing, and maintaining information itself." Stodder (1993)

One of the frequently referenced models of client/server computing was developed by the Gartner Group (1992). This model divides an application into three logical parts (the user interface *presentation*, the business function *processing logic* and the *data management*) and two physical parts (the client system and the server system). The Gartner model outlines five different styles of client/server distinguished by where the network division of the three logical parts of the application occurs.

Styles of Client/Server Computing



source: Gartner Group, Inc.

These five styles of client/server can be summarized as follows

Distributed Presentation: data management, processing logic and presentation components all reside on the server hardware and the presentation component is networked to the users local device (terminal, or desktop computer).

Remote Presentation: data management and processing logic components reside on the server hardware and, separated by the network, the presentation component resides on the users local computer.

Distributed Logic: data management and some processing logic components reside on the server hardware and separated by the network, additional processing logic plus the presentation component resides on the user's local computer.

Remote Data Management: the data management component resides on the server hardware and, separated by the network, the processing logic and the presentation component resides on the users local computer.

Distributed Database: some data management components resides on the server hardware and, separated by the network, additional data management components reside on other server hardware or the users local computer. The processing logic and the presentation components resides on the users local computer .

Depending on a variety of factors (including the application need, the configuration of hardware, network resources and available software tools), any one of these five styles of client server may represent an appropriate and advantageous use of the client server model.

This brief overview of the Gartner Group model is highlighted here only to provide a framework for discussion of this evolving technology. As further client/server experience is gained and the available repertoire of tools evolves, the existing models will be extended or replaced. For example, one variation on the Gartner Group model, reported by Winsberg (1993), states that the issue of distributed database is not directly germane to the model since database management system software should hide the issues of distributed database from the application programmer.

> "Defining client/server seems to be a new kind of parlor game for the industry. I've heard it described as a style of computing, a collection of technologies, an architectural platform, an application development method, a systems integration solution, a re-engineering tool and - heaven help us all - a paradigm shift." Johnson (1993)

Organizational Responsibility and Client/Server

In addition to providing models for various configurations of application components, client/server architecture creates an opportunity to move away from the model of centralized responsibility for developing and maintaining systems. Among its more optimistic and ambitious goals, the vision of client/server facilitating opportunities for the flexible independent creation and support of decentralized computing systems can encourage a new model of decentralized system control and responsibility. These opportunities can compliment and further extend the advantages of decentralized computing staff. However, institutional size and information technology budget levels need to be factored into decisions to move towards decentralized responsibility for development and operations of computing applications. Large institutions which have an appropriate number of decentralized competent systems development staff can be effective in using a client/server application architecture to move towards further distributing a systems total development and operational responsibility. A small university or college, having retained the centralized organizational model of supporting administrative systems, can more economically achieve many of the advantages of client/server systems with no change in who is responsible for systems development and support.

Partial Summary of Anticipated Benefits of Client/Server

- flexibility of independence between application components
- reduced later maintenance costs
- better utilization of lower cost (per MIP) decentralized computers
- elimination of high maintenance costs on older mainframes and minicomputers
- separation of some programming tasks (e.g. presentation) from complexities of network or database management system.
- reduced dependency on one or a few vendors' proprietary systems environments

Summary of Management Considerations and Concerns

The essential issues for management are to understand what information system needs are to be met and what are the costs and success factors involved among possible alternative approaches. An informed management strategy needs to understand: what applications will gain the most from a client/server approach?, what are some of the cost and risk factors?, and when should their organization venture into this approach? Despite the obvious facts just stated, it is surprising how many managers seem willing to buy into a change in systems strategy without attempting to assess the facts.

Cost Issues

Understanding an institution's current level of information technology resources is essential in planning the costs or estimated savings involved in moving to client/server systems. Efforts to plan the costs of client/server applications need to consider: expenses associated with creating or upgrading campus networks; the capacity of installed desktop computers; design complexities of many client/server applications; and the staff learning curve or retraining issues.

Trade press and industry consultants {e.g. Gartner Group (1992); Kennedy, et al (1993); Cafasso(1993); and Anthes (1992)} are increasingly reporting that moving to client/server actually increases costs. As client/server methods and tools mature, and after an organization successfully completes the initial learning curve, many of the costs of creating and supporting these systems will drop and the anticipated long-term benefits are expected to outweigh the costs.

However, Ambrosio (1993) reports that recent studies completed by the Gartner Group present the conclusion that, when considering the total cost of computing, moving from a mainframe-centric model of application development and support to client/server can cost 50% more than a comparable mainframe-based system. It is important to note that this analysis is based upon the current costs of *new* mainframe and mid-range hardware and software licenses, not earlier generations of higher-priced mainframes and astronomical platform-based software pricing. A key cost factor in the Gartner Group's equations is the fact that client/server based systems typically have technician labor support costs, per user or workstation, that are ongoing and are higher than the labor support costs of a centralized system.

But, for some applications, a move to client/server can be quite justifiable and desirable, as a way to better meet the needs of some applications that have compute-intensive or screen I/O intensive needs that are best localized closer to the users desktop. Therefore, moving to client/server should be considered in terms of the improved functional value delivered for some applications, not as an approach to cost savings.

Network Resources

Realizing the potential of Client/Server applications architecture depends upon the completeness of adequate network bandwidth to all desktops to be served. Reliable, high speed, high capacity network services are essential to succeed with client/server. Capabilities of 10Mb/sec network speeds, to the desktop, should be considered a minimum for applications of moderate complexity. If multiple desktop applications will each involve concurrent client/server sessions, then higher bandwidth is needed. To accommodate future applications involving the transmission of digitized voice, video or images, higher network speeds will be necessary (e.g. FDDI at 100 Mb/sec or ATM at 150+Mb/sec).

If a campus is still being served by only asynchronous networks intended to support host to terminal session access requirements, there are many reasons to emphasize network upgrades as a top priority. As a foundation for client/server applications, reliable network services should include a minimum of: network access to all desired campus constituents; comprehensive electronic-mail; print services; network authentication; and file transfer services.

Desktop Resources

In most institutions, the deployment of desktop computers has been incremental over a period of several years of rapid expansion of available desktop computing power. These computers have often been selected according to varying assumptions and understandings of desirable device capacity requirements. This has often resulted in an installed base of not-fully-depreciated desktop equipment, that is insufficient to support the memory, CPU speed, I/O channel or disk requirements of client software and/or data needed as part of a new application. New client/server systems may require upgrades or replacements to some or all desktop PCs. If the desktop device is still a terminal, the costs of acquiring desktop PCs or workstations needs to be factored in.

Other desktop considerations include: the limits of earlier operating systems (e.g. the memory allocation limitation problems of DOS, or the limits on file-sharing of older version of Mac OS). A suggested minimum client CPU is a 386 class Intel chip (or a Macintosh with an 68030-25MHz) and, for low-end server CPUs, at least a 486 class Intel chip (or a 68040).

Standards and Planned Architecture

Successful implementations of client/server applications must be built upon standards of a well-defined systems architecture - if they are to be reliable, scalable, expandable and enduring. A comprehensive strategy defining standard requirements for software, operating systems, data administration, APIs and RPCs, network protocols supported, and hardware configuration is a prerequisite for widespread success with client/server based systems. Such an architecture may include locally defined standards for system component interface requirements or preferably established industry standards. The architecture should include a definition of the intended scope of the problem being addressed and the policies and procedures that will ensure adherence to the architecture's standards.

The very real potentials of interoperability, decentralized independent software development or acquisition, and independence from proprietary systems will fail without success at further establishing and adhering to standards.

Among the shifting sands of vendor consortium or user group standards definition efforts, the Open Software Foundation's Distributed Computing Environment (DCE) standards are emerging as a set of "vendor-neutral" standard APIs (application programming interfaces) that are demonstrating much promise as a cornerstone of software interfaces upon which to implement client/server software. One key remaining weakness of OSF's efforts have been the delays in completing their set of Distributed Management Environment (DME) standards which are intended to address many system and operation management needs. DME is anticipated to be completed in 1995.

Despite the efforts of OSF and many other standards shaping organizations, achieving standards that are comprehensive to any domain, and then accomplishing vendor adherence to those standards is a slow and painful process, at best. Despite the tremendous advances that efforts to achieve open systems have successfully delivered and the examples of successful realization of standards facilitated interoperability, open systems are not yet open! Given the politics of change plus the free-market economic forces upon which a vendor's product differentiation in the marketplace can determine market share and survival, progress towards standards and the commoditization of software components will continue to move ahead slowly, at best.

One way that this can create a problem for client/server is referred to by Roti (1993) as "versionitis... the software malady that causes version 1.2 of product X to work only with version 2.1 of product Y and not with version 2.0 or 2.2. In client/server systems there may be as many as six or seven distinct pieces of software between the user and the database, there may be only one specific version of each of those pieces that works correctly with the others. Change any piece and the whole thing stops working." Considering the lack of sufficient debugging tools in many client/server application development environments, this problem of "versionitis" creates a significant cause for concern. Roti concludes that, given the not-yet-realized promise of 'open systems', it may be wise to minimize the number of vendors involved in components of a client/server application.

Data Considerations
The ideals that many vendors and systems designers are pursuing envision an institution's logically integrated database comprised of networked, distributed application databases created and managed on different but openly accessible software and hardware platforms. According to this model, the integrated databases, some of which may exist on physically separate hardware platforms, can be made to appear to any client program as a single uniform system resource.

Some of the advantages of this model include:
- the ability to accommodate a department's local data needs in ways that coexist with solutions to institutional data needs
- the utilization of less expensive distributed hardware options that can be independently scaled to meet localized processing requirements
- opportunities for reduced network traffic when localized data needs can be met by a departmental server
- increased opportunities to design and tune database and hardware resources towards specialized needs (e.g. high volume transaction updates versus read-only query access)
- greater vendor independence

Some serious disadvantages (or remaining flaws) of this model include:
- the advantages of mixing and matching most current database applications comes at a cost of complexity in making distributed applications work together. In the current state of these technologies, *transparent interoperability* is frequently only partially realized.
- the current state of systems management tools to support coordination of distributed heterogeneous databases is both weak and incomplete. Problems of configuration management, operations management, transaction journaling, auditability, contingency planning, security authentication and access controls remain to be properly resolved.
- offsetting the hardware budget savings of less expensive localized departmental servers are the increased labor costs of managing networked distributed hardware.

It is also anticipated that, simultaneous with the maturation of the complex tools and design methods required with distributed databases, there will be a continuation of the trend towards lower cost of larger electronic, magnetic and optical data storage devices, faster and higher capacity data I/O buses and more powerful single and parallel CPUs. More progress towards the outcome of these sets of evolving technologies should be achieved prior to any substantial move towards distributed databases, unless there are other factors to justify such a change.

Issues of data administration should also be considered. As database management system (DBMS) tools continue to mature, much progress has been made in preserving the integrity and consistency of distributed databases. However, prior to worrying about which DBMS vendor has solved "two-phase commit" problems of updating a transaction across a distributed dataset, or before assessing whether a vendor's product can handle data rollback across heterogeneous databases, many organizations should continue efforts to reconcile their lack of successful data administration involving their central systems. These challenges won't get any simpler to solve if databases become more distributed. This is not an argument against client/server. It is a reminder of the need to judge an organizations position relative to newer technology against the degree of success to which more mature methods and technologies have been applied!

Is a reluctance to move to distributed databases running against a real or perceived trend towards "downsizing and decentralizing" all of computing? Yes. Is this a sound position or is this just a resistance to change and a perpetration of the old model by a shortsighted "mainframe bigot"? According to Gillan (1993), when asked about the future of centralized data storage, Bill Gates (founder and CEO of Microsoft) stated, "We're in the information age and that means there'll be a lot of information. There are still large economies of scale in storage costs and administration of centralizing that data, and as fiber brings communication costs down, you'll be able to pool a lot of that data in one place... The productivity application world and the data center world are not separate any more".

Systems Management in a Heterogeneous Environment

In contrast with available systems management tools for use on mini or mainframe computers, an area of concern in the client/server arena involves the lack of complete and reliable tools for a wide array of important systems management tasks. These missing or incomplete tools include operating system or application utilities to support operations scheduling and control; audit tools; rollback journaling; backup and recovery tools; performance monitoring and capacity planning tools; and change control utilities.

Staffing Issues

Experience and skill levels of current IS staff and the costs of new training represent a substantial current obstacle to the adoption of client/server methods. Anthes (1992) reports that the Cambridge Massachusetts research firm Forrester Research Inc. found that 75% of Fortune 1000 firms included in their survey lack the skills needed to work with client/server based systems. Exacerbating this problem is the burden on current staff to support required production maintenance and the ongoing stream of enhancements to existing systems.

While it is wise to encourage the highest potential of our staff, it is also essential to acknowledge limits. Many of the very skills that made some 3GL programmers successful (e.g. linear procedural thinking), seem to get in the way when more abstract reasoning requirements of the multi-layers of software and data manipulation control become involved. Most data processing professionals should be given every chance to make the leap to client/server, and management needs to find ways to fund and nurture that effort. However, there remains the pragmatic reality of some staff who can't or don't choose to keep up with new technologies. For example, consider the difficulties of some staff to move from record oriented to set processing, or the slowness of introducing many software engineering methods, and the difficulty some have with either full or partial data normalization. These past perfomances should give a manager second thoughts about the future career paths of some programmers and systems staff.

Separate from issues of skills retraining, the fact remains that there is a shortage of computing professionals with the proper mix of experience with complex applications development and many of the talents needed to design and build client/server systems.

Some Systems Are Not Appropriate to Current Client/Server Technologies

All forms of centralized systems are not going away. The trend of greater MIPS per dollar spent on smaller machines does not, by itself, dictate that the model of the central computer is no longer of value. In nearly all cases cited in business management or computing trade journals, a business cost analysis which compares the relative cost and capability of mainframe or mini computers to the alternatives are comparing old machines to newer more powerful ones. While the old model of centralized million dollar hardware generating unacceptable recurring maintenance costs to support high-priced application software is being replaced by the competitiveness of newer economies of hardware and software, the appropriate role of centralized computing applications and operations continues to provide economic and operational advantages for many institutional administrative information systems needs. The lower prices of desktop and workstation software are forcing down the previously astronomical pricing structures associated with mainframe or minicomputer software. The marketplace is forcing most applications vendors to shift to per-user software licensing rather than purely machine-sized pricing. The systems management tools necessary to administer distributed systems do not yet compare favorably with those available on single clustered systems.

For small universities and colleges, having most business functions located within a single campus, centralized systems continue to provide the most efficient economies of scale for many institutional administrative systems.* When costs of decentralized hardware, dis-economies of scale in vendor negotiation, programming or support staff, and non-coordinated data definition are considered, many distributed systems are proving to be more costly than centrally developed and managed systems.

As Blythe (1993) reported in the CAUSEASM listserv's summary of an electronic roundtable discussion on "Client-Server Computing: Management Issues"

> Ted Klein, President of the Boston Systems Group writes that there are five types of systems that are NOT applicable to downsizing with today's technologies:
>
> 1. applications with large databases which cannot be easily partitioned and distributed
> 2. applications that must provide very fast database response to thousands of users
> 3. applications that are closely connected to other mainframe applications
> 4. applications that require strong, centrally managed security and other services
> 5. applications that require around-the-clock availability

Software Development Considerations

A software development team can move towards client/server by establishing and beginning to encourage adherence to a set of client/server modeled software, data access and user presentation design recommendations. These recommended design features, refined by experiences with pilot applications, can begin to incorporate OSF model concepts for RPCs, APIs, and other utilities of the DCE model. In addition, good modular design of software (for any application architecture) should incorporate divisions of programming code between: GUI or screen presentation; SQL statements; business rules; and the linkages between the screen I/O and business rules. Efforts should also be made to experiment with PC, Macintosh or workstation 'front-end' tools that use SQL to access host system databases.

Consideration should be given to learning more about client/server success stories and the opportunities to partner, for example, with the efforts of Dartmouth College's DCIS or Cornell's Mandarin project.

In considering new software tools:

- Attempt to minimize the varieties of DBMS and GUI vendors until there is further progress on standards efforts.
- Favor vendors or programming tools which support industry efforts towards standard protocols (e.g. SQL, OSF's DCE RDA s and APIs). Assess vendors' demonstrable commitment to standards and gateways with proprietary DBMS products.
- DBMS system recoverability: look for working solutions to two-phase commits needs, or data rollback across heterogeneous databases
- Query optimization: be cautious about the proposed database designs creating the distribution of databases that may need to be joined for query. The technologies of query optimization, still maturing within most single vendor DBMS tools, have yet to adequately address query optimization across multiple vendor DBMS.

* It should be noted that the model of centralized systems can be consistent with goals of increasing departmental access to and control of data and systems resources.

Overview of Two Successful Dartmouth College Client/Server Projects

Dartmouth College's BlitzMail® electronic mail system.
Placed into production in June 1988, BlitzMail was created to provide a GUI electronic mail system for a primarily Macintosh equipped user community. Currently serving 17,000 members or affiliates of the Dartmouth Community, this client/server based system is capable of 1000 simultaneous client connections and recently hit a new usage peak of 73,000 messages sent in one day.

Connecting more than 7000 Macintosh-based clients, spanning over 200 AppleTalk LANs and a TCP/IP internet link connecting UNIX and XWindows clients as well, BlitzMail is a ubiquitous part of student, staff and faculty work at Dartmouth College. The GUI client software was written in Pascal, the server software was written in C. The server hardware currently employs five Next machines; we plan to install a DEC Alpha workstation as a sixth server in late December 1993. This single new server should provide the capacity to handle an additional 500 simultaneous users. Periodically, upgraded versions of the Macintosh client are distributed using BlitzMail itself. Such upgrades are also accessible for users to copy to their desktop Macintosh computer from a public AppleShare file server.

In addition to a full complement of electronic mail features, BlitzMail allows arbitrary Macintosh documents (such as word processing or spreadsheet documents) to be sent along with mail messages as enclosures. BlitzMail also provides a Macintosh interface to bulletin boards containing "semi-official" information about groups and departments around the campus. BlitzMail acts as a client to a standard NNTP server which is part of our normal Usenet news system.

Dartmouth College Information System (DCIS).
Dartmouth College, with the support of Apple Computer, Inc., has developed an integrated campus-wide information system. DCIS is a client/server architected system which provides an average of 700 users per day with access to over 60 local databases and hundreds of off-campus Internet database resources. DCIS provides access to data from a variety of sources, including: reference encyclopedias; indexes to the Dartmouth College Library's collections and the journal literature; scholarly resources such as the Oxford English Dictionary, a library of commentaries on Dante's Divine Comedy; administrative systems data resources such as the central supplies inventory; and resources like Books in Print.

The software architecture uses the OSI model of communications protocol stacks, incorporating the Z39.50 search & retrieval standard, WAIS protocols, and other locally developed protocols. DCIS databases are distributed across several mainframes and servers spanning multiple operating systems and database management systems. Written in C++, the viewer (client) portion of DCIS, is distributed to thousands of users. DCIS has a self update capability and is also distributed via Dartmouth's blitzmail and from a AppleShare public file server.

The DCIS system and tool set are available to be exported to other environments, including other academic institutions. The available products include: viewer application software; search and retrieval protocol software (a WAIS gateway, a Z39.50 gateway, and a Telnet connection server); servers for BRS, PAT and SPSS database managers; and an authentication server (IDAP).

Conclusions

The following conclusions can be reached about current client/server methods and technologies:

- client/server is real, desirable and inevitable for many applications
- it should be seen as a means to better meet user needs, not as a way to cut costs
- for most applications it is neither simple, nor cheap
- central administrative computing departments should provide leadership in realizing its benefits and optimizing an organizations chances of success with client/server
- it is not a panacea and is not, for the foreseeable future, appropriate for all applications
- it is a fairly immature, emerging technology full of risks and unresolved pitfalls.

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Client/Server as a Software Architecture

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Abstract

Adding telephone registration to an already overloaded multi-use computer forced the University of Saskatchewan to consider a client/server architecture. A survey of client/server implementations left us very confused: we encountered everything from PC's accessing database servers, to X-windows systems with the server on the desktop. The only common theme was hardware components on a network.

We came to understand client/server as an interaction between software components. Four distinct components are recognised in a typical operational system: presentation servers, client applications, business servers, and database servers. Each interaction between components has a distinct client and a distinct server side, with the client side being in control. There are general principles governing the function of each component. We call this the 4 box architecture.

In applying this architecture in our project, several trade-offs were necessary to function within our available technology, but the end result was an application system with well defined components that can be re-packaged for different environments in the future.

The Confusion over Client/Server

In late 1991, the University of Saskatchewan embarked on a project to implement a telephone registration system. We started with an Rdb database, an existing over-the-counter registration application written in a 4-GL (DEC Rally), and a new piece of hardware, a Periphonics voice response system. It became clear quite quickly that a straight interface between the new hardware and the 4-GL would overload the host hardware, mostly due to the doubling of the number of consumptive processes running the 4-GL. We turned to client/server ideas as a possible solution.

We discovered that the term *client/server* is very hard to define. To some, it is PC's accessing a database server on a network. To others, it involves remote procedure calls (RPC's) between very sophisticated software components on different network nodes. To vendors, it is anything they can use to sell more product! Most often, it is associated with a particular hardware configuration on a network. In the PC arena especially, it is very hardware oriented: the *server* is usually a database on a dedicated box, and the *clients* run on desktop PC's and contain all the business logic.

The client/server concepts surrounding X-terminals further confused the issue. Here, the X-server is on the desktop delivering display services to the end user, and the application program running on a bigger machine is the X-client! This seemed exactly backwards to the PC situation, where the user's desktop device is the client.

The only feature shared by all these examples is that there is a network connecting two or more machines that are co-operating to accomplish a task. The thing that differentiates one configuration from another is how the work is split among the various processors. At one extreme, we have an IBM mainframe running a CICS *client application*, and block-mode terminals on a 3270-controller (*terminal server*) that handles key-press level events. (I have also seen this described in a way where the terminal is the client and the *big iron* is the server.) The other extreme is a file server on a LAN with the whole application, including DBMS, running on a desktop PC or Mac.

But we were left with the question of what distinguishes *client/server* from other similar concepts, like distributed processing and distributed databases?

A Common Theme

When we examine all these configurations for a common theme, we start to see client/server as an interaction between components, especially software components, more than a hardware configuration. Each pair of software components has a well-defined protocol for interacting with each other. The thing that distinguishes client/server from other architectures is that one side of the interaction is labelled the *client* and the other is the *server* (Figure 1). The question then becomes, what properties do the components on each side have that make them one or the other?

The guidelines we arrived at are:

- The client is in control.
- The server defines the communication protocol and message formats.

- The server does the bidding of the client.
- The server either succeeds or fails in providing the requested service, and leaves things in a well-defined state.
- If the server cannot provide the service, it notifies the client as to why and the client must decide what to do next.

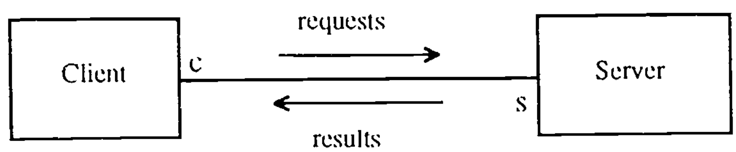

Figure 1 : The Client/Server Relationship

Note that a particular software component can be a server for one component, but a client to a another. Also, not every set of communicating processes meet these criteria; for example, co-routines co-operate to perform a task, but do not have this client/server relationship.

The 4-box Architecture

For operational systems, we define four software components, the "4 boxes", that interact using this definition of a client/server relationship (Figure 2).

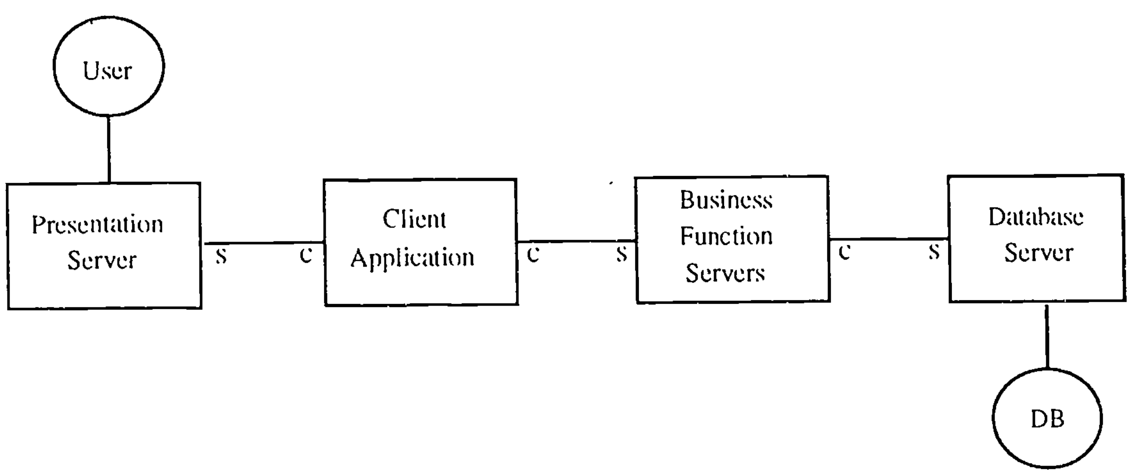

Figure 2 : The 4-Box Architecture

- The **Presentation Server** handles the interaction with the end user of the application: it knows how to communicate with the user, but not the meaning of the communication.
- The **Client Application** is the component in control. It knows both the business functions and the user interface, and makes the business functions available to the user in a controlled way via the interface.
- The **Business Function Servers** provide the basic business functions, and should be sharable among several different client applications.
- The **Database Server** is whatever interface is required to the DBMS, or possibly the DBMS itself.

We generally do not go any lower than the database server, since that is usually where the application programming stops. In reality there could be a file server involved, but it is generally hidden by the DBMS itself.

The Four Components

The presentation server is the component closest to the user, and handles the details of the user interface. It provides its service to the client application. Important examples are X-servers, a "voice server" in an Interactive Voice Response System, a forms handler such as Digital's DECforms, or even a 3270 terminal controller.

The database server is often a relational DBMS such as Rdb, Oracle, DB2, etc. It could, however, be any set of routines that provides access to data at some level above file access. Services are requested by the business servers, often in the form of SQL statements.

A business function server, or simply business server, is a software component that knows the details of the specific business function being delivered. An example of a business function in this context is adding a class for a student, or calculating fees for a student. The main role of the business server is to maintain the integrity of the business data and enforce business rules, for example, ensuring that enrolment and credit unit counters are updated when a class is added, or not letting a student take a class that has been cancelled. Business services are provided to the client application. In turn, business servers are clients of the database server, starting and stopping database transactions, and usually issuing multiple SQL statements to complete their function. In our environment, business servers are stateless, handling each request in isolation from others and never holding database resources between requests, but this need not be the case in general. In many ways, these business servers are like the "transactions" in a transaction processing system (e.g., CICS, ACMS), except that they concentrate on the business issues and ignore the user interface. A business server should be able to deliver its service to multiple clients of different types.

The client application is what ties it all together, and is in control of everything. It uses the presentation server to communicate with the user. It uses various business function servers to do the real work. Where the servers know the specific details of the interactions with the user or the database, the client must know the general nature of both, for example, knowing that the user is on a PC, terminal, telephone, etc. The main role of the client is to make the various business services available to the end user in a controlled way, using the presentation server for communication. It interprets the business server requirements and results to the end user, and interprets the user's requests for the business servers. In our environment, a client application cannot directly access the database, but must use the business servers to get all required information.

Note that what we have called the *client application* is the only "pure" client in the 4-box architecture: it is the only one that is on the client side of its interaction with all other components. Most *servers* are also clients of other components, even if those components do not appear explicitly in our architecture.

The Components as View Translators

There are several different views of what goes on in a computer system, and we can think of each of the four boxes as translating between two such views.

- The client application translates between the user's view and that of the business.
- The business server translates between the business's view and that of the database.
- The database server translates between the database's view and that of the underlying file system or disk controller hardware.
- The presentation server translates between the user's view and that of the underlying presentation/display hardware.

Implementation Issues

In summary, the client/server paradigm can be characterised as having software components that are defined so that each interaction has a well-defined client side and a well-defined server side. The 4-box architecture is one example of how a client/server system can be configured. When we then ask about hardware configurations, we see that this is an architecture that can be distributed across a network in many different ways. In fact, the network can be introduced at any of the interfaces between the four boxes, and where it is placed will generally determine which piece of hardware is called a *client* and which is called a *server*.

An application that requires many SQL statements to process one business function might be best split at the link between the client application and the business servers, so that the business servers are on the same node as the database server. Another application might best be configured with just the database server (network DBMS) on the "server" machine and the other three components on a desktop PC. If the desktop device is an X-terminal, the division is between the terminal server and the client application.

Note that the hardest place to put the network is between the client application and the business server. Communication between a business server and the database server is probably done using SQL, and can be accomplished across the network with tools from the DBMS supplier. Communication between the client application and the presentation server is probably predefined by the nature of the presentation server, for example, if it is an X-terminal. But network communication between the client application and the business servers requires mature middleware that is now only starting to become available in the market-place. Remote Procedure Calls (RPC's) and the Distributed Computing Environment (DCE) are examples of such middleware.

It is, of course, possible for the four components to reside on more than two network nodes. For example, the database server might be on a mainframe, the business servers on a departmental server machine, and the client application on a desktop workstation. Or they might all run on different nodes.

Also, there may be several business servers in a given configuration, and they need not all be on the same node. For example, the business server that registers students might be on a machine in the Registrar's Office while the one that checks for overdue accounts might be in the Business Office, even though both receive requests for service from the same client application. And in these days of multiple and distributed databases, it is likely that a business server itself might have to use database servers on multiple nodes.

Operational Systems vs. Decision Support Systems

An operational system is characterised by very well-defined and often repeated functions that must be performed quickly, such as adding a class. In contrast, a decision support system (DSS) is required to provide very complex processing that is repeated only a few times, such as asking "how much time does the Psychology Department spend teaching Medicine students?" This tends to be ad-hoc read-only processing that has few if any pre-defined access paths, and does not require an immediate response.

The 4-box architecture is not very appropriate for decision support systems. Indeed, it was developed expressly for operational systems, and Telephone Registration in particular. Direct end-user access to the database would seem to be the best way to provide the ad-hoc access required in a DSS. This access is properly provided by a "client application" such as a spreadsheet or a report writer running on a desktop PC and using SQL to access departmental data stored on a network server and/or institutional data on a mainframe. There are no business function servers, and our architecture collapses into just three boxes. Note that this is much closer to what the PC industry generally means by client/server.

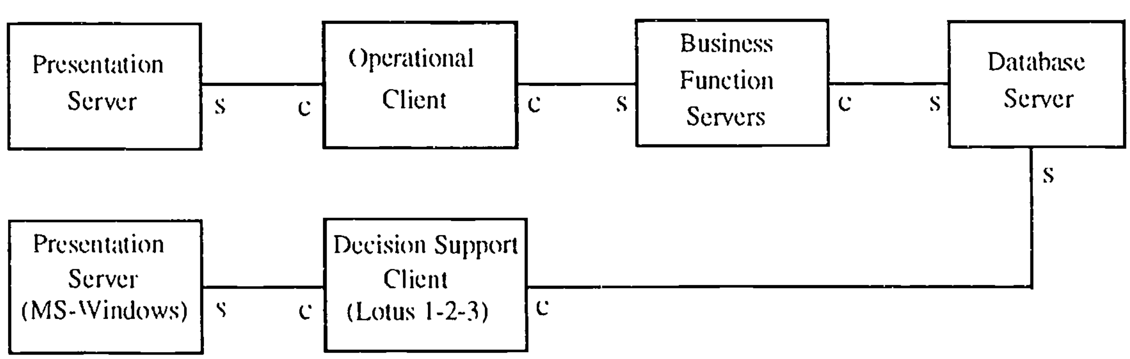

Figure 3 : Operational and Decision Support Clients Co-exist

One direction in the industry is to satisfy DSS needs by building an *information warehouse* as an extract or summary of operational data, and to store it in a relational database on a network server. This is especially attractive when the operational data is stored in a so-called *legacy system* and not available via modern SQL-based tools. However, if the operational system is already based on a relational DBMS and uses the 4-box architecture with stateless servers, there is no reason why it cannot co-exist with DSS's (Figure 3). The only issue might be whether the DSS degrades the performance of the operational system, but that is probably a symptom of a more serious capacity problem with the network and/or the *server* nodes.

Client/Server Transaction Processing

Operational systems are really "lots of the same thing, over and over again", and this is exactly the situation addressed by on-line transaction processing (OLTP) monitors. A natural question is how the 4-box architecture relates to OLTP's.

Basically, we have treated this question as an implementation issue. Some OLTP's like IBM's CICS seem less in line with our architecture, while others like Digital's ACMS seem more so. ACMS has an architecture that on the surface is very much like our four boxes (Figure 4), where the Execution Controller plays the role of our *client application*, and Digital is less explicit about the *database server*. However, it does not permit separation of the client application and the business servers across a network, and we found it to be not completely able to support the level of complexity required in our client application.

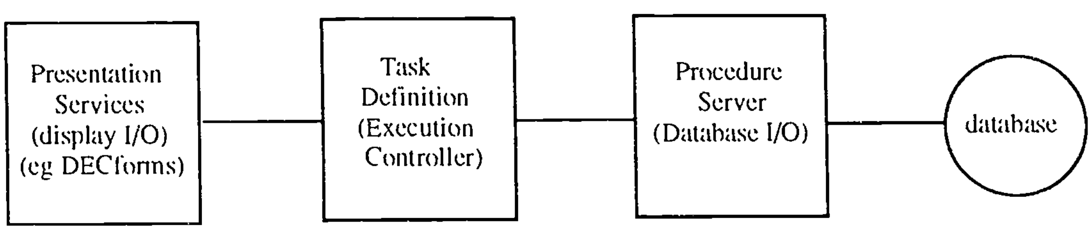

Figure 4 : The Architecture of Digital's ACMS

Our Example: Telephone Registration

The 4-box architecture was developed for use in a Telephone Registration application (TelReg). Our administrative computing environment consists of a VAXcluster with two VAX 6430's and 14 VAXstations running OpenVMS, all connected to the general campus network. We had existing Rdb databases supporting various Rally (4-GL) applications in the Registrar's Office, including on-line registration. An Interactive Voice Response Unit (IVRU) was purchased from Periphonics, with connections to 32 phone lines, a UNIX-like operating system, and application programming in COBOL.

Once the 4-box architecture was developed, we began to look at the implementation issues with respect to TelReg. Specifically, we looked at what middleware could be used to facilitate communications between the various components. We examined Digital's Application Control Architecture (ACA) Services (recently renamed ObjectBroker) which showed great promise in routing messages between clients and servers, and which would allow us to distribute the components in any way we wanted. However, at that time (April, 1992) the product was still immature: we could not find a production installation with an application similar to ours, and we were concerned about our ability to use it effectively.

The decision was made to write our application using ACMS, Digital's transaction processing system described above. The idea was to implement the presentation server on the IVRU in the form of a voice server, which would process *voice forms* sent from the host computer across the network. These voice forms are the voice equivalent of screen forms, with prompts being spoken and input fields entered via the telephone buttons. The client application was to be in ACMS, and the business servers were to be ACMS procedure servers, coded in COBOL/SQL.

We knew this would not allow us to separate the client from the business servers, at least not in the near term. But we still had the possibility of moving the bundled client application and business servers to their own machine, which would then access both the database (via SQL Services) and the voice server across the network. And the ease with witch ACMS handled our inter-process communication needs made it the best alternative.

High level design was done using these ideas. But both ACMS and IVR technology were new to our shop. As we progressed through more detailed design and became more familiar with the technology, we encountered further limitations and made additional compromises. These are described below.

First, we found that the ACMS language was not able to handle the level of programming logic required in our client application; it is geared towards, and is very good at, the routing of work between servers and terminal users. Consequently, parts of the client application were coded in COBOL and bundled into the ACMS servers along with the business server modules. We called these *client procedures*, and they were required to obey all the rules for a client application: no direct access to the database, and all work done through the real business servers.

ACMS requires that its servers be packaged a certain way for use in this environment, and this means they are *not* accessible to other non-ACMS client applications. We could re-use the business server modules, but we were required to re-package them for use elsewhere.

We found that trying to implement each business server as its own ACMS procedure server introduced excessive overhead and complexity into the system. In addition, one business server could not gain access to a different one unless they were bundled into the same ACMS server, so there was limited code sharing that could take place. Our solution was to bundle related business servers into the same ACMS server, along with the client procedures that use them. This allowed for better re-use of common subroutines. Also, we were able to use fewer server processes, since one process could provide multiple services and stay busy more of the time.

We ended up with three types of ACMS server, one controlling general access to the system, one performing pure registration functions such as adding and dropping classes, and one providing class information. Multiple instances of each type are run, based on frequency of usage. This has provided acceptable response on a fully loaded system.

At the presentation interface, we found that ACMS could not talk directly to the voice processing hardware, and the voice hardware did not connect directly to the network. Consequently, additional modules were implemented to facilitate the communication between the client procedure in ACMS and the voice server. We insisted that no new functionality be introduced here: the new modules were to be transparent as far as content of the messages was concerned, and could act only to move messages to the correct destination. We consider these modules to be middleware, and we expect to replace them as better functionality becomes available in ACMS and on the IVRU.

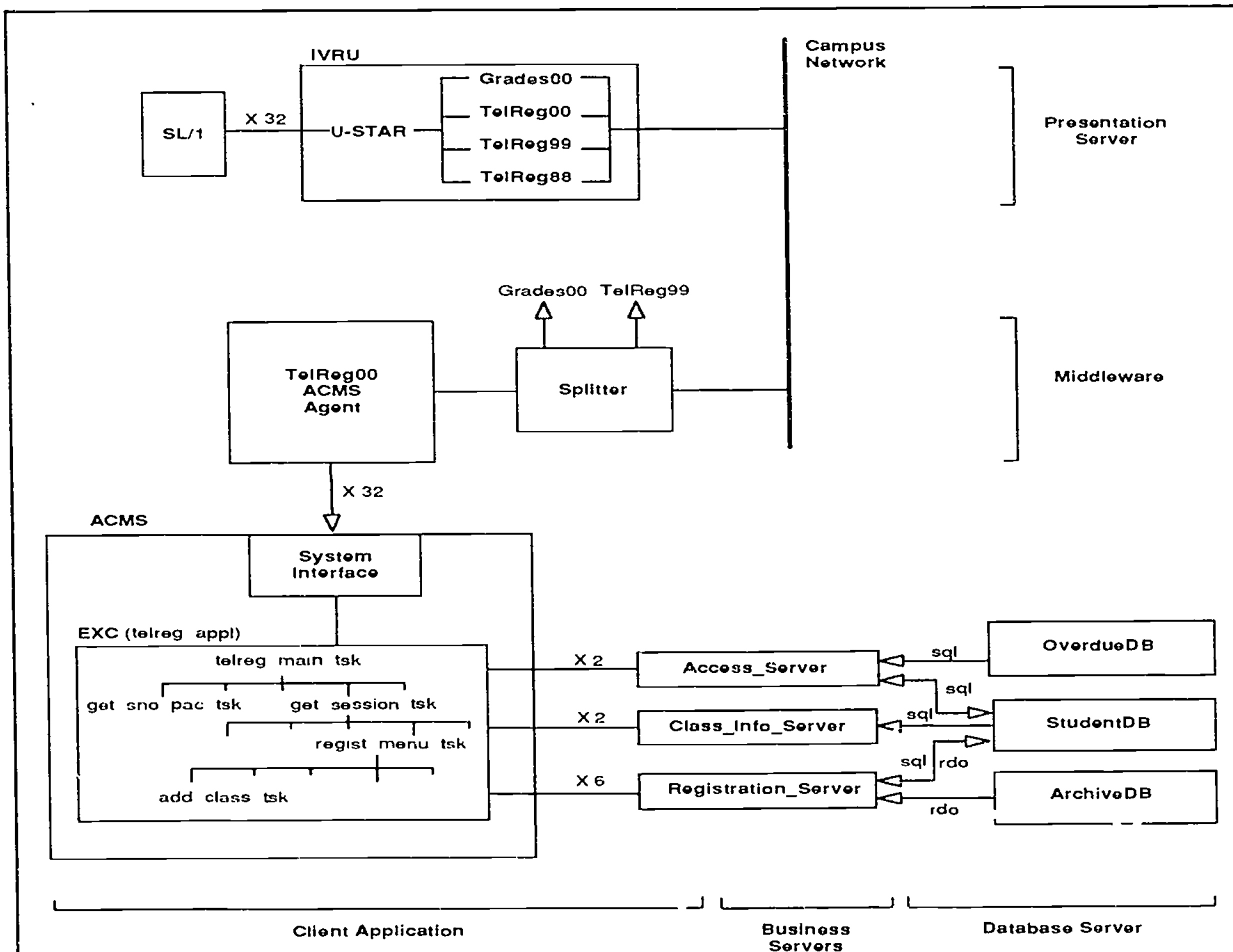

Figure 5 : Telephone Registration Architecture

Figure 5 shows our architecture, with notations as to which software modules correspond to each of the four boxes. Note that the U-STAR front-end can route calls to other applications, and that these are tapped off at the middleware component labelled *Splitter*. The inner structure of the three ACMS procedure servers is not shown, but has a well-defined dividing line between modules that are part of the client application and ones that are part of the business servers.

In summary, the fact that ACMS is a transaction processing environment rather than a client/server environment has pushed our implementation away from the 4-box architecture. Even so, all the compromises we made were made consciously, and the spirit of the architecture was always followed. We have ended up with a set of software modules that have clearly defined roles, that localise functionality, and that only need to be re-packaged to operate in a different environment.

The Future

As hardware becomes more powerful, database management systems will become more sophisticated, and allow incorporation of more business rules into the database itself. Examples of this that are becoming available today are field and record validation rules, triggers, enforced referential integrity rules, and stored procedures. Unfortunately, these are not yet sophisticated enough to handle all the processing that we need in our business function servers. But we expect that as these and other features mature, there will be less need for business servers, and they will eventually be subsumed by the DBMS. Then, the four boxes reduce to just three, the distinction between operational and decision support systems disappears, and things look much more like the PC community views them today.

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SOLAR
Harvard's Client/Server Based Fundraising Management System

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Abstract

During the planning phase for its multi-billion-dollar fundraising campaign, Harvard University recognized the importance of information technology to the campaign's success. The University is implementing a fundraising management system on a relational database, accessed by desktop systems using client/server technology. The project, known as SOLAR, is an interactive fundraising system designed to provide fundraising management and personnel the capability to access and share management summary and prospect information, such as automatic summary charts, prospect tracking, research, events and so forth.

University management is able to view, from the desktop, up-to-date campaign status information in the form of charts from a wide variety of views such as goal versus actual charts by University, School, theme, program, fundraiser, class, geographical area, etc. These charts may be selected by a wide variety of possible views. For example, the President may desire to see how a school is progressing within the Health theme, while the Director of Development may need to analyze how a class is proceeding with the technology theme. These charts are also available in reports that may be viewed on the desktop display and/or printed to a report. All charts may be cut and pasted to wordprocessing documents, spreadsheets, or presentations.

Introduction/Strategy

Although possessing a well-invested endowment, Harvard University is facing many challenges when it comes to providing the best possible educational environment. Maintaining leading-edge laboratories in the modern fast-moving high technology fields, for example, requires large annual allocations of limited funds. Salaries and benefits for outstanding faculty and staff continue to rise as does the ever-increasing burden of facilities maintenance. In order to meet these challenges and prepare for the next century, Harvard will be initiating a multi-billion dollar campaign.

Currently, Harvard processes over $200 million in gifts annually with a COBOL-based application on a pair of Hewlett-Packard minicomputers. Like many organizations, management was reluctant to invest additional funds on a new and, as far as the University was concerned, untried technology. In short, in order to meet the long-term objectives of the University and the demands of the upcoming campaign, it was decided that a two-staged strategy would be followed. The first stage retains the investment in the existing transaction system while moving forward with client-server technology to support the ambitious fundraising effort. The second stage calls for the replacement of the aging transaction system with transactions being processed through client-server technology.

By following this strategy, management is not completely committed to a technology until it has been proven. Although the second stage depends on the completion of the first, the strategy may be limited to the first stage and still obtain significant improvement in information services.

The first stage of the strategy is based upon the concept of following a plan that *extends* the legacy of the COBOL system beyond transaction processing to a client-server environment in which the fundraising information is readily available in a form that can be integrated into the fundraiser's overall scheme for displaying and analyzing information. While the existing system continues to process transactions, emphasis will shift increasingly toward extension. By following this strategy, Harvard will be able to preserve its investment in its existing system and current desktop computers while giving administrators, development, and alumni support personnel easy and immediate access to alumni, prospect, and gift information through their microcomputers. Through the use of the simple point-and-click method, information will be available, directly from the server, in report, on-line, or chart form.

Once the first stage of the strategy is in place, the processing model will appear as depicted in figure 1. The legacy system will continue to process gift and biographical information. As the transactions are applied to the old data base, information will be transferred to the appropriate relational data base located on the Sun 690MP data-base server. The Sybase relational data base will provide secure, efficient access to up-to-date biographical and gift information. In effect, this separates the day-to-day gift and biographical transaction process from the more ad-hoc inquiry and reporting process. This separation of the data-gathering function from the data-access function will lead to a more efficient use of the legacy system, while at the same time improving reporting. For example, fundraisers would be able to generate their own labels and reports locally rather than following the current time-consuming method of requesting reports from the central MIS group.

Unlike many warehouse systems, SOLAR is not designed for data access only. It is designed to be a system that uses the strengths of warehouse type systems while adding the utility of interactive systems. SOLAR contains two categories of information: core and fundraiser-specific. Core information consists of those pieces of information that are entered and maintained by the legacy transaction system. Core transaction information consists of data such as individual gifts, pledges, and matching gifts. Fundraiser information is relevant only to the fundraising function and is added to and maintained directly by the SOLAR system. Fundraisers work with prospects in a fashion similar to sales and marketing personnel in the business world: rating the prospect's ability to give, researching the prospect's background and interest, developing cultivation activities and events, and, of course, completing the actual ask.

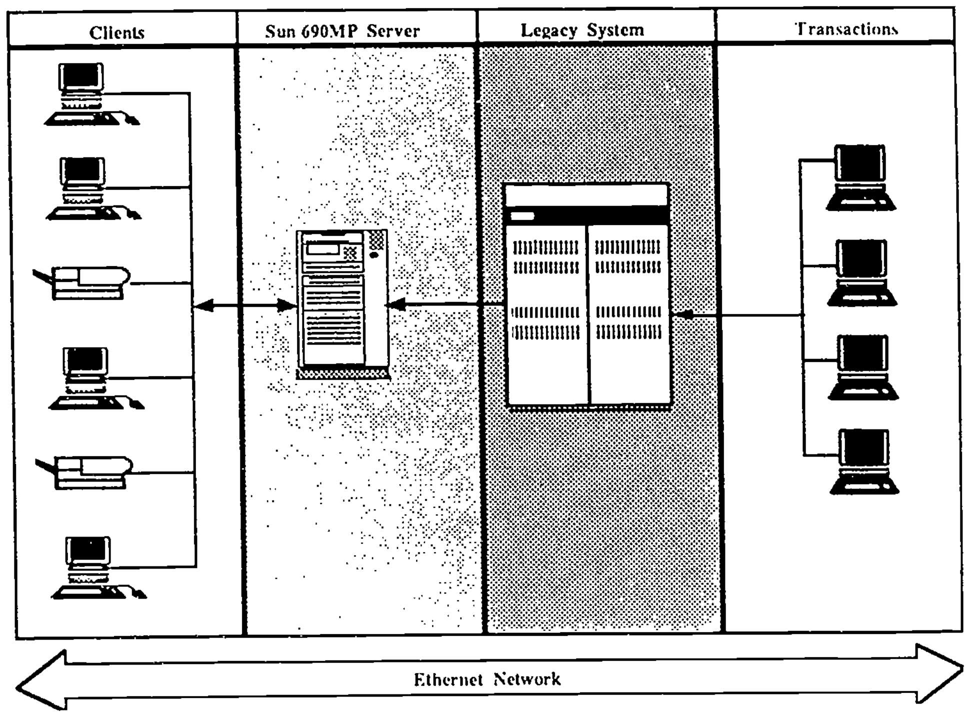

Figure 1 Phase One

Once the first stage has been completed, migration to the new environment may commence (or at management's discretion, the project may be halted without disruption in processing). Migration has as its objective the replacement of the legacy system with transaction processing moving from the old system to the client-server model. During this phase, maintenance of alumni and prospect core information will be performed on desktop computers connected to either a central server as depicted in figure 2 or to individual servers located at each of the schools. Although analysis of this phase is just beginning and many decisions are yet to be made, preliminary plans call for an in-depth evaluation of using Sybase's Replication Server to distribute not only functionality but also the information. Under this model, the information pertinent to the individual school will be located at the school and yet be available for access from any of the other schools over the University network.

Project Organization

To be successful, it was essential that an organizational structure, with its accompanying responsibility, be defined and agreed upon by all parties. Since SOLAR's objective is to construct a system that fulfills functional needs, management not only needed to be involved but committed to its success. With this in mind, the project organization shown in figure 3 was proposed to senior management and accepted to manage the project. It brings to bear a wide range of management and program experience while providing necessary commitment.

The Project Sponsor, at the Executive Director level and possessing the primary line authority for the project upon its completion, has overall authority for the project. As the Senior Staff manager that funds the project, the sponsor is responsible for the project's scope and overall quality.

The *Project Manager* is a full-time employee reporting to the Information Technology Director, is the leader of the project, and is full time for the life of the project. The project manager is responsible for developing estimates and schedules, preparing funding recommendations, managing the project team and communicating project status to the Project Sponsor and Steering Committee.

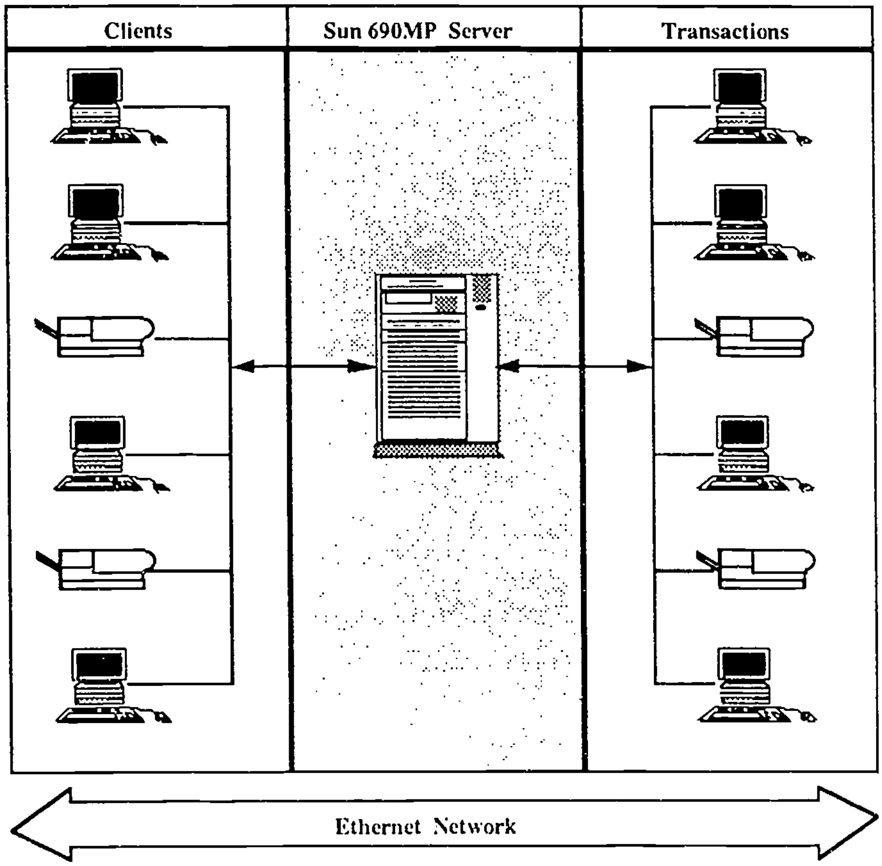

Figure 2 Phase Two

The *Quality Review Committee* consists of senior staff and/or supervisors from the departments affected by the project. The committee reviews the project at specified milestones and is responsible for the project's meeting its objectives in an efficient and effective manner. The committee ensures that the project solves the right problems and ensures the quality of the finished product.

The *User Coordinator* ensures that staff members from the interested departments are available, as needed, during the life of the project. The user coordinator should be at the manager level and have direct reportability to either the Vice President or the Executive Director. Coordinating all user tasks, the user coordinator keeps the Project Sponsor informed of all problems that may arise in the allocation of user resources and chairs the Quality Review Committee.

The *Project Team*, reporting to the project manager, consists of members of both the IT department and user departments. Team members carry out the project tasks and are responsible for the overall design, construction and implementation of the project. Computer projects require a wide variety of skills that include analysis, systems design, programming, training, and operations.

While the team organization needed to be flexible, in that the project required more resources during the middle phases than at the beginning and end, the management structure remained permanent.

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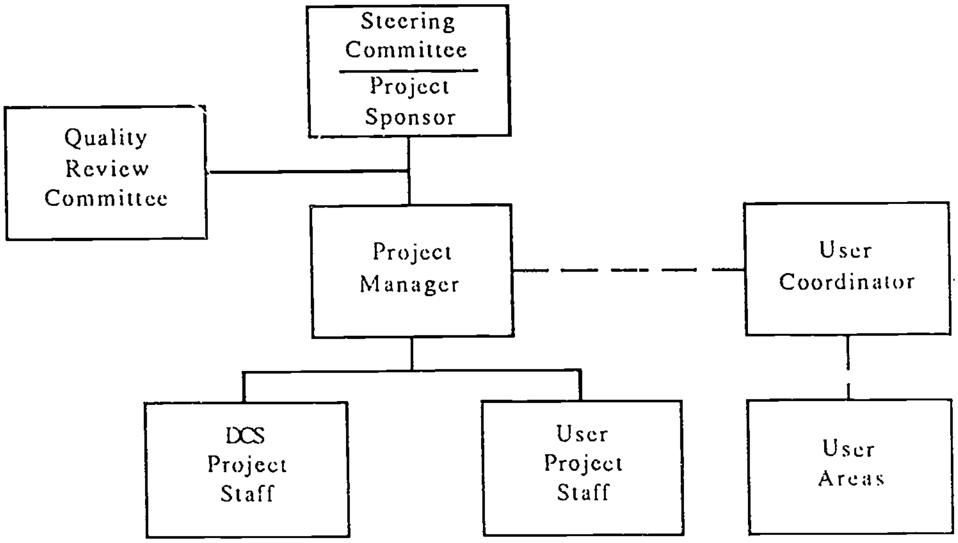

Figure 3 Project Organization

The SOLAR System

SOLAR, scheduled to go live in early 1994, is a client-server fundraising system designed to provide management and fundraising personnel the capability to access and share summary and prospect information. The server, storing information on over 500,000 prospects and nearly two million individual gifts, is a Sun 690MP utilizing the Sybase relational database. The Sun 690, with four coprocessors, is configured with 256 megabytes of memory and 16 gigabytes of disk capacity. The clients consist of nearly 200 Apple 610s and 650s configured with 20 megabytes of memory and 230 megabytes of disk. The client front-end application software is ACI's Fourth Dimension and provides access to the Sybase database over an ethernet network. Similar to many sales and marketing systems, SOLAR will provide a wide-range of functions that include:

- management charts
- ad-hoc report writer
- prospect management
  - prospect tracking
  - research summaries
  - prospect clearance
  - gift and gift history tracking
  - planned giving
  - volunteer and committee activities and membership
  - event management
- merge selection of prospects, singly or in groups, to word-processing documents
- data extracts

Management Summaries

SOLAR management summaries are organized to provide important fundraising progress information in management chart and text formats directly to the microcomputer display. University management will be able to view, from the desktop, up-to-date campaign status in the form of charts from a wide variety of views such as goal versus actual charts by University, School, theme, program, fundraiser, class, geographical area, etc. These summaries are organized to meet the differing information needs found in the management hierarchy. At the highest level of summarization, SOLAR displays University-wide views of campaign progress. In addition, management is capable of "drilling down" the summarization hierarchy to more levels of detail. For example, SOLAR provides management the capability to review progress for Themes for the University as a whole or, by simply clicking on another selection, to review an individual school's overall progress.

One of the summarizations that management finds helpful in its planning efforts is a chart of the campaign's trend (figure 4). To view the campaign's trend from a University perspective, the manager

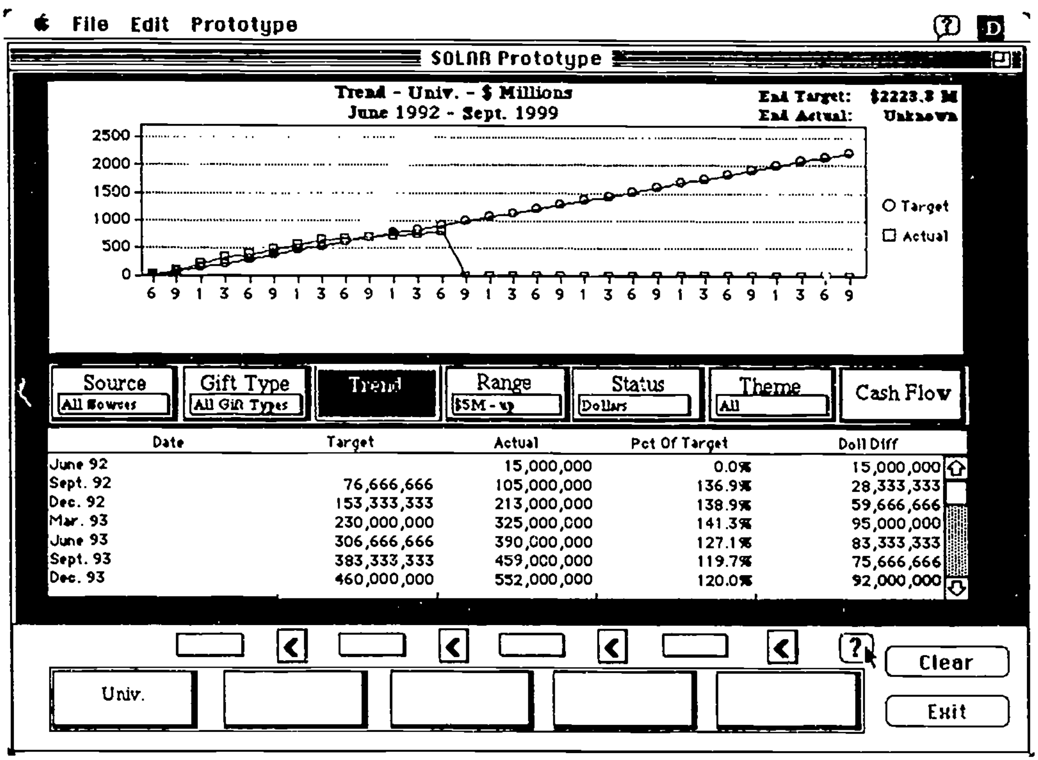

Figure 4 High Level Trend

simply selects "University" from the hierarchy buttons (located on the lower section of the screen) and clicks on the "Trend" button. The lower half of the Trend Screen displays, by quarter, the target amount to be raised up to that date, the actual amount raised to that date, percent of target and the amount of difference. To the right of these figures is located a "scroll" bar that will allow the manager to view the trend for all the campaign years by quarter. The upper "window" shows a graph of actual monies raised (outright gifts plus pledges) vs. planned objectives based on the figures shown in the lower "window".

Although this high level view of the campaign's trend may be useful for an overall view, it doesn't provide a fine enough scale to view trends in more specific time frames. To meet this need to view smaller ranges in time, SOLAR provides a mechanism to view trend in "slices of time". For example, rather than viewing trend for the entire campaign, if management would like to see the trend for the specific date range of June 1993 to December 1994, they click on the "?" button. SOLAR returns a dialog box, as shown in figure 5, asking the user to enter the desired date range. The user enters the

"Start Date" year and month and the "End Date" year and month by simply selecting the appropriate years and months from the pop-up buttons and clicking on the "OK" button.

Similar to the high-level view, the lower half of the Trend Screen displays, for the selected date range, the target amount to be raised, the actual amount raised, percent of target and the amount of difference. The upper "window" shows a graph of actual monies raised (outright gifts plus pledges) vs. planned objectives based on the figures shown in the lower "window".

The example given is but a brief view of the type of graphing available in SOLAR. Fundraising management is able to drill down and, at the same time, graphically view the information a number of different ways. As you can see from figure 4, there are seven major types of graphs available to the fundraiser. In addition, each of the seven major groups contains a number of chart/display options. The introduction of automatic and up-to-date management charts is expected to not only increase management efficiency but also, just as importantly, to free management and staff time from the time-consuming efforts required to build similar charts by hand.

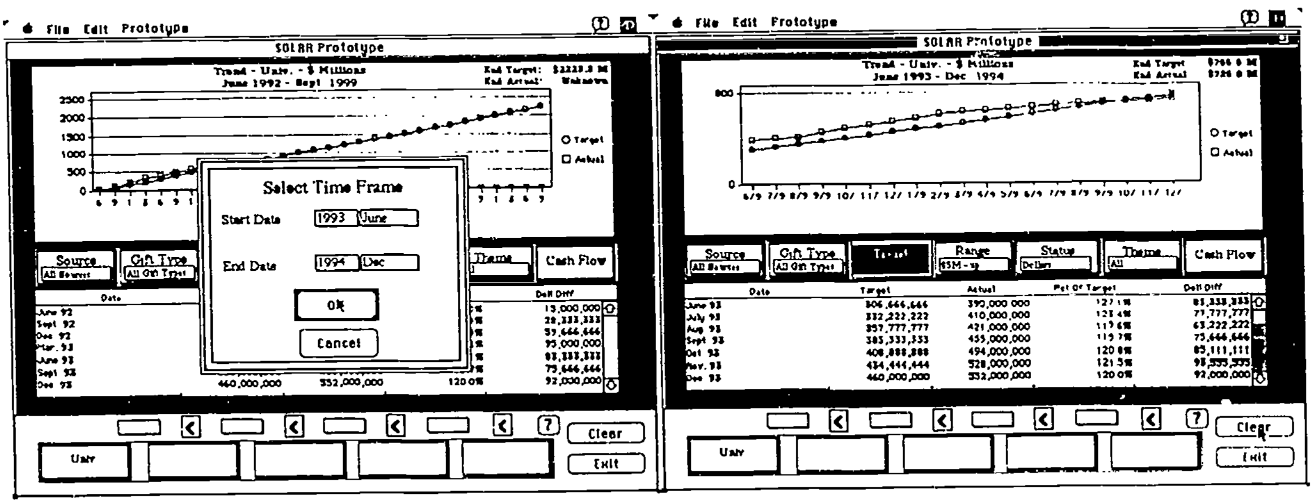

Figure 5 Trend Range Selection

Reporting

Similar to many other applications, report generation is a critical piece of the design. With over 40 local laser printers spread throughout the organization, fundraisers will be able to select preprogrammed reports directly from their desktop, view the report on their screens before printing, and print the selected report directly to their local laser printer. When a one-time report is needed, the system will include a powerful report writing facility. Similar to the functionality for reports, SOLAR will provide users the choice of using their personal standard extracts via the push of a button or the ability to execute one-time ad-hoc extracts. In addition, the user will be able to select information from the database and automatically link to other client application packages such as Microsoft's Word.

The benefits of introducing the ability to select and print reports at the local laser printer are obvious: report turn-around has been reduced to minutes; the actual volume of paper used is reduced (the users select only what they want to see - not an entire database dump); users are able to select what is to appear on the report and the sort sequence that they, as individuals, wish to see.

Prospect Management

The main objective of SOLAR, of course, is to provide a tool for the fundraiser to manage information on his or her prospects and to share that information with other fundraisers on a University-wide basis. The project team decided that the best way to meet the needs of the fundraiser for quick and easy access to the information was through the use of a graphical interface using a simple point-and-click method. Using the graphical interface, a fundraiser obtains all relevant information on a prospect by simply entering the pertinent search information such as the prospect's name. SOLAR returns a display as shown in figure 6.

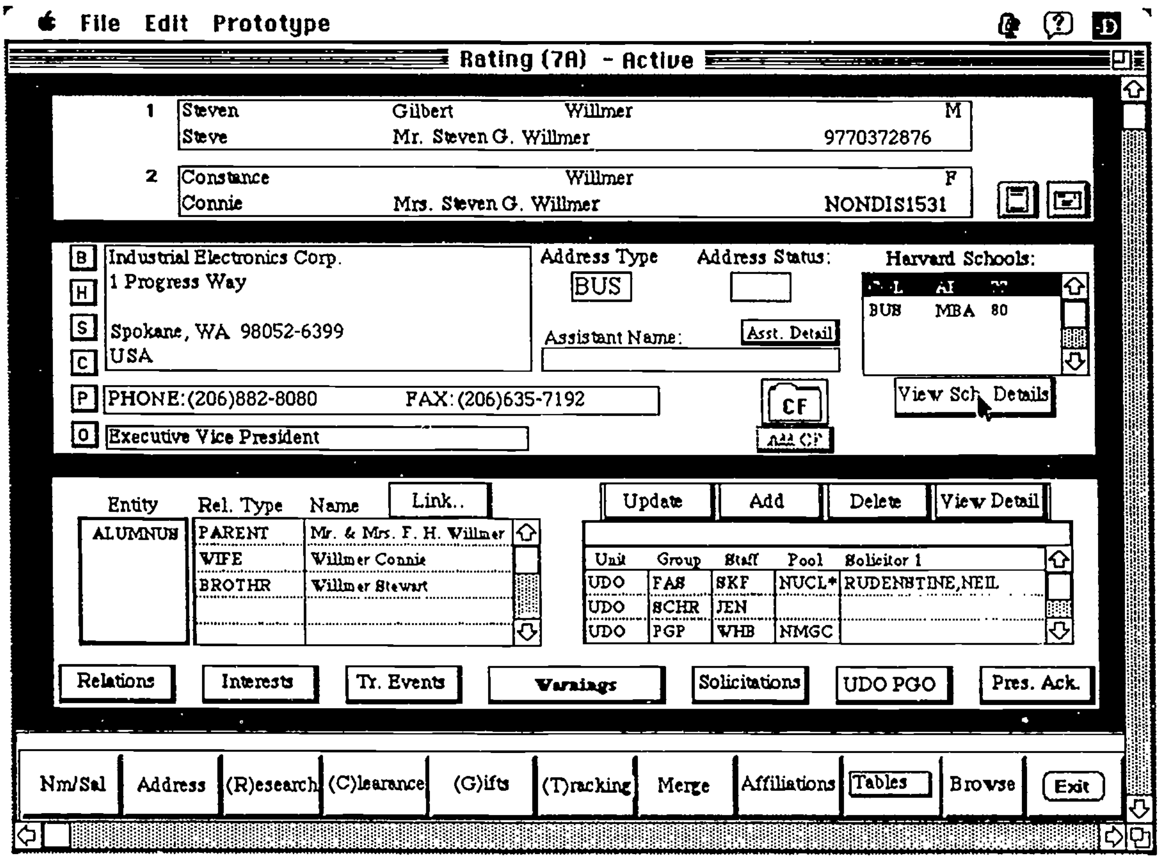

Figure 6 Main Prospect Screen

Top section of the screen displays the prospect's giving rating along with the prospect's name and identification number. The spouse's name and ID number are displayed directly below the prospect's name. The second section of the screen displays the prospect's address information. The prospect's preferred address is displayed on the screen initially. To display other addresses, the user simply clicks on the buttons "B", "H", or "S" to display the business, home, or seasonal addresses. For example, the fundraiser clicks on the "C" button to display the current address, the "P" button to display the preferred address, or the "O" button to display any other address. The selected address then appears in the address area, leaving all the other information as originally displayed.

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Along with address information, the second section contains information about the prospect's assistant and related school information on Harvard degrees. The fundraiser may see the schools, degrees and years by scrolling in the Harvard Schools box. If he or she double clicks on a school record, the School Detail Screen will appear, displaying information for the selected school record such as degree awarded by Harvard, years of attendance, concentration, honors, and house of residence.

The third section displays the names of people related to the prospect and the relationship: wife, husband, son and so on. Next to relationships is located summary information on solicitations related to the selected prospect. The view areas for relationships and solicitations may be expanded by simply clicking on the appropriate button.

In addition to those mentioned above, buttons are provided to allow the user to access more information on a given area. The buttons located on the bottom of the Main Prospect Screen, for example, allow the fundraiser to access and/or enter more in-depth information on the prospect such as Name and Salutations, Address, Research, Gift and Giving histories, and Tracking information. Figure 7 shows an example of research information on a prospect that may be accessed by simply clicking on the Research button.

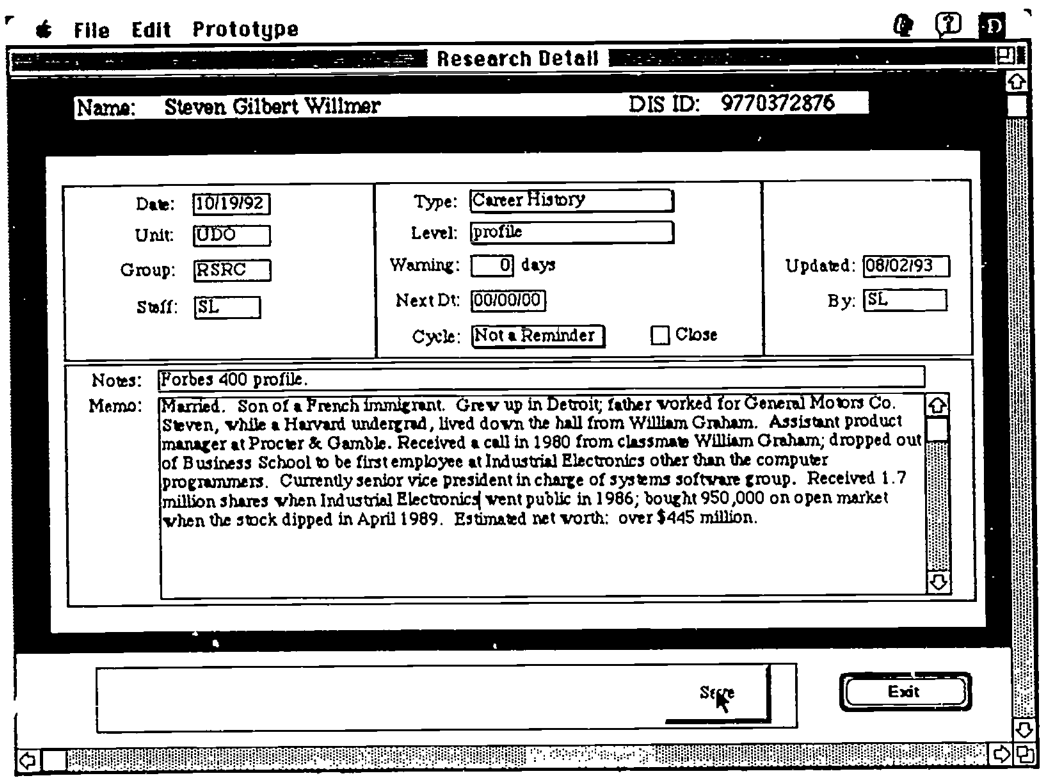

Figure 7 Research Screen

One of the most popular SOLAR features that will be available to the fundraiser is the Tracking function. During a cultivation of a prospect, many individual events occur that are important to note and/or share with other fundraisers interested in the prospect. The fundraiser, for example, may have just returned from a prospect luncheon meeting and have collected relevant bits of information on a prospect's interests. Upon returning to the office, the fundraiser simply accesses the prospect's individual record via the Apple Centris, presses the Tracking Button and enters a comment on the luncheon and dates the comment for further reference. If the fundraiser learns that the prospect's daughter is planning to be married two months in the future, the fundraiser enters a "Tickler" to remind him/her to send a note to the prospect 10 days before the wedding by simply entering the reminder as a comment and entering that he/she would like to be reminded of this event 10 days before a specific date. The system, 10 days before the specified date, will automatically notify the fundraiser to send the note.

Another feature of SOLAR, Merge facility, allows the fundraiser to build a wide variety of name and address merge queues that may be automatically merged to any word-processing document. For example, a fundraiser may plan to hold a number of prospect-review meetings at various locations throughout the country. Each session will be held with a different group of volunteers and, thus, will require different sets of correspondence depending on the meeting topic and attendees. Through the merge facility, the fundraiser builds a list of attendees and their addresses for each meeting. As the events are held throughout the year, the fundraiser simply selects the event by queue name; the current names and addresses meeting the original selection criteria are selected and merged to the designated word-processing document.

Critical Management Issues

This case illustrates an important point about the strategic use of information technology in the support of a university's overall objectives. Although the system and the technology upon which it is built are important to a school's success in achieving and maintaining the funds required to provide a first-rate educational environment, an overall fundraising strategy developed by university management that leverages technology must be in place. A committed, informed executive management that supports the use of information technology is a prerequisite for the successful development and installation of such a system. Management must know the needs of the school and possess an understanding of information technology. In addition, a member of the executive management team, if not the President, must also be willing to champion the system and create the environment in which information technology and its use are considered important to the school's success.

In addition to this high-level support, it is important to identify a project sponsor. As mentioned earlier, the sponsor is a high-level manager that has overall responsibility for the project. Ideally, the project sponsor should be the manager responsible for the primary function supported by the system. For SOLAR, this meant that the manager responsible for the overall management of the fundraising campaign has responsibility for not only fund-raising activities but the supporting information system as well.

Although management support and involvement is critical to the success of any information technology project, buy-in from the people that are actually expected to use the system is just as critical. Nothing causes a system to fail more than the underestimation of the importance of the people in the trenches and their agreement to use the system. If these people feel a system is being forced on them without first soliciting their input and allowing them to critique it in a meaningful way, the system will not be used to its full potential or, in the worst case, the system will not be used at all. To achieve buy-in, the SOLAR team consisted of a number of fundraisers charged with the responsibility to develop, with the aid of computer specialists, a full prototype of the system. Once the prototype met the fundraising team's specifications, in-depth reviews of the prototype (each review session took one to three days) were provided for the entire 200 person user base. Problems and requested changes raised in each session were applied to the prototype and ready for the next review, showing the users not only that their input was listened to but that their requested changes were regarded by the team as important. This approach, although time consuming, raised overall morale, the desire for the new system, and eased the trauma commonly associated with change.

Summary and Conclusion

Four factors were critical to the success of SOLAR. First, SOLAR was initiated and championed by responsive and visionary management. Management understood how the application of information technology would be an important ingredient in the overall success of the fundraising campaign. Second, fundraising management was ready for change and willing to encourage other departments such as gift processing to participate in the new system. The third factor was the selection of the project leader. The Project Leader needed not only to understand the new technology and its application, but also to possess an in-depth understanding of fundraising. Fourth was the overall method of communication and involvement. From the start, the project involved not only computer personnel but fundraisers as well. Management appointed a User Coordinator to work with the team at least 50% of his time. In addition, buy-in was achieved by allowing all fundraising people to review and critique the system prototype during development.

The benefits we expect to reap with SOLAR are many, but chief among them are:

- it offers fundraising personnel a quicker and more easily used mechanism for accessing and reporting data, since a client/server architecture is able to respond to queries more completely than is possible when data is transmitted in a terminal-oriented system, one screenful of data at a time;

- the officers have access to current information, since queries are accessed in "real time" rather than against data that resides in a file that has been previously downloaded;

- the amount of effort required in training new staff is expected to drop sharply due to the ease of system use;

- the amount of time that it currently takes the computer staff to develop programs for various functions and reports will be reduced by a factor of 10 to 20 times.

The ability to access and enter fundraising information through simple, easy-to-use methods means that fundraising personnel will have information at their fingertips when and where they need it and will not have to wait for the computer staff to write reports and/or extracts. The fundraiser, through this direct access to critical information such as giving histories, is able to answer donor queries while still on the telephone - thus improving personal relationships between the fundraiser and the donor.

We anticipate that SOLAR will contribute to a fund-raising success unequaled in the history of fundraising in higher education. Working with over 500,000 prospects, the University will raise two billion dollars over the five-year life of the campaign. These funds will allow the University to maintain and increase its ability to provide a first-rate education for its impressive student body into the next century.

Talking Turkey About "Real Change"

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ABSTRACT

We see a coincidence of new management and new computing models, with information being viewed as a prime enabler in meeting institutional goals. The prognosis is for more change -- not less.

What is the nature and timing of this change? What business needs are driving IT changes? Are organizational structures being affected? What are the motivations behind the move to client-server? How fast is the movement and where are the early adopters? Who and what is connected to the campus backbone and what services are provided? What technologies and issues do IT professionals see as most important to the future of their own institutions?

This paper addresses these questions by reporting on the answers given directly by the institutions themselves and represents a documented snapshot of "real" change over the past three years. The data for the paper are derived from our survey of Higher Education conducted during the spring of 1993, combined with data from surveys conducted the previous two years.

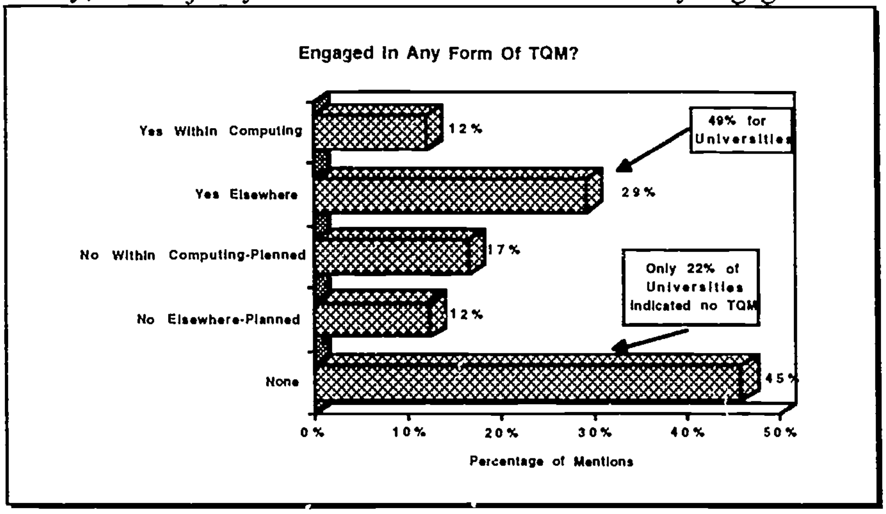
Introduction

Our 1991, 1992 and 1993 studies entitled: Understanding Information Systems in Higher Education reported significant change in many aspects of IT on campus. While, it is not possible, in this short paper, to summarize three 200 page reports, we will discuss several areas of pivotal change.

The data for this paper are derived from our survey of Higher Education conducted during the spring of 1993, combined with data from surveys conducted the previous two years, The text is further augmented by comments obtained by interviewing many notable Higher Education trendsetters. We begin at the top by looking at key management issues.

The Challenge of Re-Framing Institutions

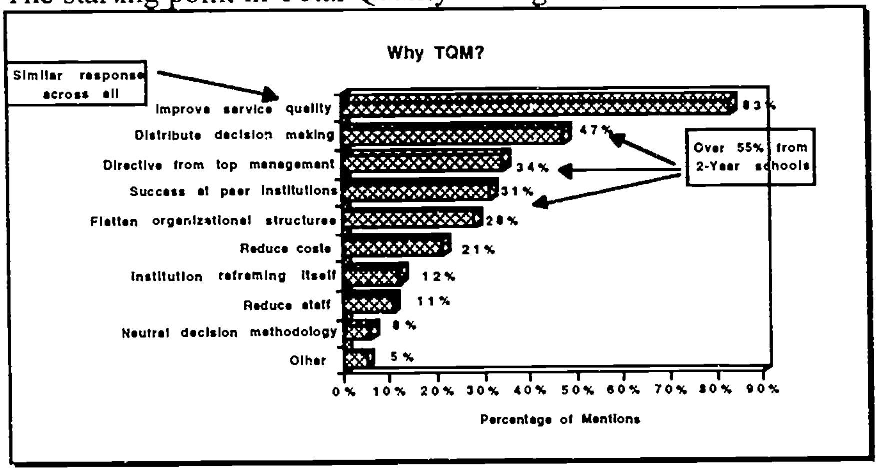
Today, the majority of institutions are either currently engaged in -- or planning to -- undertake some form of re-engineering with the dual goals of improving overall institutional effectiveness and controlling costs. We asked several questions about institutional activities in TQM, and found that 41% are currently engaged in some form of TQM. Further, 22% of those who reported no current TQM activities are planning for it.



As expected, the Universities tend to be ahead of all other classes of institutions. Only one in five Universities reported that had **no** TQM activities. In comparison, the total market ratio is just under one in two. Twelve percent of all respondents (30% of all Universities) indicated TQM activities within Computing and an additional 17% that they were planning for it. (Please note that this was a multiple response question and therefore, responses do not add to 100%.)

Motivations for Undertaking TQM

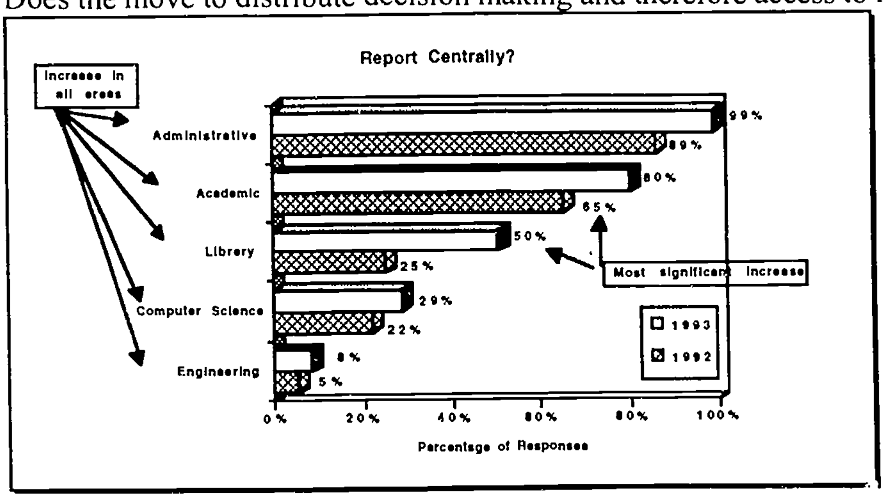
The star.ing point in Total Quality Management is to focus on the customer, and it appears that



Higher Education is doing just that! Looking now at the motivations for undertaking TQM activities, the most frequently mentioned reason (83%) was to "Improve Service Quality," and the pattern is consistent for all Carnegie classes. Oddly, only 21% mentioned "Reduce Costs" as a motivator. There were, however, different responses across the Carnegie classes; the Universities (30%) and the 2-Year (32%) schools were both above the total market response. And even fewer (11%) mentioned "Reduce Staff" as a reason for undertaking TQM. The Carnegie class responses to this question also varied widely. Two-Year schools did lead in this area, with 28% of mentions, while 4-Year schools, with just 2% of mentions, anchored the bottom end of the curve.

Which Computing Organizations Report Centrally?

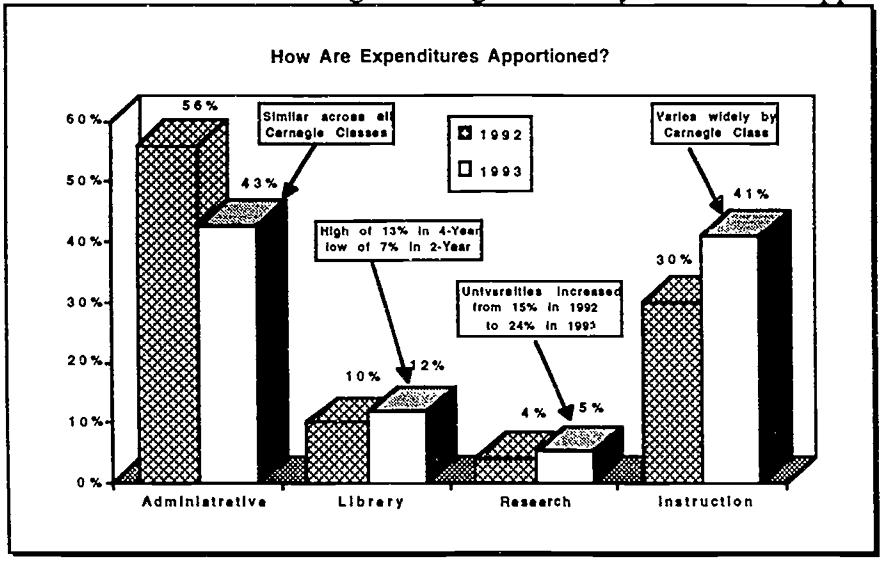
Does the move to distribute decision making and therefore access to information result in more



centralization of computing organizations. Looking at two years of data, we see what appears to be a genuine movement to consolidate computing organizations. When asked which computing organizations report centrally, our respondents indicated increases in all areas. WHY? Perhaps because the move to distributed computing creates a compelling need to build and maintain a coherent IT infrastructure in order to support decentralized information needs.

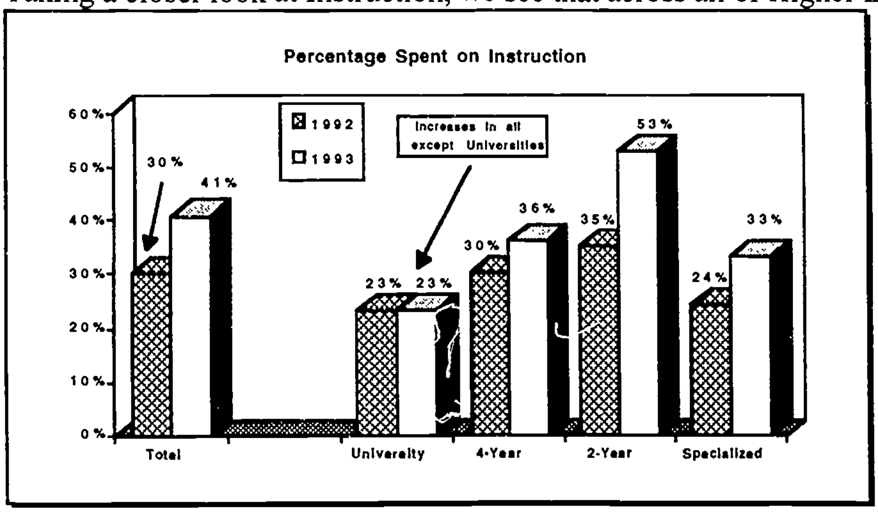
How Are Computer Expenditures Apportioned?

What effect are these changes having on the ways institutions apportion their total -- not just central -- expenditures for computer hardware and software across the major functional areas? And, has it changed over the last year? Looking first at the overall picture, we see that Administration is down while Library, Research and Instruction are all up. There are significant pattern differences among the Carnegie classes. Only Administration, at 43%, is similar across all Carnegie classes. Library varies from a high of 13% in 4-Year schools to a low of 7% in 2-Year schools. Research expenditures, as a percentage of the Total, are highest in Universities, where this percentage increased from 15% in 1992 to 24% in 1993 and lowest (<2%) in 2-Year schools. The big story is in Instruction.



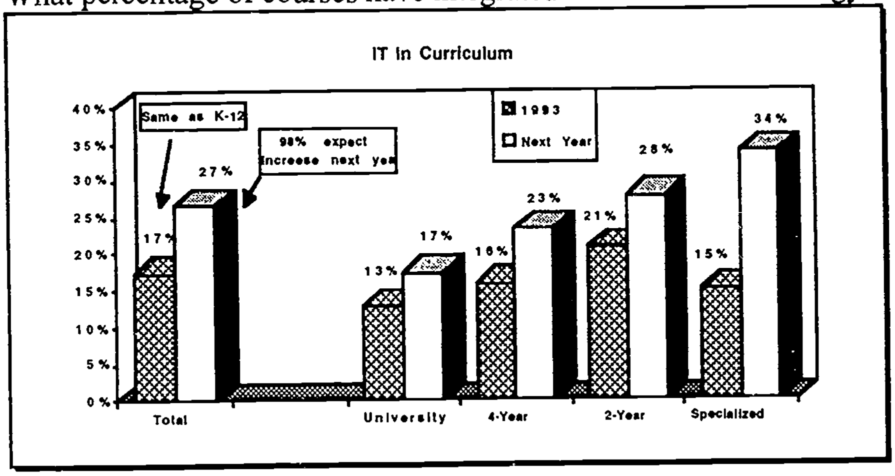
A Closer Look at Instruction

Taking a closer look at Instruction, we see that across all of Higher Education, 41% of total expenditures on computer hardware and software were devoted to this area in 1993. This represents a 37% increase over last year. Further, we saw increases for all Carnegie classes -- except for Universities -- where it *appears* that funding stayed flat. Did the Universities actually "flat fund" Instruction, or are we seeing distorted responses resulting from the fluid boundaries which define Instruction and Research? The most significant change is in the 2-Year schools who reported that they spend 53% of their Total computing expenditures on Instruction. Is there a correlation between the percentage of funding allocated to Instruction and the rate of IT integration into the curriculum? They do appear to be correlated.



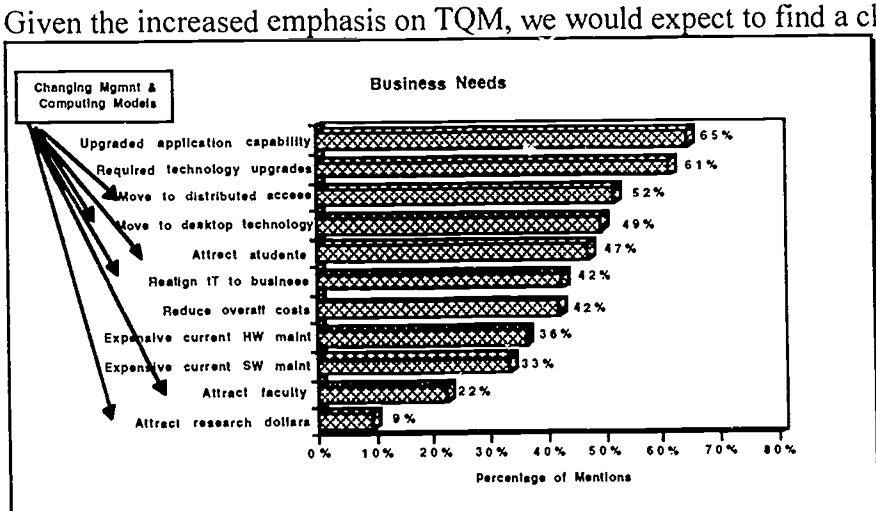
How Pervasive Is IT In The Curriculum?

What percentage of courses have integrated information technology into the curriculum? By "integrated," we mean that *IT is used an integral component in the course, as differentiated from simply using word processing to type papers.* Overall, the mean response was 17%. Coincidentally, this is the same mean response we found in our K-12 study! And the best news is that 98% of our respondents are projecting an increase next year. The mean percentage of courses which will integrate IT into the curriculum is projected to be 27% next year -- reflecting increases across all Carnegie classes -- but once again we see large differences, which range from a low of 17% in Universities to a high of 34% in Specialized institutions. (Please note that we have taken all responses at face value. It is likely that there are wide variances in respondents' interpretation of what is meant by "technology integration into the curriculum.")



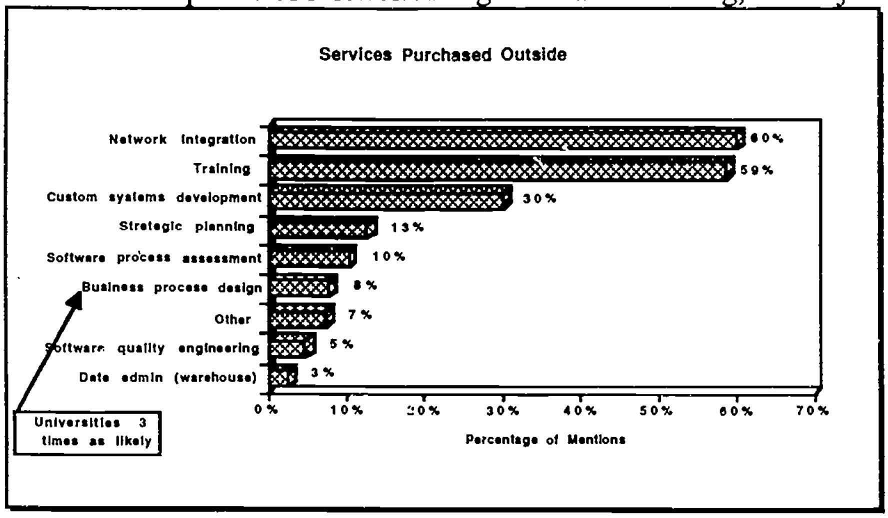
What "Business" Needs Drive IT Expenditures?

Given the increased emphasis on TQM, we would expect to find a close alignment between the mission of the institution and IT. When asked to define which business needs drive technology expenditures, we found that those needs relating to changes in computing models and/or management models received a high percentage of the responses. Further, the top two mentions: Upgraded Application Capability and Required Technology Upgrades are likely to be the resulting tactical changes required to implement new management and new computing models. Looking beneath some of the market-wide responses, we found that the University responses were significantly above the market average in *most* areas, while the other classes tend to cluster about the mean.



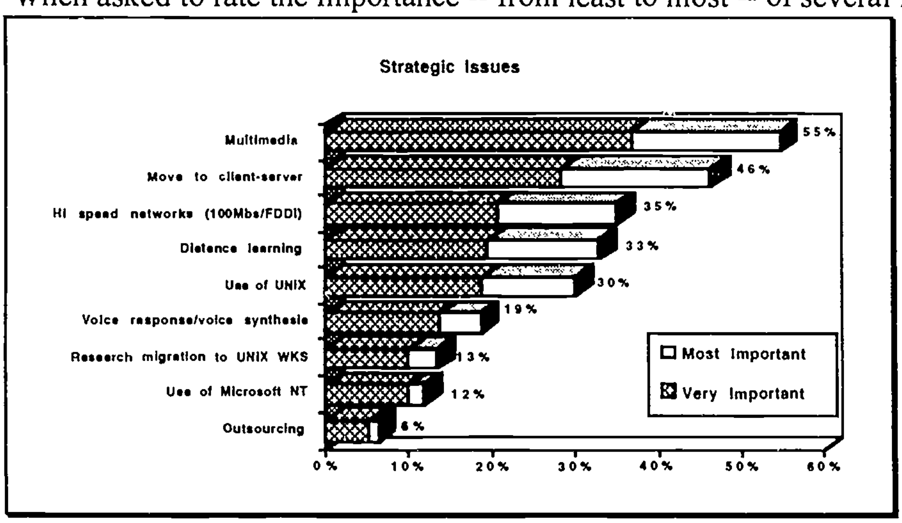
What Services Will Be Purchased?

With the exceptions of Network Integration and Training, the majority of institutions did not indicate that they would be purchasing large quantities of outside services. Except for the Universities, the responses for the Carnegie classes are consistent. The University response to Network Integration was much lower (36%) than the market average. WHY? We would speculate that this low University response probably results from the mature state of their own networks and/or from the relatively higher networking skill sets found in this environment. Training is in second place, with 59% of mentions, and here the Universities lead, with 74% indicating that they would purchase this genre of service. In the area of Business Process Design, the Universities are almost three times as likely to purchase this genre of service than all other institutions.



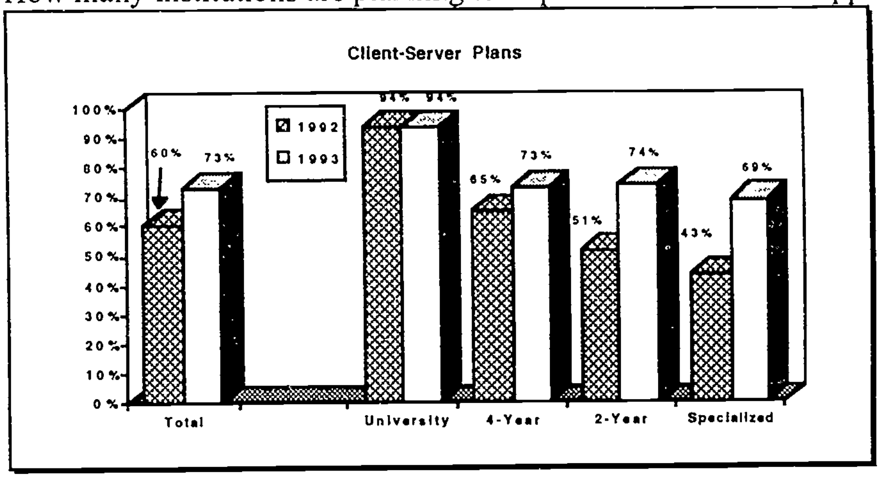
Which Issues Will Have the Most Strategic Impact?

When asked to rate the importance -- from least to most -- of several issues on their institution's strategic plans, the highest rated response was for Multimedia, with 55% rating it either "Very Important or Most Important." It is followed closely by Move To Client-Server (46%). While Outsourcing anchors the bottom of this list, in a related question, we found that 63% of all institutions currently outsource some aspect of their computing operations. Today, more than half of all institutions outsource hardware and software maintenance, and the forecast is for continued growth in these areas as well as in network infrastructure and maintenance.



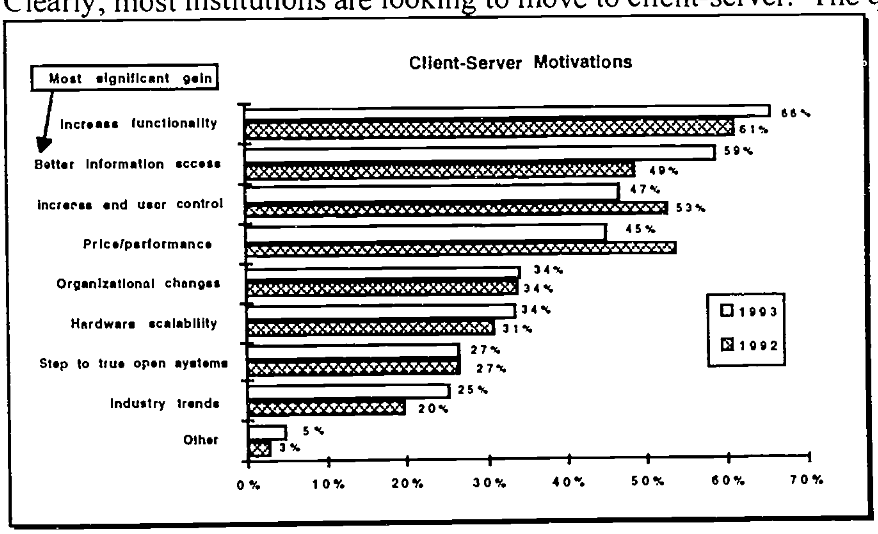
Client-Server Plans

How many institutions are planning to implement client-server applications? MOST! Overall, 73% -- a significant increase over last year's response of 60% -- indicated that they were planning a move to client-server. And, in contrast to last year, when there were significant differences across the Carnegie classes, this year only the Universities, with 94% planning for client-server, stand significantly apart from the crowd. The remaining institutions cluster reasonable close to the market average.



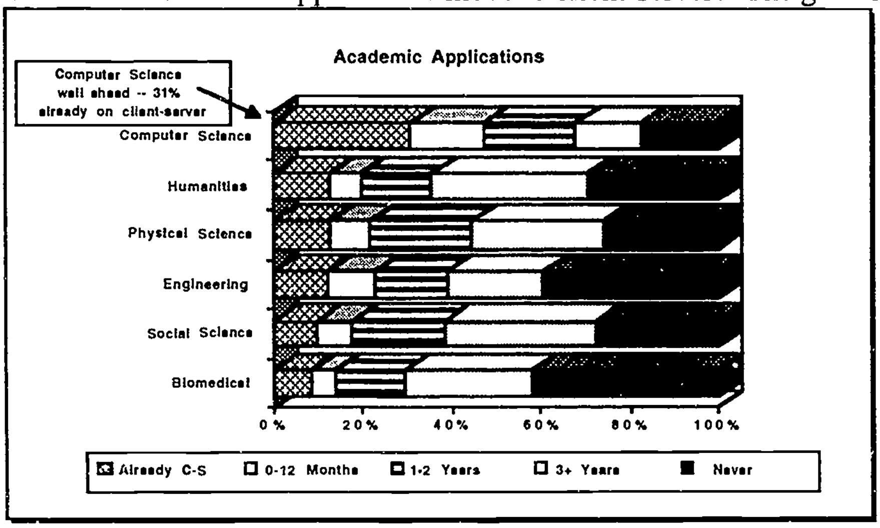
Client-Server Motivations

Clearly, most institutions are looking to move to client-server. The question is WHY? We asked respondents to tell us about their motivations. Increased Functionality tops the list, with over 60% of mentions, for two years in a row. The most significant gain is in Better Information Access. In both cases, the University responses were higher (82% and 78% respectively) than the other Carnegie classes, where the responses tended to cluster closer to the market average. In contrast, Price/Performance fell from #2 in 1992 to #4 in 1993, and the pattern was consistent across the Carnegie classes. WHY? We would speculate that as schools implement client-server applications, they come to understand that client-server may *not* be less expensive -- but instead a better -- way to define an IT architecture that meets institutional needs.



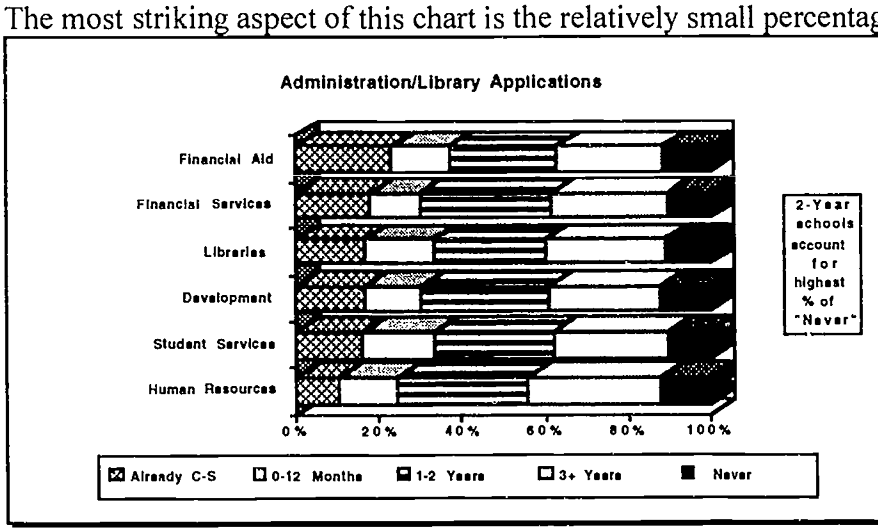
Client-Server Timing

When will Academic applications move to client-server? The good news is that a surprising number are already the·e. Computer Science leads this group, with over 30% of its applications currently running in a client-server environment. By adding those expected to migrate within the next 12 months, we can project that approximately 50% of Computer Science applications will be client-server based next year. What is the prognosis for the remaining Academic applications? Adding the percentage which are already client-server, to those expected in the next twelve months, we see a range of migration patterns from low of 14% in Biomedical and the Humanities to a high in the low 20's in Engineering and Physical Science. Social Science, with an expected 17%, is expected to straddle the middle of the range.



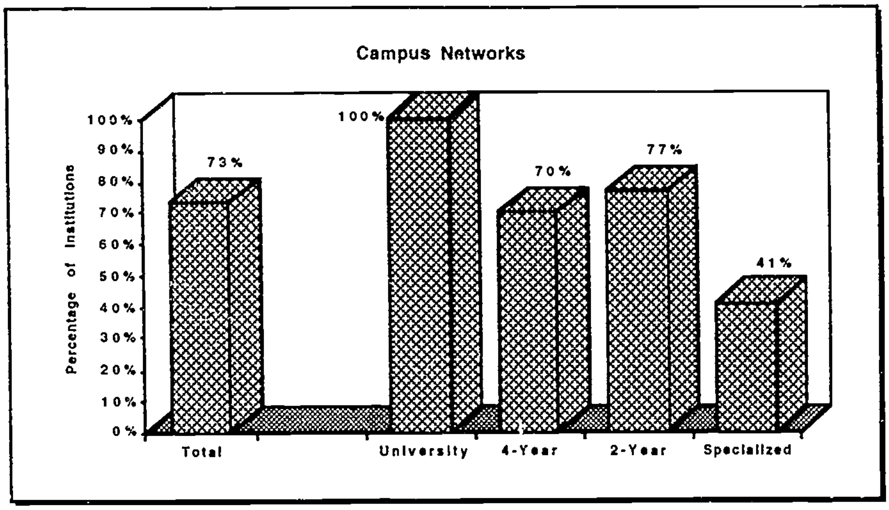
Administrative Applications Moving to Client-Server

The most striking aspect of this chart is the relatively small percentage of difference among the various Administration and Library applications. They all appear to share a relatively similar status for both the current and projected rate of client-server adoption. Financial Aid, with 23% currently client-server, is only *slightly* ahead of all others. Looking ahead to the 12-month projections for other Administration and Library applications, we should expect to see application migration to client-server ranging from a low of 25% for Human Resources to a high of 33% for Student Services and Libraries. The Universities, with their large and complex Administration applications, are expected to lag behind all others.



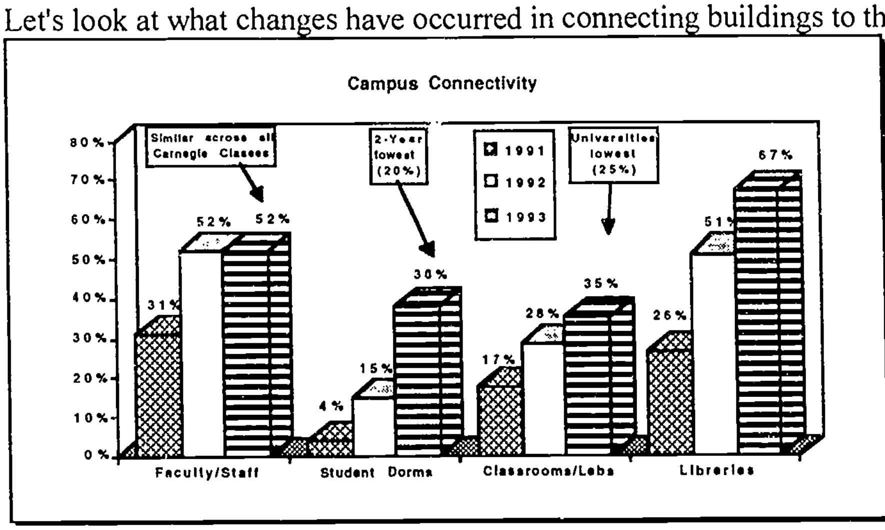
THE Issue Is Access

Ubiquitous access to information -- be it administrative, student or scholarly research -- is the pivot about which the Higher Education "wheel of fortune" turns. With access comes the ability to: empower work groups with the information they need to make decisions, enable administrators and advisors with real-time information to resolve student issues, encourage collaborative research, and facilitate the learning process through student and faculty access to e-mail, bulletin boards and external databases. How are institutions responding to this never-ending demand for more access? We believe that there are four dimensions with regard to access: (1) the presence of a campus network; (2) the provision of a wide array of network services; (3) the relative accessibility of those services by network users; and (4) the extension of network access to all members of the community. Our data addresses the first three and we begin by looking at the current status of campus networks. We have estimated that 73% percent of all institutions have a campus network.



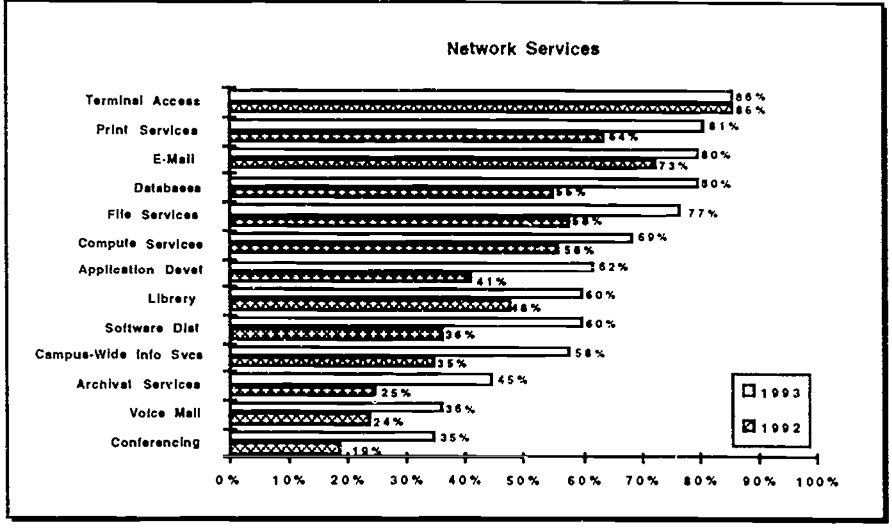
What's Connected?

Let's look at what changes have occurred in connecting buildings to the backbone. We have seen an increase -- over the last three years -- for all space categories. Faculty/Staff offices top the list, with 52% of those spaces connected, and this proportion is relatively similar across all Carnegie classes. In Libraries, where 67% are connected overall, the Universities lead. Likewise, they also lead in dorm connectivity, but they lag behind all other institutions in Classroom/Lab connectivity.



Network Services

The name of the game in networking is delivering services to end-users. What services are schools providing to network users? Overall, we found growth in the provision of most services over the last year. Terminal access and Electronic Mail lead the list, with well over 8% mentioning these services. There are also several other community-wide services which grew last year. Approximately 60% provide access to the Library catalog, Campus-Wide Information (CWIS) and Software Distribution. The emerging applications -- like Voice Mail and Electronic Conferencing -- are also growing, but currently have the lowest rates of provision.



Further, it appears that when institutions offer network services, they are accessible to a majority of network users. Over seventy percent of network users have access to: E-Mail; Voice Mail; Compute Services; Terminal Access and Print Services From the perspectives of both the provision of services as well as from the proportion of network users with access to them, institutions have made great strides. Perhaps the next challenge facing all institutions is to provide network access to all members of their communities... Education is, after all, about ACCESS!

Conclusion

Technology is not an end unto itself, but rather a means to an end... and hopefully a means to a "new end." It provides a scaffolding to launch new ways of thinking about -- and implementing -- the education mission. In order to deal with the enormous changes in the economic, political, cultural and competitive environment of the 90's, an increasing number of institutions are re-engineering their organizations from the perspectives of management, teaching and research. In turn, this organizational transformation is driving Information Technology priorities.

And, the priority should begin with ACCESS. It is THE major issue. In fact, broad-based access to all forms of information may be the delineating factor in predicting which institutions will thrive and which will teeter on the edge of survival. In the information age, survival of the fittest may be redefined as survival of the "most connected."

Desktop Information Delivery for Effective Administration Client/Server Solutions

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ABSTRACT

Current and proposed changes in the financing and management of higher education are fueling an ever increasing demand for information at the desktop of administrators and executives.

Client/server solutions can deliver critical information while enabling the IT organization and administrative customers to maximize computer resources, and more importantly, limited human resources.

This paper provides guidelines and strategies for implementing client/server solutions for management reporting, decision support, and executive information systems. A practical framework for using client/server architecture will be discussed with examples of applications implemented in a complex multi-vendor environment at the University of Massachusetts.

Introduction

CAUSE 93 comes at a time when the need for information to manage and support the mission of our institutions has never been greater. Regulators, legislatures and the public expect clear information describing the effective operation and value provided by each institution. This was highlighted in the June 1993 SHEEO/NCES Network Conference (State Higher Education Executive Officers/National Center for Education Statistics) which discussed important changes at NCES. "These changes have resulted from several causes including technological developments, the emergence of additional federal and state data needs and reporting requirements, and organizational changes within NCES and other agencies."(SHEEO/NCES,1993)

As Information Technology continues to evolve, there are more options available to provide the management information that is in such high demand. This paper provides guidelines and strategies for implementing one such option, client/server applications, as a solution for management reporting, decision support and executive information systems. The paper concentrates on the business issues and success factors rather than any specific technical designs.

The Challenge

Much has been written of the rate of change in information technology, especially in view of the ability of systems to offer meaningful information for management of the enterprises. Without regard to the debate of evolutionary change versus revolutionary change, we need to take stock of the situation at our institutions and identify rapid deployment strategies to deliver the critical information needed today, (or more likely in our customers eyes - yesterday). While our strategies should also have an eye to the future we must avoid the inclination to design the perfect system - time is of the essence.

The Changes

The 1980's saw extensive growth in our legacy systems and data stores. Disk storage costs decreased, new programmer productivity tools and methodologies became more effective, and we began to see data as a resource to be managed! Of course like all valuable resources, we saw more as better, so the data stockpiling combined with cheaper storage combined to create massive data stores.

PC's came on the scene and continued to explode through barrier after barrier: faster, cheaper, and "ubiquitous". The talk was of the number of PC's per worker, and the forecasts of deployment to the desk of every knowledge worker appear to be very accurate. The 80's were also a time of limited use of graphics in the everyday operation. Graphics were the things of special occasions - annual reports, etc.

Current Management Information Environment

Now in the 90's we are often drowning in data. How do we turn this wealth of data into information? What is the cost of this transformation? Bill Inmon, regarded by many as the father of the data warehouse, has noted that the unresolved issue is the transformation of distributed data into usable information regardless of the platform.(Knight, 1991) The business areas at our institutions have acquired extensive technical capability. The staff are increasingly computer knowledgeable, especially using desktop computers. Many

Information Systems organizations have established the policy that the business areas are responsible for producing their own reports, a step which the University of Massachusetts President's Office took in 1992.

Regulators are also stocking their databases and expanding their reporting capabilities. Explaining findings derived from our "exported" data taxes our institutions ability to respond rapidly with in depth and comprehensive reporting and analysis. According to the National Center for Education Statistics, "Various legislative requirements are also leading to the development of new data sets for higher education.[such as] the 1992 Higher Education Re authorization Act, as well as the Student Right to Know Act of 1990 which give new importance to the need for accurate and comprehensive information." (SHEEO/NCES,1993)

Business graphics have become essential to credible communication, again, the result of years of desktop computer deployment, friendlier packages, more skilled users, and everyday use in newspapers, newscasts, business weeklies and even political debate.

Our current environment is one of demand for rapid information delivery. Increasing experience with the responsiveness of desktop computers has led the business user to view timely delivery of information as an entitlement that should be within the abilities of their information suppliers.

If we are to meet the information needs of our administrators, we must act now, leveraging our resources to deliver more capabilities in the short term, while building toward a service environment that keeps pace with the demand for management information.

Leveraging Strengths

At the University of Massachusetts we began by assessing our core competencies as they related to delivering information access and reporting in a client/server approach. That is, an approach that provides requested data from a designated source computer (server) to desktop workstations (client) applications. In our environment this was assumed to be a VAX server accessed by desktop computer application software. The areas of strength that we identified as essential to success were infrastructure, data, business area readiness, and management support.

Our infrastructure strengths were in the area of networking, a critical factor for our dispersed environment of six sites throughout Massachusetts. In 1993 we implemented a wide area network using a T1 ring. The networking services group has extensive experience in multiple protocols on the wide area network as well as experience in local area networks consisting of both Apple and IBM compatible desktop computers. Experience in configuring workstations, supporting desktop computer software, and administering a local area network for several years were also recognized strengths.

The university had made an effort to improve the management of the data resource through the efforts of a university-wide Information Systems Task Force, which adopted a resolution that data administration should be a priority. As a result, a University Data Administrator was named in 1992. The official focus on data as a key resource led to improvements in the data dictionaries for the primary systems administered by the President's office. Particular attention was devoted to the Human Resource Management Information System(HRMIS), which provides all payroll and on-line human resource processing for the university. In addition to supporting this processing with operational reports, HRMIS also provides detailed data to the Commonwealth of Massachusetts.

In 1992, University Information Systems senior management decided to form the University Information Resources organization. This organization was charged with promoting University-wide data administration and implementing a data warehouse to improve management reporting capabilities. The primary business area supported by the University Information Resources is the President's Office. Secondary support is provided to the campus administration through the Vice Chancellors of Administration and Finance, Institutional Research Office, Budget Directors and Human Resource Administrators. Notably, these constituencies were making extensive use of desktop computing and, in many cases, batch ad hoc report generators accessing legacy system extracts.

While there was a history of commitment to management reporting and the development of a data warehouse, the work prior to December 1992 was limited to research and fact finding. The activities from December 1992 through the Fall of 1993 included implementation of the data warehouse, client/server reporting, ad-hoc reporting and an Executive Information System. The strategies and lessons learned may offer ideas and examples of how success can be achieved in developing and implementing client/server reporting to promote effective administration.

A Solution in the Real World

Given the pressing business demands, it was clear that a protracted development process was not a viable approach. While there was preliminary support for the concepts of data warehouse, data administration and management reporting, it was clear that continued funding would require visible tangible results.

Certainly the core of this client/server project was the business need for management information. The strategy employed was to identify a single area of business need, and focus the project on implementing a generic solution. It was important that solving the particular business problem require us to address the essential components of client/server access to a data warehouse.

One of the early advantages realized through our focused approach was positive movement toward a clear goal. I contrast this to a protracted planning process that might require an early consensus that is extremely time consuming. An example of a task that could delay progress is deciding the full range of data to be included in a data warehouse. The answer to political issues such as this could easily require months, if not years, of meetings with representatives from many functional areas. Our strategy is to develop the data warehouse in stages, consistent with an evolving University Data Model.

One problem area that came to light in early meetings with key business managers was that of human resource information. Some standardized monthly reporting had been developed to provide key measures and indicators for comparison across the five campuses. However, the reports only provided information for the current month. Over a period of three years, a spreadsheet application grew around this monthly data. The application, which was developed in the President's Office, grew to a set of eight reports that accessed an Excel database to calculate comparisons to prior periods, average salaries, and permit trend graphing. The data entry from the standard production report, and the manipulation of massive spreadsheets made this a high cost application which was identified in several discussions as needing a "better approach".

Since the business area staff had clearly established Excel as their standard, we decided that the initial client/server implementation should be able to deliver data to Excel spreadsheets with minimal user effort.

The decision to implement a client/server solution was made basically from the requirement to deliver a solution that offered easy access to critical data, and recognized the need to provide for more extensive reporting capabilities. Some of the clearly identified reporting needs were in the area of more detailed Human Resource data as well as financial and academic data that knowledgeable business staff could combine as needed without specialized technical skills.

The need to provide this type of cross functional reporting clearly indicated a relational database would be required. While the majority of our legacy systems reside on an IBM mainframe, the IBM environment does not have a relational database environment. However, our VAX environment had Rdb as an installed supported relational product. During some of the early research into improved management reporting strategies, Digital Equipment Corporation had provided extensive information describing their implementation and use of Rdb for massive data warehouses. As previously noted our networking capabilities and support were very good, especially in the options available through our VAX environment. We decided that the warehouse would use the exact data that was reported in the standardized monthly reporting. This would provide more detail than was available in the spreadsheet database, and would allow us to start the warehouse with over 30 months of history.

The general information needs identified were: ad hoc access to produce summary reports and comparisons, the need to provide executive information, with perhaps some direct hands-on executive access, and an easy way to move data directly into Excel spreadsheets for manipulation and graphing.

Our early research had identified that Data Access Language(DAL) was a reliable widely supported facility to use on the VAX to enable client machines to access data stores on a VAX platform. Testing indicated that indeed Excel and DAL worked quite well together, so the combination was identified as the first implementation of client/server reporting from the data warehouse.

The decision to utilize Data Access Language(DAL) precipitated a number of other decisions. One notable area of some uncertainty was software for ad-hoc reporting. Years of experience in non-workstation based access tools indicated that better service to our customers would require a client/server solution. Once DAL was identified as a standard client/server technology, several DAL compliant products were identified that would provide highly flexible ad-hoc reporting.

In summary this project answered a critical data need expressed by some of the top administrators in the institution, by providing easy access to well defined data using familiar tools. This has proven to be as successful an implementation as this summary would suggest it should be. A variety of other factors contributed to the success of the project. The remainder of this paper describes some specific lessons learned and provides guidelines for other key success factors.

Lessons Learned

1. Once the decision-making process began, a clear framework emerged, with of course certain limitations . However, initial decisions such as selecting the database management system, focused the thinking of the team on implementation tasks and time frames. It also become much easier to identify activities that were not essential to the initial implementation.

2. Client/server need not be viewed as a radical change of direction, but rather an extension of other initiatives. We had clearly decided to implement a data warehouse, but had not established that the initial access would be client/server.

3. It is not practical to become expert at everything that is listed in the technical critical success factors for client/server. You may need to develop alternatives such as an interim solution, or a partnership with an expert.

One of the key components of our data warehouse is an encyclopedia. Our design called for the encyclopedia to be integrated into the desktop environment, such that business rules and definitions could be viewed, and queries could be generated via navigating the encyclopedia; Aetna Insurance has developed a facility that is highly successful. However, this functionality could have added as much as 6 months to the implementation, so we developed some standard queries that could be invoked to provide the core information. Since our Rdb expertise was lacking, we partnered with DEC who provided some long term design assistance, as well as some rapid delivery of Rdb services.

4. The specialized knowledge, the need to have innovative approaches, the need to build ongoing support in the IS group requires a cross discipline team. We included the University Data Administrator, a networking and architecture specialist, and an end user computing expert as part of the core team. This worked very well in raising the concerns necessary, and in building commitment in these essential areas.

5. Partnerships with user constituencies are invaluable. We plugged into some key university-wide groups that would be stakeholders in the data warehouse, such as Institutional Research and Human Resource Administrators. The number one concern of these groups was ensuring proper definition and understanding of the data that would comprise the data warehouse. Groups such as these offer help in definition work, as well as provide essential feedback. One way of gaining support for data warehouse, or similar activities that make data accessible to management, is to make the implementation a "win" for these constituencies. Whatever capabilities we provide for the President's Office, we also provide to the campus. Although the campus may already have the data, the access via a new client/server tool may be welcomed. For example campus access to President's office EIS reports and graphs, provides these facilities without any development cost, limited of course to the data that the campus is authorized to access.

6. You do need to pay some attention to the "open systems" approach. Open solutions can provide flexibility and lower implementation costs. Open architecture, open systems is really driven by what your environment is, and what you expect it to become. Why wouldn't you strive to have an open solution? Do I really want to develop one application for Macintosh and another for DOS platforms? These are some of the issues which client/server forced us to answer. We have decided to require portable applications. This is working out quite well using open solutions such as Excel's database interface, and the HOLOS Executive Information System. You may also find that by starting into client/server, you will actually act as a catalyst for the organization to set a direction toward open architecture.

Choosing Initial Applications - The Business Case

The popular phrasing applied to newer approaches seems to be, "*it's more of an art than a science*". However, there are some basic approaches that can make choosing an initial client/server application more science than art. No doubt as your reputation, time and money are going to be invested in the first client/server application, it would be nice to find a "sure thing". The easiest aspects to address is what types of applications should be avoided.

If client/server is new to your organization, there are a number of areas that must combine to make the effort successful. Although client/server has some similarities to what you might have done in the past, it is deceptively different. It is more than installing a new mainframe reporting package, it is more than installing a new PC package, or a new network access, and yet it often includes all of these activities. For this reason, it is recommended that the initial application should not be: mission critical, date driven, or a large application. A somewhat more conservative approach is to "concentrate on a class of applications that do not require real-time data access between the microcomputer and the mainframe because these applications are more easily manageable, fit better with the current skill level of most organizations, and can be delivered more quickly." (Capraro, 1993)

Aside from the inherent risks in these projects, cost can be a significant issue. Frank Dodge, co-founder of McCormack & Dodge Corporation, in responding to a question on cost savings realized with client/server solutions, indicated that "it's a mistake for companies to believe that overall costs they allocate to a particular set of applications will dramatically decrease within the first eighteen months or so." (Dodge, 1993)

While the technical components are clearly important, the best technical development of a low value application will not produce a successful result. One of the best approaches to finding a high value application is to be engaged with the business areas you support. Involvement in the business issues and understanding the demands being made of the business areas, provide a basis for answering the central question "*Where can I provide a new information service that gives the business area a boost in productivity or information access?* "

Why consider productivity first? The stories are legion about the reams of paper that are printed from legacy systems, distributed to the business areas, and then used as a source for a few key data entered into a desktop computer. The desktop computer can then be used to produce the report that has real value to management. I would suggest that this is perhaps one of the top candidates for an initial client/server application.

Looking at some key success factors shows why a focus on this type of data re-entry situation can offer a high probability of a successful client/server solution.

Business Need - With resources generally limited, the reporting topic is likely to have some importance if it is being maintained in spite of the cost and delay of data entry. The topic area offers opportunity to improve quality, timeliness and the scope of the data available for analysis and accuracy.

Well Defined Data - Whenever business area access is provided to a data source, the data should be clearly defined. Client/server can accentuate the need since the particular solution may require distributing the data to local servers. Data that is reflected in standard reports is often defined in the "business rule" or logic that produced the report. In addition, data that has been available for a period of time in a standard report usually has an accepted definition. The availability of these types of de-facto definitions enables the client/server project to proceed without needing to invest immediately in potentially lengthy data definition sub-projects.

Easily Accessible Data - The fact that report programs exist provides an easy opportunity to extract, at a minimum, the same data that is included in the standard reports. Data distribution and access policies can be less of an impediment if the initial client/server application is simply deploying new capabilities to areas that already have paper access to the data.

Historical Data - While typical operational system reports focus on the management of the business function, operational reports do not provide the type of trend information needed for decision support and executive management. Often, these management reports require a business area to key enter data to create local private "databases". A client/server solution can address this need, by providing a much easier means of drawing on the data, especially if the solution is to convert the data to a relational data store.

There are two areas of human factors to consider in choosing the initial application - the business partnership, and the staff expertise.

Business Partnership - If management in the targeted business area is an ally in the project, then the likelihood of success is increased. While building on past successes is a definite advantage, strong allies can be established by developing a shared view of the benefits. One way of enhancing the benefits is to have as little disruptive impact on the business area as possible. The single most important area to address in minimizing the impact is to avoid solutions that require major changes to the business area, such as conversion from PC to Macintosh, or from one spreadsheet package to another.

Staff Expertise - Client/server is an evolutionary step in information service delivery, particularly for reporting applications. This means that there are similarities to many of the services already being provided. Staff who have been heavily involved in building databases, supporting ad hoc data access via 4 GL tools, supporting desktop tool installation, and system design are key resources for a client/server application.

In addition, skills are required in networking and desktop network access, which may necessitate expanding the team beyond the system development group. At the University of Massachusetts, the data warehouse team, responsible for implementing client/server reporting applications included key infrastructure staff. These infrastructure experts addressed the networking, desktop connectivity and many open architecture design issues.

Partnerships with vendors - Vendors can bring very specific expertise to the project, which allows the team to focus on strengths, rather than trailblazing in new technical capabilities. One example of vendor support which was highly effective in the University of Massachusetts' client/server implementation was a one day project review with a Digital Equipment Corporation Team. The DEC team included experts in relational database design, wide area networking and desktop connectivity. The review provided some expert advice, and an extra measure of confidence in our project plan. We later contracted with DEC to develop an EIS client/server application using the HOLOS software developed by Holistic Systems Corporation. While the University of Massachusetts team was responsible for all other components of the EIS project, it was extremely helpful to use DEC's expertise to develop our first HOLOS-based application.

Cost Savings and Justification

The debate of whether or not client/server and downsizing save money will probably continue for some time into the future. However, in focusing on reporting applications, we can rely on some clear business issues to determine if client/server is a cost-effective solution for a particular information need. We can consider some of the common applications and issues to illustrate how cost and value might be presented to support a decision to implement a client/server solution.

A key question to answer is "how is critical reporting being addressed?" If data is being key-entered to desktop computers to create reporting databases, there are some associated costs. In addition to the data entry cost, there are some quality control costs in checking for keying errors. If the keying errors are not detected, what is the cost of decisions based on incorrect data? While this cost cannot be quantified as easily as key entry time, raising the question may be a powerful factor.

Data entry report applications can be problematic due to the inherent delay in producing the report, and the potential loss of some important information that was deemed "too much" data to be keyed. These situations lead to decisions being made without the benefit of a key resource, the institutions' data. There is also a high potential for duplicate effort since many recipients of a valuable standard report may use the report for similar purposes such as tracking the same trends via their desktop computers.

The nature of management reporting applications often implies use of central data stores with distributed access, a standard model. When this model is not used there is increased risk not only of duplicate effort, but of arriving at different answers to the same question, depending on the design, quality, and currency of the redundant, locally created data sources. Even given consistency, if complex rules are needed to evaluate or manipulate the data, these rules need to be replicated for each locally created data source, further increasing the risk of erroneous results.

A key characteristic of client/server applications is the familiar and comfortable desktop access they provide. Training business area staff to access data from graphical interfaces and desktop query tools with context-sensitive help is much simpler and faster than delivering training and support for 4 GL languages. The cost savings for the business area is in both the reduced training time and the more effective use of the reporting capability; the difficulty and time spent making 4 GL's produce desired reports and graphs is dramatically reduced in client/server approaches.

While there are a variety of ways that cost savings could be approached, improved information quality and effective use of scarce resources, particularly in the business areas, can be a powerful illustration of the benefits that can be derived from a client/server approach to management reporting.

Implementation Strategies

Creating a Focus

Once you have decided to proceed with a client/server solution to a key information reporting need, it is essential to create a focus that will assure success.

Although the justification for the project may be that a number of business areas will benefit, the initial implementation should be limited to a small number of customers in the same location. Allowing for a few problems is realistic and quite manageable if you have targeted the customers who will succeed with you. Undertaking the initial client/server implementation with a customer who does not share your belief in the project, is inviting intolerance and negative publicity that can brand a project or technology as a failure.

One way to maintain the targeted area's support for you and the project, even if you are experiencing some delays or problems, is to be highly visible in the customer's area. Frequent demonstrations of prototypes, validation of workstations, networking tests, etc. all show that the project has commitment, and invite a supportive reaction from the customer, even if the project is off schedule. Again, it should be emphasized that the potential for problems is one of the reasons that the initial client/ server application should not be "mission critical".

Client/server applications are well suited to prototyping and therefore promote satisfied customers, provided that the developers pay close attention to customer reaction to issues such as ease of use and features the customer deems critical.

Marketing

The initial client/server application represents an important event in both the business and Information Systems organization. A successful implementation will require support from many individuals in these organizations. Since people can not support what they don't know about, it is important to keep these constituencies informed.

Using a variety of communication opportunities, as often as these opportunities are available, will help to ensure that everyone is aware of your client/server project. Updates in newsletters, staff meetings, departmental meetings, and informal updates are all effective in ensuring that the project is visible, and a recognized priority.

An important aspect of the communication, particularly for the business areas, is to set realistic expectations, and continue to reinforce these expectations regularly. This is especially important if the implementation will occur at only one of several planned sites well in advance of the implementation at the other planned sites. In this situation, and as a general means of sharing information, demonstrations of the client/server application are a powerful communication tool. Since an amount of skepticism is often attached to new initiatives, demonstrations serve to dispel the notion that the whole effort may be vapor-ware. Demonstrations also help to clarify issues and surface key concerns before the project is delivered. For this reason, demonstrations within the Information Systems area may be conducted very early in the project and may show only product features, since application and development may be in very early stages.

Once the project has reached final testing stages, demonstrations take on a different role. At this point they can serve as a "wake up call" to everyone who will be involved in the implementation. This can help to create a push to wrap up any outstanding tasks. The demonstrations of production-ready systems also create enthusiasm in the business areas, which is important to generating more interest in future applications.

Infrastructure

The network plays a key role in client/server applications since the client workstations must be able to communicate precisely with servers, whether on local area networks, wide area networks, or a combination. For this reason, the infrastructure support is more critical to success than ever before.

New areas of support that should be considered with networking include workstation configuration and workstation product installation, particularly for products that support the network communication. Whenever possible, the infrastructure support areas should be offered the opportunity to participate in product selection.

Involving these areas at the inception of the project and ensuring a continuous update process will pay dividends in a client/server project.

Summary

While client/server development can appear daunting at first, there are strategies that can be used to introduce this technology with limited risk and expense. As with any new technology, success should be measured by the value that the application of the technology brings to the institution rather than the inherent potential of the technology. This paper has attempted to provide some insights into one approach that was highly successful in delivering business value to the University of Massachusetts.

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From Server to Desktop

Capital and Institutional Planning for Client/Server Technology

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I. Project Goals

In 1988 we initiated a project to provide enhanced decision and strategic planning support to senior management in our Division. The impetus behind this project was senior management's desire to integrate information from disparate University systems in complex reports while avoiding the high costs associated with mainframe computing. To fulfill this need, we developed an integrated database encompassing many domains of administrative data and a suite of reports. As this project proceeded the potential power of combining this database with emerging new technologies in networking and graphical user interfaces became apparent and the original undertaking was expanded into a full-scale client/server development project. The range of services to be provided was enlarged to include not only decision support services but also applications to automate routine administrative tasks, ad hoc reporting for administrators, internal communications tools such as electronic mail, and higher quality desktop computer tools and services. All of these services have been delivered during the past five years using client/server technology.

In this paper we will review the major planning issues we faced during our project and consider several important factors in implementing client/server technology in general. First, we will discuss how and why the scope of the original project was expanded beyond its original boundaries. Then we will consider each major phase of the project in turn, presenting the planning and implementation issues that we faced during each one and the critical factors for success. While we will touch on staffing issues throughout the paper, in Section VII we will describe in detail the challenges we faced in organizing our technical team and the processes we adopted to overcome them. Finally, we will conclude with a summary of the overall costs of our project, with particular emphasis on the distribution of those costs and the implications of the costs and their distribution on institutional capital planning.

II. Early Organizational Issues

At the outset of our project, senior managers in central Divisional administration were the exclusive consumers of our services and little thought was given to extending these services into the individual departments that make up the Division. Indeed, central computing staff were reluctant to foray into the departments because we believed that departmental support could be best provided locally. Two factors led to a change in this attitude and a broadening of our client/server initiative to include the entire Division.

The first of these changes was a shift in management style that accompanied a change in senior management personnel. Whereas in the past the central administration had formed a rather closed circle and each department operated more or less autonomously, the new management of the Division fostered a more open style and encouraged close interactions between the departments. One important aspect of this approach was the appointment of a focus group on information systems. This group was charged with identifying opportunities for departments to collaborate in developing solutions to administrative computing problems. The formation of this group rapidly led to much closer working relationships between departmental administrators, who also began to look to central administration for leadership and assistance, especially technical assistance. This new atmosphere of cooperation and shared interests provided an essential foundation on which future organization-wide systems efforts were based and provided these efforts with both an engaged group of users to guide the projects and a source of "early adopters" for new systems.[1]

The second change that contributed to the acceptance of our client/server initiative was the successful implementation of a central, integrated database and the success of the networking technology deployed in central administration. While these two technologies were originally targeted only to support decision making and strategic planning centrally, the utility of these technologies to the departments was apparent, and their early success gave the technology and the technical staff of the Division credibility. Coupled with the new management style in which departmental administrators cooperated to solve problems and shared successful tools, our more ambitious plans for an organization-wide client/server initiative were put forward in a receptive environment that might otherwise have been hostile or disinterested.

III. Project Planning Issues

Given the modest initial scope of our project, we did not plan to deliver full-scale client/server access to our database and, although we anticipated the widespread use of networking in our Division, no strategic networking plan was put in place. Within a year, however, as we completed the most significant segments of our database, the need for networking services, became apparent and pressing. This need was driven at first by the demand for electronic mail and later by the need to deliver interactive access to our database to administrators throughout the Division. When we considered the requirements of our newly expanded project, four critical components emerged: a system architecture with three technical layers and a team of personnel to implement the project. The three technical layers were the data repositories, network infrastructure, and desktop computer environment. Since a significant portion of database repository had already been developed by the time the project was expanded, early work focused on developing the network infrastructure. Work thus proceeded in a bottom-up fashion, with servers and networking receiving attention before specific desktop applications. This approach served the project well, since we were able to deliver rapidly several new services to our users once the infrastructure began to take shape. One such service was electronic mail which, while not the ultimate goal of the project, proved extremely p: ılar and generated tremendous support for our efforts in the organization.

Although the ›riginal goals of our project dictated that we develop the database and server components first, we believe that client/server projects would benefit from this phasing in general. While all three components of a client/server implementation could be developed in parallel, this approach is difficult for several reasons. For example, if the server and network infrastructure is not in place during client-side application development, programmers will be forced to rely

1. The lecision to undertake strategic information technology initiatives is often difficult to justify quantitatively and this lack of quantitative evidence often inhibits organizations from undertaking strategic projects that may be critical to their success. For a discussion of how these decisions can be made sensibly in the absence of hard, quantitative support, and the importance of both strong leadership and cooperative risk-sharing in strategic technology deployments, see Clemons, Eric C., "Evaluation of Strategic Investments in Information Technology," *Communications of the ACM*, January 1991.

entirely on the infrastructure specifications and may therefore lack an adequate application testing ground. Also, in our project (and probably many client/server projects), staffing was limited and it simply was not feasible to have three distinct development efforts underway concurrently. Where efficiency or other constraints force an organization to address its development serially, the most stable and scalable technologies should be addressed first followed by the more volatile and vertical technologies. Our experience shows that server and network infrastructures are both relatively stable and have had, at least over the last six years, far longer lifetimes than desktop computer and user interface technologies. Thus, in our project and, we believe in other complex long range projects, success is best fostered when effort in early stages is concentrated on deploying stable technologies and is gradually shifted into the more volatile technologies as the infrastructure falls into place. Our expectations that server and network technology would remain stable while offering rapidly increasing levels of performance proved accurate, and today, nearly six years after the project began, our server and network technologies, as well as our original data model, continue to provide a solid foundation on which new client applications can be readily developed.

IV. Servers and the Integrated Data Repository

Relational database technology was chosen to implement the integrated database because of its powerful data modelling capabilities and its expressive data manipulation and definition language, SQL. We also desired a rich programming environment while minimizing the number of platforms our technical staff would be expected master. This platform also had to be capable of supplying a full range of network services over our chosen network protocol, TCP/IP. Finally, we had a strong preference for working in C, because of its support for structured programming methods as well as its flexibility and power. In many ways, these criteria amounted to language decisions which clearly limited the field of potential platforms and environments and had a great influence on the design methods we would later employ.

In our case, we chose Ingres (and later Sybase) for our DBMS, and Sun servers running Unix as our platform for database and other server services. Although our server technology has remained relatively stable and consistent over the course of our project, the potential offered by "open systems" to replace a component supplied by one vendor with another supplied by a different vendor was also very attractive to us. And, in fact, we did make one major change to our server technology during the project. After originally developing our database using Ingres we chose to migrate to Sybase once our full-scale client/server development began and we re-examined our DBMS requirements. While this decision allowed us to implement our client/server systems more easily and greatly enhanced the performance of our database, it did entail significant migration costs. Even though the programs we developed during the 18 months we used Ingres were written almost exclusively in C and SQL, migrating these programs to Sybase required a substantial effort, equivalent to about 30% of the resources expended during the original Ingres development phase. In addition, because staff had moved on to other projects and had to be reassigned to complete the Sybase migration it took over one year to complete this transition. Our experience contrasts with the often emphasized promise of ready portability between "open" systems (such as C, SQL, and Unix) and has tempered our willingness to consider changing vendors for our other server technologies.

Our selection of Sun Microsystems' hardware and operating system for our hardware platform made available servers of various capacities, ranging in size from small desktop units to large rack-mounted machines. This flexibility and the successful implementation of these systems in central Divisional offices, along with the University's disposition towards departmental autonomy, encouraged individual departments to install servers and local networks in their administrative offices. Central computing staff did not discourage these installations because departments who installed servers made a visible commitment to the project which carried much political significance. Consequently, the demand for Unix system administration and end-user support burgeoned as servers and networks proliferated throughout the Division. Many departments hired local technical staff to provide these services, but because the skills necessary for Unix system administration and end-user support are very different, and the demand for end-user support was often overwhelming, the quality of local system administration varied greatly from department to department and was sometimes very poor. In response to this situation, we have begun to consolidate both system administration and servers within the Division, allowing departmental technical staff to concentrate on end-user support while achieving economies of scale in the one area where they appear most realistic in a client/server environment, namely in the purchasing and administration of file and database servers. This need for specialization and its impact on our staff organization recurred in many areas of our project and we will explore it in detail below.

V. Network Infrastructure

We elected to adopt the TCP/IP protocol suite running on Ethernet as our enterprise-wide networking strategy. This strategy met our need for a network infrastructure that could support campus-wide connectivity[2] and was well supported by the relational databases of the time.

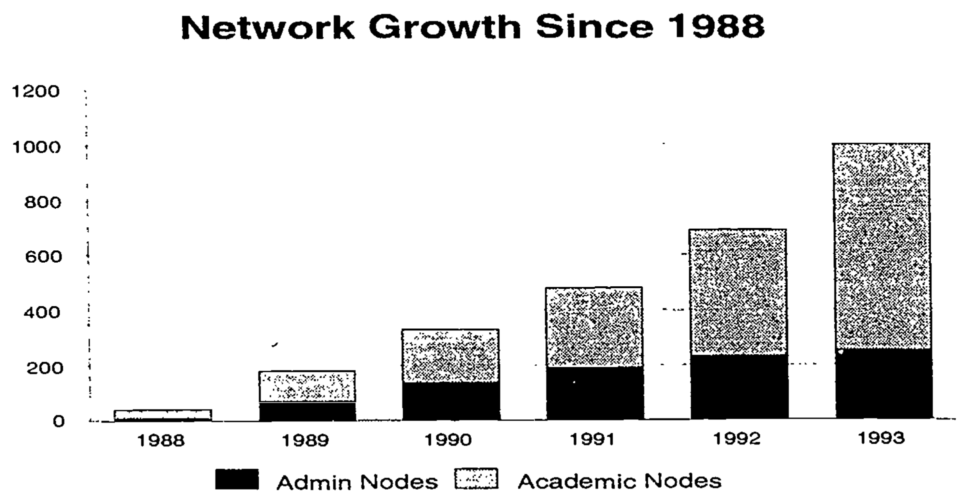
The network was implemented with two initial aims: to extend the backbone to cover more area, and to install the network in the early adopter departments that had also committed to our server strategy. Although the backbone was funded centrally, local area networks were funded by the users, either departmental offices or individual faculty. While this approach was adequate for the initial deployment, as the network began to grow very rapidly (spurred largely by the discovery of electronic mail) our ad hoc approach began to unravel. The technical staff responsible for extending the network was small and was also responsible for developing the database and server infrastructure. Their ability to meet the demand for new network installations was severely strained.

It is our belief that this funding mechanism for network expansion was the most significant factor in our failure to develop a strong central staff capable of properly planning and managing our network. Network planning and management is largely an overhead cost, and our funding mechanism did not provide a method for recovering these costs, which are quite significant, and users resisted our attempts to introduce service fees or other cost recovery methods. Without a ready, self-sustaining source of funding for the staffing and management tools needed to plan, design, and implement our network infrastructure, both the MIS organization and senior management were reluctant to channel resources into this effort. Even as our technical support organization matured, the lack of an adequate funding mechanism for network planning, coupled with the difficulty of explaining the benefits of such planning to senior management, inhibited us from ever fully establishing a network planning and support staff. In our experience, it is not fruitful to argue for such efforts using quantitative analysis, and other means of winning senior management's support must be found. Some useful techniques might include analogies to other services traditionally provided as overhead services or, perhaps even more effectively, using either scenario

2. A TCP/IP Ethernet backbone was already in place on campus to provide inter-building connectivity and this allowed us to take advantage of the existing campus-wide network technology rather than reimplementing an entirely new network infrastructure in parallel.

analyses and decision trees to illustrate the best strategy in the absence of hard quantitative evidence.[3]

The absence of a plan for installing and managing the network resulted in high fixed incremental costs for new network installations, while the shortage of staff left the network undocumented and unmapped. Despite these circumstances, the network has grown to reach 95% of all administrators in the Division and now serves nearly 1,000 faculty and staff (see Figure 2).



VI. Desktop Computers and Custom Applications

Delivering direct access to the database through intuitive and flexible tools to manipulate and analyze that data is the great promise of client/server applications. While the server provides a powerful, enabling service to client, the client is responsible for mediating all end-user interaction with the system and it is through the client that the ultimate functional benefit of client/server computing is achieved. Client applications for our database had characteristics of both decision support and transaction processing applications. Administrators needed to perform both ad hoc and routine, repetitive queries. At times users needed to incorporate the results of these queries into other tools, most frequently worksheet models. Finally, users also needed to be able to easily enter information into the database.

The critical role played by the client requires a more capable machine than a simple character-based PC and this fact was reinforced during our initial attempts to deliver client/server solutions for our existing stock of aging, DOS computers. Character-based DOS computers could deliver neither easy-to-use access to a wide variety of network resources simultaneously nor the development tools we needed to implement complex client/server applications. Instead, client-side services require intuitive graphical user interfaces to provide the user with simple, expres-

3. *Op.cit.*, Clemons, Eric C. In our University, network infrastructure services in the last year have been assumed by the University's telecommunications office. Nonetheless, planning and implementation of the network infrastructure remains ad hoc and service is inconsistent and often inadequate. In our view, this continued ad hoc and unplanned approach to network infrastructure can still be traced to a reluctance of middle managers to use non-quantitative analysis to support a request for proper funding to senior management and, for senior management, an over-emphasis on quantitative justification for strategic investment which is then communicated to their middle managers.

sive, and powerful mechanisms for understanding and manipulating information. Large monitors are needed to allow the user to view information from multiple sources or through different applications simultaneously and to move readily from one application to another. Large virtual memory spaces are required to support both the graphical display and the simultaneous use of many different applications. Network support must be pervasive in the desktop computer; in the client/server environment, the desktop computer is less the private tool of the end-user and more the user's network access tool which transparently intertwines network resources with the applications running on the user's desktop. Finally, tools are needed for developing custom client applications that allow a small programming team to very rapidly develop and enhance applications that deliver the database to the user in a graphical interface.

Our vision of the ideal client workstation stood in stark contrast to our installed base of DOS-based PCs and led us to re-evaluate our desktop computer strategy. In particular, we developed a coordinated capital replacement plan to invest in new desktop technology specifically capable of supporting a client/server environment. This approach to desktop computers was entirely new to our institution, where desktop computer purchasing had always been the province of the individual, rather than a part of an institutional capital strategy. With the aid of a committee with members drawn from departments throughout the Division and central University administration, we were able to develop a consensus for a desktop computer capital replacement plan centered around a minimum set of hardware requirements and a desktop Unix operating system featuring powerful object oriented development tools.

We have seen two major benefits from treating desktop computers as a capital, institutional investment. First, our ability to plan and design applications and services has been enhanced by a stable, well understood desktop computer strategy. No longer are we forced to stretch resources and expertise thinly, and inadequately, over several platforms all running different software packages. Instead, we can focus our support and development efforts on a single platform with a well defined growth path while, at the same time, avoiding the trap of the "least common denominator." Secondly, by treating desktop computers as an institutional investment rather than an operating and unit expense, we are able to raise the standards of capability in our desktop computers. While more expensive units are sometimes purchased for individuals under a capital plan than would be purchased on an incremental, ad hoc, operating budget, our desktop computer stock has become far more flexible than it otherwise would have become. All desktop computers in our organization are essentially interchangeable allowing them to be redistributed easily to meet our needs. Moreover, we believe that the marginal savings of purchasing less expensive and less flexible computers for less intensive tasks are more than offset by decreased flexibility in deploying these workstations and by increased support costs. With a single desktop platform savings in technical staff time accrue both because a smaller set of computer configurations must be mastered and because technical staff are freed from the need to develop cumbersome, and unstable methods of providing services on less capable hardware.

Armed with a powerful set of development tools and workstations fully capable of supporting graphical user interfaces and network access, development of client applications progressed very rapidly. Two new tools, an object oriented interface builder and object toolkits bundled with our development environment, provided a dramatic jump-start to our effort. These tools fostered an entirely new approach to the application development process. In place of the traditional waterfall model of application development, with its discreet steps of analysis, design, implementation, testing, release, and maintenance, a new iterative approach was followed[4]. In this approach prototypes were created rapidly using the new development tools and users were able to respond to the look, feel, and functionality of an application in the first weeks of a project. Rather than attempting to deliver all conceivable functionality in one pass through the development cycle, a simple version of an application was quickly developed and deployed, usually within three months after the original prototypes. The modular, object oriented composition of application allowed the developers to readily and rapidly extend the functionality of the application in response to user preferences or changing business conditions. This approach of concentrating on core functionality and prototype evolution, along with the added emphasis on abstraction in object oriented design and programming, also greatly reduced the complexity of the problems the developers faced, enhancing their ability to deliver quality products and reducing the risk that the sheer scale and complexity of a problem would jeopardize a project's success. Where two years ago we introduced a new application or a major upgrade to an existing application perhaps twice a year, we now introduce a new application or major upgrade every four-to-six weeks. We estimate that programmer productivity has increased between 3-to-5 times based on comparisons between prior development efforts and analogous efforts in the new object oriented environment.

VII. Staffing Issues

We began our project in 1988 with a small, highly motivated, and skilled team of developers for whom experimentation was both an important tool for discovery and an organizing principle. Addressing a new problem domain with novel technology required a flexible, exploratory approach, and the early of results of our work were encouraging. In a short time we created a functioning integrated data model and database; a new suite of previously unavailable management reports; and a nascent set of network services such as electronic mail and file servers. These early successes reinforced our tacit belief that a small, highly motivated staff could achieve great results. But this structure began to show signs of strain as the scope of the project and the community it served grew. In each phase of our project, making the transition from a small, leading edge development effort to a high-volume production service provider forced us to re-examine our organizational structure.

As our services became more widely used and an infrastructure of networks and servers was building throughout the Division, the need for more formal procedures and methods for planning, analysis, design, and implementation came to the fore. In addition, it became clear that not only did we need a larger staff, but we also needed to depart from our traditional, jack-of-all-trades approach and develop staff specialists. Indeed, this shift toward specialization was our first real step toward a more coherent and mature staff structure. One model for assessing the maturity, or capabilities, of an organization is the Software Engineering Institute's (SEI) Capability Maturity Model (CMM).[5] This model describes the attributes of organizations and their processes at five distinct levels of maturity or capability, beginning with the initial (or chaotic) level (the most

4. The primary method of project management and software engineering that we adopted was the Booch method. A clear benefit to object oriented design and programming, in Booch's view, is the ability of designers and programmers to work with higher level, encapsulated abstactions that are naturalrepresentations of objects in the problem space and which reduce a program's complexity. See Booch, Grady. *Object Oriented Design with Applications*. Benjamin/Cummings, Redwood City, California, 1991.

5. Paulk, M., Curtis, B., and Chrissis, M. "Capability Maturity Model, Version 1.1." *IEEE Software*, July 1993, pp 18-27.

common), through repeatable, defined, managed, and optimizing levels. In the SEI model,

> Success in [initial level] organizations depends on the competence and heroics of the people in an organization and cannot be repeated unless the same competent individuals are assigned to the same project. Thus, at [the initial level], capability is a characteristic of individuals, not organizations.[6]

Our early staff organization and processes clearly exhibited these characteristics. Moreover, as our project was growing on several fronts simultaneously, we could not simply reassign trusted staff members to new projects, we needed more hands. In response, we increased our staff size and, more importantly, began to segment our staff into specialties. This specialization allowed us to develop deeper expertise in specific technical domains; to improve our institutional memory by assigning whole areas of expertise to individuals rather than spreading the load among several staff; and to more rapidly deliver service by reducing the task switching overhead created by constantly changing the technical domain in which a staff member worked.

Despite this improvement, our organization remained at the initial level of the SEI model for some time. Progress to the next level is characterized by establishing repeatable and predictable processes and, even after instituting specialization, it still remained difficult for us to accurately predict the time or resources required to complete a new project in the absence of formal processes. Instead, individual projects continued to be managed in an ad hoc fashion and, although we were able to provide more services more quickly through specialization, we were no more capable of making informed resource allocations than in the past. After the initial glow of the improved throughput that we gained from specialization began to wear off, the continued difficulties of reliably and consistently repeating successes (or avoiding failures) resurfaced. At this time, we began a short-lived and unproductive search for an "out-of-the-box" methodological panacea. But this effort failed primarily because we had not prepared our organization for these new methods. That is, the fundamental characteristics of our organization remained ad hoc and new methods were quickly abandoned when subject to stress or shifting priorities.

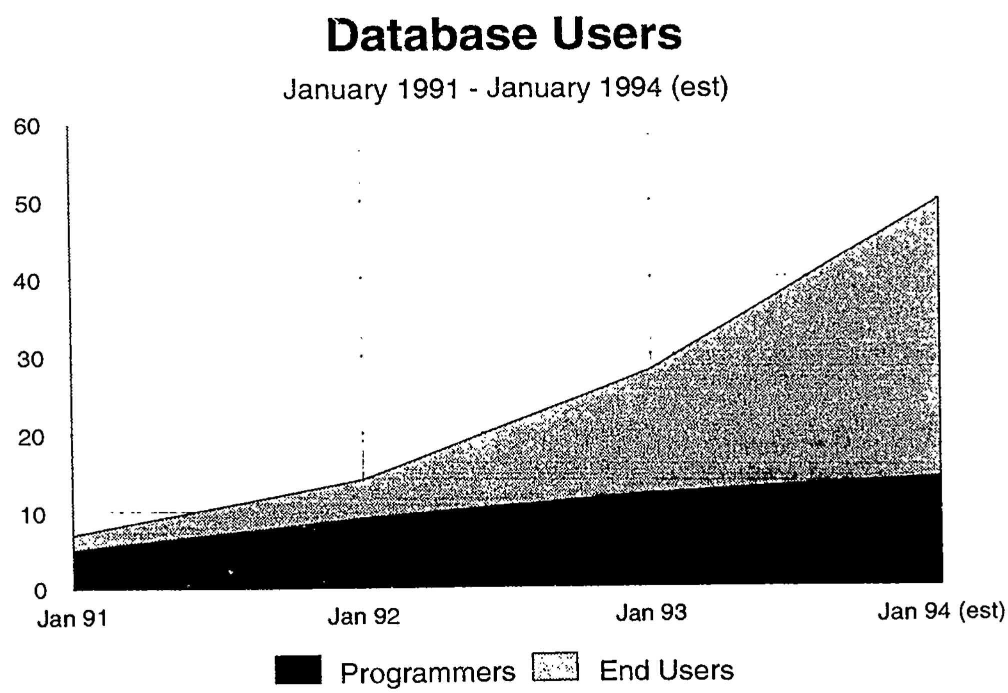
Our second major step toward a more mature and capable organization came after our unsuccessful attempts to find and implement a "magic" methodology. At this time we began to realize that the process of elevating and bringing consistency to the performance of an organization was one of continuous improvement, where fundamentals must be learned and routinized before more advanced and specific methods can take root. Along these lines, we began to develop basic procedural guidelines for application development and system administration processes. The aim of these guidelines was not so much to rigorously define specific procedures, but rather to establish a basic set of operating principles, a framework which could at once guide our current processes and evolve into a set of more formal procedures. In short, this approach reflects the view that radical change is more difficult to achieve in an organization than gradual and steady improvement that first addresses the most basic factors in an organization's capabilities. We believe that our efforts along these lines have raised us to the repeatable level of the SEI model and we are now engaged in fleshing out our framework to achieve the third of the five CMM levels by defining and documenting our development processes. Most importantly, we believe that our organizational capabilities have improved over time, and through the SEI CMM approach we will be able to continually enhance and improve these capabilities.

6. *Ibid.*

VIII. Results

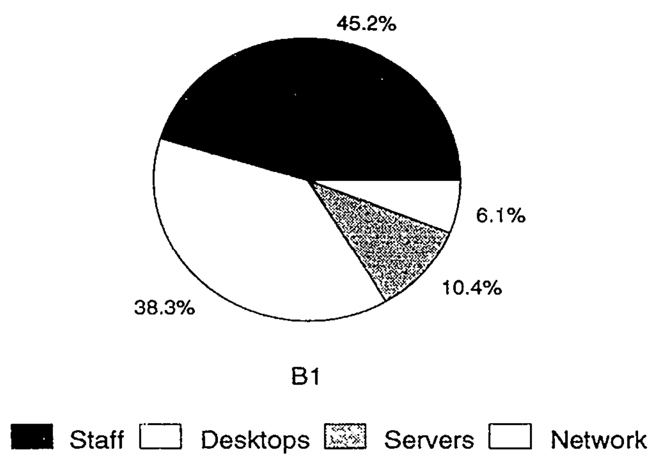
Each of the three major technical components of our architecture are now in place. The core of our integrated database was completed in the second year of the project and has since been enhanced by the addition of new data domains and security mechanisms. Currently, the database incorporates information on academic and non-academic personnel, financial accounting, pre- and post-award grants, facilities management, professional (clinical) fees, course and instructional effort, regulatory compliance, and equipment inventories into a single data model. It is used as the basis for most application development in the Division. The success of the database component of our project has been confirmed by the recent decision of the University to work together with the Division to scale the database to a University-wide scope, providing the University with its first integrated, universally available decision support database.

The infrastructure of networks and file servers grew steadily throughout the project and achieved 95% coverage of administrative users in the winter of 1992. Approximately 250 administrative and 750 academic users in the medical center and nine other campus buildings are now served by the network.



Delivering Division-wide access to our database was one of the major motivations behind the initial expansion of our project, and today over 50 administrators access the database through client/server applications, with 25-30 users typically connected at any one time. Custom applications have been developed to support personnel management (academic and non-academic), facilities management, post-award grant and account fiscal management, regulatory compliance, and unrestricted budget modelling. The role of desktop computers in the success of our project extends beyond custom application development. Service calls among the community of users with the new client workstations has fallen to one half their prior levels, belying the stark contrast between the underlying complexity and power of the new workstations and the character based PCs they replaced. Other tools, such as ad hoc query tools and links between spreadsheet and the database provide users with alternative methods of accessing and manipulating data.

Distribution of Client/Server Costs



The critical role of the desktop computer in client/server technology is reflected in the graph above. Desktop computers accounted for over one third of the ultimate cost of our client/server implementation, exceeded only by technical staff costs, and constituted over two thirds of the capital budget. While desktop computers account for a large the proportion of the total cost, it is important to realize that these costs would generally be incurred anyway. But rather than treating these costs simply as incremental, ad hoc operating expenses, we view them as a major component of an institutional capital plan. We believe that the scale of the expenses associated with desktop computers points up a need for a fundamental change in how they viewed, away from the uncoordinated approach of the past and toward a managed capital investment.

Over the past five years we have attained most of the goals of our client/server development project. By first building a solid infrastructure and then concentrating on client-side development using object oriented methodologies, we are now capable of reliably delivering data and applications to our customers even as desktop computer technology rapidly evolves. Our user base has grown from a handful of senior managers to users at all levels of administration across the Division. Our staff and organization continues to enhance and improve its capabilities and services by exploiting the underlying technical architecture in new ways while continuously striving to improve the reliability and quality of our procedures and methods. Most importantly, however, by incorporating desktop computers into the institutional and capital planning of our Division, we have been able to provide new services more quickly and reliably to our user community by developing a comprehensive technical architecture extending from our server technologies to our users' desktops.

Right Sizing a Mainframe Administrative System Using Client/Server

Presented at CAUSE93 by

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RIGHT SIZING A MAINFRAME ADMINISTRATIVE SYSTEM USING CLIENT/SERVER

During the last five years there have been extensive changes in the administrative computing environment at Colorado State University (CSU). Beginning with a planning process that developed an open blueprint for the future, the University has moved carefully forward towards an open, collaborative administrative environment predicated on a gradual transition to client/server systems, in house development using CASE, and broad campus involvement in the development of next generation administrative systems.

THE MAINFRAME CONVERSION

In 1991 CSU completed the conversion of its administrative software to IBM hardware and the CA-IDMS database. The current mainframe configuration is an IBM 3090 model 200E with 60 gigabytes of EMC DASD attached. All of the major administrative systems are purchased and, with one exception, are still on vendor maintenance. An IBM RS/6000 model 370 is also being used to support an administrative data warehouse. It is running Oracle version 6 and a migration to version 7 has begun. These systems support the University's administrative needs with good interactive response time and an adequate batch window.

This phased conversion process has not been without its bad days and some trauma, but the campus is generally very pleased with the results. Without this stable environment as a starting point, the transition to the next generation of administrative computing would not be possible.

THE ADMINISTRATIVE COMPUTING PLAN

CSU's Office of Information Systems (IS) initiated a campus-wide administrative computing planning effort in 1990. The resulting planning document encouraged the use of partnerships for implementation and recommended special funding to support such efforts.

"The Plan" was a key document for this project. It provided the high level management support for important changes in the way applications software is conceived, designed, and implemented. Its broadly based focus and extensive emphasis on the larger campus needs were catalysts for a shift in emphasis that continues to benefit the University in more ways than this project highlights.

THE INFORMATION WAREHOUSE EVOLVES

Significantly, the planning document was sub-titled, "Creating a Balanced Environment." It contained a clear call for better vertical balance between both mainframe and desktop platforms and central and college level applications. A key concern for the planners in preparing for this adjustment was the need to create standards for data exchange. This was particularly true given the University's heterogeneous administrative environment of DOS, Macintosh, and UNIX computers.

The initial effort to standardize distributed data focused on developing mainframe data extracts for use on microcomputers. At the time, human resource system extracts were available, but their content had been defined centrally and was in need of review. No standard extracts existed for financial or student data. An open process was launched that brought central data managers and college administrators together to define the content of a complete set of data extracts. This required considerable "education" because most of the new departmental computer people were unfamiliar with the amount and complexity of the data in the mainframe systems. (The classic case of users not knowing what it is but knowing they want it.) The teams were assisted by technical people to assure that the data was suitably organized for use in a relational database.

In parallel with a growing interest in access to central data, departmental microcomputer users were maturing in their use of desktop software. Spreadsheets were being replaced by full featured database products as platforms for local applications, and "software standards" began to emerge. Standards that were not centrally imposed but grew from popular support for a product throughout the campus community. For example, when a critical mass of interest developed for Paradox and Oracle, IS responded to this development by providing support and encouragement. But, this approach created problems because Information Systems did not always have appropriately trained people. Turning to the source of the interest in these products, IS begged, borrowed and sometimes shanghaied talent from the user community.

Having developed complete data extracts that met the needs of college administrators, IS needed a distribution platform. The first hardware platform for the data warehouse was a 486 Banyan Vines server running Oracle. Departments accessed the data warehouse from their microcomputers using Paradox and the middle-ware products SQL*Link and SQL*Net. As usage grew, the Banyan Oracle server was ported to a more powerful and responsive UNIX minicomputer but not without some discussion of costs. A general rule for expense distribution has existed for many years that stated the departments paid for the desktop system and its connectivity while IS purchased and upgraded the central facilities as needed.

In the early nineties, CSU found itself in a unique situation: a stable mainframe environment, a plan that mandated change, and the appropriate resources available to make change happen.

DEVELOPING A COLLABORATIVE PARTNERSHIP

Coincident with the emergence of the data warehouse, the College of Business Computer Center (CBCC) was asked to develop a management information system for the College. Specifically, the Dean wanted to have pertinent and current management information at his fingertips. Existing University reporting systems could not support this for the following reasons:

Transaction processing was not timely: Most data was provided through manual processing of administrative documents. This processing involved extensive authorization loops and hand carried mail which typically delayed processing one or two weeks.

Administrative units could not easily track transactions: Administrative units were removed from transaction processing resulting in a further one or two week period when the exact status of a transaction could only be determined by contacting the University's accounting personnel.

The University's mainframe applications did not support easy to use query or reporting tools: Ad hoc query tools did not exist, and, even though information was accessible, the access methods were not suited to the casual user.

It was clear that gathering a timely and comprehensive data set would be the key element to meeting the Dean's request. Post processing data capture from the mainframe systems was discarded as a standalone solution because the authorization loops caused significant delays in mainframe data entry.

Preprocessing data capture of all College transactions was the most feasible solution but had two weaknesses. First, externally generated transactions would not be captured leaving a data set that was incomplete. Secondly, CBCC staff had already experimented with several database products. PC based databases were too weak for the job while minicomputer databases were beyond the limited financial means of the College. Only the relatively new client/server software offered a cost effective solution that still provided enough performance, security, portability, and connectivity to make such an approach viable.

To address the second weakness, the CBCC opted for an Oracle client/server platform built around the College's existing Banyan Vines network. Key factors in this choice were Oracle's portability, availability for Banyan Vines networks, and the Oracle expertise already present in two other administrative areas on campus. With hindsight, this was an excellent choice as the product has met all expectations.

Addressing the first concern of preprocessing data capture was a more complex issue, but, with the Dean's support, the CBCC proposed a campus wide effort to develop electronic transaction initiation, approval, and processing. This project was presented as the College Information System (CIS). A set of five integrated client/server database modules (Human Resources, Financial Services, Undergraduate Information, Graduate Information, and Research Services) that addressed the general needs of administrative end users.

The CBCC had three objectives in proposing the CIS:

1. Make all campus transactions accessible to all users.
2. Promote changes in administrative procedures that led to more efficient processes.
3. Create a broadly based coalition with sufficient political muscle to manufacture change.

This strategy was initiated by contacting the College Administrative Advisory Group (CAAG). The CAAG is a group of Assistant Deans, Directors, and Managers from the colleges, libraries, continuing education, and several auxiliary agencies. This group agreed to endorse the CIS if the University's Information Systems was an active participant in the design and implementation of the project. After joint discussions, the CAAG, CBCC, and IS signed a partnership agreement with the following distribution of responsibilities.

Through its broad support and direct channel to the Deans, the CAAG empowered the partnership to approach and enlist key university administrators from Internal Auditing, the Controller's Office, Registrar's Office, Human Resource Services, and many other areas. Additionally, the CAAG provided end user expertise, prototype reviewers, and assumed the financial responsibility for connecting their users to the CIS.

Information Systems enabled the partnership by providing financial and technical assistance to the CBCC staff, reworking rough CIS prototypes into production modules, providing the production platform and server software, and guaranteeing to maintain and enhance the CIS production modules. Their successful efforts to tactfully defuse the inevitable political fallout were also critical to the project's overall success.

CBCC implemented the partnership by providing client/server expertise IS had not yet developed, a development platform, and strong, aggressive team leadership for module analysis, design, and prototyping.

METHODOLOGY

A rapid prototyping methodology was selected for the following reasons:

Rapid prototyping is an action oriented process that discourages posturing and gamesmanship. Prototyping brought tangible products into the hands of reviewers quickly. The speed of delivery made review groups intolerant of group members who dissembled or otherwise blocked action items.

Prototyping let the end user shape the design process. Since the design process was not artificially structured by the development team the end users had a greater sense of control, involvement, and impact.

End users were not familiar with the potential of the client/server environment and had difficulty visualizing what was feasible. Prototyping's iterative review process allowed end users to experience client/server possibilities and encouraged a broader, more visionary response from end users.

Prototyping built a working model that shaped reasonable end user expectations. End users reviewed a working prototype containing the features they had specified. If a feature could not be implemented, the reasons were identified and explained to the end users during the review process.

ANALYSIS/DESIGN OF BUSINESS PROCESSES

Analysis and design committees were formed. They consisted of three groups: **policy setters** who managed many end users, were responsible for a family of business processes, or influenced the University policies and procedures surrounding a family of business processes; **end users** with generally recognized expertise within a specific business process; and **technical experts** who translated and reconciled committee work into prototype specifics. Policy setters were typically University business officers, for example the Controller, Associate Dean of the Graduate School, or an Assistant to the Dean for Administration (College). End users came from all parts of the University organization, for example accounting technicians, undergraduate advisors, or staff assistants. Technical experts were managers of administrative subsystems, development team members, or analysts from Information Systems,

Analysis and design success was predicated on an environment that encouraged the free flow of ideas, mutual respect for each group's needs, and dialogue instead of confrontation or impasse. Needless to say, the committees struggled to maintain this ideal, but leaders from each group stepped forward at crucial times to facilitate, encourage, and defuse. This ongoing and relentlessly tiring task proved to be the most difficult of the entire project.

As the committees defined business functions, the technical experts translated these definitions into database design, functionality, and finally working prototype. Committee results were relayed to the programmers immediately after the committee meetings. Any concerns or questions about technical feasibility were identified and brought to the committee's attention at the next meeting.

The programming staff consisted of one or two graduate students who were usually quite familiar with the Oracle development tools. They were equipped with powerful PC workstations and the standard Oracle development tools. They worked an average of

20 hours a week with an increase to 25 hours a week during the end user review process.

The development team set two design constraints for the committees.

First, the prototype would contain 80% of any business process and would not address the remaining 20%. This constraint was based upon the belief that the easiest 80% of any business process contained all the essential elements while the remaining 20% contained all the customization (and 80% of the development workload).

The CAAG and Information Systems did soften the long term impacts of this constraint by adding two stipulations: 1) Any administrative unit could do its own customization but had to bear the full cost of that effort; 2) A standing review committee would judge future customization proposals and those that provided broad benefits without undue costs would be adopted and maintained by IS as part of the production module.

The second constraint stated that manual processes would be mirrored whenever practical. This constraint had four powerful advantages: it reinforced the value of existing processes and their supporters; it reassured employees who were dependent upon the existence of these processes and would be important contributors to the prototypes; it encouraged the committees to focus on how they might improve existing processes without reinventing them; and it helped overcome end user inertia by producing prototypes that contained many recognizable elements.

Even with the second constraint, the open environment of the analysis and design committees encouraged an atmosphere that has lead to truly remarkable changes in administrative perceptions. These frank and open discussions of administrative procedures have led to a re engineering of administrative processes that goes far beyond the scope of the initial project. In fact, all of the campus' administrative procedures are being looked at from a new perspective. A perspective that focuses on using collaboration, cooperation, and partnership to effectively achieve improvements in quality and productivity. Improvements that are being defined by the whole campus community.

IMPLEMENTING THE PROTOTYPE

When the end user analysis/design committees were finished and a prototype was working, each administrative unit was asked to provide a review group consisting of 4 to 6 end users. Most of these end users had not actively participated in the analysis/design process but were going to be primary users of the production module.

Module prototypes went through six to twelve review sessions depending upon the number of available reviewers and the complexity of the module. Reviewers came to a special facility where they had their own PC for testing the prototype. To help the reviewers focus on the prototype features and to reduce frustration with the new environment, there was one technical support person for every two reviewers.

As each feature of the prototype was explained, the reviewers used the feature and provided their perception of its effectiveness. Every effort was made to address ideas, suggestions, and problems on the spot. Most of the comments were refinements to screen or report design, but there were instances where reviewers made suggestions that offered significant improvements to the functionality of the prototype. These suggestions were shared with other reviewers. If they reacted favorably to the idea, it was presented, informally, to the members of the end user analysis/design committee. Several productive enhancements were identified and implemented in this manner.

All review groups were given several weeks to comment fully about the prototype. During this period, all modifications were implemented and the prototype was documented. In the final step, the prototype was handed over to Information Systems to be reworked and reshaped into a production module.

TRANSITION TO THE UNIVERSITY LEVEL

The prototypes created by the College of Business were transferred to IS for implementation across all colleges. Initially we expected that the modules would be implemented as created in the College of Business. However, when the time came to do it, we found the initial module prototype contained unacceptable technical differences regarding data and keyboard standards. These differences were resolved in future prototypes. Nevertheless, there were real difficulties in implementing the prototypes from an expected source but a surprising direction.

The first module (graduate information) was shared with the graduate school and there were some significant differences between the perceptions of college administrators and the graduate school. Superficially, these differences focused on some of the traditional reporting, but at a deeper level there were real differences in defining the roles of the respective players. This was the first time a central group had not dominated the definition and design process for central administrative software. Overcoming these differences required actively selling the attractive functionality of the client/server modules.

As the second module (undergraduate information) was being completed and receiving rave reviews by college administrators, central student records administrators took notice. It was obvious that the module contained degree audit functionality that was planned for the mainframe. After a detailed review of the module, it was agreed that the college created software would be enhanced to produce an official university document. This also meant that central policies would be reflected in the module and that the records office would maintain most of the data tables. The addition of central influence meant that the project had changed from the original plan.

REDEFINING ROLES

The desire of central administrators to use parts of the CIS system was largely unanticipated and led to the creation of a supplement to the informal agreement created at the beginning of the project. The supplement dealt with the process of moving the modules from prototype to production and specified the role of the college administrators. It also clarified respective roles regarding future enhancements, maintenance, and any new modules that may be created by the colleges. A college review team was established to represent the interests of the colleges in the implementation process. Check points were defined to assure the integrity of the functionality in the prototypes and a thorough college level testing process was included. A key part of this document was the role of the college review team in reviewing and prioritizing requests for change.

However, this supplement to the contract was limited by an agreement with central administrators on three issues:

1. The availability of data must be approved by its central owner.
2. Any process that creates data for input to a central application must be approved by the responsible central administrator.
3. Both the content and presentation format of data for students must be centrally approved.

These limits are not surprising. What was surprising is that these are the only limits. In addition, the agreement specifically states that central administrators will not judge the desirability or usefulness of college developed software.

A simple process was created for implementing the supplement. Namely, Information Systems will assure that the appropriate people are brought together to review any proposals from the colleges. So, after several years of organizational jostling, a compromise acceptable to all parties is in place. The colleges have established their right to define and create centrally supported administrative software. Central administrators have established that they control certain aspects of university administrative data and its use. Progress.

IMPACTS ON INFORMATION SYSTEMS

These interlopers in the colleges had their impact on the central development staff, too. UNIX - which one? Relational database -what's wrong with IDMS? Client/server - sure. Come back after we get payroll fixed. Seriously, this project was the opportunity to make some significant changes within the central Information Systems office. The Information System's staff was very much aware of the changes occurring in computing, and the only real question was what would the specific impacts be.

Whenever IS encounters significant change, it is always the policy that existing people will be trained to take on the new tasks. The only question is how to do it. For this project, the start was to transfer a software developer from an administrative department to Information Systems. This person had extensive experience with microcomputer applications development. Consequently, he installed the first module and became the seed person for training the mainframe staff.

Unfortunately, until very recently all of the central support skills for the project were focused on only one, sometimes two, people. The new employee was the systems programmer, DBA, network manager, and the applications specialist. His vacations were scary events. IS' efforts to train other analysts to support the project did not yield any clones because it was simply too much for one person to learn all at once. The new analyst's experience represented ten years of incremental learning, and the mainframe analysts were simply overwhelmed. Early attempts to create micro-generalist clones were also handicapped by a lack of formal training. Consequently, a different approach was necessary.

Will any one be surprised that the new functions are now being dispersed to their mainframe equivalents? And formal training classes are being provided where the expense is not great. The IDMS DBA is going to Oracle school. A mainframe systems programmer is going to UNIX school. These two will use a recently replaced IBM RS/6000 as a training platform. Security administration on the CIS platform will be handled by the same people who manage mainframe security. Applications support will be provided by the same analysts who support the mainframe. Unfortunately, providing a complete Oracle training program for all of the analysts is not financially possible, so their training will be on-the-job implementing specific projects using training materials supplied by the vendor: tutorials, manuals, and texts.

One problem remains. Within Information Systems, the skills required for designing and creating new applications have fallen into disuse because of the policy of purchasing mainframe software. In addition, the contemporary methodologies are quite different from those used ten years ago. CIS implementation has become an opportunity to explore these new technologies. Accordingly, an experiment with Oracle CASE is underway. The prototypes created by the College of Business are viewed as the strategy and analysis phases of information engineering. The detail design and construction phases will be done using Oracle CASE. Support and future enhancements will use the CASE dictionary and Oracle tools rather than relying on traditional documentation and third generation languages. The early results of this CASE experiment have been very promising.

COMPUTER DEMOCRACY

Technologies often go through phases that start with only a few highly skilled people users and end with the product becoming ubiquitous. The telephone is a commonly cited example, and a parallel could be drawn between the early telephone operators and the mainframe programmer. The CIS project at CSU may be the technological turning point where administrative computing is moving from an autocracy towards computer democracy. Obviously, the project has distributed many of the key aspects of administrative computing to a far larger group of people. However, the most important accomplishment may be the general acceptance of distributed responsibilities that has followed the distribution of tasks. The acceptance of these new responsibilities will be the foundation for further democratization of administrative computing at CSU.

Security in a Client-Server Environment

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"Securing a client/server environment is like throwing mud at the invisible man -- it may be messy, but pretty soon you get an outline of what you're up against."

(James Daly, *ComputerWorld Client/Server Journal*, August 11, 1993)

Security: the basic message

There are three basic messages that we want to communicate in this paper. First, that the purpose of security is to enable access, not to impede access. Our approach to the design of security solutions is focused on delivering access to computing and information resources at levels of risk that are known and accepted. The more access we want to deliver, the more attention we pay to security. Client-server computing opens new paths of access, and these require new security solutions.

Second, that there is no single solution to information security. The metaphor of a locked door -- that if we can just put the right lock on the door we'll be protected against intruders -- no longer applies. A complex computing environment, especially one that includes a client-server computing component, presents multiple points of entry: the workstation, the network, and local and central servers. The challenge is to recognize these points of entry, to understand and assess the risk that each presents, and to choose protections that are prudent and cost-effective.

Third, that even if specific security solutions are tactical responses to risk assessment (and they most frequently are), the process of designing and implementing security solutions is based on principles, objectives, and an overall strategy.

Information Systems at Indiana University: a two-minute tour

Security solutions are always in response to specific problems of access and risk. A brief overview of Indiana University's computing environment for enterprisewide information systems will help form the basis for understanding the design of our security responses.

The network is the integrating force in our computing environment; it ties together an array of computing and information resources, and is the bridge between central computing facilities and individual workstations or departmental networks. IU operates a multi-protocol network, carrying the TCP/IP, IPX, DECnet, and Appletalk protocols. User workstations at Indiana University are a mix of Intel-based DOS and Windows personal computers, Macintosh computers, and a small but growing number of Unix workstations.

The primary host computer for enterprise information systems has been a large MVS mainframe. To this we have recently added Hewlett-Packard application hosts running Unix (HP/UX) for client-server systems. We also run a large VMS cluster, primarily for instructional and research computing and as a host for IU Bloomington's campus-wide information system (though our CWIS is rapidly migrating to client-server technology with Gopher and World-Wide-Web).

The database management systems we use for enterprise information systems are DB2 on the MVS host, and Sybase on Unix application hosts. We also run Ingres, again primarily for instructional and research computing.

Our application development and CASE tools are Uniface and Bachman. Uniface is an application development tool for creating client-server and host based applications. Bachman is used for data modeling, process modeling, and database design.

The computing environment that is the target for our first major administrative information system using client-server technology consists of: a Hewlett-Packard (HP/UX) host, the Sybase database management system, applications written in the Uniface development environment, TCP/IP connectivity, and client software running on Windows or Macintosh workstations.

The application that is the target for our first major client-server system, and thus the first iteration of a client-server security design, is a university-wide financial information system. We have explored issues of client-server security with two smaller systems that we have used to pilot new technology, but the security risks of a distributed financial information system -- entry of financial update transactions at their source, routing and approval of transactions by multiple users, and eventual posting of transactions to the general ledger -- required a more comprehensive security response.

Security: principles, objectives, and strategy

Security principles apply to all stakeholders in an information systems implementation effort: application developers, users, security managers, and university administrators. There is virtually no such thing as the elimination of risk in a computing environment. If there is a resource, and there is access to that resource, then there is risk to the resource. The principles of security that we apply are risk analysis and risk reduction, with the intent to manage risk at an acceptable level. What everyone involved in an information system implementation must understand is that the final design will entail risk. The responsibility of these stakeholders is to understand the risks, understand the steps taken to reduce risk, and accept the results.

Security objectives provide users, developers and security managers with a way to focus their analysis and attention on broad, general areas of risk. The primary objectives of a security analysis and response are:

- User identification. Knowing who the user is; assuring that each user can be uniquely identified.
- User authentication. Knowing that the user is who s/he says s/he is.
- User authorization. Knowing what is permitted or prohibited to each user, and enforcing these permissions and prohibitions.
- User accountability. Knowing and keeping record, for each access or other significant event in a system, the identity of the user responsible for that event.

A *security strategy* provides the framework for the development of an overall security design. It is the strategy that brings continuity and helps assure forward progress to the security efforts of an organization. The information systems security strategy that we use at IU has four key components.

Security design is *iterative*. We engage in a cycle of identifying security exposures, assessing the relative risk of each exposure, designing an intervention to reduce the highest risk exposures, evaluating the effect of the intervention, and identifying the remaining exposures.

Security design is *collaborative*. There are multiple stakeholders, both within the computing organization and among the user population, who have an interest in the design of security solutions. Because understanding and acceptance of risk is the basis for a security solution, these stakeholders must participate in design process. There are also multiple areas of expertise needed to identify exposures, assess risk, and design interventions. In increasingly complex computing environments, the need for collaboration across several areas of technology specialization becomes greater: network designers, network operations staff, workstation software specialists, database administrators, in addition to application developers, user support staff, and security management.

Security design is *responsive*. Fundamental technology components are changing on an annual basis, if not more frequently. Changes in technology may open new exposures that did not previously exist. Or new technology may create opportunities to respond to exposures that had been previously left unaddressed. Security management and its collaborators from other technology areas need to monitor change in the industry, to assess the effect on risk and on the available measures of protection.

Security design is *accumulative and evolutionary*. Each security action is a response to a specific exposure or set of exposures; it is an intervention designed to reduce some known risk. As such, security actions are components of an overall security solution, but no total solution is ever implemented. One of the greatest challenges in security design is to choose components that work together, and that minimize the constraints placed on future choices of security actions. Equally challenging is to choose security components that fit with, or anticipate, the direction of the industry on providing information systems security solutions.

Securing the mainframe in an open environment

These principles and strategies were initially developed and refined in the design of security solutions for our mainframe computing environment, especially as we expanded access to this traditionally closed environment to a wider audience of university users. A brief overview of the migration of our mainframe connectivity from a relatively closed SNA network to a more open TCP/IP network will set the stage for the more radical transformation we are responding to in the area of client-server security.

At most institutions, security of the mainframe environment is relatively mature, and there is abundant experience in implementation and administration of the various host access control products available for these computers. The Indiana University situation in this area is typical: mainframe security has been the focus of our attention for some time. CA-Top Secret and Terminal Productivity Executive (TPX) have been installed for several years, and are interfaced to provide user login and menu services, password authentication and management, scripted application logins, and access authorization. CA-Top Secret is also integrated with many other program products to limit multiple application user data bases, which helps reduce administrative overhead.

Outside of these standard host access and authorization requirements, we also had some specific objectives to consider in providing access to the mainframe over a more open network:

- o We had to offer "guest" access to an otherwise secure computer (e.g., to provide anonymous and unlimited access to the library's on-line catalog).
- o We had to cope with unpredictable connections from diverse users on the same "open" network.
- o We wanted to protect passwords on the network as much as possible.
- o We needed to improve on password as the sole user authentication method.

In order to satisfy these objectives, computing staff members from data administration, security administration, and network operations spent many meeting hours analyzing the network topology for possible exposures. In the end, we addressed these concerns with four modifications:

- o We established two "access areas" on the mainframe, each with its own network interface. One area permits access to only "guest" services, such as the library on-line catalog and some student-oriented applications; the other area permits access to all defined applications. We used CA-Top Secret and TPX to enforce identification (login) and password management policies, and to limit the applications that could be accessed in the "guest" region of the computer.

- o In conjunction with these separate access areas, we installed router filters that permit access to the secure access area only from a select set of networks within the IU domain, and that deny access from specific high-risk networks (e.g., campus public computing facilities).

- o We implemented password token cards as an additional method of user authentication for users accessing the secure area. Each card is keyed to an individual user. It is used in a challenge/response dialogue during the system login sequence and must be in the possession of the user at that time. The combination of these two authentication methods -- something the user knows (password) and something the user possesses (password token card) -- is generally accepted in the industry as adequate for all but the most sensitive systems.

(Figure 1 gives an overview of this mainframe security configuration.)

We feel comfortable that our efforts in these areas have resulted in adequate protections for the mainframe environment. However, we still must contend with the constantly changing software set and various network topologies in order to ensure that changes to the mainframe and network environment do not adversely affect security mechanisms.

Client-server security

The client-server environment is new to almost everyone. It is a new way to provide access to the same data, stored in a new place, in a possibly new format. But there are still the same security requirements that were encountered in the mainframe environment. Security administrators, application developers, and system managers must still have the same comfort level in user identification, authentication, authorization, and accountability.

As designers of a client-server security architecture, starting basically from zero, we agreed on some basic understandings:

- o All of our solutions may very well be interim ones.

- o We must always plan for enhancements or replacement based on new software, changes in application requirements, changes in server configuration, etc.

- o The mechanisms that we deploy should be able to protect against what we perceived as the highest risk exposures, both in terms of the degree of damage that *might* be done and the probability that the damage would actually occur.

Given these basic thoughts, we developed five core objectives for our client-server security design:

- o protect host passwords;

- o reduce exposure to network intruders;

- o require the same challenge/response password tokens used for mainframe access;
- o protect database server passwords; and
- o restrict database server access to authorized connections.

There are several components that comprise the security architecture we have developed to satisfy these objectives: client application, network filtering, host security, Security Server, Gateway Server, and Telnet Server.

The client application performs two main security functions:
- o it interacts with the host security process and provides the user interface to the challenge/response authentication dialogue; and
- o it encrypts the user's host password during identification and authentication so that it never passes on the network in clear text.

A standard client module has been developed to execute these functions. This module can be called from any Uniface client application running on a desktop computer.

The network filtering element of the architecture is comprised of subnet router filtering and a subnet bridge. The router filtering is modeled on our use of network control of access to the secure mainframe region; the router filtering denies all connections to the host server from non-IU addresses and from high-risk addresses within the IU domain. The subnet bridge is placed directly in front of the database server on the host computer; it denies ANY network connections to the host's database server port.

The host security component involved the conversion of our HP/UX operating system to a "trusted system". This irreversible conversion (provided with the operating system by HP) involves the use of a shadow password file and the installation of an audit server, which permits full auditing of users or events.

The Security Server is the heart of the security architecture. This program interacts with all other components, and is the "authorizing agent" for access to the database server. For client application sessions, this host-based server receives, decrypts, and validates the username and password from the client application. If the supplied password does not match, a negative return code is passed to the client application. For both client and telnet application sessions, the server obtains a unique session challenge from the authentication software, and passes it back to the application for presentation to the user. The application then returns the user-supplied response, which the Security Server validates with the authentication software. Given that the challenge/response validation is successful, the Security Server generates a one-time database server password, accesses the database server and changes the user's password to the new one-time password, and writes the new one-time password and a session ticket to a database.

The Gateway Server manages access to the database server. All access to the database server MUST come through this program (the database server port is blocked!), and only with the "permission" of the Security Server. This Gateway Server intercepts connection requests to the database server, and searches a ticket database for a valid access ticket issued by the Security Server. Given that a current ticket is found, the Gateway connects the user to the database server with the one-time password that was issued by the Security Server and stored (encrypted) with the access ticket. Subsequent traffic for the user session are passed by the Gateway Server directly to the database server.

Although the applications developed for the client-server environment are primarily meant to be accessed from a client workstation, we also had to provide for a host-based version of the application for users without adequate devices to handle the client code. The Telnet Server uses the standard telnet service of HP/UX, and is invoked when users telnet directly to the host for host-based applications or other database access tools. The telnet service has been bundled with an interface to the Security Server as well as a menu structure. Following standard host login validation, the interaction with the Security Server provides the same challenge/response dialogue that the client user undergoes, and issues a database server access ticket and one-time password for the user session. The menu structure serves to limit user access to the HP/UX system prompt, and adds convenience for the user when choosing applications. The options on this menu vary with the user: some have only user application choices, others have DBA-oriented tools, such as Interactive SQL. In any case, applications on this menu which access the database server must go through the Gateway Server, which will first check for a valid ticket in the ticket database before connecting the user to that database server.

By way of review and comparison of the security architecture components with our stated objectives we see that:

- we have protected passwords on the application host by encrypting passwords at the client and by using the host's shadow password file facility;
- we have reduced network exposure by using network router filtering to limit the source of connections to the application host;
- we require the use of challenge/response password tokens for all accesses to the application host;
- we are protecting database server passwords by issuing one-time passwords -- which are never known by the users -- for database server access; and
- we are restricting database server access to authorized connections by denying direct access to the server port, and by requiring all other access via the Gateway Server.

(Figure 2 gives an overview of this client-server security design.)

It's worth noting that our client-server security design is a evolutionary development of our mainframe security design. The network filtering of traffic to the application host is borrowed directly from our mainframe security design, as is the use of challenge/response password token cards. In fact, our choice of vendor for password token cards was based on the requirement that a user be able to use the same physical card for authenticating his/her identity on multiple host computers.

Security: the state of the industry.

> "No significant headway has been achieved in any of the competing visions of enterprisewide security..."
>
> "It is left...to the user to build together the available technologies with sound business practices to guarantee the integrity of business information."
>
> (Gartner Group; "Client/Server Security"; *Third Annual Symposium on the Future of Information Technology*; October 4-8, 1993; Orlando, FL)

Our experiences in designing security solutions for a client-server computing environment are consistent with this view of the industry that the Gartner Group offers. There is, among the vendors we have worked with, no shared vision of a heterogeneous client-server security solution.

The database and software tool vendors we have reviewed and worked with offer basic security services, with much attention focused on the problems of authorization services: increasing the functionality of roles and groups, for instance, as a means of more easily managing the grant and revoke of database permissions. By contrast, the database and tool vendors have spent less effort on authentication services, which are often incomplete and need to be supplemented with outside help: either third-party or home-grown add-ons. Unfortunately, vendor emphasis is weighted toward proprietary security solutions: looking for answers within the constraints of their product offerings, rather than helping build solutions that cross these lines. Although their products are "open" in many respects, they are slow to adopt emerging security standards and are surprisingly closed when it comes to enabling software integration with products from other vendors or with user-written code. This mix of minimal solutions for user authentication and an unaccommodating attitude toward external software has made development of high-quality authentication services a particularly difficult challenge in this multi-vendor client-server environment.

Our experience is that the hardware and operating system vendors are doing a somewhat better job on security. They seem to have a good awareness of security issues, and are improving their solutions to problems of auditing, accountability, and system integrity. It is the hardware vendors, too, who have put the strongest support behind OSF/DCE, which presents the best potential as a standard for supporting a heterogeneous client-server security environment.

Responding to the industry

There are three ways in which computing organizations can respond to the state of the industry:

- Assemble its own client-server security solution.
- Design with the future in mind.
- Respond directly through collaboration and market pressure.

Since no vendor or group of vendors -- whether of hardware or software, of mainstream or specialty products -- offers a solution to heterogeneous client-server security that can be purchased and used, the only viable answer today is to assemble a security solution from a mix of purchased and locally-developed components.

In our first iteration of a client-server security design this consisted of:

- Selecting *specialty products that fulfill specific needs* in the computing environment and for the target application. (In our case we chose a specialty product, Unix-Safe, to offer challenge/response authentication on a Unix host computer.)

- Using *features available in primary products*. (In our case, we used the "open server" and "open client" features of our database product to develop a Gateway Server that validated user connections against a valid-ticket database.)

- Using *home-developed code to tie the pieces together*. (Our Security Server is a locally-written piece of code that interfaces to our Unix-Safe authentication product, interacts with stored procedures in our database product to set passwords, and writes the valid-ticket entries that our Gateway Server uses to permit database access.)

Given the developing state of the industry for distributed computing, any client-server security solution should be designed with the future in mind, acknowledging that the security design will be undergoing change for some time to come. One area to anticipate change is in the future features (announced, promised, or merely rumored) of existing software products. A second area to anticipate change is the potential adoption of standards-based features, such as those in DCE Security Services, by hardware and software vendors.

The future availability of these features should be considered in the initial security design -- postponing inclusion of the feature altogether or, if the feature must be locally-developed, isolating it in the design so that a commercial product or standards-based design may be more easily substituted in its place. For example, in our first design of client-server security we include a ticket-database which has interactions with the Security Server (the source of tickets) and with the Gateway Server (the user of tickets). If an industry standard for authentication tickets is adopted by any of our vendors, our design would permit us to replace this initial ticket management system with one that is standards-compliant.

A final course of action available to every computing organization is to create market pressure on vendors to adopt security standards and address client-server security needs in their products. They can make their case to vendors, arguing the need for security standards, and they can take their business to vendors who are willing to work with customers on security solutions. Organizations may do this individually or, more effectively, in collaboration with others.

Toward this end, the Big Ten computing directors have collectively endorsed the OSF/DCE standard for distributed computing and are focusing their attention on influencing a key group of hardware and software vendors. One important way to influence vendors is to place security requirements prominently in all RFPs for client-server hardware and software. Compliance with standards or a commitment to work on an integrated security solution should be a heavily-weighted factor in the evaluation of any vendor's product. Indiana University used OSF/DCE compliance as a major criteria in its RFP and evaluation of host/server hardware for the client-server financial information system.

Conclusion

Indiana University is in the very early stages of implementing a security design for client-server computing that can be applied to enterprisewide information systems. The design we have today is a package of individual security actions in response to known exposures. Our view is that all client-server security designs will, for the foreseeable future, be a collection of such tactical security responses, and that our design will change and evolve in significant ways over the coming months and years. Our confidence in this initial security design is based on our strategy of iterative risk reduction and evolutionary growth; because we are addressing exposures in a planned way and are at the same time planning for change, we feel our first step is a step in the right direction.

Note: The work of two University Computing Services staff members needs to be acknowledged in this paper. Charles McClary (Information Technology Analyst) and Tom Davis (Security Analyst) have done significant research, detail design, and code development on our first iteration of a client-server security solution. Their initiative and individual efforts were essential to the overall success of this project.

Mainframe Security

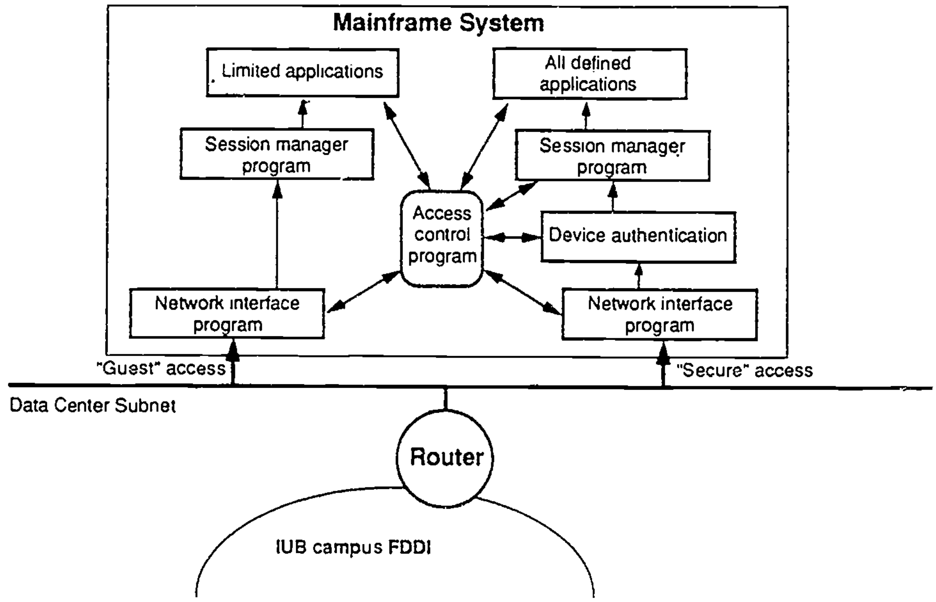

Figure 1: Mainframe Security Design

Client-server Security

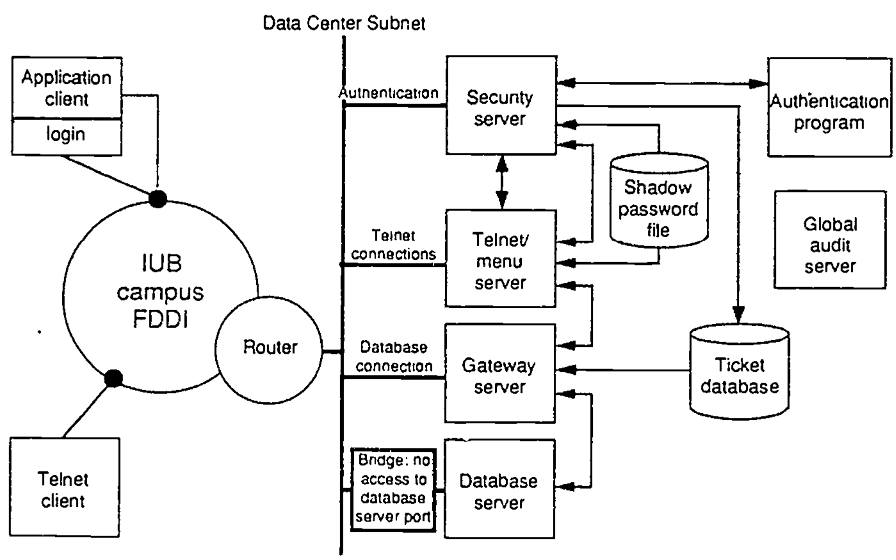

Figure 2: Client-Server Security Design

TRACK V

OPTIMIZING THE INFRASTRUCTURE

Coordinator: Kathleen M. Ciociola

As our need to be connected—to each other and the world—grows, networks proliferate and the clamor for new networking access grows. Tantalized with the possibilities for instantaneous communication and immediate access to vast sources of new information, staff, faculty, and students hold high expectations for the new order. However, while the potential held by the new infrastructure is immense, so are the challenges for those who plan for, implement, and manage it.

Where Do We Go From Here: Summative Assessment of a Five-Year Strategic Plan for Linking and Integrating Information Resources

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Abstract

This paper describes the implementation and the outcomes of Grambling State University's five-year strategic plan for linking and integrating its disjointed information resource systems under the umbrella of telecommunications. The range of services encompassed in the plan included energy management, surveillance and security, voice, data, and video communications, office automation, and administrative and instructional computing.

After a brief recap of the original plan, this paper sets forth the primary aspects of its implementation including technical implementation, integration of the technology into the workplace, and quality issues as related to human, physical, and capital resources. Also described are current and future directions for telecommunications as outgrowths of the successes and shortcomings of the original plan.

OVERVIEW

Emanating from senior management's realization that the attainment of virtually all of its institutional goals was dependent on an improved technological base, Grambling State University (GSU) set out several years ago to develop and implement a strategic master plan that would serve as the infrastructure for telecommunications, computing, information systems, surveillance, security and energy management. The vision for information resources at GSU was to:

- Establish telecommunications as the foundation for information;
- Embrace the philosophy of user-driven and distributed computing;
- Increase decentralization of access to information processing resources;
- Integrate network-based applications, such as voice, data, video, energy management, surveillance and security; and
- Accommodate new applications such as electronic mail, computer conferencing, bulletin boards, etc. (Lundy, 1986).

GSU is now in its fifth year of implementation of the strategic plan for information resources. After a brief recap of the original plan, this paper sets forth the primary aspects of its implementation. It includes discussions about the technical implementation, integration of technology into the workplace, and quality issues as related to human, physical, and capital resources. Further, the paper describes current and future directions for telecommunications as outgrowths of the successes and shortcomings of the original plan.

The theoretical model adopted as the foundation for the strategic plan was McKinsey's 7-S Framework. This planning paradigm has the appearance of an atom with seven factors, all beginning with the letter "S": (1) superordinate goals or shared values, (2) strategy, (3) structure, (4) systems, (5) staff, (6) skills, and (7) style (Peters & Waterman, 1982). Using the seven elements of the 7-S Framework, the university assessed current computing and communications resources and determined needs and desired outcomes. All goals and objectives were couched in this theoretical model.

The primary goals developed to help achieve the desired linkage and integration of computing resources were as follows:

- Install an outside cable plant using fiber optic technology;
- Implement an integrated voice, data, and video local area network (LAN);
- Upgrade existing computing hardware and software by acquiring and linking (clustering) a VAX 8350 (upgraded to the VAX 9000) computer with other VAX computers ("Vax Family");
- Establish a Computer Information Center to develop and implement a training program in computer literacy for academic and administrative users. (Lundy & Carter, 1988 & 1989).

GSU's vision for the future was a totally integrated environment characterized as network-centered, workstation-based, server-enhanced, and software-integrated.

THE OUTCOMES

In general, the implementation of GSU's strategic plan for information resources has been a tremendous success. The technological environment on campus now is greatly improved over the environment that existed five years ago. But given the ever-evolving state of technology, there will always be room for expansion and improvement. Five years into formal implementation, the milestones point to documentable success. Below is a summary of the major achievements related to each of the four primary goals.

Goal 1: Implement Integrated Voice, Data, & Video LAN

GSU retained the consulting firm, Network Group, Inc., to assist in the design, procurement, and installation of the campus communications network. The system was designed to integrate all computing, telecommunications, and video transmission systems on the campus and was to use fiber optics as the transmission medium for all three elements of the network--voice, data, and video.

Although integration of voice, data, and video was achieved campus wide, it was not achieved using fiber optic technology as was originally planned. Instead, integration was attained by employing two different transmission media--twisted wire pairs and coaxial cable. The explanation for the change in transmission media is presented below in the discussion about the outside cable plant.

The integration of capabilities commenced with the acquisition of a new telephone system. Prior to 1984, GSU's voice communication was supplied by an antiquated cable plant and switch that was installed in the 1940's. This outdated technology greatly limited the university's ability to provide basic telephone services.

During the time span of 1981-83, a new cable plant was installed and a new telephone exchange building was constructed with funds appropriated by the Legislature (State Project No. 19-23-00-79-4). In 1984, GSU installed a four-node ROLM VLBX PBX system on campus. This system, which is housed in the Telephone Exchange Building where the cable plant is centralized, did not have data capability. Since the initial PBX installation, there have been some minor upgrades and one major addition--the installation of a fifth node to increase capacity and provide data access. The fifth node provided a 40 percent to 60 percent split between voice and data offerings. Even with these recent upgrades in place, the university is at capacity in terms of its ability to provide basic telephone service.

The modified telephone system did, however, set the stage for the initial integration of data with voice communication. The new ROLM telephone system provided the needed capability to connect data lines directly to ports in the telephone switch; thereby giving all users voice and data capabilities.

The campus ROLM telephone system supports serial RS-232 data transmission on a limited number of circuits. While this service is too expensive ($1111 per circuit) to be used as a campus-wide network and is less sophisticated (only one device can be used at a time) than the high speed Ethernet TCP/IP network, data transmission through the ROLM system represented a viable alternative to a full-fledged ethernet network node for users in remote locations not connected to the cable and in facilities that required few network connections.

In the ROLM system at GSU, data communication takes place between a ROLM Phone with data (at the user end) and a data termination interface (DTI) located at the host computer.

In the new network, all DTIs were relocated from the various host computers to a central location in the Telecommunications Central Office. Network terminal servers for both the administrative network and the academic network were located there and were connected to the DTIs. A user of the ROLM Phone with data dials into the campus network by connecting through the ROLM system to a terminal server in the Central Office. From that connection with the terminal server, the user can connect to any host computer or service on the network.

In addition to the telephone upgrades, accomplishing the integrated LAN with voice, data, and video required making some changes in the SMATV frequency spectrum plan for the campus SMATV broadband cable transmission system. This involved changing spaces for the exclusive use of different services on campus such as data networking, cable television, security video, and energy management. This needed to be done because the signal channels used for the television channels on the Grambling system conflicted with the data communications channel recommendations given in the Institute of Electrical and Electronic

Engineers (IEEE) Project 802.7 specification, "Broadband Local Area Network Recommended Practices". In order to purchase standardized, off-the-shelf data communications equipment to work with the campus SMATV system, the channel allocations for the SMATV system had to be changed.

Also, when the SMATV system was installed, all of the television signals were placed in channels other than those used for VHF television. This made a "cable ready" television or a converter necessary to receive any television signals. Seven of the cable television channels were moved into the broadcast channel 7 through 13 spectrum. This served two purposes; it freed the channels necessary for data communications to meet the IEEE standard, and; it allowed students without "cable ready" televisions or converters to receive at least the three major networks--PBS, the two local programming channels, and one independent channel (BET). Reception of the other six channels still require either a "cable ready" television or a converter.

This new frequency spectrum plan allowed for the installation of two data communications network allocations (each requiring 3 video channels). They are the academic communications network and the administrative communications network. Both networks are carried on the broadband SMATV system, but on different assigned channels. The frequency separation between transmit and receive signals for the data communications allocations is 192.25 MHz, as recommended in the IEEE 802.7 specification.

The two networks are interconnected using an intelligent bridge and gateway. The intelligent bridge allows authorized users on the academic network to access the resources on the administrative network but restricts certain users from bridging between the two networks and maintains an audit trail of all users working through the bridge. This prevents unauthorized access to the sensitive data stored on the administrative network.

A gateway for the AppleTalk local area network was installed and performs three major functions:

- The gateway provides connection between the AppleTalk network and the campus Ethernet network.
- The gateway translates between AppleTalk protocols and TCP/IP protocols.
- The gateway supports simultaneous terminal emulation on the Ethernet TCP/IP network by multiple Macintosh computers on the AppleTalk network. The Macintosh computers are able to access all network computers and services through the gateway.

Six broadband ethernet modems support the administrative network and seven support the academic network. Terminal servers are the principal devices providing user connection to the networks. The terminal servers allow multiple terminals, personal computers, or host computer ports to be connected to the networks.

The administrative network operates on a transmit frequency band of 35.75 MHz to 53.75 MHz and a receive frequency band of 228.0 to 246.0 MHz. This network allows users access to the services on the Digital Equipment Corporation VAX 9000 (which replaced the VAX 8350 and the VAX 11780), 2 VAX 4300, and the Library VAX 4300 computers located in the new Business/Computing Center Building.

The academic network operates on a transmit frequency band of 53.75 MHz to 71.75 MHz and a receive frequency band of 246.0 to 264.0 MHz. This network allows academic users (including students and faculty) access to any of the academic computer systems on campus. Both broadband ethernet networks were connected to the data ports on the ROLM telephone switch, so users in buildings not yet served by the networks can still access network services.

In the initial configuration, both networks provided ample terminal connection service with each network functioning as a large distributed data switch. Any user on either network with proper authorization may initiate a connection to any host computer on the network, and thereafter, communicate with that host computer as if the user were a dedicated terminal connected to that computer.

Another equally important aspect of the success in establishing an integrated network is the training of personnel. Included in the scope of work of the consulting firm, Network Group, Inc., was the task to train network technicians in theory and operations of the ethernet networks. The training prepared university technicians for both operational responsibility and maintenance of the network system. Specific aspects of the training included:

- Ethernet network operation theory and practice;
- Terminal Server setup and operation;
- Network Control Server setup and operation;
- Network security features and practices;
- Broadband Ethernet Modem theory and operation;
- Broadband Ethernet Network troubleshooting; and
- Data communications testing.

Goal 2: Install Outside Cable Plant with Fiber Optic Backbone

Installation of an outside cable plant provided the data and video link to the integrated network. As previously mentioned, the transmission medium of choice for this outside plant was fiber optics. However, circumstances necessitated that coaxial cable serve as the backbone of the outside cable plant instead of fiber optics.

The decision to forego fiber for the immediate future came about as a result of persistent student demand for cable television. Students wanted cable television **NOW!** They insisted that the university enter into a contract with a local cable company to provide the service. The university acceded to providing cable access in a more timely fashion, but would not concede to making the substantial expenditure of funds to provide cable television only. Students had to be convinced that their demands were shortsighted and that it was necessary for the university to acquire as much as possible for the dollars expended. At a minimum, video and data capabilities had to be purchased.

This concession made it possible for students to receive their greatly desired cable television in a timely fashion and afforded the university the opportunity to establish its networked system of communication using two transmission media, twisted wire pairs and coaxial cable, rather than the single fiber optic medium. Thus, coaxial cable, rather than fiber, became the backbone of the integrated network.

Goal 3: Upgrade Computing Hardware & Software and Create (Cluster) a VAX Family

Another important component in achieving integrated information resources was the clustering of the same types of processors or creating a "VAX Family" (VAX cluster). This clustering together of computer systems and/or devices allows for the sharing of disk resources by processors. Each processor can recognize the devices attached to other processors in a cluster group. Managing a cluster is easier and can be controlled from one designated processor within the cluster. If one processor is not available (down), the remaining clustered processors are still accessible to users. GSU's current VAX cluster includes:

1 VAX 9000 Computer System;
2 VAX 4300 Computer Systems;
11 Disk Drives;
3 Tape Drives; and
3 Line Printers.

Goal 4: Establish Computer Information Training Center

Recognizing that a state-of-the art technology environment is useless if customers do not or can not use the resources, the university developed a strategy to ensure greater use of the new technology. The strategy was education and training.

It was believed that a full-scale, intensive, and comprehensive effort had to be launched to increase the comfort level of faculty, staff, and students with new technology applications. As a result, it was proposed and Title III funds were secured to establish a computer information training center.

The Computer Information Center, (CIC) a component of the Information Resource Center, was established to aid in developing a computer-fluent population at GSU. Programs are designed to aid faculty, staff, administrators, and graduate students develop proficiency in the use of computers and the application of computer technology.

The Computer Information Center opened in very small quarters on September 15, 1988 and has evolved from a one-trainer, one-assistant, six-microcomputer, two-printer classroom to a spacious, sophisticated laboratory containing eight IBM PS/2 microcomputers, 13 DEC PCs, five Hewlett Packard laserjet printers, one Hewlett Packard Paintjet printer, one Hewlett Packard Paintjet XL300 printer, two IBM 4019 laser printers, one Epson FX-1050 dot matrix printer, one Epson LQ-1170 printer, a Macintosh IIcx scanner and laser printer, a full-page scanner, and a hand-held scanner. The Center also will maintain a twenty-station terminal lab with printers.

All instruction is provided in a "hands-on" environment with each participant assigned to a personal computer. The seminars and workshops are video taped and cataloged for future use and transmission on the university's television station. At its inception, the CIC offered four seminars. The number of offerings now exceeds twenty-five seminars including topics such as: Introduction to Microcomputers, DOS Commands, dBase III+, dBase IV, WordPerfect, WordPerfect for Windows, Desktop Publishing, Lotus 1-2-3, Microsoft Windows, Microsoft Word for Windows, Microsoft Excel, PrintMaster Plus, Printshop, Using Quattro Pro, Your PC-Inside and Out, and Harvard Graphics.

In addition to the seminars and workshops, the CIC provides various other services to its clientele. It serves as a resource base for users who need help with applications which may include installing and testing new software, performing demonstrations of the software, and setting up some hardware devices. In addition, microcomputing support is provided by assisting users in selecting software to fit individual needs as well as providing vendor and price listings for both software and hardware. Assistance is also provided for those who wish to establish micro-to-mainframe communications. Additionally, the CIC runs a "help desk". Individuals needing assistance call the "help desk". If possible, the problem is resolved over the telephone; if not, someone from the Center goes to the problem site to assess and resolve the problem.

The CIC has established its own library. The library houses multiple resource materials including guides to the latest computer technologies and techniques, various periodicals, reference texts, and audio and video tapes. The addition of a VCR and monitor created an alternative method of training for individuals unable to attend regularly scheduled seminars. All materials may be checked out for limited time periods.

Two of the more recent additions to the CIC have been the purchase of a Macintosh computer, laser printer and scanner specifically for desktop publishing purpcses and the establishment of a demonstration local area network.

Since opening, the small CIC staff has trained well over 600 participants from various departments throughout the entire university and at least 100 others from the surrounding communities as a result of the Center's very popular Community Outreach Program. Outreach services have been provided to employees of various city, parish, and state offices and to area retirees.

The CIC is also quite popular with graduate students enrolled in the College of Education's doctoral program. Many graduate students spend considerable time in the Center preparing research papers and dissertations.

If there is a shortcoming of the Center, it lies in its staffing. In spite of the vastly expanded services, staffing has increased from the original one trainer and one graduate assistant to two trainers and one graduate assistant. Given the quantity and quality of service rendered by this Center, the staffing is sorely lacking; and unfortunately, resource projections do not indicate any immediate relief in this regard.

FUTURE DIRECTIONS

Though much has been accomplished, as the outcomes have shown, the constantly evolving state of technology requires that information resources be upgraded continuously if the university is to maintain its competitive edge. Thus, future directions are already being charted and strategies developed. Short-term objectives include:

(1) Installing and outside cable plant using fiber optic technology to interface with the inside coaxial system;
(2) Upgrading existing computing software to take advantage of mainframe speed and flexibility;
(3) Expanding the university's computer fluency program to include mainframe training;
(4) Developing electronic classrooms in all academic building;
(5) Expanding the telephone system to accommodate the increasing demand for on-campus housing; and
(6) Implementing energy management and surveillance and security systems.

Each of these objectives is discussed in more detail below.

Transfer to Fiber Optic Technology

As noted earlier, Grambling State's original strategic plan for information resources called for a system with fiber optics as the backbone. However, persistent student demand for immediate access to cable television resulted in a decision being made to forego fiber as the first choice transmission medium and to use coaxial cable instead. As predicted, the utility of coaxial cable has been compromised greatly due to it lack of durability; its difficulty to maintain; and its vulnerability to damage during work on campus construction projects. The goal now is to install an outside cable plant using fiber optic technology to interface with the inside coaxial cable system. This technology is an industry-standard solution for an organization that needs flexible, high performance networks that will increase productivity for entering, transferring, retrieving, and updating information.

More than 10,500 linear feet of fiber will be installed to complete the first phase of the campus distribution system. In Phase I, the fiber will be installed in all major academic and administrative buildings currently linked by coaxial cable. The fiber will be installed using single and multi-mode fibers with built-in redundancy capability to prevent interruptions in service to network users.

In Phase II, fiber will be installed in the residence halls and new structures. This phase will allow the use of fiber electronic technology and devices to integrate with existing broadband technology creating an easy transition for network users.

At the completion of Phases I and II, the network will have full capability to operate with the university's existing 802.3 Broadband Ethernet Network and will accommodate current projections for future expansion.

The fiber network will be able to share software and hardware resources, preventing the duplication of resources throughout the university. Fiber optic technology will allow the university to interface with national and international networks and realize the full benefits of increased speed. The fiber network allows remote log in that provides the ability to access any computer on the network from any campus location; provides remote command execution, giving users the ability to submit jobs at one site for execution at another site; provides closed-circuit high-speed transmission; and, provides the capability to transmit large volumes of data in experimental laboratories in a classroom setting.

A major factor involved in moving to a fiber optic transmission medium is the installation of a **conduit system**. As recommended by Network Group Inc., the university will begin to develop and install a campus-wide system of telecommunications conduits. A small system of conduits and manholes already exits. The system of conduits and manholes will provide: (1) an installation path for a dedicated fiber optic cable link between Woodson Hall (location of the Head End of the SMATV system) and the Security Building, (2) an installation path for telephone cable plant expansion, and (3) will serve as a backbone for future expansion and installation of telephone and data communications cables.

Upgrade Existing Computing Software

In the near future, GSU plans to upgrade existing computing software to take advantage of mainframe speed and flexibility. Toward this end, GSU will explore data base management systems to achieve full data base integration. Data base management systems allow multiple users to access and share common data; thereby providing a better fit between administrative applications and the software chosen to perform the various functions.

If the university is to meet the demands of an information society, GSU must put in place a fully-integrated Relational Data Base Management System (RDBMS) software packet to manage its academic and administrative information. This software will integrate all aspects of enrollment management, records management, student accounts, fiscal management, academic affairs, office automation, and planning and decision making functions. The Relational Data Base Management System, 4GL, and related tools will enhance the university's capabilities by:

- Improving decision making,
- Increasing production and integrity of information,
- Reducing data redundancy,
- Reducing application development time,
- Enhancing the management of budget/planning units, and
- Increasing end-user participation.

Expand Computer Fluency Programs

Another of Grambling's short-range goals is to expand the university's computer fluency program to include mainframe training. The new information technologies and the creation of a LAN imply that all students, faculty, and staff should acquire certain computing skills. GSU will expand its computer fluency programs to address the increasing need for training.

Grambling State's computer fluency module is designed to serve faculty, staff, administrators, and graduate students. The major objectives of the computer-fluency module are to help the user demonstrate an understanding of:

(1) Capabilities, applications and implications of computer technology;
(2) Computer systems including software development, design, and operation of hardware;
(3) Use of computers in problem solving and model simulation; and
(4) Use of specialized computer software such as word processing, electronic spreadsheets, data management, and statistical packages for interactive computer applications.

The computer fluency program will be enhanced to meet the needs of those persons requiring training and additional support on the PCs as well as training on the mainframe. The Computer Information Center also will expand its computer fluency program to include the students of the university as well. This portion of the training program will consist of broadcasting the videotapes of the microcomputer seminars over the airwaves of the university's television station. Eventually, the Computer Information Center and the computer fluency program will impact the entire Grambling State family.

Develop Electronic Classrooms

An increased emphasis will be placed on developing electronic classrooms in all academic buildings. Establishment of full function educational telecommunications service units in support of the university's instructional and research program is the intent of this objective. The term "education" telecommunications is used here to describe the programs and services within the video area that operate primarily in support of instruction and public service.

The "electronic classroom" concept at GSU is the application of technical solutions to the classroom environment for the purpose of increasing the availability and enhancing the presentation of instructional material. Instructors must be provided access to an array of instructional media, including but not limited to, all varieties of video tape recorders/players, laser disc players, video floppy disc players, 16mm film transoptic projectors, slide transoptic projectors, cd-rom file servers, and all forms of interactive video systems. Thus, GSU seeks to facilitate the development of instructional material, custom designed and integrated with the instructor's normal teaching techniques. The electronic classroom concept centers around the development of an integrated information system in an option-laden environment which would compliment and improve modern teaching methodologies. This system will feature a video/audio switch housed in a control room along with a wide variety of source machines and terminal equipment. The control room will serve as a central distribution point for a multi-media delivery system to classrooms equipped with monitors, local inputs, and control panels providing the instructor with full-function control of source machines and communication with the control room. In its initial design, the system will have the capacity to serve up to five classrooms, multiple source machines, and provide access to satellite facilities and cable systems and audio/video teleconferencing. Instructors will be provided full-function control of multiple source machines simultaneously and instructional material may be custom designed and scheduled for presentation. Classrooms will be equipped with an adequately sized monitor with respect to the number of students, a control panel with remote capabilities, telephone access to the control room, LAN access, and capabilities for local input. Some of the classrooms will be designed specifically and equipped for distant learning applications.

Expand the Telephone System

Another emphasis of the new planning cycle for information resources will be on expanding the telephone system to accommodate the increasing demand for on-campus housing and to service new buildings scheduled to come online.

The minor upgrades that have occurred since 1984 and the more recent installation of a fifth node have served as temporary solutions to serious capacity challenges. Currently, the university population is utilizing all 2750 of its available station lines. The university, at this time, cannot provide telephone service to four new dormitories currently under construction--two of which are expected to go online in January 1994.

If the university is to meet the demand for basic telephone service, a new ROLM 9751 Model 50 node needs to be added to the current five-node system. The model 50 will support up to 1100 additional lines and provide the needed capacity to expand service to the new buildings. Acquiring the model 50 will make available ROLM's 9750 series of telecommunications products and will position the university to take full advantage of technological advances not available in the 9000 series. The installation of the 9750 node also will allow the university to install a Voice Response Unit (VRU) to work in conjunction with the VAX 9000 mainframe computer. The VRU will facilitate the automated distribution of selected information via the telephone. Students will be able to call into the system from any touch-tone telephone, enter their social security number, and retrieve selected information stored on the VAX computer. The VRU will provide an excellent avenue for students to obtain the status of their financial aid and can be used in a telephone registration system.

In addition to the new node, the university needs to expand the phone-mail, voice-messaging system. Students should be allowed to subscribe to phone-mail on a per-semester basis. Since voice-messaging is password controlled, the student would not have to reside on campus to take advantage of this technology. Multiple phone-mail boxes can be assigned to a single extension. A voice-messaging system for students will greatly enhance students' ability to communicate with parents, friends, and university personnel.

Implement Energy Management and Surveillance and Security Systems

Although outlined in the original strategic plan for information resources, not much has been done to install university-wide energy management and surveillance and security systems. These projects are, however, still in the plans for the future.

The energy management system is intended to allow centralized data collection and control of energy-consuming devices such as chillers, water heaters, furnaces, and lighting systems throughout the university campus. The data collection and control is to take place using dedicated channels on the SMATV system. The design phase of the energy management system is not complete at this time. It is expected that the design will be completed in 1994.

The surveillance and security system has been designed. Currently proposed is a dedicated fiber optic link to security. The security surveillance video system will provide video signals to the SMATV System Head End in Woodson Hall from surveillance cameras located throughout the campus. In order for the video to be viewed by the security personnel, it must be transmitted from Woodson Hall to the Security Building.

A dedicated fiber optic cable system will be installed to carry the video signals between Woodson Hall and the Security Building. Dedicated facilities are used rather than channels on the SMATV system, as using the SMATV system would allow anyone on campus to view the security video channel. Such a system would not be conducive to good security, as a viewer could tell when a particular camera was not being used and time his actions accordingly.

Cost Estimates

Below is an estimate of the total costs of the network equipment and services to be acquired in future years. The costs noted are estimates only; the system will be acquired under the state bid system and actual network equipment and service costs will vary. The estimates are:

• Network Equipment	$140,285
• Test Equipment	23,325
• Conduit System	66,700
• Security Surveillance System	24,150
Per Surveillance Site	4,800
• Telephone Cable Plant Addition	38,850
• Year 2 Cost Totals	
(excluding energy management system)	$389,310

CONCLUSION

Given sufficient resources--human, physical, and financial--GSU should be able to cultivate a technological environment second to none in the state of Louisiana. Successful attainment of the six goals proffered for the next five years is certain to move the university closer to its ultimate goal of **creating and achieving excellence in all programs and activities.**

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Wireless Communications - Come in Dick Tracy!

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ABSTRACT

Articles on wireless communications have hit the press in a big way with reports of a fabulous future enabling people to communicate with anyone, anywhere, anytime using any media. Have all our wiring problems now been solved? Do we no longer need to worry about having to install that "expensive" fibre-optics and copper infrastructure? Is the Dick Tracy wrist-watch around the corner?

The University of Toronto's Computing and Communications (UTCC) Division has been monitoring the development of wireless technologies and services over the last two years to determine how these recent developments relate to the University's campus network plan. The physical infrastructure that was chosen to support the long-term goal of integrating voice, data, image, and video on our campus network was, not surprisingly in 1991, identified to be a fibre-optic and copper-based wiring system. In 1993 is this still the right choice?

This paper will introduce the novice to the wireless "lingo", describe some of the various types of wireless communications technologies and services, discuss issues related to the use of wireless, identify opportunities for the deployment of wireless technologies in an institutional setting, and explain what we chose to do about wireless and why. Additionally, predictions for future services based on wireless technologies will be made.

1. Introduction

The University of Toronto's Computing and Communications (UTCC) Division has been monitoring the development of wireless technologies and services over the last two years to determine how these recent developments relate to the University's campus network plan. The physical infrastructure that was chosen to support the long-term goal of integrating voice, data, image, and video on our campus network was, not surprisingly in 1991, identified to be a fibre-optic and copper-based wiring system. In 1993 is this still the right choice?

This paper will introduce the novice to the wireless "lingo", describe some of the various types of wireless communications technologies and services, discuss issues related to the use of wireless, identify opportunities for the deployment of wireless technologies in an institutional setting, and explain what we chose to do about wireless and why. Additionally, predictions for future services based on wireless technologies will be made.

2. Wireless "Lingo"

The following basic terms are explained for reference purposes.

Spectrum Allocation: Refers to the allocation of radio-frequencies to provide specific wireless services. For example in Canada, the new cordless digital telephone technology will operate in the 944 to 952 MHz frequency range.

Infrared: Infrared enables information to be transmitted through the air using very high frequencies (3 x 10 power 14 Hz). Many VCR and TV remote controls use this technology. Infrared signals behave like visible light and the signals can not penetrate solid objects. Line of site must be maintained in order for communications to take place effectively. The Federal Communications Commission (FCC) does not regulate infrared signals.

Spread Spectrum: Spread spectrum enables information to be transmitted through the air using radio frequencies. The information is spread over many frequencies making the message difficult to jam, and difficult to intercept and decode. Products using spread spectrum do not need to be licensed by the FCC although their use is regulated to prevent interference problems.

Narrowband Microwave: Narrowband microwave is another way in which information is transmitted over the air using radio frequencies. Narrowband microwave products must be licensed by the FCC.

Digital Cordless Telephone (DCT): This is a specification of a personal communications device, the telephone, for use in second generation systems. Some of the air interface standards that are being used or considered for various implementations of DCT are DECT (Digital European Cordless Telephone), CT-2 (cordless telephone, second generation), and CT-3 (cordless telephone, third generation).

Channel Access Standards: This refers to the method in which a wireless device accesses the shared wireless communications channel. Some of the standards that are being used or considered are FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access).

Mobility: There may be some confusion over this term. People use "mobile" in different ways. A system may provide mobility in that a person can communicate with this system from various locations (e.g., home, work, shopping mall, etc.). A system may also provide mobility by allowing a person to communicate with this system while literally in motion. The speed at which a person is in movement greatly affects the ability of a given wireless technology to support reliable communications. For example, cellular telephone technology was designed to provide service to a user while traveling at high speeds in a vehicle. Other wireless services may not provide this capability.

Personal Communications System (PCS): PCS is a concept that has many definitions. A reasonable definition is as follows:

Definition: A personal communications system is one which provides universal accessibility to a wide range of voice, messaging, and geographic positioning services, to individuals at home, work, remote locations, or in-transit on a premise [building], local, national, and international basis[1].

Perhaps hidden in this definition is the supplementary concept that a user is assigned a unique, personal identifier that may be used to reach the user irrespective of the user's location. Note that this definition does not refer to how a PCS system is implemented. In particular, it does not mention whether wired or wireless technologies would be part of the system. However, it is clear that wireless technologies have to be part of the system in order to provide the mobile capability for the user. It may be less obvious that wired technologies will still be a big part of providing the PCS infrastructure.

3. What are Some of the Wireless Technologies and Services?

There are a significant number of wireless technologies and services available today. Satellite, cellular, and paging services are available from carriers, although, perhaps not at the "right cost". Private facilities may be constructed using satellite, microwave, and wireless versions of PABX (Private Automatic Branch eXchange), point-to-point modems and LAN (Local Area Network) interfaces.

The variety and quantity of carrier services and products (existing or proposed) are greater in the U.S. and Europe than in Canada. Some of the products that have been developed in the U.S. and Europe may not be usable in Canada, or vice-versa, because they operate in an unsuitable section of the available frequency spectrum. The U.S. and Europe are investing considerable amounts of money and time into wireless R&D, standards, and lobbying (spectrum, licensing) efforts. The Canadian efforts are modest by comparison.

The following existing technologies and services have potential relevance to our University.

Satellite: Many communication services that we use everyday, including cable television and the telephone system, make extensive use of satellite technologies. The use of satellite technologies for private (non-carrier) applications is becoming more pervasive. Examples can be found in the trucking industry (messaging and dispatch), the financial sector (bank branch office connectivity), and education (reception and transmission of educational programs).

Satellite technology has been continuously improved over the years to deal with system limitations, overcrowding of orbiting space, the cost factor, etc. This has resulted in a multitude of services and a diversity of hardware. For example, there are two types of satellite dishes in common use (C-band, Ku-band) and a third type is in the experimental stage (Ka-band). All of these use different segments of the frequency spectrum and have different physical characteristics such as the size of the dish and the power level for transmission. Satellites now come in many flavours such as LEO (Low Earth Orbiting), VLEO (Very Low Earth Orbiting), and GEO (Geosynchronous Earth Orbiting).

[1] Dr. K. Murthy, "Personal Communication Systems and Services", IEEE International Conference on Selected Topics in Wireless Communications, June 24-26, 1992.

Microwave: Microwave has long been used, primarily by carriers for long-distance applications. The clutter of the spectrum, wide-spread availability of satellite bandwidth, interference from C-band satellites, and the reliability of optical fibre has slowed the deployment of this technology for traditional applications. A niche market still exists for the local trunking of cellular voice traffic, but the main new applications that have been developed are for short-hop LAN traffic and "private" high-bandwidth (DS1, DS3) communications in intercampus situations.

Cellular: Cellular telephone services have been around for some time and are becoming more affordable. There are plans to upgrade the existing cellular networks from analogue to digital technology to improve the service quality and capacity. DCT may encroach on the market for cellular and other personal wireless services. Only truly mobile users will need cellular so that they may communicate with the network while in motion.

Paging: Paging systems and its variations (e.g., alphanumeric dispatch applications) have seen tremendous growth over recent years as these services have become cheaper and cheaper to use. However, the one-way communications restriction of paging services and the decreasing costs of cellular services will have considerable impact on this market. DCT systems may also provide substantial added function compared to paging systems at a cost that may shrink the paging market.

Private Automatic Branch eXchange (PABX): The potential business applications of cordless telephones were one of the early drivers for the development of wireless voice communications. Wireless PABX enables the user to roam throughout the business site while retaining the features of the PABX (unlike cellular). Additionally, wireless PABX can provide cost-effective, quick, and convenient access for users within new or existing premises that have insufficient wired facilities. Available wireless PABX products are based on proprietary protocols. Some manufacturers are developing products that will support one or more of the various standards (e.g., DECT, CT-2, CT-3) that have been adopted by various interested parties around the world (e.g., Canadian and Swedish governments, European Telecommunications Standards Institute (ETSI)).

LANs: There are a small number of wireless products on the market today that may be used to construct local area networks or pieces thereof. The role that the wireless component takes on in the LAN environment is varied and may differ by manufacturer. A network concentrator, a PC interface, or a LAN modem may all be replaced with wireless "equivalents". The capabilities of these wireless components and the vendor's implementation vary. A key element that should be highlighted is the method used for the transmission. Spread spectrum, narrowband microwave, and infrared are the three commonly used systems. Each system has different operating parameters such as the frequencies used for transmission, the maximum coverage, whether line of sight is required, and whether a license is required.

4. Wireless Issues

The are many technical and non-technical issues associated with wireless communications technologies. Some of the more salient issues are addressed below.

Health Considerations: The primary metric used to measure the health risk of exposure to radiating energy such as is emitted from a wireless transmitter or a video display is based on the ELF (Extremely Low Frequency) rating of the radiating device. None of the foreseeable modulation schemes for wireless technologies use ELF modulation, rendering the current methods of assessing health risks useless for wireless devices. The health issue is very contentious - vendors will need to convince users that their health is not at risk when using wireless devices. In particular, significant research into long-term exposure to low-power, high-frequency radiation needs to be done.

Security/Integrity: The jury is still out on this one. Vendors like to believe that their systems are secure. Users like to prove them wrong. Certainly for some types of wireless systems the security is very weak or non-existent. Other systems are much more difficult to "break" due to the difficulty of

Low Frequency) rating of the radiating device. None of the foreseeable modulation schemes for wireless technologies use ELF modulation, rendering the current methods of assessing health risks useless for wireless devices. The health issue is very contentious - vendors will need to convince users that their health is not at risk when using wireless devices. In particular, significant research into long-term exposure to low-power, high-frequency radiation needs to be done.

Security/Integrity: The jury is still out on this one. Vendors like to believe that their systems are secure. Users like to prove them wrong. Certainly for some types of wireless systems the security is very weak or non-existent. Other systems are much more difficult to "break" due to the difficulty of interpreting or capturing the wireless signal rather than the provision of any intentional security scheme. However, a few systems do claim to provide a "secure" channel intentionally. Unfortunately, one of them, the digital cellular standard IS-54, has already proven to be readily defeatable.

Wireless communications must be secure from the standpoint of eavesdropping and not allow any alteration of the content of the "call". Additionally, the communications signaling and "call" setup must be protected to avoid fraud and abuse. All this must be done without adding features and capabilities that frustrate the rights of the law enforcement and protection agencies. This has already become a big issue with the FBI in the U.S. vis-a-vis the upgrade of telco central office equipment to support advanced services such as ISDN (Integrated Services Digital Network). With this new central office equipment it is much more difficult for the FBI to wire-tap a conversation!

The integrity of a wireless communications session may be affected from outside sources (e.g., radio frequency) whether the interference is intended or not. Furthermore, wireless systems can be influenced by multipath effects, "dead" zones, etc. that may ultimately affect their deployment in some areas. For example, leaded or gold plated glass in buildings could make wireless systems unreliable.

Privacy and Etiquette: The PCS concept touts the ability to communicate with "anyone, anytime, anyplace". While this is an interesting concept it may not always be appropriate. Some people view the beeping of pagers and cellular phones in meetings and in public spaces as an annoyance. User perceptions of privacy and etiquette issues may even be a limiting factor in the market success of some wireless technologies. A parallel in the wired world may be made with one of the new features offered on the Public Switched Telephone Network (PSTN) in the Toronto area. "Call Display", which provides the telephone number of the calling party to a called party, has met with some very negative consumer reaction. The effectiveness of this feature will be greatly reduced if significant numbers of the consumer base refuse to allow their telephone numbers to be transmitted on the network.

Mobility: Distinguishing what is meant by the term mobility is extremely important in the design and expected use of a system. For example, while the CT-2Plus DCT standard allows for mobility, a system based on this standard will not allow a person to communicate with the system while traveling in a car at high speeds.

Spectrum: The allocation of frequency spectrum for wireless technologies is one of the hottest issues. Spectrum is a limited resource. Most of the "currently useful" spectrum has already been allocated. To complicate matters, the assignment of spectrum to specific technologies and services varies from country to country. This will make it extremely difficult to coordinate global services, and in particular, a PCS system. The World Advisory Radio Council (WARC) and the International Telecommunications Union (ITU) are two major players dealing with spectrum allocation and other PCS-related issues, on a global basis.

Contiguous spectrum is another concern. There have been some discussions in the U.S. to move certain technologies to a different area of the spectrum so that large chunks of contiguous spectrum for new wireless services may be allocated. This is extremely contentious as there are differences of opinion on who should pay the bill for such a massive reorganization.

Techniques for the co-existence (same spectrum) of new and current technologies and services are being explored. Compression algorithms to make more effective use of spectrum are being studied.

Licensing: Some wireless technologies need to be approved by a government agency to ensure that the wireless transmitting device will not interfere with existing systems. This can be a very time-consuming venture. For example, one major vendor of wireless LANs encourages potential customers to buy its products by handling the licensing arrangements on the customer's behalf at "no charge".

The method of handing out licenses to carriers so that they may allocate spectrum and provide wireless services is also a hot topic. Spectrum is a scarce resource that is managed by government and awarded to interested parties in some "equitable" manner. There are undoubtedly disagreements with the level of fairness no matter what method is chosen. In the U.S. the hot debate before the Senate as to whether licenses should be awarded by lottery or by auction has concluded. It is expected that the FCC will auction radio frequencies in the 2GHz range for "emerging technologies" in late 1994.

Standards: It took over two years for Canada to decide upon a standard for the radio interface of the portable unit of the DCT. And there were only two standards in the running! There are potentially many standards for the various areas of the provision of wireless services. As in other areas of IT, much work needs to be done to settle on some reasonable standards. Unlike other areas of IT, the diversity and number of players in wireless who have vested interests in standards is huge. And with the eventual goal of PCS, it may be argued that international issues and standards are more of a concern than any other single sector of information technology. Note that some efforts have been made to standardize LAN technology under the IEEE (Institute of Electrical and Electronics Engineers) 802.11 work group.

Bandwidth: As with the wired world bandwidth is always a consideration in the delivery of applications. However, wireless speeds do not compete well with the speeds of their wired equivalents. Furthermore, what is possible to deliver via the allocated bandwidth and what is actually delivered as a service may differ greatly. It is generally believed that wireless networks will not have the bandwidth to deliver multimedia applications to a mobile user within the foreseeable future.

Intelligent Networks: PCS will require an extremely intelligent network to support roaming capabilities and to integrate multiple networks. Such a network will require excellent network management and will be software-intensive. The complexity of the networking software of traditional LANs and the PSTN pale in comparison.

Even in the wireless world of today there are examples of missing features that are provided in the wired world. To take one, some wireless ethernet hub products do not provide any network management capabilities (such as SNMP).

There are also certain aspects of networks that prove to be problematic whether the communications takes place over wired or wireless technologies. For example, network addressing either in wired-based or wireless LANs is not a well structured area.

Reliability/Quality: There is a lot of research being performed in this area. If wireless services are unreliable, or this is perceived to be the case, then the market will not grow enough for the services to be cost-effective. The quality of the wireless channel is also important and should at least meet, or exceed, the standards of the wired equivalent.

The software that is required to keep track of mobile users such that the user may originate or receive a call from "anywhere" is estimated (in current proposals) to be 25% larger than the software proposed for the ill-fated U.S. Space Defense Initiative (SDI). A major reason why the SDI did not proceed into development was the near-universal agreement that the problems of creating, testing, and maintaining software of this magnitude was not solvable at the current state of technology[2].

Cost: While on the surface it may look like wireless communications are more costly than their wired equivalents, this is not always the case. Installing wiring in certain areas within a building or to a building may be nearly impossible or prohibitively expensive. Wireless solutions may also be cheaper when long term network costs are considered. For example, in environments where a structured wiring plant does not exist, it can be very expensive to relocate or install wires when people are moved within the workplace. On the other hand, the complexity of wireless systems may increase overall network maintenance costs.

5. Wireless and the University of Toronto - Institutional Opportunities

Wireless technologies are being used at the University today but with one exception - satellite, these technologies only support the transport of voice or brief alphanumeric text messages. Some thoughts on, and the current status of wireless technologies that are of relevance to the University follow.

Satellite: The University currently has a satellite reception and rebroadcast system which is used to support distance education and conference participation. Two receive dishes, one C-band, the other C-band and Ku-band, are mounted on the roof of a central building on campus. A transmitter is used to broadcast received satellite signals to various locations on campus which have a receive antenna. The demand for this service is increasing.

A need to transmit signals to satellites for distribution to other locations has been identified. For example, the University has hosted several occasions where leased, uplink satellite facilities were used to distribute programs. The possibility of acquiring a permanent uplink facility so that the University of Toronto may be a more active participant in distance learning activities is being investigated.

[2] R. A. Stanley, "Systems Issues in Wireless Communications", IEEE International Conference on Selected Topics in Wireless Communications, June 24-26, 1992.

Paging: Paging systems are used by highly mobile staff within the Facilities and Services (e.g., building property managers) and the Computing and Communications (e.g., field technicians) divisions. These systems provide the ability for a caller to leave a brief one-way voice or alphanumeric text message for the person carrying the paging device. Falling costs for cellular services will eventually replace a large part of this market.

Cellular: As the costs of buying cellular devices decrease, more and more mobile staff are considering using this form of wireless communications. Currently, the cost of using cellular is about an order of magnitude greater than that of paging. Some University staff have replaced their paging services with this more functional but more costly alternative.

Digital Cordless Telephone (DCT): It is unclear when DCT services will become available to our University. Ultimately, the service providers must install infrastructure (base stations) on our campus for the community to be able to tap into a DCT network. The initial offering of this service is likely to include only voice services since voice is the driver of this technology and the largest market. Opportunities to apply this type of wireless technology in the University environment will depend on the service roll-out, the types of services offered (voice, data, facsimile), and the cost of the service as it compares to other services such as cellular, paging, or the traditional wired access.

Narrowband Microwave: This technology is not being used within the University. However, the advent of low-powered microwave and the simplified regulatory process associated with this technology, may provide some opportunities for deploying this technology. For example, the Computing and Communications division has proposed that this technology be used for connections to buildings where it is prohibitively expensive, or next to impossible, to connect the building to the campus network with fibre-optics. Additionally, a project has been launched to connect two remote campuses to the main campus using narrowband microwave facilities.

Local Area Networks (LANs): To the best of our knowledge there are no LANs on campus that make use of wireless products. Providing the ability for students to "roam" on campus, asbestos-related concerns with the installation of wiring, and the difficulty of wiring architecturally-sensitive buildings are a few of the challenges that wireless LAN technology may help to resolve.

General Mobile Computing and the LAN: The cost of purchasing small lightweight computing devices such as laptops and notebooks is rapidly decreasing. Many of the portable devices include "wired" modems to connect to the PSTN. In some niche markets, such as the trucking industry, these devices may have a built-in proprietary wireless modem that makes use of cellular or satellite networks. However, it is currently very difficult, if not impossible, to provide a LAN environment for highly mobile users of these types of equipment. Dealing with the addressing of the network component is a major problem in the wireless LAN. Additionally, providing distributed functions, such as a file system that "follows the user", prove to be problematic.

The common LAN protocols need to be enhanced to allow the highly mobile user to be a participant of the LAN via a wireless service. In the meantime, these users will have to use terminal emulation in conjunction with wireless services to access non-LAN facilities. For example at our University, it may be possible to provide access to our terminal-switched backbone through private wireless PABX or concentrator facilities.

6. The Future of Wireless

Not surprisingly, based on the very large potential market for wireless communications, there is no shortage of standards, implementation proposals, architectures, grand architectures, and suggested evolutionary steps being proposed by a host of players, nationally, internationally and globally. Most of these proposals are intermediate steps to the ultimate in wireless communications, a Personal Communications System (PCS).

The wireless systems that exist today are categorized as "first generation" or "second generation" systems. These generations differ in their capabilities and in the ability to deliver a PCS environment. Third generation systems are being researched and are not publicly available (although there are some trials in progress). It is not known how many generations will be required to reach the goal of a PCS system but it is unlikely that "n=3" will get us there.

Digital Cordless Telephone (DCT): The Canadian Department of Communications (DOC) recently approved the technical standard CT-2Plus for the radio interface of the wireless telephone handset. This standard is based on digital communications and will allow for a much more reliable and noise-free communication channel than the current analogue wireless telephone (a first generation system). In the U.S. there is no movement to select a standard for DCT.

Third Generation Systems: Third generation systems could add significant improvements in functionality to the second generation systems. Five of the key areas being researched are bandwidth, compatibility with multiple wide-area networks, true mobility, the provision of an intelligent network infrastructure, and the provision of new services such as data and video.

Personal Communications System (PCS): PCS will be an evolution of existing and future services and not an outright replacement of existing technologies. Some suggest that a PCS will be available in the year 2000. While it is true that forms of PCS, based on one's definition, will exist over the next number of years, it is extremely unlikely that a PCS that is ubiquitous, seamless, and provides multimedia capabilities, will be in place by the year 2000.

The Author's Predictions: Predicting the future of wireless communications is a very onerous task. Wireless technologies and services are expanding in scope with the ultimate goal of providing a PCS. The number of stakeholders is increasing dramatically. For example, in the U.S., over 250 companies have shown interest in wireless communications by requesting test licenses for PCS trials. Recently, there was a "merger" of a very large U.S. telephone company and a cellular telephone company which some industry analysts believe has a good chance of resulting in a defacto standard for wireless communications in the wide area environment. Of course only time will tell.

It is likely that wireless technologies and services will polarize around two important markets - the application of "fixed wireless" in situations where installing wiring is not possible or is expensive, and the application of wireless to provide mobility. Initially, the driver for the former will be connecting machines to networks. The latter will be driven initially by voice applications and some use of low-speed, terminal emulation data applications. In both cases, in the U.S., there are no wireless standards and this will result in incompatible networks and customer equipment. Wireless will be more expensive than "wired" until the customer base is large enough to drive down the costs of manufacturing wireless equipment, and, the cost of sharing the network infrastructure. Once the standards obstacle is overcome there will still be the issue of network provisioning. This will be more of a problem for the mobile market than the fixed wireless types of applications. Wireless networks will first be installed only in high-traffic corridors and large cities since the potential for revenue is higher in these areas. We have already seen this phenomenon with the cellular telephone. While various forms of PCS will exist over the next few years, the required integration of multiple media and the geographical coverage that will make the Dick Tracy wrist-watch a reality, will not occur before the new millennium.

How will this affect using wireless in an institutional setting? The answer is unknown and is one of the reasons as to why the following recommendations were made.

7. Recommendations - What We Chose To Do About Wireless and Why

Based on the current status of the various wireless technologies and the opportunities that may exist within our University for the deployment of wireless technologies and services, we recommended that:

1. *Basic Infrastructure:*

- we make use of proven wireless technologies, where appropriate, for basic (physical) infrastructure (e.g., cost-effective application of microwave facilities for the "hard to reach" buildings and for intercampus connections).
- we investigate or implement a pilot use of emerging wireless technology for basic infrastructure (e.g., wireless LANs).

Why? A stable, proven technology such as microwave is a good candidate for providing basic connectivity to buildings that are difficult to connect to the campus network via wiring. It may be possible to connect some of these buildings using infrared or spread spectrum technology but the few products that are available to implement these types of connections have met with mixed success. On the other hand, there is great potential in using wireless technologies to form fixed LANs where installing wiring is not possible or the costs are prohibitive. We have had no real experience with wireless LANs. A pilot implementation would give us the opportunity to understand when and where to use this technology.

2. *Wireless Services and Applications:*

- we continue to make use of proven wireless services and applications where appropriate (e.g., paging/cellular services for campus dispatch, support of highly mobile University staff).
- we continue to monitor emerging wireless services and applications in the University context (e.g., DCT services for campus dispatch, personal security).

Why? Wireless services such as cellular and paging are well established and provide a reasonable level of service to highly mobile staff. New services, such as DCT or digital cellular, which will become available in the short term, may provide added function such as wireless data access to mobile staff and students.

8. Conclusion

While there have been forms of wireless technologies around for years (e.g., satellite television, analogue cordless telephones) the true potential of wireless has not been tapped. Major issues such as spectrum allocation, standards, and government policies need to be addressed and resolved before this burgeoning technology can begin to realize its full potential. This area of information technology is undergoing rapid growth resulting in a plethora of wireless technologies and potential services (and a lot of confusion!). Vendors, governments, researchers, carriers, and "educated" consumers all agree on the vast potential markets and economic opportunities that exist for wireless. For example, the Canadian government believes that the research, products, service development, etc. that will be made possible due to the recent selection of the CT-2Plus DCT (Digital Cordless Telephone) standard for cordless telephone service in Canada, will position Canada as a significant player in the global production and deployment of wireless technologies and services. However, there are a lot of stakeholders in wireless and if the Canadian experience of deciding upon a standard for DCT is any indication, it will take time and a lot of hard work for wireless services to become pervasive and cost-effective.

In this vein, it should be stressed that there are wireless products and services that exist today. However, most of these products and services (with perhaps the exception of cellular) are either too expensive, limited in geographical coverage, or just too limited in function to be used as the primary method of allowing people and/or machines to communicate with one another. This is not to say that wireless is not being used cost-effectively in certain niche markets. There are many examples where wireless is quite cost-effective. Two prime examples are the delivery of POTS (Plain Old Telephone Service) to rural areas, and the provision of local area networks in large open areas where workers are relocated frequently.

In conclusion, our wiring "problems" are not going to be solved by wireless communications in the foreseeable future. The typical wired campus plant provides much better bandwidth, reliability, and coverage than the wireless alternatives that exist today. Wireless communications does have a role to play on campus in serving highly mobile staff. Fixed wireless LANs will become popular through the use of the IEEE 802.11 wireless LAN access protocol standard. As can be seen from the number of issues that need to be addressed, the scale of the effort required to provide a personal communications system, and the vast number of parties competing to provide a PCS, the Dick Tracy wrist-watch is not around the corner.

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VOICE, VIDEO & DATA BACKBONE NETWORK PROJECT IMPLEMENTATION

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Abstract:

Monroe Community College is committed to the strategic goal of the advancement of technology within the institution. To that end, the College has actively promoted the use of information technologies throughout the academic and administrative communities of the College.

MCC is challenged with supporting an anticipated four-fold increase in demand for voice, data, and video services as a result of a steady and dramatic increase in the overall student population, additional campus locations, and an increased use of network services for instructional purposes.

It is the College's desire to support this increase in demand, and the need to interact and share information between any device, anywhere, by enhancing the College's current network environment through the implementation of a new, high speed integrated college-wide voice, video and data communications backbone network capable of supporting a wide variety of communications technologies and protocols.

MCC is underway with implementation of this project, and would like to share our experience with others who are interested in pursuing implementation of an integrated network environment. The presentation will highlight a historical summary of the network, including where the institution was when the project began, where it is now, and where it expects to be when the project is complete.

INTRODUCTION:

Monroe Community College was founded in 1961, and is one of 30 community colleges within the State University of New York (SUNY) system. It is the largest community college upstate, with 14,000 students enrolled in credit courses in a multi-campus environment. The College employs approximately 734 faculty, and 514 administrative personnel. The College is committed to it's strategic goal to support it's population in the use of information technologies, and to promote the advancement of technology within the institution.

The College is challenged with supporting a four-fold increase in demand for voice, video, and data services as a result of a steady and dramatic increase in student population, additional campus locations, and an increased use of network services for instructional purposes. Space constraints mean that departmental networks will continue to spread out to various buildings on the main and downtown campuses presenting additional challenges. Trends confirm that there will continue to be a growing need to share information between a diverse set of computing platforms. This challenge is further complicated by the need to plan for the possibility of locating more college facilities throughout the county.

It is the College's desire to support this increase in demand through the implementation of a high speed College-wide voice, video and data communications backbone network capable of supporting a wide variety of communications technologies and protocols.

MCC is well underway with implementation of this project in a phased approach. It is the intent of this presentation to share our experiences in implementing the various phases of the project with others who are also interested in pursuing implementation of an integrated backbone network environment. This presentation will highlight a historical summary of the network and its design, including where the institution was when the project began, where it is now, and where it expects to be in a few years.

HISTORICAL PERSPECTIVE OF MCC NETWORK ENVIRONMENT

Before implementation of the fiber network, voice and data communications connectivity utilized separate cabling systems. Voice communications in the late 1980's were completed through the utilization of a ROLM Computerized Branch Exchange (CBX) 8004 telephone switch which serviced approximately 830 stations and 100 trunks in an analog environment. Systems administration was very cumbersome, and most service on the infrastructure was outsourced to a vendor (very expensive). Due to capacity constraints of this analog switch, incoming calls were blocked (often busy) during peak times. This switch also maxed out growth potential for additional users.

In its earliest configuration, data communications were carried out on a one-to-one basis utilizing "miles" of coax cable. 32 cables were run from each of the Computer

Center's workstation control units to 32 user workstations. This configuration eventually evolved to a 1:8 ratio by running 4 cables from the control units to multiplexors located in user areas supporting 8 users per multiplexor. This cabling process was costly and inflexible, and sometimes required months to complete requests for adding new data users. In addition, a finite number of mainframe computer ports required prioritization of which users would be fully cabled and connected.

A second connectivity method required purchase of a microcomputer, modem, communications software and a dedicated telephone line for dial-up capability to administrative or academic computing systems. Providing modems for each end user requiring connectivity became a costly operating budget expense. Response time using a modem was slower than direct cable connects, and resulted in loss of user productivity. Authorizing new user connections to MCC's computer networks was time-consuming, inflexible, costly and involved a myriad of college personnel (e.g. electricians, data technicians, systems administrators, etc.).

All of the issues related to providing timely, cost-effective service to our voice and data customers were culminating in a poor image problem. Customer service had to be improved, and the philosophy of "Do More with Less" had taken hold across the College. This crossroad led us to develop and propose a long-term strategic plan for voice, video and data téchnologies. It is what we later referred to as MCC's Backbone Network Project, phased implementation plan:

PHASE I	DIGITAL SWITCH IMPLEMENTATION
PHASE II	DATAPHONE AND MODEM POOL IMPLEMENTATION
PHASE III	CONSULTING SERVICES
PHASE IV	CURRENT STATUS OF THE PROJECT
PHASE V	FULL IMPLEMENTATION OF THE PROJECT
PHASE VI	PROJECT EVALUATION AND RECOMMENDATIONS

PHASE I -- DIGITAL SWITCH IMPLEMENTATION

In 1990, the College began investigating a new telephone switching system to replace the aging analog telephone system in an effort to alleviate the problems noted above. The College was convinced that by replacing its analog telephone switching system, it would realize a substantial cost savings versus upgrading the old system. A new digital switch would provide the college with the ability to implement other beneficial, cost-saving technologies and strategic initiatives such as telephone registration and other voice applications.

In line with the College's strategic goals for advancing technology and providing end users with state-of-the-art equipment and access, the Telecommunications and Information Services Departments installed a ROLM 9751 telephone switching system. This switch has full digital capability supporting synchronous and/or asynchronous data communications, centralized inbound/outbound modem pool access, a common dialing plan for off-campus sites, data group access and compression video support.

Advantages of the ROLM 9751 CBX telephone switching system include:

- Potential data communication through utilization of existing twisted pair cable located where ever telephone service was available. This was accomplished by connecting a PC with a RS-232 interface to a voice line plug for data communications;
- Office moves could be accomplished with no additional cabling, though charges for software changes in the CBX were still incurred. As we trained in-house staff to perform this software change function, associated costs were minimized;
- Ease of problem resolution through single vendor commitment to design, implement, train and support MCC staff for one year;
- Through standardization on level 3 and level 5 UTP cable, redundancy is built in. If one line goes bad, additional lines can be used for other data applications (i.e. LAN, Video, Print Sharing);
- Elimination of duplicate cabling for voice and data applications;
- Ability to establish management controls for user functionality;
- Voice mail capabilities.

PHASE II -- DATAPHONE AND MODEM POOL IMPLEMENTATION

Installation of the ROLM 9751 CBX digital telephone switching system paved the way for the College to implement a dataphone network which accommodated an escalating number of computer users, located on two separate campuses, requiring access to a myriad of on and off-campus hosts. It also allowed the College to incorporate an inbound and outbound modem pool.

The inbound modem pool allows users off campus to connect to a variety of on-campus hosts and services. The outbound modem pool allows users on campus to gain access to computing resources located off-site. The modem pools utilize ROLM Data Communications Modules (DCMs) to establish connectivity to the ROLM 9751 CBX telephone switching system.

Access to modem pools is accomplished through a user-friendly, ubiquitous menu system which requires minimal training of about one hour to become functional. Modem pooling has resulted in college-wide standardization of communications software, and a reduction in equipment expenses by eliminating the need for individual modems at each end user workstation.

The dataphone network utilizes the digital ROLM 9751 CBX switch as the hub, together with data phones at end user microcomputer workstations, providing asynchronous connectivity to various host computer systems on and off campus. With this application, the College utilizes existing unshielded twisted pair (UTP) cable to provide simultaneous voice and data transmission capability from the end user's data phone and workstation.

To place a call through the dataphone network, an end user first activates communications software on their microcomputer workstation. The switch displays a Call, Display, Modify prompt at which time the user types a call command and group name. The call proceeds through the telephone switch to the data group, and the DCM connects the call to a port on the remote system.

The College has realized several benefits as a result of this phase of network implementation, primarily in the area of end user productivity:

- Increased accessibility for end users, while at the same time drastically reducing hardware expenditures and implementation time;
- Users call host computing systems at a speed of 19,200 baud, faster than any modem currently available at the College;
- Improved College-wide communications by establishing connectivity to electronic mail systems and wide area networks;
- Increased portability by allowing users to relocate between various college campuses and offices, and resume access to the network in a timely manner. The end user simply takes their dataphone and workstation with them, reconnects the hardware, and requests minor software changes from the Telecommunications Department to complete the access path;
- Reduced turnaround time for such moves to less than 24 hours;
- Eliminated need for dual workstations (i.e. PC and non-intelligent terminal). PCs are becoming the standard workstation, providing access to more productivity tools.

The technology continues to be utilized as new users are added to the communications network system. The dataphone network effectively provides connectivity to occasional users of the computer systems in a user-friendly, cost effective manner. These users are satisfied with connectivity, and ease-of use of the dataphone network. Heavy users of the computing systems achieving connectivity through the dataphone network, have experienced degradation -- slower response times. In these instances, non-intelligent terminals or 3270 emulation connections for microcomputers are recommended, though it is a more costly connectivity method.

FINANCIALS ASSOCIATED WITH PHASE II

I. PRE-DATAPHONE NETWORK

MAINFRAME CONNECTION METHOD COSTS
DIRECT-CONNECT VIA NON-INTELLIGENT TERMINAL

LABOR	COST PER CONNECTION
LABOR Electricians, Systems Analyst, Facilities Management, Technical Support and Information Services Management	*$155*
EQUIPMENT Multiplexor, Cable, Cable Ends, Control Unit (leased), Control Unit Maintenance (leased), Terminal (leased), Terminal Maintenance (leased)	*$722*
TOTAL	*$877*

MAINFRAME CONNECTION METHOD COSTS
INDIVIDUAL MODEM AND PHONE LINES

EQUIPMENT	COST PER CONNECTION
Modem, Telephone Line Installation, Labor, RS-232 Cable	
TOTAL	*$835*

II. DATAPHONE NETWORK

LABOR	COST PER CONNECTION
Systems Analyst, Telecommunications	*$66*
EQUIPMENT Data Phone/Power Pak, RS-232 Cable, Modem Pool Costs, Surge Protector	*$391*
TOTAL	*$457*

III. COST COMPARISON

METHOD	PRE-DATAPHONE COST	DATAPHONE COST	SAVINGS PER CONNECTION
DIRECT CONNECT	$877	$457	$420
DIAL UP	$835		$378

The initial direction of the dataphone network was to supply connectivity to the "casual user". Expectations have been surpassed. MCC's technology goal is to forge ahead with emerging technologies, therefore we have determined the criteria for a dataphone connection to be a casual user versus heavier users of various systems. The modem pools have also exceeded our initial expectations. The trend for end users to access remote hosts has become an emerging arena. Due to this growth in off-campus network access, we are utilizing the technology of modem pools, and promoting a cost reduction in modem purchases for each user.

The dataphone network served as a fundamental stepping stone on the road to a complete voice, video and data backbone network, and went a long way in providing end user connectivity to various hosts. However, the problem of anywhere-to-anywhere connectivity for hosts and workstations still needed to be addressed.

PHASE III -- CONSULTING SERVICES

In 1992, Monroe Community College released a detailed bid request for consulting services regarding the design of a voice, data, and video cabling (Backbone) system to provide these services.

The Consultant, Rotelcom, located in Rochester, NY, completed an extensive review of all college facilities, existing cabling systems, existing computing, telephony and video support services, and the (then known) needs/wants/desires of staff, faculty, administrators.

Using the collected information, a final report recommendation for a college wide backbone system was released, including:

1. Recommendations for each building's cabling design and cost estimates to install the system;
2. Route drawings for installation of the backbone;
3. Material and installation specifications;
4. A phased implementation recommendation;
5. Finally, the ideal voice, data, video infrastructure recommendations for MCC.

The Recommendations:

VOICE

Much of the voice (telephone) network at MCC was relatively new, and had been designed to complement an integrated backbone implementation.

Briefly the recommendation outlined:

1. Standardization of telephone switches at non-compliant sites;
2. Standardization of phone mail;
3. Implementation of Automatic Call Distribution (ACD) for high-traffic areas;
4. Standardization of cable types between buildings and to the desktop.

DATA:

Topology: Physical Star/Logical Bus (10BaseT Ethernet). This physical design dramatically improves network management capabilities, and reduces failure points. The vast majority of backbone designs utilize this topology.

Media: The above design is essentially a point-to-point design, allowing inexpensive level 3 and level 5 twisted-pair wiring to be run from the hubs to the workstations. Fiber optic cable will be run between hubs and to high-bandwidth areas (conference rooms, classrooms, etc.), which also provides redundancy and eventual implementation of FDDI or ATM.

Access Method: In order to provide the most standard connectivity both internally and externally, both the MCC Committee overseeing the project, and the Project Team recognized TCP/IP as the predominant choice of access methods.

VIDEO

While there is much activity in the video products marketplace in 1993, this area is in its infancy with respect to backbone designs. Compressed video and digital transmission are several years away from economical maturity.

With that in mind, the team had presented both short-term and long-term recommendations:

Short Term (1-2 years) distribution to classrooms will continue to utilize much of the existing CATV cable that is in place.

Short Term distribution to offices will be accomplished via compressed video over unshielded twisted pair wiring (UTP) utilizing the ROLM switches.

Long-Term (3+ years) distribution to strategic areas will utilize the fiber optic cable being run to those areas.

Long-Term distribution to offices will be accomplished via an ethernet network, using PCs as the vehicle.

PHASE IV -- CURRENT STATUS OF THE PROJECT

Computing is a fundamental problem-solving tool at the College. The College community uses computing for word processing, computation, modeling, simulation, computer-based instruction, and problem solving. Today, the College community routinely uses information systems, external data bases, electronic mail and office systems for instruction, research, student services and administrative services.

In 1992 and 1993, the College experienced a dramatic increase in the number of facilities it had to support. The additions included a downtown city campus, two new main campus buildings totaling 120,000 square feet, and extensive renovations of existing space. This paved the way for the College to implement a portion of the recommendation of the consultant's backbone study.

Administrative computing functions of the College are currently supported with an IBM ES/9000 Model 210, two VAX 3100 minicomputers, three RS/6000 computers and a 9751 Model 50 ROLM CBX switch in support of voice/data networking. Instructional and Academic Computing support has migrated from an IBM mainframe computing environment to distributed workstations, microcomputers and DEC VAX mini computers. Enhanced academic management support capabilities are also provided through an IBM RS/6000 platform. The College is part of a beta group of four SUNY colleges to participate in a SUNY-initiative to implement a state-wide, automated library system on a VAX mini computer platform.

College-wide access to the diverse computing platforms noted above is accomplished through an infrastructure consisting of a dataphone network, a SNA network, and an administrative ethernet network. The key objective of these networks is to bring computer accessibility to the desk tops of faculty, staff and administrators in a user-friendly environment. The flexibility, efficiency and cost-effectiveness of this network has contributed to the successful implementation of a number of strategic applications for the College.

The SNA Network consists of the IBM ES/9000 with ten 3174 locally attached workstation controllers, each with 32 ports and a 3720 front end processor for remote site access. A variety of terminals and microcomputers with 3270 emulation cards connect to the terminal controllers through RJ62 coaxial cable and UTP.

The Ethernet Network consists of fiber optic cable and thick wire coaxial cable which allows access to all computing platforms. As recommended by the consultant, the network is designed as a physical star/logical bus topology. Primary points of connectivity include the hub at the Main Distribution Frame (MDF); the Computer Room; and the campus Library. The Damon City Center campus is linked to the main campus networking environment via a Bridge and public T1 leased lines. Currently the network uses a variety of Synoptics hubs and high speed megabyte networking functionality to provide connectivity to multiple computer platforms and host systems.

Today, by strategically placing the fiber optic cabling, we have effectively linked users on MCC's main campus and the Damon City Center campus to the networked environment. With the addition of Synoptics network equipment, we have implemented network management in a way to set the platform for future growth and migration from the existing network to a comprehensive voice, video and data backbone network.

The final backbone network will be capable of supporting all existing computing systems, and provide for an orderly conversion to future computing systems. The installation investment would allow support of multi-vendor solutions, inter-operability among diverse computers and networks, and provide solutions that could deliver savings, as well as productivity enhancements.

STRENGTHS AND WEAKNESSES OF CURRENT NETWORK

Strengths

- Increased accessibility for end users in a user-friendly environment;
- Reduction of hardware expenditures and time to install new users;
- Decentralization of data processing applications for a wider spectrum of users (promotes rightsizing);
- Improved College-wide communications by establishing connectivity to electronic ail systems, and wide area networks (BITNET, INTERNET, SUNYNET);
- Ability to allow users to physically relocate between various college buildings easily and resume access to the networks within hours;
- New users require minimal training (1 to 2 hours) to become functional;
- College-wide standardization of communications software, with fewer steps required to access wide area networks;
- The network provides for sharing resources and faster communications for intra- and interdepartmental data sharing;
- Improved data accuracy by elimination of redundant entry of data;

- Reduced obsolescence through the ability to tie older and new equipment together via the network;
- Improved network management of information systems.

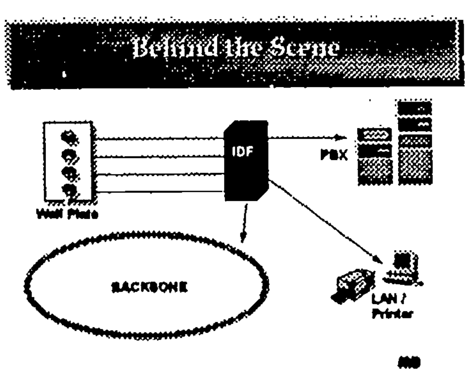
Weaknesses

- Due to a lack of standardization of computing platforms, the proliferation of networks, equipment and software from a wide variety of vendors has led to incompatibility/interconnectivity problems;
- End users not geographically located near an active Synoptics hub in an Intermediate Distribution Frame (IDF) could not easily gain access to the Ethernet Network;
- High startup costs associated with Ethernet implementation.

PHASE V-- FULL IMPLEMENTATION OF THE PROJECT

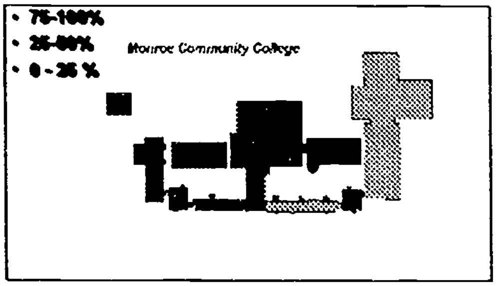
Even as MCC plans to implement the final phase of the College-wide backbone network, most of the original design and installation of the network is still working satisfactorily. This phase of implementing the entire backbone infrastructure will have to meet the bandwidth demands of the growing numbers of users, and the requirements created by more sophisticated network applications.

Utilizing the consultants study and report recommendations, the College has begun to fully implement a backbone network with a physical star/logical bus 10 BaseT ethernet topology using DECNET, Appletalk, and TCP/IP. We have migrated from expensive workstation coax cable custom links to host resources, to a less expensive level 3 and level 5 twisted pair wiring run from the hub IDF/TER to the workstation. Fiber optic 12 and 24 strand multimode cable inter-connects college buildings and floors.



This illustration depicts the standard quad plug located on each wall for voice, video and data communications connectivity, and the wiring scheme followed to connect to the backbone.

Current Backbone Installation



This slide indicates the extent to which we have already implemented fiber cable between and within college buildings. The completion date for full backbone access in all areas of the College is August, 1994.

PHASE VI -- PROJECT EVALUATION AND RECOMMENDATIONS

We believe the benefits of implementing a backbone network infrastructure outweigh the disadvantages. A carefully planned, phasing-in of connectivity techniques, such as we have reviewed in this presentation allow as-needed growth in a cost-effective manner. A needs analysis is absolutely necessary and will identify the need for resource sharing, access to remote hosts for research, e-mail, file sharing, etc. The tools are placed on the desks of the staff who will benefit the most from them. The benefits lead to improved customer service.

Recommendations we leave with you are:

1. Carefully benchmark and plan your backbone network implementation. Use the findings of a needs analysis to provide direction; and

2. Do not reinvent the wheel. Yes, your environment is different from ours, however, the method or process used to sell the concept of a backbone network, to implement it in a phased approach, and to evaluate results are generic and could be adopted to your needs.

Some College/University Roles in the Transition to an Information Age Society

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Abstract

New York State, like most states, is reeling from the on-going effects of national (and global) changes. Major businesses are still "rightsizing," some military bases are scaling back or closing their facilities, defense-oriented industries are seeking new applications of their product or service capacity, rural sections of the state are continuing to lose agriculture and heavy manufacturing as a base of employment. In this period of transition, the public sector (e.g., state and local government, education, health and social services) is doubly confronted with a diminished tax revenue and an increased need to supply services.

The State University of New York (SUNY) is now focusing on how it can help meet state needs. In one facet of this effort, SUNY has spearheaded an assessment of information technology and telecommunications as a facilitating vehicle to "re-engineer" the public sector in the Information Age. In December 1992, a task force from government and education produced a report that outlined a vision and a strategy in which the educational community of the state could be "anchor tenants" of "open" community networks that could be linked together across the state and with the envisioned "super digital highway" across the nation, the National Research and Education Network (NREN).

This vision and strategy was carried forward as the starting point for the Public Sector Task Force of the Governor's "Blue Ribbon" Telecommunications Exchange, a group of key leaders drawn from both the public and private sector to examine the state's telecommunications and recommend directions for its development. This paper summarizes these efforts from the viewpoint of higher education. It outlines some roles that we can play in creating the National Information Infrastructure, and it outlines briefly some pilot projects now underway in New York to apply advanced telecommunications in telemedicine, distance learning, library access, and the creation of community networks to promote improved access to the public sector of the state.

Some College/University Roles in the Transition to an Information Age Society

Introduction

Over the past six years, SUNY has been an active participant in establishing and furthering the development of a state-level organization of public officials concerned with information management, policy, and technology. At this time, some 65 units of state government (including virtually all the executive agencies and statewide public authorities, the court system, the State University, and both houses of the Legislature) are represented in the New York State Forum for Information Resource Management (the **Forum**). In May 1991, at the request of New York State's Division of the Budget, the Forum formed a Telecommunications Task Force to examine the strategic role of telecommunications for the state. It was my distinct privilege to chair that task force effort and present our findings in a report published December 1992.[1] We believe this effort aligned well with other assessment initiatives to prompt Governor Mario M. Cuomo to deliver the following points in his 1993 "State-of-the-State" address:

- *To make sure we are prepared to seize the opportunities presented by telecommunications technology, I established a Telecommunications Exchange ... bringing policymakers together with industry, users, and other interested groups ... to develop ... a comprehensive State strategy for telecommunications.*

- *I will ask the Board of Regents, the State University, and other appropriate agencies to develop and implement an integrated statewide telecommunications system that will extend advanced voice, video, and data networking capabilities to every student, teacher, researcher, and librarian in the State. [This initiative included the development of] ... a capital financing plan ... to enable public and private schools, colleges, universities throughout New York to develop on-campus networks to allow students, faculty, and researchers to benefit from advances in telecommunications, high-performance computing, and networking.*

- *As State and local government push to make gains in quality and efficiency, they are just as hungry as the private sector for the benefits of modern technology ... To make sure New York continues to lead in this field, we will set up a Center for Technology in Government to pursue creative new ways of applying technologies directly to practical problems of information management and service delivery in the public sector — focusing on increasing productivity, reducing costs, increasing coordination, and enhancing the quality of government operations and public services.*

The state did establish the Center for Technology in Government at the State University Center at Albany. The remaining initiatives cited in the Governor's address have been folded into the activities of the Telecommunications Exchange.[2] The "Task Force on Public Sector Applications" was co-chaired by Robert B. Adams, the NYS Commissioner of General Services, and D. Bruce Johnstone, Chancellor of the State University. Task Force members were the NYS Commissioner of Education, the Deputy Commissioner of New York City Public Schools, and the Executive Director of the NYS Association of Counties. I was pleased to serve as their chief staff resource and the Forum's report was adopted as the starting point of our deliberations.

This paper summarizes the key findings of these studies, some of the major recommendations, and highlights the rationale for the proposed strategy to create New York's infrastructure for the 21st Century. We believe that the state's recommended program of telecommunications development can further the Clinton/Gore Administration's action agenda for advancing the

National Information Infrastructure. Most important, it is vital to recognize that the public sector is both a beneficiary of and an instrument for this development strategy.

Statement of the Problem

In Governor Cuomo's prior (1992) State-of-the-State presentation, one of the major concerns was that:

> *"... more and more Americans are losing their place in the income-earning, and therefore, tax-generating - sector of our population. Instead, they must rely on Government for support."*

This address cited the problems of growing unemployment, that more people are without health benefits, and that more families live in poverty than ever before in our history.

As we approach 1994, the national trend has placed even more families under the poverty rate; unemployment and underemployment continues; with a new phenomenon ... the "disposable worker" now on the scene. Major industries are still "down-sizing," some military installations are being eliminated, and many of the defense-related industries need to shift to new avenues of work. In rural areas of the Great Lake states, agriculture continues in its decade-long decline; many heavy industries are scaling back production or entirely closing down, creating pockets of unemployment, declining public school systems and health services.

The Forum's report had asserted that -

> *New York is now facing one of the most difficult challenges in decades. The fundamental problems do not stem from a transient economic downturn ... The nation, itself, is griped in a shift in global economics, resource uses, environmental concerns, and cultural changes. While business and industries are "re-engineering" themselves to become more competitive and profitable in this new age, government will be severely stressed during this period of transition. As corporations "downsize" and people lose their jobs (or fail to find appropriate work for their level of experience and education), the public sector needs to increase:*
>
> - *citizen's access to education, training, health care, food and shelter,*
> - *support for business start up and development,*
> - *maintenance of infrastructure to attract new industries*
>
> *while it tightens its belt to reduce the tax burden on the people and corporations in transition.*
>
> *With few exceptions, this challenge is beyond the labor intensive efforts of existing public sector operations* ***unless profound changes can be made in how these services can be provided.*** (p.3)

Fortunately, one of the root causes in the economic shifts taking place may also provide the opportunity for the public sector to re-engineer itself and meet these challenges of the 21st Century.

Over the past 30 years there has occurred a dramatic convergence in computing and communications technologies. These advances have entirely changed the way information can be generated, collected, analyzed, and utilized. The "information revolution" has opened global financial trading, revolutionized modern university research, transformed manufacturing with computer-aided design and plant processes, and, in general, is touching every business and industry throughout the world.

These same technologies have direct application to the information-intensive activities of education, health care, and government. It may be plausible to collect and preserve vital information electronically and share both the information and information resources (specialized hardware, software, and staff) between and among state and local government, secondary and higher education, and between the public and private sector to reduce costs of operations and increase the quality and timeliness of the results.

While the academic community may take some pride as "pioneers" in advancing the Internet as an "open digital highway" across our campuses, it is evident that we are no longer the only participants in shaping the new electronic frontier. The "commercial internet" is now growing at a higher rate than the NSFNET/Regional Internet. There are almost daily newspaper headlines featuring yet another announcement of corporate mergers and acquisitions (such as the U.S. West investment in Time-Warner, AT&T's intended purchase of McCaw Cellular, NYNEX bidding for Paramount, and the Bell Atlantic announced $30 billion acquisition of Tele-Communications Inc. and Liberty Media). The Fall *CAUSE/EFFECT* Current Issues article noted that there are "... profound opportunities ... to harness information technology for the benefits of society, [but] ... history reminds us that technical innovation and market forces alone may not unlock this potential fully for the public good."[3] A major issue will be to find an appropriate balance between the need to stimulate the "Information Marketplace" to create jobs and new business opportunities, with the evident need to bring the fruits of these technological innovations to the benefits of all sectors of our society.

Conclusions of The "Telecommunications Exchange and the Public Sector Task Force"

The major conclusion of the Governor's Telecommunications Exchange is that the state must move from a framework of telecommunications based on a regulated monopoly to one stimulating competition and innovation in the private sector. The critical centerpiece of a competitive telecommunications environment will be to foster an open "network of networks" in which any provider can participate and through which end users can seamlessly and transparently access or move any information (audio and visual) any place. Government, however, must remain an active participant in this transition to both stimulate and guide the process when necessary and to ensure that the results benefit all sectors and communities of the state.

The Clinton Administration is now also pressing forward with a program plan to stimulate the private sector's investments to create a "Network of Networks" as the underpinnings for a National Information Infrastructure. The shifting policies at the federal level are not only evident in activities of the Federal Communications Commission (FCC), but now encompass programs (particularly in the area of health care, education, and access to government information and services).

It is most likely that the National Information Infrastructure will be built on **existing local, "community networking infrastructures"** (e.g., local telephone systems, cable TV, cellular outlets, and alternative metropolitan networking providers). Thus the national program must be built on state efforts to accelerate their internal telecommunications infrastructure against global networking standards.

The telecommunications report to the Governor will not only set the direction, but can give the Governor the direct means for accomplishing the objective. State government and higher education are not only major beneficiaries of advanced telecommunications, they can be the state's prime instrument for developing its infrastructure for the 21st Century. The public sector of New York, by design, is located in every community of the state. As a workforce, it is also the single largest employer in the state.[4] State government and higher education, alone, now operate major television, telephone, and data networks that span the state; touching every local telephone exchange, many of the franchised cable TV outlets, and most of the national telecommunications providers.

By focusing the programs of the public sector, that now use (or could benefit from) advanced telecommunications, New York would create an enormous market potential to accelerate the roll out of the private sector's investment in modern communications. Most importantly, by the state's public sector adoption of "open" networking standards[5], it also sends a dramatic signal to the vendors serving the state of our intention to move away from proprietary products and services that will not contribute to the advancement of the state's open information architecture.[6]

Program

It is necessary but not sufficient to only accelerate the development of new telecommunications technologies across New York. This state must be proactive in applying the emerging infrastructure to the critical needs of its citizens and industries. Qualified workers need jobs that provide adequate compensation and opportunity for growth. Industries need access to a qualified workforce, an adequate infrastructure of telecommunications, and other supporting services to enable them to compete in the dramatic shifts taken place around the world. New York needs to have more of its citizens producing (rather than receiving) benefits for communities across the state.

Since people live, work, and seek much of their education, recreation, and services in communities, these geographic areas (urban, suburban and rural) are basic foundations for telecommunications initiatives. Figure 1 illustrates one view of the "networked community." In this depiction, each element (library, school, business, not-for-profit civic group, etc.) of the community can be accessed by each and every other element over an "open" communications environment. Figure 2 illustrates many of the physical communications services that can be found in communities. Today, however, the existing community networks are often separated by regulation (e.g., telephone and cable TV), technological underpinnings (printed newspapers, analog television, and digital data communications), and economics (rural areas may not be served by cable TV, cellular services, or a competitive access provider such as Teleport Communications).

With the convergence of computing and communications technologies, however, all forms of communications are adopting digital standards because this form of communications is less expensive, more reliable, and allows the information to be processed (e.g., address routing, store and forwarding, packet or cell switching) for more efficient handling. Regulatory barriers are beginning to fall. Strong proposals have been made to allow full competition in the delivery of telecommunications throughout the community ... cable TV can deliver "dial tone" and the telephone company can deliver video. Even cross-ownership may be allowed between these two dominant telecommunications industries. Uniform access to advanced telecommunications for all, however, may still be an issue.

The Clinton Administration has accepted the private sector's basic argument that they will continue to invest billions of dollars to roll out the National Information Infrastructure.[7] New York accepts this pledge from the telecommunications industries and aligns with the Administration's program calling for a "**Network of Networks**," where all providers can be interconnected in a new and "level playing field" that allows anything to be transmitted anywhere across any transport system. There are some key challenges to this concept to promote a "seamless" interface among disparate networks. Universal standards for all forms of communications are not fully in place. There will be a tendency for telecommunications providers to differentiate their services by developing distinctive networking capabilities. It is no small task to level a "playing field" that has been shaped by very different interests for several decades. Perhaps most important, there is no known operational network management system that can span a network, composed of such diverse transport services, to ensure that the applications are responsive and end-to-end delivery can be maintained.

On the other hand, if the existing networks cannot be utilized together, then the nation faces an incredible cost to rewire itself to be competitive in the Information Age. In fact, if information is separated by distinctive networks, large users (e.g., a college campus) would have to contract with multiple network providers to access a full spectrum of information products and services. This unnecessary redundancy of transport systems would not only be expensive, but could limit (if not doom) movement towards multi-media where integration could exist at the desk-top (e.g., attach a voice message and a video clip to electronic mail and forward).

To move the state's telecommunications program <u>and</u> enabling applications forward, the Public Sector Task Force of the Governor's Telecommunications Exchange has endorsed the Network of Networks concept and further recommends —

- Establishment of a state Office of Telecommunications, reporting directly to the Governor. This would be a <u>small</u> office, but the "... staffing should come from the best and the brightest in the field of telecommunications ... and have the capability to provide creative, innovative, and forward thinking policy."

- Defining initial program priorities of the Office to include:

  Secondary and higher education,
  Health care (institutions and rural medical services),
  Small and medium size businesses,
  Research and development, and
  Transfer of R&D to current and future needs of state and local government.

- Creation of a Council on Telecommunications and Information Technology---representing executive leadership in state government that are now responsible for public sector issues (e.g., education, libraries, public health, safety, etc.)---to identify **how** an advanced telecommunications infrastructure and an "open" networking architecture should be applied to improve the cost-effectiveness of public programs.

- Appointing an Advisory Council---composed of representatives from the telecommunications industries, local governments, small business, and community-based organizations (concerned with issues of consumers, the disabled, schools, health care providers, etc.)---to ensure that state programs and policies are well considered and diffused rapidly throughout New York.

It is believed that the on-going transition into the Information Age requires a new level of focus and guidance within the state and that this organizational structure can provide a foundation to better shape the evolving infrastructure.

Approach

New York State government (both the executive and legislative branches) can coordinate its efforts to influence local government and other components of the public sector while it stimulates the private sector to (a) create the new Infrastructure for Telecommunications and (b) apply this emerging infrastructure to create/expand work opportunities across the state. The key to this two-prong approach lies in clearly adopting the recommendations of the Telecommunications Exchange and creating the instrument for its execution.

One component of this strategy will be to examine the potential for this state to capitalize the financing of important aspects of the infrastructure that will (or should) not be developed by the private sector. This would include wiring premises (such as college campuses, libraries, classrooms) for information services. It might also include the construction of the "on and off" ramps for the public sector to access all appropriate networking services by defining a neutral link between major premises (e.g., major complexes of state and local government, correctional facilities, college campuses, school districts, etc.) and the new access points for the Network of Networks (see Figures 3 and 4). This latter initiative could produce four desirable outcomes, i.e., it:

1. allows the state to contract with any (and all) service provider(s) that meets the "interconnectivity and interoperability" standards established by the state.

2. removes the investment costs for this linkage from the rate structures of all affected providers (both present and future entries into the service market), thus not burdening the industries with the need to recover the capital costs for these access links.

3. eliminates this component of the infrastructure costs from the service fees to the public sector. This immediately lowers existing costs for telephone, data, and television usage across the public sector ... allowing government to reinvest these "savings" to apply to the new uses of the Infrastructure. This new market for telecommunications services provides the industry with income to pay for its upgrading of their infrastructure (switches, network interconnections, etc.) across New York.

4. creates a new form of access to government services and information.

Since there are large concentrations of public sector units in every section of the state, this approach will allow state government and the private telecommunications industries to also identify where "long haul" stretches of the state will not have adequate markets to stimulate private investment but the state would benefit from its own investment to create improved access into these regions.

Pilot Efforts Now Underway

Across New York, in many communities, there are now emerging metropolitan and rural networking initiatives that support prototype and pilot efforts in Distance Learning, Telemedicine, Improved Public Safety, etc. These are independent efforts, often sponsored by different sections of the telecommunications industries that are seeking the "killer" applications to spearhead their investments for new technology. In brief, some of the numerous initiatives include:

Rochester Area Interactive Telecommunications Network (RAITN) ... Initiated by Rochester Telephone Corporation, with the assistance of Rochester Institute of Technology and the New York State Education and Research Network (NYSERNet). A fiber optic network linking a number of high school districts, several Boards of Cooperative Educational Services (BOCES), and higher education institutions to provide educational audio/video/data services into classrooms and into the community.

INFINET 2000 (*INTERACTIVE FIBER OPTICS FOR NEW EDUCATIONAL TECHNOLOGIES*) Distance Learning Network ... A New York Telephone partnership with the BOCES that links six Dutchess County School Districts and BOCES together to provide diverse instructional offerings into small school districts.

NYNET (*The New York Network Project*) ... a NYNEX trial of ATM (Asynchronous Transfer Mode) technology at 155 mbps. The present effort links the Cornell University (a Supercomputer site), Syracuse University (a parallel computing site), Rome Labs, and the University of Rochester. Some applications include — Digital Library, Electronic Publishing, Health Care, Virtual Reality in Education, Financial Modeling, and Medical Information Processing.

Comprehensive Health Information Network ... a program of the Western New York Health Sciences Consortium, consisting of hospitals, schools of medicine, research institutes, and medical centers in the urban and suburban areas of western New York linked together in an Information System Network and connected with Rural Health Cooperatives in a pilot effort to improve and extend health care through telecommunications.

NYClassNet ... a New York City, NYNEX, New York Telephone, and Northern Telecom venture with the City School District and the City University of New York to link city government, schools, and higher education with broadband switched interactive video for education and teleconferencing.

The New York State Learning Network ... a state government, NYNEX, New York Telephone venture with the State University of New York to link the University Center at Albany, the Hudson Valley Community College, and the SUNY Satellite network together to provide high quality interactive video/data support among remote classrooms and academic resources (e.g., libraries) as well as to increase the number of campus sites that can broadcast educational programs via satellite.

Other initiatives are not pressing advanced technology, but are targeting deployment of community information networks such as the FreeNet™.[8] Presently, there is a FreeNet™ in operation in Buffalo, with several regions of the state (e.g., Albany, Utica/Rome, the Catskill region, Ithaca) in various stages of planning/implementation. The community information network is presently based on dial-up data access to community-based information provided and maintained by volunteers. It offers bulletin boards for "posting" civic events and announcements; provides electronic mail and discussion services on topics such as health care, education, government activities, recreation, and anything else of interest that the community wants to provide to itself.

While the underpinning technologies may differ, all of these innovative efforts have a number of things in common, e.g.,

1. they are separate, independent initiatives that are targeting important informational needs of communities, and

2. they all use one or more of the existing community networks beyond their original goals of providing telephone or broadcast cable television services throughout the community.

3. an institution of higher education is usually an important component of the program.

4. If successful, there is no mechanism (other than market interest) to accelerate their deployment to other needy communities throughout New York.

Another recommendation of the Public Sector Task Force is to create a public sector/private sector telecommunications laboratory test-bed environment to accelerate the test and evaluation of innovative uses of telecommunications under the new direction for developing an infrastructure for the 21st Century. The test-bed program would examine the interaction of policy, procedures, technology, economics, etc., to accelerate the diffusion of positive change. It would also provide a means for discovering and examining new issues that emerge from such a large scale interaction of novel systems. This would tap the state's considerable depth of research capability across the higher education community of New York.

Summary

New York's economic future rests in having private sector business and industries that are competitive in the world markets. This state must ensure that viable business and industries, both large and small, have access to a skilled labor pool, appropriate university technological research and development, an efficient and responsive government, and the emerging telecommunications infrastructure that can link them within this state (and across the globe) with an expanding and changing marketplace and list of suppliers.

To meet this need, it has been recommended that New York —

1. Adopt a transition strategy to move from a framework of telecommunications based on regulated monopolies to one stimulating private sector investment, competition and innovation.

2. Foster an open "network of networks" where all interested parties are able to fully participate and compete in the network fairly and without discrimination.

3. Encourage a policy of an "Open Architecture" for communications among all components of its public sector to remove incompatible technology as a barrier to sharing information and information resources when appropriate. This architecture is to improve the links among secondary and higher education, between education and employer provided training, between state and local government, and between government and the citizens and businesses that they serve.

4. Establish a Council on Telecommunications and Information Technology for state and local government that can examine and implement changes in applications and policy that can accelerate the development and use of this state's Open Architecture and the infrastructure for telecommunications to improve education, health care, economic development, and government operations at all levels.

5. Forge linkages with existing organizations of New York (through the Advisory Council) such as the Business Council of New York State, the New York State Telephone Association and Cable Television Association, etc., to maintain continuous lines of communications concerning the needs and opportunities of the private sector to develop and grow in New York.

As the concept and architecture for New York's *Network of Networks* is identified, a policy study would also be made to determine how the state's investments in its own use of telecommunications and information technology could best complement the private sector's investments in providing telecommunications and information services across New York. It may be plausible for this state to bond a portion of the needed construction to accelerate private investment opportunities to reach and better serve all areas and sectors of the state.

Higher education, as members of the community and a major outpost on the new electronic frontier, is well positioned to apply advanced technology and telecommunications within its own programs of research, instruction, and community service. It is also best positioned to ensure that the new settlers benefit from the positive aspects offered by our on-going transition into the Information Age.

END NOTES

*1. TELECOMMUNICATIONS: A Vital Infrastructure for the **New** New York. This report is available in the CAUSE Exchange Library (CSD-0711).*

2. To complete its efforts, the Telecommunications Exchange established five task forces working in the following areas:

Telecommunications-based and Related Industry
Technology Diffusion
Infrastructure, Technology and Investment
Regulatory Options
Public Sector Applications

3. "Some Roles for Higher Education in Shaping a National Information Infrastructure," CAUSE/EFFECT, p.3, Volume 16, Number 3, Fall 1993.

4. Winokur states in the Empire State Report, October 1992, that government employs 1.4 million workers, health and social services some 2.3 million ... versus 1.2 for retail trade, 1.0 for manufacturing, and 110,000 in agriculture.

5. The recommendation has been made that New York's public sector adopt the data communications protocols of the NREN. Presently this encompasses the four-layer internetworking communications architecture which includes the unique Transmission Control Protocol and Internet Protocol (TCP/IP).

6. It is estimated that the annual "technology" purchasing power of the state and some 4,000 units of local government exceeds $1 billion annually. This figure does not include the remaining components of New York's public sector (e.g., 139 private institutions of higher education, public libraries, not-for-profit organizations, and some areas of health care).

7. "...The private sector will lead the deployment of the NII. In recent years, U.S. companies have invested more than $50 billion annually in telecommunications infrastructure...In contrast, the Administration's ambitious agenda for investment in critical NII projects...amounts to $1-2 billion annually." (p.6) The National Information Infrastructure: Agenda for Action, September 15, 1993.

8. FreeNet™ is sponsored by the National Public Telecomputing Network (NPTN), begun at Case Western Reserve in Cleveland, Ohio, by Dr. Thomas M. Grunder. The NPTN-affiliated community information networks are provided with programs such as Academy One, aimed at providing K-12 schools (students, teachers, administrators, and parents) with "Educational Telecomputing." The NPTN also offers its affiliates with a number of information services such as electronic news (e.g., The Los Angeles Times, The Washington Times, USA Today), electronic journals and magazines (e.g., Forbes, The National Review, Insight), electronic books and documents, medical information services, software services, etc.

TELECOMMUNICATIONS + ISDN = OPPORTUNITY

CAUSE 93

by

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Abstract

On-campus connectivity is important to the daily operation of the institution. We can expect the speed and access requirements to have continued growth. As we look outside of the university, we see opportunities of significant proportions for an institution's infrastructure. Appalachian State University and Cal Poly, San Luis Obispo have used the campus infrastructure to provide opportunities to their institutions by connecting K-12 public schools and off-campus student housing through the use of narrow band ISDN. Corporate partnerships were instrumental in these installations, but operating expenses are now a part of ongoing budgets. The campus organizations have been flexible in accommodating these external networks and systems. Cal Poly has primarily data applications but has recently added distance learning and other functions, while Appalachian has interactive video, voice, multimedia and data. If you are thinking about external connectivity, networks and systems, these are both proven components of existing systems. Technical specifications, costs, development, funding and applications will be discussed.

INTRODUCTION

Higher education is going through a transition. Some have described the current situation as a revolution. Whatever one calls it, something is happening in higher education. The ground rules are changing, the "business as usual" is being challenged and the methods of funding education are being revisited. Accountability, reengineering, outsourcing are no longer confined to the corporate and business sector and are finding their way into institutions of higher learning. Strategic alliances and business partnerships are no longer found entirely in the corporate sector, they are indeed becoming a way of life at many institutions. What we are seeing is a revolution in education that happens maybe once in a lifetime. Opportunities and challenges abound for those who seize the initiative to expand their horizons, for those who seek a new way to do business. As resources dwindle and competition for those resources increases and the marketplace for our product becomes more aligned with a global perspective, the demands and necessity for change march on undiminished.

This paper will describe how two institutions, Appalachian State University in Boone, North Carolina and California Polytechnic State University (Cal Poly) in San Luis Obispo, California are approaching this revolution. Both institutions are known for their technical orientation, telecommunication infrastructure and the integration of technology into their educational and administrative processes. The process has not happened quickly, but is the result of visionary CEO's who early-on saw that education and technology were inextricably bound together in the ultimate success of the institutions. They recognized that the world was changing and positioned their institutions to change appropriately. It was at times arduous journey, but as will be shown, a successful one.

CURRENT CAMPUS INFRASTRUCTURE

Appalachian State University

Appalachian State University has a 13 year old coaxial cable system which is nearing the end of its life cycle and is currently being replaced with a fiber backbone. The new backbone will consist of an inner redundant ring with a series of six hubs around the campus. The campus buildings are being serviced with stars off each hub. Both single mode and multi mode fiber are being pulled in a 3 to 1 ratio. Class 5 wire is being pulled in all new buildings with fiber being used in specific cases and when justified. ISDN lines are available options on all campus telephones.

Ethernet is the center of the communications network and a VAX cluster forms ASU's mainframe. Standard protocols, Internet, LANs, E-mails, etc., are standard integral parts of the architecture, as is found at most institutions. What is different at Appalachian is the use of narrowband ISDN initially in the College of Education and ultimately across the campus.

Southern Bell installed the ISDN module and software on an existing 5ESS digital switch in the Boone Central office. The AT&T Foundation provided a $775,000 grant of software, computing and telecommunications equipment and the Appalachian State University Foundation purchased the video equipment. To date almost $3 million has been generated from private funds for the project. Vendors in the project who have provided equipment, technical assistance and financial support include CLI, NCR, Combinet and DIGIBOARD.

Cal Poly

In 1987, Cal Poly signed a long-term contract with Pacific Bell to provide Centrex IS telephone service. Using flexible, least-cost routing and other techniques, Cal Poly was able to reduce long distance costs and reinvest the savings to upgrade its telecommunications infrastructure.
One of the first efforts involved replacing the outmoded broadband baseband coax with a new

FDDI fiber optic backbone in 1990 supporting campuswide data and video distribution. Like ASU's, the backbone is a redundant, multi-fiber ring with a series of five CISCO hubs or routers servicing 39 core campus buildings and selected residence halls. Wiring in key instructional buildings were upgraded to support ethernet, token ring and Appletalk LANs.

With more than 4,000 on-campus connections and 15,000 accounts, Cal Poly's network provides campuswide access to academic and administrative applications on the university's IBM ES/9000-732 mainframe, an IBM RS/6000 cluster running AIX (Unix) for instruction, distributed Unix servers, local and remote on-line library systems and services, instructional databases, E-mails, Internet, Bitnet and other resources. Access to off-campus computing resources is provided by CSUNET, a T1-based systemwide regional network.

Many faculty, staff and students take this level of on-campus network connectivity for granted, and want and need the same level of connectivity at home. Older, 1200-baud analog modems used to be sufficient to dial into the campus network, but enhancements in personal computers and application software have rapidly outgrown their capabilities and the capacity of Cal Poly's 150 dial-up modems.

In December 1990, Pacific Bell installed an AT&T 5ESS ISDN-equipped switch in its San Luis Obispo office, making ISDN service an option on all campus telephones. ISDN provided not only improved phone services and simultaneous high-speed data transmission, but increased the deliverable bandwidth on campus to 57.6 Kbps. While making current networking needs easier, ISDN also opened the door to a whole new range of applications the university can deliver into homes.

As part of a joint study with Pacific Bell and AT&T, Cal Poly installed 250 ISDN lines on campus in faculty and staff offices where direct network access was not feasible, and tested ISDN service in 13 local residences. When the one-year trial ended in 1991, the results were positive and the Cal Poly Residential Information Services Project (CRISP) was born.

PROJECT DESCRIPTION

Appalachian State University

In 1991, BellSouth, Southern Bell and AT&T entered into a 10 year partnership with Appalachian and a seven county public school partnership to integrate telecommunications technology into the educational process using interactive video, voice and data.

"Impact North Carolina: 21st Century Education" came on-line in February 1992 with three ISDN lines to each of the following locations: Blowing Rock Elementary School, Parkway Elementary School and Watauga High School and four lines to the College of Education at Appalachian State University. One line is for data and is tied to a LAN. Another line is connected to a multimedia workstation. The final line is tied to a videoconferencing unit. All of the ISDN lines are dedicated and are currently used in a point-to-point configuration. There is one spare line at the university site.

The four sites have 20 computers in a LAN using NOVELL software. The file servers are connected with an ISDN line and have connectivity with Appalachian State University's Ethernet backbone. This provides project users access to the university's VAX cluster and a full array of resources that are available to the university employees, such as electronic mail, library catalogs and Internet. Software can be shared between sites and has been purchased with this in mind. The data component is the most heavily used portion of the system.

The multimedia workstation is used to enhance the data connectivity by providing interactive graphics. Images can be scanned or retrieved from storage and passed between sites. A digitizing tablet allows each site to annotate on the image. This is the second most heavily used portion of the system.

The videoconferencing unit has proven to be the culminating portion of the system for the users. After activity has been completed on the data and multimedia portions, video connectivity is generated for users to see and talk with each other. The video uses 112 Kbps for the video signal and 16 Kbps for audio.

The total video unit consists of two monitors (one for outgoing pictures and one for incoming pictures), a three chip camera, a document (overhead) camera, an audio system and a remote, wireless control unit.

This is a flexible, communications system which is being used to integrate technology into the total education process, as well as provide a communications infrastructure for all users, kindergarten through university faculty. The project is application driven and addresses issues of pre-service, in-service and K-12 studies concurrently. ASU has shortened the learning curve and implementation of results by addressing these three areas simultaneously.

Pre-service activities include integrating the telecommunications and technology into the curricula of undergraduate and graduate students, student teaching functions and hands on experience in the test bed schools.

In-service activities have focused on obtaining a lead teacher at each school who has full release time to conduct training for the teachers at the school. These lead teachers have become the resource to brainstorm with other teachers how to use the equipment and technology in their courses and involve the students.

K-12 studies have involved the students in cross age, cross discipline, and cross school and university activities and projects. Examples of the types of activities include: an at risk class at high school working with a graduate class at Appalachian to research Appalachian religions; high school math student working with an 8th grade student because he had gone beyond the teachers at the grade school; graduate student teaching a class at the high school; two 4th grade classes at different schools preparing riddles and answering them; and accessing data bases and information and communicating outside the university through Internet.

Cal Poly

In 1991, Cal Poly began providing ISDN services to staff faculty and students in the Cal Poly Residential Information Services Project (CRISP). This project provided a campus Centrex ISDN line into 13 student, faculty and staff homes initially, a number that has grown to about 60 now.

In 1993, CRISP enhanced its services through the use of new customer premise equipment (CPE) providing analog voice service over an ISDN line as well as high-speed data connectivity. As a result, CRISP members now have CPE with an analog phone jack providing up to five ringer equivalents or lines, and a simultaneous 57.6 Kbps data connection. Cal Poly makes this service available for under $40 per month. At first glance this appears expensive; however, many households have multiple phone lines for voice and data each costing approximately $15 per month, a minimum outlay of $30 per month for one voice and one data line.

Two types of ISDN lines are available: the Basic Rate Interface (BRI) and the Primary Rate Interface (PRI). The BRI provides two B channels each capable of providing voice or 64 Kb circuit switched data services to a distinct device. The BRI includes an additional D channel providing 16 Kb of bandwidth on a packet network. The BRI uses the packet network for signaling and supporting several other packet devices simultaneously. In comparison, the PRI or ISDN T-1 provides 23 B channels and a single D channel.

The bandwidth of several B channels can be combined in a process called inverse multiplexing or bonding. During this process, a single data service with bandwidth exceeding a single BRI is broken up into separate 64 Kb segments by a piece of equipment known as an inverse multiplexor. The inverse multiplexor sends each of these 64 Kb segments in parallel down one B channel. At the other end, another inverse multiplexor recombines each of the segments creating the original data service.

To deliver video data which is inherently bandwidth intensive, a compression scheme to reduce the size of video images is required. Two common formats found on microcomputers are JPEG and MPEG.

JPEG stands for Joint Photographic Experts Group, the committee that wrote the standard. Designed for compression of photographic images, it uses a lossy scheme, meaning the compressed picture differs slightly from the original. JPEG takes advantage of distortions undetectable by the human eye so that people rarely notice the difference between the original and compressed picture. When compressing 24 bit/pixel images (256 colors), JPEG typically reaches 10:1-20:1 compression ratios. For example, a full-screen 24 bit VGA picture (640x800 pixels) takes approximately 140 K.

MPEG, developed by the Motion Picture Experts Group, is used to compress video data with motion. This format allows 200:1 compression ratios in a sequential series of single frames. MPEG accomplishes the high compression ratio by compressing the original frame, and instead of compressing each following frame individually, only compressing the changes from the previous frame. Thus, a comparable television picture (512x480 pixels) MPEG picture takes approximately 3.5 Kb.

Cal Poly's ISDN network consists of two sides, the machine room (or incoming side) and private residences or offices. On the machine room side, Cal Poly owns 11 BRIs connected to AT&T 7500 terminal adapters. These terminal adapters each provide two X.25 9.6 Kbps connections over the D channel associated with the line. Users entering the Cal Poly network in this fashion connect to a terminal server for a direct Internet connection and full access to available resources.

In addition, Cal Poly owns three BRIs each connected to two Telrad 285-D1 terminal adapters providing six ports. The Telrad ports offer 38.4 Kbps connections over the B channels of the BRIs using a proprietary rate adaption format. To access these lines, the end user must use another Telrad set to place the data call. These ports allow the same access as the low speed 9.6 connections available through the AT&T 7500s, but also allow a Serial Line IP (SLIP) connection. By installing the correct drivers on a user's PC, this line in effect mimics a direct ethernet IP connection, enabling users to run telnet and file transfer protocol IP programs directly from home.

Currently, these SLIP connections require a dedicated IP address for each high speed port. However, Cal Poly is exploring new software for the terminal servers that will allow the user to choose their IP address when initiating the SLIP connection. In this manner Cal Poly can provide each user with their own independent IP address and name service.

ADVANTAGES

Appalachian State University

"Impact North Carolina" has been a cost-effective project during its first year and a half of operation. The ISDN lines received a special assembly from the Public Service Commission of

North Carolina because the rates had not been tariffed. The monthly charge for the 13 lines is $13,000 per year. The rates are distance sensitive and the lines are available 24 hours a day.

Since this is a university-sponsored project, all upgrades to the system and LAN software become a part of the university or state negotiations with vendors. Appalachian is a depot site for NCR, and hardware maintenance receives a special rate. One of the options from NCR is to purchase a specific number of hours of maintenance with parts being available at a specified discount.

Multiple user licenses have been purchased for software that will be used at more than one site. Software costs have been reduced and availability of software is from fileservers at the different locations.

With ISDN, all users on a LAN can be using E-mail at the same time. A modem on one phone line would allow only one computer to access the system at a time.

The K-12 students are bringing an increased level of knowledge of the technology and telecommunications to the next class level. Appalachian undergraduate and graduate students are using the equipment in their course work and student teaching.

Because the technology is being made available to teachers without specific instructions on how to use it, creative and innovative ideas are surfacing, being tried and used in the classroom settings.

Cal Poly

Placing ISDN in private residence makes it easier for students, faculty and staff to access the various computer systems on campus at a speed comparable to that found in campus labs and offices.

Students at Cal Poly today, regardless of major, can expect at least one class every quarter requiring the use of a computer. For many students, this means spending long hours in campus computer labs or purchasing expensive devices to access resources from home at less than ideal speeds.

Cal Poly currently supports some 2,000 student workstations in computer labs and not all are networked. Space for new and larger labs is limited and demand for access is increasing. ISDN connections could eliminate the need for "dumb" terminal labs entirely, replacing them with microcomputers linked to ISDN connections providing round-the-clock network access. Equipment could be consolidated into existing spaces, freeing up lab space for other purposes. With physical access to the labs no longer necessary, operating costs would be significantly reduced.

The ability to access campus resources from home will encourage increased use of computing in the curriculum and classrooms, providing faculty with incentives for exploring new methods of using technology for teaching and developing educational materials. Many Computer Science classes already require students to submit assignments in electronic form. As faculty and students become more comfortable with the technology and access increases, this trend towards *paperless* assignments will only expand.

San Luis Obispo County recently enacted laws requiring places of business, Cal Poly included, to reduce the number of vehicle trips made to and from their location. Increasing telecommuting and delivery of education via the network can greatly reduce the number of required trips to campus. The ISDN service enables staff and faculty to access their office computers from home using software such as PC-Anywhere, Carbon Copy or Timbuktu. With the ability to forward office calls to the home, this makes telecommuting a reality. As students become more familiar with

various information resources and the concept of telecommuting, their marketability in today's competitive job market will also rise.
Other benefits include unlimited connectivity to campus data systems at no additional cost; the ability to have multiple appearances or phone numbers ring at home including work numbers; and complete compatibility with any household phone, answering machine, modem or fax machine. This allows ISDN to completely replace existing residential telephone service without sacrificing existing functionality.

Finally, because Cal Poly provides the phone service and thus performs the billing, Cal Poly recoups the cost of providing the service as well as the costs of providing the on-campus network connections, making CRISP self-supporting. Moreover, Cal Poly anticipates significant productivity gains to result from more cost-effective and efficient use of campus resources.

IMPROVEMENTS

Appalachian State University

The data runs at 64 Kbps between LANs, which is not adequate in some situations. Combinet has provided two bridges that increase the transmission from 64 Kbps to 128 Kbps. It uses both B channels and provides for data compression to increase speed between the two sites. Initial access is to one B channel with compression and then access to the second B channel when traffic passes a threshold level. An example can be seen with loading Worldbook Encyclopedia CD-ROM at one location from another location and reducing the time from 7' 6.98" to 3' 35.65".

Interactive sessions have been held from "Impact North Carolina" sites to TRIP92 (Transcontinental ISDN Project 92) in Reston, Virginia, Governor Cuomo and New York State Technology Commission in Albany, New York, and AT&T Network Systems Executives in Basking Ridge, New Jersey. The K-12 students were active participants in these teleconferences.

North Carolina's CONCERT network is a high-end videoconferencing network that connects several universities and medical research institutions in the state. It uses greater bandwidth than "Impact North Carolina," but interoperability to the K-12 sites is obtained through service multiplexors and coaxial cable. The three public schools will have connectivity through ISDN, although with reduced bandwidth.

CD-ROMs, VCRs and portable video cameras have been used a variety of programs and projects to enhance the teaching and learning environment. The teachers and faculty are finding new uses and ways to incorporate additional equipment into the infrastructure.

Cal Poly

Current customer premise equipment allows for analog voice service on the first B channel and a simultaneous data connection of 57.6 Kbps over the second B channel. Ideally, Cal Poly would like to see a box providing bonding of the two B channels to provide a 128 Kbps connection and analog voice service. This new CPE would set up a dual bonded (128 Kb) connection, and when detecting an incoming voice call, drop the second B channel (and the connection down to 64 Kb) for voice use. When the user terminates the voice call, the CPE would again bring up the second B channel and bond it with the first.

In addition, ISDN implementation around the country is still limited, with islands of activity. Data calls within the same Centrex are easy and efficient. However, calls outside of a CO remain difficult to guarantee and manage. Local telephone companies must strive to develop a residential flat rate tariff. Although the current system allows for users to place unlimited data calls within Cal Poly's Centrex system, voice calls not within the university system are charged by message unit.

ISDN service is currently distance limited to certain areas beyond the campus. Cal Poly is negotiating with Pacific Bell to extend ISDN service throughout San Luis Obispo County in 1994. Other plans are underway to expand network capability between the campus and other parts of California through pilot projects with telecommunication vendors to develop and test high-speed, gigabit networks.

Future goals at Cal Poly include developing a method to deliver full-motion video resources over ISDN lines. As noted previously, a television quality MPEG picture requires 3.5 Kb per frame. Full-motion video is almost undetectable at 15 frames or 52.5 Kb per second. A single BRI with bonding provides 16 Kb (128 k) of bandwidth. To deliver full-motion, real-time video over ISDN will require caching or a compression scheme utilizing higher ratios. Under a caching scheme, the user would first download the data to their local machine, requiring three times longer than the actual length of the video signal, and then play it back at real time. This system would work for a video version of voice mail, or overnight delivery of a movie or a class lecture.

THE FUTURE

Appalachian State University

"Impact North Carolina" will install a multi-point control unit (MCU) to provide the users with the added capability of being able to communicate with video from one site to multiple sites. Being looked at is a central office bridge and a customer premise bridge. A decision will be made soon as to the direction the project travels. As one might expect, there are advantages and disadvantages to either approach.

The CLI CODECS at the present time operate with a proprietary compression algorithm and cannot communicate with other vendors. CLI will supply upgrades to be installed in December to modify the CODECS to meet CCITT standards. They will further add the industry standard 16 Kbps, low bit rate audio and Standard Plus software.

DIGIBOARD will supply three bridges for the data component which will allow faster communication from the LAN at the College of Education site to the LANs at two other sites. One dual IMAC bridge will be located at the College of Education and a single IMAC at the other two sites. This will provide similar improvements in transmission speeds with Combinet bridges as previously discussed.

The North Carolina Information Highway (NCIH) is a statewide infrastructure that will install nine ATM switches across the state and use SONET for transmission. "Impact North Carolina" will be connected to the NCIH through the state's CONCERT network which is a high-end videoconferencing network that connects several universities and medical research institutions in the state. It uses greater bandwidth than "Impact North Carolina," but interoperability to the K-12 sites will be obtained through service multiplexors and coaxial cable at 330 mhz. The three public schools will have connectibility through ISDN, although with reduced bandwidth.

Video technology has advanced since the inception of this project. "Impact North Carolina" started with dual monitor units for classroom conferences. In the last nine months, personal video units and small group video units have become available and will be made available to the users. The users will determine how these smaller video units can be utilized in teaching and in the classroom.

NCR will install their new WaveLAN on the local area network at the university. WaveLAN uses advanced radio-frequency communication and will be used to show alternatives to hardwired LANS. There are benefits to having this type of networking and the teachers will assess the utility and enhancements it can make to the project.

Cal Poly

In 1992, Cal Poly began using two way interactive video to distribute courses on campus and to its satellite agriculture facility at Swanton Pacific Ranch, 200 miles to the north. Just recently, Cal Poly and IBM began a joint study to test the viability of delivering instruction ("education on demand") over the network to classrooms or homes using a repository of digitized materials stored on the ES/9000.

Adjacent to Cal Poly's video production and distance learning facilities, a Faculty Multimedia Development and Testing Center was established in March 1993 and equipped with 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.

Cal Poly is committed to developing electronic classrooms equipped with high-resolution projectors, quality audio, microcomputers with high-speed network access, and presentation software. Faculty will be able to bring their own presentation control software to the classroom, connect to a local or remote server, and access a wide variety of digitized materials to enhance a classroom lecture under their individual control. Cal Poly envisions having the capacity to "digitize" lectures which can be edited, indexed and stored along with course materials. Both the lectures and materials can be retrieved later to supplement existing classroom instruction or as education courses delivered "on demand" in non-traditional settings, such as a graduate-level degree program for students who work full-time.

Electronic textbooks and libraries will become the standard rather than the exception. Cal Poly is working 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. Future enhancements will include electronic or video mail to enable instructors and students taking "education of demand" courses to interact, remote registration and payment of fees, and sharing of courses between multiple campuses.

ISDN in the community will play a major role in bringing "education on demand" to the home. With high-speed ISDN data lines, users can access Graphical User Interfaces (GUIs) like X-windows to take advantage of integrated multimedia applications like ***SuperBook***.

Several related issues will be addressed as these concepts are implemented, including licensing and copyright protection of intelligent properties; faculty release time and compensation for developing course materials; and the impact of non-traditional educational methods on learning and interpersonal relations. Transactional monitoring and pricing techniques will be explored in a joint study between Cal Poly, Bellcore, Lawrence Livermore Lab, Chevron, and the American Chemical Society.

On a systemwide level, CSU is spearheading Project DELTA to support multi-campus efforts to develop new methods of delivering instruction using technology. For example, Cal Poly is working with CSU Long Beach to develop a distributed database of digital information provided by CSU faculty. Cal Poly is also cooperating with local community colleges and K-12 school districts to implement distance learning and multimedia services, and assisting with efforts to develop community access networks. One concept currently being explored is a "Video Yellow Pages" in which users would connect, enter the name of the service they want, and retrieve multimedia "want ads" such as a restaurant menu featuring pictures of that day's specials.

Companies, such as Hewlett-Packard, have expressed interest in having Cal Poly deliver graduate level degree programs remotely to their employees in Silicon Valley, and Cal Poly is working with Pacific Bell, SP Telecom, Sprint and other vendors to establish the necessary high-speed data links to facilitate these and other "education on demand" services.

CONCLUSIONS

"Impact North Carolina" and "CRISP" have proven that strategic alliances and partnerships can work effectively between public education, business and higher education. Commitment, compromise and common goals are indispensable in the success.

Prototypes and models can be initially funded through a partnership, but expansions must be accomplished through hard dollars, budgets and purchases. The corporations cannot be expected to fund expansions since their initial involvement was to develop a process, a model or a prototype. The cost of expansion has been found to be less than the initial project cost. Product improvements and unit prices have fallen in most instances.

With ISDN as a telecommunications infrastructure, the on-going annual costs are reasonable and affordable. These costs are divided between the user groups and placed into the fixed budgets of each user. Major annual expenses have been identified as hardware and software maintenance, ISDN lines and additional equipment, such as CD-ROMs, VCRs etc. Software purchases have been handled out of existing budgets. ISDN provides an affordable way for students, faculty and staff to access the campus network from their homes. It also provides the university with a revenue source to continue network enhancements.

The opportunity to work with the education community has been stimulating to faculty. A sense of ownership has been generated in the project and curriculum revisions have started. The inclusion of the technology in courses is expanding in the public schools, Appalachian and at Cal Poly. Students and faculty are all levels of education are participating and benefitting from the enhancements.

A paradigm shift is taking place in instruction, from a mode of faculty–student interaction taking place in specified locations (campus classrooms) at specified times (class schedules, office hours) to one in which students have access to most of the information content in a variety of forms at their convenience (when they choose, and where they choose from a variety of locations, including their living quarters). This shift is possible because several technologies have matured which provide the basis for major changes in the delivery of instruction.

Education in the future must support delivery of real-time, simultaneous two-way video presentations, multimedia presentations, and "education on demand" to students, faculty and staff both on- and off-campus in their homes and work places. This is vital to overcome economic, cultural and physical barriers to learning. Shrinking resources and increasing demand require innovative methods of delivering education and services to traditional and non-traditional students, and appropriate use of information technology is critical to meet this need.

Both ASU and Cal Poly are exploring several cost-effective technology solutions designed to improve productivity, reduce labor intensity, provide new ways of delivering education and better services to students, "customers" and "stakeholders," while maintaining their competitive edge. Achieving these goals will move the institutions towards becoming fully integrated "electronic campuses" in which students, faculty and staff are linked to information services and technology without regard to their physical location.

Eventually ISDN will be replaced with something newer, faster, and cheaper, just as it is replacing analog telephones. However, ISDN represents an important breakthrough in preparing society for the concept of providing information services in their homes. ISDN allows the leap forward from providing simple text information over the telecommunications line to a full-scale multimedia delivery system.

Strategies for Recovering the Costs of the Campus Data Network

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1. Introduction

This paper explores the methods an institution might use to recover costs associated with an internal campus data network. Choosing and implementing such a strategy is becoming more important as data networks grow in size and complexity. Such growth brings increasing operational and management costs. Pricing network services is an extremely delicate task. If not done correctly, network growth could be stifled, or, alternately, over built and misallocated.

2. Background

Approximately two years ago, the University of British Columbia changed the way service units derived their operating budgets. Instead of relying on central funding from the President's office, the service units would be paid for services rendered by individual schools, departments, and other functional groups on campus. This represented a major departure from prior budgetary policy. Luckily, the transition was to be staged rather than occurring overnight.

The term "cost recovery" has become synonymous with this type of decentralized budgetary scheme. That is, selected support services recoup their costs from other groups within and outside of the campus community.

Institutions are beginning to explore cost recovery for data networking for several reasons. First, it introduces an element of market forces into the decision-making process with regard to allocation of information technology resources. Second, it holds the promise of bringing costs under control, and increasing efficiency. Expenditures are made only if the users of related services demand them. Whether these advantages accrue in reality lies outside of the realm of this paper, but is an extremely relevant topic.

The UBC Computing and Communications unit was given the mandate to operate using decentralized funds as soon as possible. The telecommunications group was already cost-recovered. Telephone users paid monthly and long distance fees, which included internal staff and overhead costs. This example is often cited internally at UBC as a successful cost-recovered organizational unit.

Other units within C&C were given the task of becoming cost-recovered. In particular, the MIS development group started operating on a contractual arrangement with clients. The Academic Systems group started to charge for UNIX computer usage. Use of the modem pool was billed at $1.20 per hour to individual users. Well over 50% of the C&C budget is currently derived from cost recoveries and decentralized funding sources.

The Central Networking group, with a mission of designing, monitoring and managing the campus backbone, was given the task of cost-recovering its activities as well. Unfortunately, little was known as to how to proceed in this area.

Augustson, in Gillespie(1989) proposed three criteria for determining whether computing services should be cost-recovered. First, the service should be strategically important to the university and its competitive position. Second, the service should be emerging, immature, or innovative. Finally, the service should be viewed as infrastructure. By these criteria, data networking would seem to be a perfect candidate for central funding.

The UBC Data Networking Task Force (Tom et al(1992)) took a slightly different position. The task force noted that by not allocating the costs of the network to users fostered the notion that it was in fact free. Of course, backbone networks are very expensive, and some method for cost allocation as well as market feedback was necessary. The task force suggested that capital costs of the network be taken from central funds, with operating, management, and maintenance costs passed on to individual units.

With scant literature on the specific topic of data-networking cost recovery in the university environment. Central Networking began to search for a method of implementation. First, a business plan was formulated, defining a market and proper vehicle for delivery of backbone networking services. Second, an advisory group of departmental network administrators was formed. One task of the advisory group was to outline possible schemes for backbone cost recovery. Finally, Central Networking undertook a survey of academic institutions which indicated that they cost-recovered data networking wholly or in part. The indication was obtained from the CAUSE on-line database at cause.colorado.edu.

This paper will be limited to discussion of the survey methods and results, presented in the sections that follow.

3. Methodology

A survey questionnaire was developed to determine the different strategies used to cost recover central data networking services. The questionnaire is included in Appendix A.

The questionnaire was constructed with two purposes in mind. First, background information regarding the respondent's institution was solicited. The questionnaire asks for the size and type of the network and whether services are provided to the wall plate. Second, and most important, the respondents were asked to describe the method(s) for recovering networking costs, and to what extent the method(s) were utilized (i.e., percentage of budget recovered).

The questionnaire was mailed electronically to institutional contacts in the early part of May, 1993. A second, follow-up mailing was done in the last week of the same month.

The responses were classed according to types, based on both budget recoveries and method employed.

4. Sample

The sample consisted of approximately 90 institutions indicated either partial or full cost-recovery of data networking according to the profile in the CAUSE database. The database was located at the Internet site cause.colorado.edu.

The report from the database indicated the institution name, the contact, and whether services were cost recovered. Email addresses for each contact were determined by querying the member database at cause.colorado.edu. Roughly 5% of the institutions listed in the initial report had contacts with invalid or missing email addresses.

The questionnaire was mailed to 90 institutions. Responses were obtained from 28, or 31%. 5 responses were not usable. Either the site did not cost recover data networking, or the responses to most questions were in large part missing. Thus, the final sample size was 23.

Table 1 contains a summary of the survey responses. It also shows some characteristics of the sample. 54% of the sites had networks comprised of 2000 nodes or more. The average number of networked nodes per institution was 3440. All budgets were $200,000 US or greater. The average number of subnet segments per site was 86, although the variation was quite large.

5. Results

Five strategies were found to be used by the respondents in the sample. Each is described below. It should be noted that none of the respondents used any type of per-packet or volume-based charging. Updegrove's

Penn State summary, found in Appendix B, makes a cogent case against such a policy. The fact that no volume-based charges were levied by any of the the institutions came as a surprise.

Mixed service offerings. This strategy offered the widest variety of products and accompanying charges. Users arranged for simple backbone connections via a wide range of media, or opt for per-node wall plate service. The fee structure was somewhat flexible, depending on the type of service desired.

Per-node fee structures. Each node on the network is assessed a monthly or yearly fee. Usually this implies that service is supplied to the wall plate. Although departments might obtain bulk discounts for large number of nodes, the fee charged is essentially fixed, regardless of the service type.

One-time Installation Fees. Costs are recovered only when a network port or subnet is installed for the first time. No recurring charges are assessed.

Telecom Subsidy. Network service costs are hidden within a cost-recovered telecommunications budget. The income from voice services subsidizes the data network.

Computing Services Subsidy. Network service costs are hidden within the general computing services budget. The income from email and cpu utilization charges subsidizes the data network.

Table 1 below summarizes the survey results, categorizing respondents by type. Network characteristics are shown. Nodes indicates total number of network endpoints. Segments indicates the number of segments or workgroups within the network. Management shows whether responsibility extends to the communications closet (CC) or the wall plate (WP). Yearly operating budget, in $1000s, is listed. Finally, the percentage of the operating budget that is cost recovered is shown. Within each category, institutions are rank-ordered by network size (node count).

Table 1
Cost Recovery Strategies and Network Characteristics

	Nodes	Segmts	Mgmt	Budget ($1000s)	% Rec	Comments
Mixed Services						
Univ Wyoming	1400	50	WP	350	100	
Univ Texas HSC	1450	70	WP	200	70	
Penn State	4200	300	CC	7000	100	
UC Davis	4500	140	CC	600	20	Moving to full rcvry
Per-node Charges						
Fort Lewis Coll	134	20	WP	200	22	
UC Irvine	4500	180	WP	500	50	% Recvry estimated
Harvard	17500	200	WP	1000	100	Fees are 50%
Installation Fees						
Queensland Ins AU		61	WP	1600	10	
Macalester	415	6	WP	800	10	
Univ Nebraska	1725	76	WP	2900	100	
Kent State	2550	8	CC	200	100	
Univ Colo HSC	2650	250	WP	2500	100	
Univ Kentucky	2900	55	WP	700	100	
Univ Arizona	6210	100	WP	2000	10	
Univ Georgia	8235	80	WP	1000	10	
Eastern Wash					10	
Telecom Subsidy						
West Michigan	837	22	WP	300	100	40% from install fee
Grand Valley	870	10	WP	300	70	
Baylor	2690	30	WP	2000	100	50% from install fee
South Ill Edw	2050	35	WP	300	100	10% from install fee
Univ New Hampsh	4100	30	WP	400	100	35% from mixed svcs
Computing Services Subsidy						
Dallas CC	2000		WP	400	100	Uses email fees
U Cincinnati	2650	50	WP	500	100	15% from install fee
Average	3503	84		1170	69	
Std Dev	3671	81		1491	39	

6. Analysis

Reliability and Validity. The validity of some of the responses is questionable. In particular, the budget figures should be considered carefully. Most respondents had difficulty determining the exact budget for central data networking. The sites with the best budget estimates are most likely the largest ones, which have cost centers dedicated to the data network. This makes it simple to determine the budget size. Second, the budget question did not asked to specify capital versus operational costs. The two were sometimes mixed by some respondents, while others just gave operational costs.

Network size estimates probably contain some error, but most seem to provide the figures with confidence. Segmentation estimates vary, as the exact definition of the term is hard to pin down. Sites with bridged networks will report few segments. Still, most of the sites use routed networks, such that the segmentation estimate holds some validity.

Charging Model. Clearly, the two most prevalent models were installation charges and service subsidy. 69% of the responses fell into these categories. Only one major university, Harvard, completely recovered costs using per-node charging. Three other major universities used the mixed service model.

7. Discussion

It was hoped that the survey would have produced larger variation in the types of solutions. Unfortunately, there were few real attempts to treat data networking as an actual cost center. This is probably due to the newness of the technology, and the propensity to treat the network as infrastructure overhead rather than a service.

Using installation fees as the sole basis for cost recovery seems untenable over the long run. In fact, the largest cost over time is more likely the operations and maintenance charges for keeping the network running. If one has to front load these expenses entirely at installation time, the users would be disinclined to join the network, and growth would slow.

Installation fees are acceptable if one makes a speculative assumption. Assume that technology is consistently changing, and that by the time the network reaches saturation, a new technology, requiring new hardware and installation schemes, will arise. This guarantees a steady income stream. Unfortunately, this is a difficult assumption upon which to build a source of revenue.

The subsidy models (central computing or telecommunications) use older technologies as an income stream to support up the data networking services. This works in the early phase of network startup, but can present problems if the old source of revenue dries up, or the user demand for networking services sharply increases. This scheme also inflates the prices for voice or central computing, making alternative technologies or third parties competitive, and possible erosion of the market. Overcharging on voice to pay for data might lead users to look for alternatives. However, distributed services such as email, directory services, CWIS, etc., might provide a future income stream that might subsidize the basic network infrastructure. However, like the installation fee scheme, the subsidy model is not likely tenable over the long term.

69% of the respondents indicate using the schemes above, which do not hold out promise for the future in a decentralized, cost-recovered environment. Two models, per-node charging and mixed services, are used by Harvard and Penn State respectively. These sites are leading the way in showing how to operate data networks in an atmosphere of decentralized funding. An edited questionnaire response from Penn State's Steve Updegrove is contained in Appendix B. The response from Harvard's Steve King can be found in Appendix C.

The mixed services model seems to make the most sense. At UBC, we have asked the network administrators for input on this issue. Most felt that if we had to charge for network services, a market basket approach was the best. This allows the departments the largest amount of flexibility. Some departments may want to install their own LANs to their own specifications (following standards, of course), and may only want a backbone connection. Others, with less technical expertise, might opt for to the wall plate service, with monthly charges per port. This scheme seems to follow the one currently followed on the Internet, whereby one can place (theoretically) unlimited number of nodes behind a router connection. Charges accrue on the basis of bandwidth allocated, and the cost of equipment and management.

The mixed service model has another advantage. Providing a market basket of services encourages the organization to broaden the offerings in order to achieve large penetration. One can establish "soft" network services, such as distributed printing, email, and conferencing. All of these depend on the network infrastructure directly, and can contribute funding as overhead. Such "soft" service offerings can foster network growth by adding to the traffic mix, and providing a revenue stream for upgrading as necessary.

The mixed model also adapts better to new technologies. One can envision setting up a wireless hub/subnet. How is one to determine the number of nodes behind this hub? Registration is obviously necessary, but the problem of enforcement can be daunting.

The per-node model is also usable. It scales the income stream to the size of the network, allowing for orderly capacity planning. However, it only works if the institution has full control to the wall plate. Speaking from experience with users at UBC, clients will balk at paying per-node fees if they are only using a backbone connection to their own custom LANs. If most LANs and requisite internal wiring are under central control (like the telephone system), then per-node charging makes sense. It is related to the way one charges for telephones - i.e., per circuit.

In summary, offering a market basket of services, tailored to the needs of the users probably makes the most sense. It allows the user to fashion a LAN to their liking, with the ability to purchase extra services as necessary. Our users at UBC seem to prefer the approach, and Penn State has provided an excellent example as a starting point.

8. References

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Appendix A

Survey Questionaire

Dear fellow CAUSE member,

We are conducting a survey to determine the various methods of recovering costs for data networking at academic institutions. We decided to survey CAUSE member institutions identified in the CAUSE member database as having implemented a cost-recovery mechanism for data networking. This survey is being distributed to roughly 100 CAUSE contacts from those institutions.

The purpose of the survey is to inform our own planning process. We will make public (possibly presenting a paper at the next CAUSE conference) our findings to assist others struggling with the same thorny issues.

Please take a few moments to fill in the form below and email it back to me. Since the sample is small, a reasonable percentage is necessary to obtain valid results. Please respond no later than May 14, 1993 to be included in the survey.

Hopefully, the form should take no more than 15 minutes to complete. Thanks in advance for your time.

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Data Networking Cost Recovery Questionnaire

Name:

Title:

Institution:

Department:

1. Are central data networking services provided (e.g., campus backbone)? Please describe *briefly*. [e.g., network management, DNS, Email]

2. Please *briefly* describe the campus network: type, topology, protocols. [e.g., inverted fibre backbone, ethernet, 10 based-T LANs, TCP/IP, Appletalk, DECNET]

3. Please give the number of total network endpoints (comput ers, peripherals).

   Break this down by

Number of Intel-based PCs/servers:
Number of Mac-based PCs/servers:
Number of RISC-based workstations/servers (SUN, HP, RS6000, ...):
Number of network-attached printers:
Other:

4. Please provide the approximate number of network devices (routers, bridges, hubs) managed by your networking organization.

5. How many subnets/workgroups are connected within the campus network?

6. How far does your responsibility for network management and service extend?

   [ ] To the building communications closet.
   [ ] To the building floor closets (including risers)
   [ ] To the wall-plate.
   [ ] Other:

7. How are data networking costs recovered? Please mark the percentage of the data networking budget covered by each.

   a. Individual user fees per unit time: %
      [where such a fee is a charge per user per month]

   b. Network endpoint fees per unit time: %
      [where such a fee is a charge per workstation/PC per month]

   c. Subnet/workgroup fees per unit time: %
      [where such a fee is charge per LAN per year]

   d. Overhead fees charged to other service offerings: %
      [i.e., internal charges to other computing or network services]

   e. Lump sum payments by faculties, schools, or departments: %

   f. One-time network endpoint installation fees: %
      [where such a fee is a charge per PC network hookup].

   g. One-time LAN installation fees: %

   h. Per-data-packet or other volume usage fees: %

   i. Grant funding: %

   j. Other: %

8. Please *briefly* elaborate on the cost-recovery methods listed in the previous question. In specific, how are central facilities charged versus local LANs?

9. What is the approximate size of the budget for central data networking services?

10. Does your organization cost recover academic and administrative computing?

11. Would you like to receive an electronic copy of the survey results? Please provide an email address for delivery if different from the one in the email header.

Again, thank you for your time.

Appendix B

Case Study
Pennsylvania State University

The response from Penn State was very thorough. It is presented here in its entirety.

From: Steve Updegrove
Administrative Director
Office of Telecommunications
Penn State University

The Office of Telecommunications is responsible for video, data, and voice communications services, and is organizationally part of the Office of Computer and Information Systems, which in turn reports to the Provost of the University.

The data network is rapidly growing and dynamic within the 23 campuses that comprise Penn State. Our philosophy is to encourage individual colleges and departments to add to their LAN's without centralized "policing" of number of devices

We administer a University-wide data backbone service, which includes the responsibility for centralized network management, all facets of providing, maintaining, and perpetuating the functions represented by the various types of equipment and services which are a part of that (including inter- and intra- LATA T-1 and 56K circuits, packet switching nodes, routers, and distribution cabling), and assisting each campus, most colleges, and numerous administrative departments in design of their LAN's. Email and other services used by those who have been networked are provided centrally by other divisions within our parent organization, or within the context of the attached networks. As the client-server model of computing matures, the nature of these are changing, but there will be some form of central data networking services, regardless of how one defines that, provided for a long time to come.

Standards of all natures have been defined as strategically desireable. Among these are the use of TCP/IP as the data backbone protocol. However, in response to pressure by DECnet users, a policy has been developed requiring us to continue support of DECnet for at least a period of one year after DECnet Phase 5 is fully announced, providing a transition time for those users to move to the OSI suite. We currently tolerate tunnelling of Appletalk. Even so, periodic spurts of interest arise in supporting Appletalk in the native mode, despite its proprietary, non-standard nature. To date, the additional costs to manage a separate logical Appletalk network have not been justified by the set of Appletalk features that cannot be supported by TCP/IP, but the evaluation is an ongoing one.

At the physical level, the backbone is based on FDDI, with some remnants of a past Pronet-80 and -10 being used to meet specific needs, and the pathways to the campuses providing at least a full 56K, and in many cases several times that. (Several campuses are connected via T-1's, which support bandwidth needs for both compressed interactive video as well as data.) Backbone services are provided centrally to a point on each campus, from which either 802.3 or 802.5 (ie., Ethernet or Token Ring) networks can be extended. Cabling is considered as being infrastructure, both among and within buildings, and is generally installed in a physical star within the buildings from a few telecommunication closets. We have adopted the use of Type 2 cabling as a minimum cabling standard, allowing for additional types of cabling (such as fiber or unshielded twisted pair) to be used where conditions warrant. We are currently evaluating the possible adoption of level/category 5 cabling as a potential successor to the use of Type 2, based on it's slightly lower installed cost, and it's similar performance capabilities. Fiber is used between buildings, with over 75% of our major buildings currently connected. At least 6 fibers are installed to each of these, with up to 144 to facilities such as the main Library build- ing.

We currently have about 4200 registered addresses, about 1200 of which are for pc's in laboratory environments. There are probably several more (100's) of unregistered machines scattered among the local networks. (Central registration is strongly encour- aged but not required. Although there are certain limitations for unregistered machines, and there is no fee to register, registration is at the discretion of the individual user or department.) There is also a large administrative SNA- based network with a 2000 users or so that is slowly being transitioned to the TCP/IP backbone.

We manage 4 class B and 10 class C networks, broken into roughly 300 sub- nets, with an additional 100 workgroups networks being divided within that structure. (These are exclusive of the network at our Hershey Medical Center, which is managed locally, except for name service which is provided centrally for this large multi-router network.) We manage abour 40 routers, 30 bridges, and 40 concentrators/10BaseT hubs.

Our responsibility includes everything "inside" the network, with the for- mal demarcation point being the end of the cable attached to the back of the router. With SNMP, we "look" further into the individual LAN's, and in some cases directly into the pc. We offer a cost-recovered service to design, install, and maintain local networks for those who do not have or want to pro- vide that expertise themselves. This applies both at our University Park cam- pus as well as at the other campuses located throughout Pennsylvania. We are also responsible for the management of the centrally installed cabling systems. This is true regardless of whether the cabling has been upgraded to meet minimum cabling specifications or is still previously installed telephone wire. The main areas, in terms of data networks, for which we are NOT responsible are for LAN electronics (concentrators, bridges, servers, communication cards) for individual LAN's which are managed by individual departments.

It will take some time to define and align our data networking budget in accordance with this criteria. We do not define a DATA NETWORKING budget per se--there is an overall telecommunications budget which includes data networking services, but which is subdivided by different criteria.) In the spirit of trying to provide something useful, there are a few comments worth offering:

--our philosophy is to avoid penalizing anyone based upon which Penn State location they happen to be at, so fees are generally location-independent.

--rates are developed based on different services, in turn functions of connect ion speed, cost of leased facilities, and whether it is useful to stimulate its growth by subsidization with central funds. (Note that there is no specific subsidy of data, voice, or video services by rates generated from either of the other two services.)

--When a service is to be fully cost-recovered, we make every effort to include in that rate not only a reasonable amortization period for up-front costs, but also a mechanism to generate both maintenance and replacement (life-cycle) funds.

--Two distinct telecommunication budgets are administered--one to account for the use of central funds (generally to support infrastructure, and to support "immature" services) and the other to account for "mature" services, for which all provisioning costs are recovered.

--To pay for fringe benefits, office space, and other services used by that portion of the office providing "mature" services, most rates include a 22% overhead to pay for those types of costs. Exceptions are notable for services having high percentages of equipment costs (assessed a half the rate) and for labor costs of networking services within residence halls (billed to the Housing office at cost).

--Departments are expected to pay for their LAN from their departmental budget.

--The data backbone service is sold at a fee of $3200 one time cost, and a recurring monthly charge, regardless of the number of devices attaced to the LAN, of $275. This pays for the electronics, installation, maintenance, and replacement necessary to continue up-to-date service levels. The connection can be either 802.3 or 802.5, at the department's direction. We also encourage individual departments within buildings to consolidate their needs. In those cases where segregation of the building is warranted (e.g., for security or performance reasons) we will install and manage a "building backbone" consisting of a small network-in-a-box, and bridges to networks attached to it. This also requires one person in the building to assume the role of a "broker" for the building networks. (This is in addition to persons being identified as the network's administrative, technical, and security contacts for that connection.

--We also offer an "individual backbone connection" in certain buildings (those in which we can make it financially viable) which is currently billed at $750 one time and $15/month, which is equivalent to past data-switch and SNA service connection costs. In those cases, we provide and manage not only the routers, wiring, and 10BaseT concentrators, but also the card and communications software in the pc itself. IBC's are provided on only individual bases--they may not be used as network connections.

--We do not count packets, and in general do not base rates upon usage level, instead using flat rate monthly costs as our preferred model. As noted above, we also encourage autonomous growth of local networks, with registration of addresses being about as close as we get to monitoring that aspect (unless we are retained to manage the network, in which case we do keep close tabs on it).

--Because we are not a academic entity, we do not directly submit grant request s, although we oftentimes work closely with those who do for telecommunications related items.

The telecommunications budget for this year is slightly over $15M, with 1/6 of that centrally funded, and the remainder cost-recovered. I'd estimate that about 1/4 of the $15M supports "central data networking services" directly, and another 1/4 indirectly (meaning it is shared with other services which bear a portion of the costs of circuits and the like.)

Appendix C

Case Study

Harvard University

The response from Harvard is included here, edited for readability. Harvard has by far the largest network of all of the respondents in the survey, and recovers most costs from monthly node fees.

From: Stephen J. King
Associate Director
Office for Information Technology

Harvard has installed a 10MB, fiber backbone for the University, a very capital project, and OIT has a high speed data network business unit doing network operations center, LAN support, and consulting

The Harvard data network is a distributed architecture, with 7 major nodes, based on TCP/IP and supporting IPX, Appletalk, and Ethernet protocols

Number of Intel-based PCs/servers: 6000
Number of Mac-based PCs/servers: 9000
Number of RISC-based workstations/servers (SUN, HP, RS6000, ...): 500
Number of network-attached printers: 2000

7 major hubs or nodes, lots of central monitoring equipment, hardware in over 500 buildings, approximately 200 LANs being connected over time Responsibility extends to the wall-plate.

50% of the budget is recovered from node fees per unit time. 10% comes from workgroup/subnet fees. 10% is derived from installation fees. The rest is made up from overhead and lump sum payments by departments. Note that the entire budget of approximately $1M is cost-recovered.

NIC Knack Paddy Whack Give That Information a Home: Campus Wide Information Systems and its Service Agent the Network Information Center (NIC)

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ABSTRACT

The global web of computer networks called the Internet is an open door to information for campus staff, faculty and students. While the potential is immense, the challenges faced by the information technology organizations and libraries is daunting. When planning for, implementing and managing this new catalyst for change; information professionals need to provide an infrastructure and support mechanism for this service in order for its use to be successful. The Network Information Center (NIC) and the Campus -Wide Information System (CWIS) will play a primary role in helping its users to master the language, culture, and tools of the next decade in education. Never before has an information technology infrastructure been such a strong catalyst for change, which will totally alter the educational process as we know it. In the wake of these changes this presentation will discuss:

- How to organizationally set up a NIC and CWIS:
- Getting the NIC and CWIS funded;
- Getting them started;
- Multiple uses of the Internet, CWIS and NIC;
- Ethics and security issues;
- Academic information delivery;
- Administrative information delivery;
- Library issues;
- Encouraging faculty, staff and student access;
- Navigating tools and services for the Internet, CWIS and NIC;
- Campus-wide issues.

Campus Wide Information System and Network Information Center as Catalysts for Change

The phenomenon of virtual communities on-line has deep roots in Campus Wide Information Systems (CWIS). Although CWISs and Network Information Centers (NIC) are sometimes hard to label, they're real, growing and affecting your life whether you participate with them or not. In the last few years we have witnessed major advances in technology and public awareness of networking solutions.

Well, time has passed since personal computers started a minor revolution. Another revolution, argumentatively larger than the first even has the President's office mentioning *the information infrastructure as a catalyst for change*[1]. Since the Internet has become mainstream there has never been a better time for properly managing the CWIS and NIC to create a positive change that can truly transform the campus and its people.

CAUSE's statement about optimizing the infrastructure should be the creed of those who develop the next generation of CWISs and build its service agent, the NIC.

> "As our need to be connected--to each other and the world--grows, networks proliferate and the clamor for new networking access grows. Tantalized with the possibilities for instantaneous communication and immediate access to vast sources of new information, staff, faculty, and students hold high expectations for the new order. However, while the potential held by the new infrastructure is immense, so are the challenges for those who plan for, implement, and manage it."[2]

In the wake of these challenges, great opportunities lie where the NIC and the CWIS will play a primary role in helping "Infonauts" master the language, culture and tools for the next decade of world wide education.

This paper's intent is to discuss the CWIS and its servicing agent the NIC and to enlighten the reader with relevant examples and experiences. Arizona State University makes no claims to be the model Campus-Wide Information System nor Network Information Center, but ASU does feel we have gained some important insights, hindsights and lessons learned on our journey to develop our new CWIS and NIC. Our method of developing these two entities on the cheap did initially hamper our efforts, but current senior management approval is providing the resources for new, more responsive, user centered systems. Practical application methods will discuss: how to organizationally set up a NIC and CWIS; getting the NIC and CWIS funded; getting them started; multiple uses of the Internet, CWIS and NIC; ethics and security issues; academic information delivery; administrative information delivery; library issues; encouraging faculty, staff and student access; navigating tools and services for the Internet, CWIS and NIC; and campus-wide issues.

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[1] The National Information Infrastructure: Agenda for Action, Vision Statement of the Presidents Office for the NII by the National Telecommunication and Information Administration, September 1993.
[2] Kathleen Martell Ciociola, Track V Coordinator and CAUSE Program Committee, "Optimizing the Infrastructure: Track V Statement," CAUSE93, December 7-10, 1993.

What is a CWIS?

According to the Internet Glossary, "A CWIS makes information and services publicly available on campus via kiosks, and makes interactive computing available via kiosks, interactive computing systems and campus networks. Services routinely include directory information, calendars, bulletin boards, and databases."[3] This definition is accurate, but quite limited. For example when Brown University first talked about the future of their CWIS, they mentioned it being a paperless society, marketing tool, menu system which integrates all campus services, latest course announcements, database applications, collection point for all campus policies, frequently asked questions , personal calendar/scheduler, and electronic forms.[4] CWISs are virtual kiosks in the sky with on-line "anytime anywhere" access to a wealth of campus resources.

Campuses are not the only organizations running wide area information systems businesses, government agencies, and cities have grasped the concept and joined the Internet world to share their resources. Since many CWISs are letting users out the back door of the system to the vast resources of the Internet, the new generation of CWIS administrators like the term World-Wide Information System (WWIS). Not only are CWISs more available to other Internet resources, but the new generation of CWISs are more responsive and user centered for all users. In order for any information system to be successful, it must have support.

What is a NIC?

Sitler, Smith and Marine (1992, p. 4) state, "A Network Information Center is an organization whose goal is to provide informational, administrative, and procedural support, primarily to users of its network and, secondarily, to users of the greater Internet and to other service agencies."[5] Just like CWISs, NICs can be anywhere in the Internet world. Because of the Internet's growth, users find it increasingly difficult to navigate through the maze of available resources, such as the hundreds of CWISs. NICs contain information of interest to the target user community (campus, community, state, world). Generally, a NIC lists information on what to do on the Internet, as well as specific local information, such as newsletters, guides, travel logues and popular navigation software.[6]

A NIC has three main functions. The first is called information services or help desk functionality. This is the place where you call, email or fax to get help about network resources like a CWIS. The NIC is your first aid station for finding out how to get connected and where resources are on your CWIS or other CWISs and the Internet. InterNIC refers to this reference desk service as the "NIC of first and last resort." What InterNIC means by this is they will answer beginners questions and expert navigators questions. The information services also handles the training and educational material for the CWIS and networks.

The second function of a NIC is directory and database services. Sometimes referred to as the yellow pages and white pages of the networked world. This is where

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[3]G. Malkin and Tracy LaQuey Parker, "Internet User's Glossary," Request for Comments: 1392, FYI 18, January 1993, p. 9.
[4]Mary LaMarca, Suggestions for Future use of CWIS, Brown CWIS, Brown Gopher, February 8, 1993.
[5]D. Sitzler, P. Smith and A. Marine, "Building a Network Information Services Infrastructure," Network Working Group, Request For Comments: 1302, FYI: 12, February 1992.
[6]Susan Calcari, "What is the InterNIC?, NIC fest '93, November 6, 1993.

someone would ask questions like: How do I find curriculum resources on the CWIS?; and how can I put my information onto the CWIS and the Internet? The directory of directories is the road map to finding rich resources like library catalogs and data archives.

The third function of a NIC is registration services. Registration services for a CWIS sets up accounts for members of the community to be information providers and provides users with assistance on policy issues. This third essential function usually operates the accounts and access privileges of the CWIS and the corresponding Internet connections.[7]

The NIC is one stop shopping for information about the CWIS and the Internet. One important aspect of the NIC is its ability to coordinate services which are across many organizations and levels within the campus. Personnel from varied functions interact and exchange experiences to provide help for the end users. The NIC support can be as instrumental as establishing on-line help for the CWIS, to working off-line with faculty on using the CWIS and network tools effectively in the classroom. In order to support these varied tasks, collaboration is a key.

Think Globally, Act Locally

The strength of the Internet's current success is collaboration, cooperation, and communication. The Internet's success teaches us the key to ultimate success of implementing a CWIS and NIC is coordination and the collaborative culture of the Internet. Never before has there been a time when so many people can communicate so much information with so many people. There are many organizations that can help, co-develop, and pool resources to ensure the CWIS and NIC at the local level is satisfactorily serviced.

Most everyone believes information is power and knowing what is occurring with other organizations trying to solve the same problems that your organization may have is what the collaboratory nature of the Internet is all about. There are many organizations at the world, federal, state and local level that can assist your campus with administering the CWIS and servicing your end users with a NIC.

World Level

A world wide group, the Internet Engineering Task Force, is the protocol engineering, development and standardization arm of the Internet Architecture Board (IAB). It has grown to be a large open international community of network designers, operators, vendors and researchers concerned with the evolution of the Internet protocol architecture and the smooth operation of the Internet. A CWIS and NIC project team does not need to reinvent the wheel, rather make adaptations and changes to other CWIS and NIC software, documentation, policies and procedures from thousands of world wide organization doing just what your organization is doing.

Federal Level

At the federal level funded, by the National Science Foundation, is InterNIC which is a focal point between Network Information Centers and end users. The InterNIC cooperates with regional, campus, governmental agencies and international

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[7] InterNIC Backgrounder, NIC fest '93, November 6,1993.

NICs to stay abreast of the current requirements of these organizations and their users. Another entity at the Federal level is The Clearinghouse for Networked Information Discovery and Retrieval (CNIDR). CNIDR is sort of a 'Consumer Reports' type group which works closely with the developers of other network navigation tools to move them toward providing compatibility and consistency. CWIS developers can get help from CNIDR regarding which CWIS software to use at your campus. These two groups are only a few of the very helpful federal level groups to cooperate with to run a successful CWIS and its service agent the NIC.

State Level

The Arizona State Public Information Network (ASPIN), with funding from the National Science Foundation, is developing a Network Information Center for the State of Arizona. The Governor's Strategic Plan for Economic Development is writing legislation to fund the State NIC and is planning on giving additional funds to the ASPIN to help expand the state network to the rural areas. Some of the rural area expansion dollars are to start CWISs in the rural community colleges. Arizona State University is helping to coordinate all of the new Internet connections in the rural community colleges and to form a cooperative NIC of NICs to help support end users and develop CWISs. Arizona's Freenet organization called Arizona Community Computing (AzTeC) is looking to join forces collectively with community level CWISs and NICs to provide seamless support for all communities, equal access and support for state internetworking

Local Level

ASU's NIC

Organizationally, the ASU Network Information Center consists of a help desk with four part-time phone consultants, a NIC-Q@ASU.EDU email list for questions, a populated on-line consulting system, and a virtual NIC, which is a Gopher directory containing items that help users find information about the Internet, NSFNET, WESTNET, ASPIN, and ASU networks and navigational software. The NIC is especially intended as a reference point for new CWIS and Internet customers to use in obtaining general information about the ASU Gopher CWIS and the Internet, especially how to connect, usage policies, and user guides. A pointer to the InterNIC (Network Information Center) of first and last resort, InterNIC, is included here. Other useful NIC Gopher Servers, general purpose Internet guides, information, newsletters, phone books, and Internet navigation information are also included.[8]

The Network Operations Center menu provides up-to-date information about Internet outages that are scheduled or have just occurred which can be used to help one plan one's use of the Internet. By checking here, a user may discover that the site they are trying to reach is down, and not a result of their own software/hardware configuration. Any user can also see various statistics for usage on the Internet/NSFNET as well as ASU's Gopher Server usage statistics.

ASU Information Technology also provides an on-line consulting service for Internet related questions as a part of ASPIN (the Arizona State Public Information Network). Questions and requests for information can be sent in an e-mail note to NIC-Q@ASU.EDU or you may call the ASPIN NIC consulting line at 965-7000.[9]

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[8]Baldwin, Doug, About the Network Information Center, Gopher CWIS ASU, November 18, 1993.
[9]Baldwin, Doug, About the Network Information Center, Gopher CWIS ASU, November 18, 1993.

ASU's CWIS

At the campus level, the Arizona State University Gopher is our Campus-Wide Information System, which provides a central delivery vehicle for information about Arizona State University. It is easy to use, and finding information is facilitated through a simple searching mechanism or browsing a hierarchy of menus. As an added benefit, the interface has the same "look and feel" of a variety of platforms, so computer users familiar with Gopher on one system can easily adapt to Gopher on the other systems. Finding information on the ASU Gopher is as simple as selecting a cheeseburger from a menu. The ASU CWIS gives computer users at ASU access to similar systems throughout the world and those at other universities access to information about ASU.

The "ASU Campus-Wide Information" directory contains information from various departments and organizations at Arizona State University. Some of this information is located on various college or department gopher servers, however, some is located on the ASU CWIS Gopher Server. In any case, the information providers are responsible for the contents of their own particular "branch" of the ASU CWIS Gopher system. ASU Information Technology makes no claims for the accuracy, currency, or reliability of the information contained in these sub-menus.

ASU departments and organizations, and soon off campus organizations, that would like to contribute their own sub-menu should read the item "How to Contribute to the Arizona State University Gopher" in the same directory and as seen below.

Figure 1 **How to Contribute to the Arizona State University Gopher**

How to Contribute to the Arizona State University Gopher (11/18/93)

As you are probably well aware, the potential for Gopher as a tool for distributing information of all kinds, from all sorts of places, is great. It takes creative ideas from all kinds of people to make a truly useful Gopher. The very nature of Gopher lends itself well to bringing information from a wide range of providers into one integrated structure.

At ASU, we are attempting to make it easy for departments and organizations to become information providers for the ASU Gopher Server. ASU Information Technology (IT) is providing the "conduit" and support for these contributions. Individual organizations and departments are responsible for their own "branch" of "gopher-space". All an "Information Provider" needs is their own Gopher server or authorization to use a new facility called "Gopher-Lunch" to "feed" the main ASU Gopher Server maintained by ASU IT.
Access to ASU department/organization Gopher Servers/sub-menus will be through the "ASU Campus-Wide Information" item from the main ASU Gopher menu. An "Information Provider" has the following options available for contributing:

1) Run your own Gopher server on a Unix workstation.
 + The Unix Gopher Server software is the most robust and reliable.
 + WAIS full-text indexing is available for database searching.
 - Unix workstations tend to be more expensive to buy/administer.

2) Run your own Gopher server on a Macintosh computer.
 + The Macintosh Gopher Server software is extremely easy to install and use, making this a good solution for new providers.
 + Macintosh computers tend to be less expensive than Unix workstations.
 + If most of your information is in Mac format, there will be less file conversion/transfer involved.
 - Depending on the processing ability of the Mac, this may not be

a good solution if traffic to your information gets very heavy.
- WAIS full-text indexing is not available for database searching.
- Disk storage space tends to be an issue.

3) Run your own Gopher server on a PC computer running Unix.
+ PC compatible computers tend to be less expensive (and used ones more available) than Unix workstations.
+ There is public domain Unix software available for PC's
+ WAIS full-text indexing is available for database searching.
+ If most of your information is in DOS format, there will be less file conversion/transfer involved.
- Depending on the processing ability of the PC, this may not be a good solution if traffic to your information gets very heavy.
- Disk storage space tends to be an issue.

4) Submit information to IT's ASU Gopher Server with "Gopher-Lunch".
+ The easiest way to get information into the ASU Gopher.
+ Gopher-Lunch works through a Gopher Client or through simple E-mail.
+ You do not have to administer the server's platform/operating system.
- You may be limited to a certain amount of disk space.
- You will have to transfer files to the system.

In all cases, you will have to coordinate with ASU Information Technology to have your submenu added to the "ASU Campus-Wide Information" menu.

For easy access, pointers to the Gopher Server software described above are included in the same directory as this file is in. The Gopher-Lunch command menu is also included here so once you get authorized as an Information Provider, then you can begin adding items.

To get authorized for Gopher-Lunch, or to have the ASU Gopher Server point to your own Gopher Server, send an e-mail note to "gopher-help@info.asu.edu". Or, easier yet, if you're running a Gopher+ Client that supports ASK blocks, select the "Request to become an Information Provider to the ASU Gopher" item in this directory, which will let you fill out and submit a request form to "gopher-help" automatically.

NOTE: Supported Gopher+ clients are: Macintosh TurboGopher (version 1.0.7 or greater), PC Gopher III (version 1.1.2 or greater), HGopher for Windows, or Unix Gopher (version 2.0 or greater). The Gopher Clients on the ASU Academic IBM VM/CMS and Academic VAX currently do not support ASK blocks and will not work). Once your request has been approved or denied, you will be contacted with more information on setting up your part of "gopher-space". Thanks for your interest!

--The ASU Gopher Team[10]

At ASU we are moving to a production Gopher CWIS server, which will be automated with the software product mentioned above called Gopher Lunch. Gopher Lunch will help ASU finish migrating off our old mainframe CWIS system. The Gopher Lunch software will allow ASU to automate and coordinate the CWIS to help lay persons to be information providers at ASU.

What Gopher Lunch Is

Gopher Lunch is a system for submitting and maintaining "gopher data" on a Gopher Server, via Gopher+ clients, electronic mail, and anonymous ftp. As it is often

[10]The ASU Gopher Team, How to Contribute to the Arizona State University Gopher, Gopher CWIS ASU, November 18, 1993.

unpopular to generously assign remote login accounts on Gopher Server systems, and as the methodologies and learning curve for updating and maintaining "gopher data" is equally unpopular, Gopher Lunch was developed as a more secure and intuitive distributed system of maintaining "gopher data."

There are two interfaces for administering all of the Gopher Lunch commands. The first is through the Gopher+ client ASK blocks. ASK blocks are simple on-line forms that providers fill out and submit. An example of a Gopher Lunch ASK block is in Figure 2. The other interface to Gopher Lunch is Internet electronic mail. Most mail clients with gateways to the Internet work fine for Gopher Lunch. Coupled with anonymous file transfer protocol (for binary and large files) both interfaces allow a validated provider to maintain his/her own files, create searchable indexes to those files, and perform various accounting functions---all from the provider's native platform. Creation, deletion, and maintenance of the CWIS accounts can be done through the same interface(s) by a "CWIS maintainer."

Figure 2. Example of a Gopher Lunch Ask Block for Adding a File

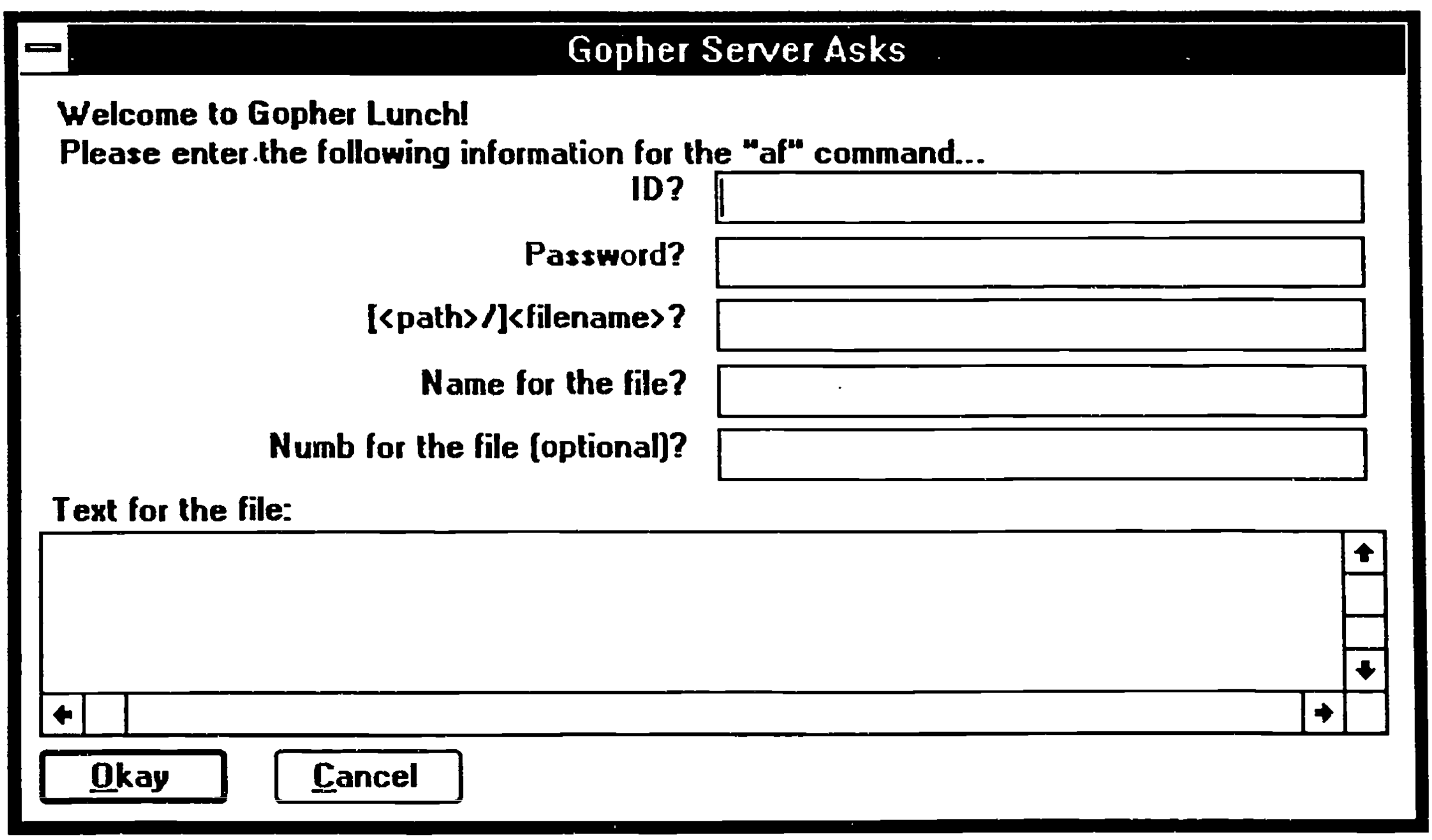

Figure 2. *The Gopher Lunch ASK block requires the Information providers identification and password for his/he account. The [<path>/]<filename> is the location of where the file should be placed in the CWIS. The "Name fo section is where the Information provider gives the new information a descriptive name for the file everyone will s for the file (optional) field is for the order of directory occurrence the Information provider wants the information The text for the file section is where the information provider types of pastes in the actual text.* \

Getting a CWIS or NIC Funded and Started

Although the CWIS and NIC are entirely different organizations they have many areas which are mutually inclusive and co-dependent on each other. One common element they share is their haphazard beginnings and practically no budget start. ASU, for example, slated that the NIC be a zero dollar budget start up, but coordinate services that are already being done and not called NIC functions were costing a considerable amount of money. Even at these early stages there was an acknowledgment for the need of future funding sources. On the other hand, the CWIS became an after hours project over two years ago, when ASU was looking to support its' distributed computing consultants with an on-line consulting system. When the consulting systems engine was designated to be a Gopher server, management desire to replace the mainframe CWIS emerged. Through the hard work of the ASU Gopher Team and their ability to educate others about navigating the Internet, progress was made and Information Technology dollars followed the progress and action. The ASU CWIS Gopher server was born by riding the coat tails of another project (on-line consulting). Presently, ASU has a test CWIS, a production ASU CWIS Gopher server, and a production server for Netnews and other future CWIS engines.

At the same time CWIS project was having its' eager beginnings the State Network Information Center became funded by an NSF grant (ASPIN) intended to network the rural areas of the state. In the grant was funding for starting a NIC of NICs for Arizona (de facto ASU for now) and geographically distributed NICs for the rural community colleges and their new Internet connections. The awareness and excitement generated by the promise of the "data superhighway" prompted a Governor's level group to request funds from the state to help enlarge the NIC development efforts and separately fund Internet applications like CWISs around the state.

There are many different strategies to getting NICs and CWISs started. Some methods include just renaming old services, organizing the elements of both that already exist, adding CWIS and NIC functionality to projects already under development, and adding another phone number to the phone consulting line or departmental gopher The ideal method of establishing a model NIC or CWIS is not to just throw things on a server and dish out ad hoc help, but to form a steering committee including faculty, staff, administration, and students to direct the structure of the CWIS and functionality of the NIC. ASU may not have had ideal starts for both of these projects, but with a "just do it" mentality the initial success developed into a clear vision, which has now been articulated by the Vice Provost. ASU's Gopher CWIS Server and the NIC are new emerging services reborn with strong commitment and new leadership.

Multiple Uses of the Internet, CWIS and NIC

The CWIS administrator and the NIC support staff person are expected to be Internet gurus. This is just not possible with the size of the network, the number of applications, and the speed of network development. The information served up by many CWISs is not just ASCII text anymore. There are many new forms of information like audio (Internet Talk Radio), video (mpeg), and multicasting (mbone) that not only require lots of bandwidth, but a technical savvy administrators and knowledgeable NIC staff people. With all of the multiple uses of the Internet a successful CWIS administrator needs to encourage others to serve up information they require, so as to not force the central IT unit to hold everyone's hand in becoming an information provider. The key to making information providers self-sufficient is a "training-free" and consistent graphical user interface. Along those same lines the NIC staff needs to have one skill greater than any other, and that is not to have all of the information needed for all types of uses, rather knowing where that information is. Bucking and referring to the appropriate location for help is the only way for ASU IT to support multiple uses of the CWIS and NIC.

Ethics and Security Issues

Ethics and security go way beyond netiquette. The NSFNET acceptable use policy used as the networking administrator's crutch is currently not enforced and therefore has no teeth. There are also trade offs that occur between ease of use and the building of fire walls for security. The most appropriate way to address security is to discuss it from the first day of the CWIS project. For example one security issue at ASU is having public dial up access to a secure Gopher CWIS server and not allowing anyone connecting to it to create links to off campus. This is so ASU does not give out entire Internet access to the general public.

Ethics and world wide cooperation is essential because anyone can easily become an information provider to the world. Educom's "Bill of Rights and Responsibilities for Electronic Learners" is an excellent document that every NIC should have and organizations like the Electronic Frontier Foundation should be consulted when dealing with responsible citizenship in the electronic community. The best way to be prepared for ethical and security issues is to have policies in place and study security case studies from other campuses.

Academic and Administrative Information Delivery

A successful CWIS can create a culture change of moving from a paper-based process to an on-line browser or search and query database process. The information resources on the CWIS get interwoven in the academic discipline and the NIC staff people are regularly helping faculty teach navigation skills to the classes. Faculty are feeling empowered at the office ethernet jack. Due to the marketing work of the NIC, academics are using the CWIS for many different things from publishing electronic journals to displaying CD photo images of the Mars probe.

Administrative users have been excited about not having to reinvent the wheel when creating policy by viewing other universities policies and procedures through the CWIS and the Internet. Many administrators after receiving training from the NIC at ASU, point up to their bookshelves and state, "We do not need all of these out-of-date paper manuals when the information is at our fingertips on the CWIS." Many of the administrative offices are interested in becoming information providers, especially those in areas such as admissions, registration and student affairs. The new CWIS has raised the eyebrows of many budget minded administrators who envision cost savings and increased administrative productivity. ASU's NIC is trying to ensure that none of the administrative or academic users will fall through the cracks.

Library Issues

The CWIS and NIC should not ask for help from the library, but *include* them. The library community has many valuable contributions to offer the users of the CWIS and the Internet. Libraries have been exposed to the paperless society; the library without walls; the move from collections to access; and the shift in emphasis from quantity to quality.[11] Libraries have experience in training patrons to glean information resources

[11]Susan Martin, "Libraries in the 21st Century: What We Should Do With NREN," in *Library Perspectives on NREN*, Chicago: Library and Information Technology Association, 1990., p. 35.

and have a large part to play in the full circle development of the ASU NIC and CWIS. For example, librarians at ASU have partnered with the NIC to teach navigation of the CWIS and the Internet. The librarians handle the resource questions and the techies handle the tools questions. Until both librarians and information technology professionals work together the CWISs and NICs will not reach their full potential.

Encouraging Faculty, Staff and Student Access

ASU's NIC staff, through the faculty development department, started teaching introduction to the CWIS tools and Internet navigation. Classes were booked solid for weeks. The NIC staff was quick to notice the only way to keep the faculty interest was to "hook them" by setting up discipline specific training sessions for each subject area. The NIC trainers even trained from the department sites. The most important teaching motto for the NIC staff was just teach them one thing they will use everyday. About five hundred of the faculty trained also challenged the CWIS and NIC teams to make tools user friendly and classes very short. The faculty interest was in the resources first, the tools second, and running a server in a close third.

Having 42,000 students puts an ASU CWIS Gopher Team of under ten staff members and a NIC staff of under ten members at quite a disadvantage. However, due to the faculty excitement and efforts, many classes on campus were going on Internet hunts and frequently meeting in computer labs to get aquatinted with the Gopher client for student survival training in the 1990s. Every campus computer lab had CWIS and Internet access and it did not take long for student Internet Users Groups to form and for a few student organizations to become information providers for the campus and the world. The students are used to training themselves at ASU and take full advantage of the on-line consulting database and tutorials.

The administrative training was much different than faculty and student training. The administrators wanted demonstrations first, then maybe hands on classes. The administration at ASU was more interested in the new CWIS conceptually, then as a personal productivity tool. Generally, the administrators wanted the NIC team to train their trainers first, and then have their trainers teach each of them. This train the trainers concept worked fine unless one of their trainers just could not grasp the material. Training administrators to be information providers involved lots of piloting first, show and tell second, then development. The administrators' culture change happened most drastically with many of them trying to think of innovative applications such as preparing for campus imaging and electronic work flow.

Navigating Tools and Services for the Internet, CWIS and NIC

The speed of development of new client/server tools is exciting, but very problematic for NIC support when a new version of a tool comes out every week and the ASU CWIS server software changes every two weeks. The policy project team screams for stability on the server side so the CWIS can be called "production," but can something that changes this much and is experimental so often, be called production? The arguments will go on for months, but the CWIS will keep functioning with over 7,000 visitors and approximately 3,000 searches a day. This CWIS traffic is increasing geometrically each month. The funding of the ASPIN state network increases the CWIS potential users to over 500,000.

The challenges of so many new CWIS users for the NIC makes the task daunting, but the research and development team is finding new tools and automated services to give end users a better interface and more advanced searching capabilities. Due to the small size of the CWIS and NIC staff ASU draws on the experiences of others and collaborates interstate and world-wide for internetworking solutions. Many of the new tools like Mosaic and WWW servers are being experimented with to see if they meet our needs. The future of the ASU CWIS does not lie within the next new navigational tool, but with the strategies for serving the campus and state with the NIC.

Campus-wide Issues

There are so many issues concerning these two entities. Most of the issues are not problematic, but opportunistic. Outreach efforts for the campus are improved immensely by effective information dissemination and strengthen linkages to others at geographic distances because of the CWIS. The ability for everyone on the campus to become an information provider and the ability to listen to audio and see video brings up an old issue of capacity. ASU has not had capacity problems yet, because many CWIS providers are willing to run their own servers. The other issues that ASU will wrestle with for some time to come is:

- Responsibility of information;
- Wide accessibility;
- Funding;
- Governance/ Policy-making;
- Network management;
- Intellectual property rights/copyright;
- Privacy/data security;
- Technical standards and;
- User training and support.

The Electronic Kiosk: Interactive Multimedia Goes Enterprise-Wide

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Abstract

This presentation will provide an overview of the University of Texas' new electronic kiosk and how it was developed. The Kiosk project is a joint effort between The University and Apple Computer to create a series ATM-like microcomputer workstations that provide campus-wide information services. The kiosks employ client/server and multi-media technologies to give University constituents access to a variety of information types (e.g. maps, sound, original images) without prior training or assistance. The kiosks provide University administrative offices with a cost-effective means for delivering official electronic information services to students, faculty, staff, and visitors. The presentation will focus on strategies for initiating and managing a university-wide project.

The Electronic Kiosk: Interactive Multimedia Goes Enterprise-Wide

I. INTRODUCTION

The University of Texas at Austin is in the early stages of deploying a series of electronic Kiosks designed to support a variety of campus-wide information services. These Kiosks are similar in concept to automated teller machines (ATMs) in that they are publicly available computers linked to common servers via network connections and are housed in enclosures protecting the equipment from damage or theft. While these Kiosks will not dispense cash, they do deliver a wide range of information from different sources and employ interactive multimedia as the user interface. All major elements of the Kiosks, from the software to the physical enclosures, were developed in-house at The University of Texas. The focus of this presentation is to relate the strategies employed in the initiation and management of this project and describe how it is being integrated into the existing information technology infrastructure.

Original Project Description

The Kiosk project is a joint development effort between The University of Texas at Austin and Apple Computer. The project was initiated with The University's Data Processing Department in 1992. In addition to the development of the Kiosks themselves, the stated purposes of the project included demonstrating the effectiveness of interactive multimedia as user interface and producing portable software tools which could be used by other institutions to build similar Kiosks.

The functions which have been developed for the first version are:

- A Multimedia Introduction to The University of Texas at Austin
- A Campus-wide Events Calendar
- An Interactive Map of Campus
- Maps of Shuttle Bus Routes
- A Directory of Students, Faculty and Staff

The multimedia introduction makes extensive use of digital video (QuickTime) to provide visitors and prospective students and faculty with background on the history and traditions of The University as well as an orientation to campus and essential facts for visitors. The Student, Faculty, Staff Directory and the Events Calendar provide real-time access to information from The University's corporate database on the Administrative Computer System. Both the Events Calendar and the Directory are linked to the interactive map so that campus locations of people and events can be displayed directly from those lists. The map may be searched by a variety of criteria ranging from building name to department, and photographs of buildings are displayed whenever they are selected.

In addition to the digital video described above, the major elements of interactive multimedia employed in the Kiosk include color graphics, digitized photographs and other images, sound, and touch screen monitors. The touch screen technology enables users to indicate selections by simply pointing. The project's goal is to make the system simple enough to be used by any adult without training or assistance. Survey results from early prototypes and other similar projects around the nation indicate that this objective will be achieved. Multimedia also enables the delivery of types of information not easily conveyed through text (e.g. the maps.)

The Kiosk client machines are Apple Macintosh Quadra 840AVs. The Kiosk software is primarily written in HyperTalk with numerous external functions in other languages to perform some of the communications and utility functions. Communications with the Administrative Computer System are handled via 3270 front-end using Software AG's (SAG) Natural Connection and its HyperCard API. The 3270 front-end is intended to be temporary as work is currently underway to convert to the SAG ENTIRE family of products enabling true program-to-program communication with the Administrative Computer. Likewise, although the QuickTime movies are currently stored on CD ROM with drives local to each machine, real time access to networked video servers is planned for eventual implementation.

One of the primary goals of software development for the first version of the Kiosk has been the creation of a developers' tool kit. The developers' tool kit includes a package of standard routines to process common functions, technical standards, documentation, and classes all of which are intended to enable individual administrative offices to produce their own Kiosk services as efficiently as possible. As of this writing, the Office of Personnel Services is the first department outside the core Kiosk Development Group to use the tool kit. They are creating an available job listings function.

This paper is, in effect, a case study on how The University tapped available resources, built on the existing information infrastructure, and leveraged alliances to create its own unique multimedia campus-wide information system.

II. DEFINING OBJECTIVES

Creating a True Campus-wide Effort

Soon after the project began, the Data Processing Department determined that the Kiosk should be managed and developed as a full campus-wide effort. This direction was both logical, since the Kiosk was intended to be a campus-wide information system, and necessary, because the expertise required to build and manage such a system did not reside in any single department. With separate departments for academic computing (Computation Center) and administrative computing (Data Processing Department) at The University, overall responsibility for information technology infrastructure is relatively decentralized. Although institution-wide technology projects have become more common, there was little precedent for providing for the ongoing development and management of an information system which crossed academic and administrative lines and potentially served all students, faculty, and staff.

To fill the void, the Data Processing Department sponsored an effort to form an ad hoc Campus-wide Steering Committee. The Steering Committee has no formal standing or authority with in The University structure, but it does have the practical effect of providing guidance from the perspective of most major campus constituencies. The positions represented on the steering committee are:

Assistant Dean	Graduate School of Business
Associate Director	Recreational Sports
Assistant VP	Development Office
Assistant Director	Division of Housing and Food

Associate Professor	Faculty Computer Committee
Associate VP	Student Affairs
Associate Director	Computation Center
President	Students' Association
Assistant Director	Library
Registrar	Registrar's Office
Auditor	Internal Audit

From the beginning, both the Data Processing Department and the CWIS Steering Committee viewed the Kiosk project as one element in an emerging direct service strategy for administrative information systems. This perspective refined the specific objectives of the project and shaped it to complement other CWIS systems.

The Direct Service Strategy

The concept of a direct service strategy simply referred to the trend in administrative information systems to provide services directly to the ultimate consumer without the need for intermediaries. During the 1980's, The University had automated almost all of its significant administrative procedures from accounting and purchasing to student records and financial aid. For services used by students and faculty, however, most of this automation was designed around a model that involved intermediaries. Specifically, administrative personnel were typically the direct users of the computer systems, and they in turn exchanged information over the counter or via telephone with students and faculty.

By the 1990's, striking examples of a new "direct service" model were evident everywhere, both inside and outside The University. Automated Teller Machines (ATMs) are probably the most common and widely used examples of this direct service paradigm. On The University of Texas campus, two of the most successful information technology projects of the last few years have been UTCAT, the On-line library catalog system, and TEX, our telephone voice response registration system. Both of these projects clearly demonstrated that providing information services directly to students, faculty, and staff could work the apparent marvel of improving service while containing costs.

Both the Data Processing Department and the CWIS Steering Committee sought to articulate a generalized direct service strategy that would enable any administrative office to provide electronic information services efficiently to students, faculty and staff. From a technical perspective, primary objectives would be 1) to develop a technical infrastructure that would enable departments to provide new information services quickly and inexpensively, and 2) to make these services as accessible as possible for the customers.

From the perspective of administrative offices, the goal is to have a cost-effective method for providing routine information services to their clients and free staff from a substantial portion of the "counter service" workload. From the customers' perspective, the goal is to reduce University bureaucracy by providing convenient "one-stop" shopping for many common administrative functions.

In short, we wanted to provide the ability for all university offices to achieve on a generalized basis what TEX, UTCAT, and ATMs had done for their specific functions. We wanted a unified campus-wide information system that would be a cost effective information delivery vehicle for all information providers and an easy-to-use single system image for all information clients whether they were students, faculty, staff or any other constituents of The University.

Kiosk as Part of a Multi-prong Approach

By the early Fall of 1992, the discussion on campus about direct service systems shifted from defining goals to implementation strategies. The ideal would obviously be to have a single campus-wide information system. Everyone involved in the discussion wanted to avoid a situation in which individual departments were developing numerous single-purpose information services. Such a balkanized information environment would produce a confusing array of choices for users and an inefficient use of resources by The University.

At the same time, it was clear that a single information system capable of meeting all requirements was impractical in the near term under existing budgets. So, a compromise plan was devised under which a limited number (primarily three) of campus-wide information umbrellas would be encouraged. Each of these systems focused on a different needs, built on existing technologies, and provided open architectures within their defined limits.

The first CWIS, UT's implementation of the Internet Gopher, was already in existence and operating successfully. Gopher is supported by the Computation Center and is used primarily for academic purposes. It is not yet feasible to place sensitive, real-time administrative functions under the Gopher menu, so the Data Processing Department set about to create a campus-wide information system umbrella that would fill administrative needs and complement Gopher. In addition to the Kiosk, Data Processing is supporting the development of a public access application, called UTACCESS, to provide campus-wide information services from the Administrative Computer System (see "Building on Previous Projects" below.)

Strengths and Objectives of the Kiosk Concept

The Kiosk was quickly accepted as a potentially important element in a strategy of providing administrative services directly to students, faculty. It is, however, definitely seen as complementing network-based services which are accessed from users' own microcomputers in offices, homes, and dorm rooms; and not as supplanting such services. Serving as one component of an overall strategy, the Kiosk concept has many strengths. First, there is no requirement that the individual user own or have access to his or her own computer workstation. The entire information delivery infrastructure is provided by The University. A further technical advantage of institutional ownership of the workstation is that developers know the exact hardware and software configuration of the client machine and can optimize the system for those requirements.

Another advantage of the Kiosk concept is that it is a true client/server system and can provide information services from a variety of services. The Kiosks are extremely convenient to use. The user is not required to go through any logon procedures (although PIN numbers will be required for personal information) or in any other way set up the machine before it can be used. Kiosks make it easy for anyone to access information quickly as they move around campus irrespective of whether they own or can use a networked personal computer.

The Kiosk is ultimately intended to bridge the barrier between administrative and academic resources through a series of networked public workstations that draw information from a variety of sources.

III. STRATEGIC ALLIANCES: GATHERING RESOURCES

"Don't try to do more with less, and don't do less." Carole Barone, Associate Vice Chancellor for Information Technology at UC/Davis, speaking at CAUSE92.

From the beginning, the Kiosk project has sought to follow Carole Barone's advice and increase available resources by pursuing unconventional approaches to funding and in-kind support. This strategy was not an exercise but a necessity. The University of Texas is no exception to the national trend toward tighter budgets. For the last several biennial sessions of the Texas Legislature, state-funded institutions of higher learning have witnessed ever strengthening movements to freeze and even reduce their allocations as the state battles to balance its own budget in difficult economic times. These budget constraints are coming at a time when overall administrative workload is expanding, and expectations for quality of service are increasing.

In this environment, the Kiosk project would not have been possible, either financially or technically, without the extensive use of alliances and partnerships. Campus-wide information systems are by their very nature projects which span The University's organizational hierarchy. No single entity has the resources or authority to undertake the challenge alone.

Internal Alliances: Building on a Base of Cooperation

Several important informal processes began on The University of Texas campus in the early 1990's which greatly facilitated the joint efforts necessary to undertake campus-wide information systems. The General Libraries initiated formation of an informal "Information Services Discussion Group" which included management representatives from the Computation Center, Data Processing, Student Affairs, and General Libraries. Although the group has taken no action to date, a number of important cooperative efforts have arisen out of the monthly discussions of institution-wide information technology challenges and solutions. The Direct Service Strategy for administrative campus-wide information systems was first discussed and refined in ISDG.

Prior to the start of the Kiosk project, the staff of the Data Processing Graphics Center had sponsored the formation of a campus-wide users group for graphics developers. The membership of this group included many of the most talented and accomplished graphic artists and multimedia developers on campus. When the Kiosk project started, a presentation was made to the graphics group introducing them to the project and requesting their input. Many of the members were immediately enthusiastic about the potential for the project and over time participated directly in the design and creation of the graphics and other media used in the Kiosk. At least four members of the graphics users group became active participants in the Kiosk Development Group.

Forming a Campus-wide Development Group

The core Kiosk Development Group was staffed by the Data Processing Department, but DP had neither the available personnel nor all the expertise required to complete every phase of the Kiosk. The core Kiosk team structured the project as a campus-wide development effort and actively sought assistance from other University offices. The response to these appeals was overwhelmingly positive (see below). In all cases, this support was voluntary.

At least three general factors motivated the enthusiasm and spirit of cooperation that characterized the Kiosk Development Group. First, the project was positioned both as a showcase for University talent and as a rare opportunity to create something in which the entire institution could take pride. Secondly, many members viewed the project as an opportunity to work with new technologies and learn new skills. The College of Pharmacy Staff indicated that their considerable commitment of time in the Kiosk was repaid by the skills they acquired in the production of QuickTime videos. That expertise is already being applied in many of their academic projects. Finally, the Kiosk became an excellent vehicle for University service. The Architecture professor who designed the physical enclosure stated that he appreciated the opportunity to make a professional contribution to the University environment.

Listed below are some of the contributions made to the Kiosk project by University departments.

- Graphic artists from several departments, such as UT Publications, volunteered their services to assist in the creation of color art work and backgrounds used in the Kiosk.
- The staff of the College of Pharmacy Learning Resources Center assumed primary responsibility for the design and production of the video, animation, and graphics used in the multimedia "Welcome" section of the Kiosk.
- The Manager of the Computation Center's Micro Technologies Group taught classes in HyperTalk to Kiosk developers.
- The School of Architecture donated the services of one of their faculty members to design the Kiosk physical enclosure.
- A programmer on the Computation Center Staff wrote several of the external utilities not producible in HyperTalk.
- Programmers from General Libraries, the Computation Center, Apple Computer, and Data Processing participated in writing HyperTalk code.

IV. INTEGRATING INFORMATION TECHNOLOGIES

The electronic Kiosk is not an isolated, independent project, but rather an integral part of The University's overall information technology environment. The Kiosk is built on the foundation of existing applications, databases, networks, and communications. It is designed to complement and extend both current and future information technology projects.

Tapping into the Existing Infrastructure

The focus in administrative computing at The University during the 1980's was automation of official administrative procedures. Electronic documents have now replaced paper forms to hire and reclassify employees, purchase anything from office supplies to laboratory equipment, transfer funds, pay vendors, and process internal billing. These electronic documents automate virtually every aspect of the manual procedures they replace, including auditing of routine data, routing for review and approval, elimination of duplicate data entry, updating of accounting records, and storage of official information.

Almost all of The University's official records are maintained in electronic form on a single database management system that is easily accessible by authorized personnel. In 1980, the Data Processing Department adopted Software AG's DBMS ADABAS as its official DBMS. Since that time, ADABAS has evolved into the central repository for virtually all of The University's official electronic records. The University of Texas now has a single, unified corporate database which supports the relatively easy development of real-time, integrated applications.

During the same period The University has also constructed a comprehensive campus-wide network system. In fact, two essentially parallel wide area networks exist on campus to serve the different requirements of administrative and academic computing. The administrative network, UTAN, is a fiber optic SNA token ring network that provides 16 Mbps service to all administrative and most academic building on the UT main campus. UTAN is a controlled access network providing a high level of security and capacity for confidential administrative traffic. UTAN is primarily used for 3270 traffic between the Administrative Computer System and departmental LANs. UTAN is supported by the Data Processing Department.

The University's academic network, UTnet, is a fiber optic TCP/IP network providing open access to a full range of Internet services primarily for academic purposes. UTnet serves all major academic buildings on campus and is accessible via departmental LANs, microcomputer labs, and a high speed modem system called TELESYS. UTnet is supported by the Computation Center.

The current Kiosk prototypes are connected directly to the administrative SNA network for secured access to administrative services via the UTACCESS application (see below.) A joint project between the Computation Center and Data Processing is now under way to develop the encryption software necessary to provide secure access to administrative data over the Internet. Once this project is complete, the Kiosks will be moved to UTnet.

Building on Previous Projects

Much of the underlying technology used in the Kiosk was pioneered in earlier projects at The University. In particular, it would not have been possible to produce the Kiosk economically without the benefit of software and techniques developed as part of the Executive Workstation and the UTCAT online library catalog. The Executive Workstation is a Macintosh-based executive information system developed within the Data Processing Department to give management level personnel point-and-click access to official administrative functions. In addition to providing a GUI style interface to mainframe functions, the Executive Workstation gathers and assimilates information from several different applications to deliver summary displays which are not available in any other system. The Executive Workstation is a HyperCard application which communicates with the Administrative Computer System via an API to a 3270 emulation session running on the Macintosh. The Kiosk, also developed in HyperCard, employs 3270 emulation communication with the Administrative Host which is based on the code developed for the Executive Workstation.

The UTCAT online library catalog system is a mainframe-based 3270 application which was developed in-house. In recent years, UTCAT has been used as the foundation for an expanded menu system, called UTCAT Plus. UTCAT Plus is essentially a campus-wide information system incorporating not only Library information, but also administrative policies, The University telephone directory, and available job openings. Access to UTCAT Plus is available to anyone via terminals in the UT libraries, by connection to the Internet, and by dial-up to the UT TELESYS system. The Library has contributed the UTCAT Plus core software for menu management, navigation, and access to be used as the basis for the UTACCESS project. From that starting point, UTACCESS has become an independent CWIS in its own right which provides easy access to information services on the Administrative Computer System. UTACCESS is also the 3270 system that provides official administrative information to the Kiosk. As with the contribution made by the Executive Workstation, UTCAT Plus paved the way for the Kiosk.

Coordination with Complementing Projects

The Kiosk has also achieved a level of cost savings and efficiency by coordinating closely with separate but related projects on campus. For example, a task force is working on producing an RFP for a campus-wide image server. The goal of the Image Server Task Force is to acquire imaging technology that is compatible with existing information technology infrastructure and can be implemented on an institution-wide basis. The task force is working to ensure that the Imaging products can be integrated smoothly with the administrative corporate database (ADABAS) and our administrative programming language (NATURAL 2) so that images can be readily included in existing and future administrative applications.

Another project with direct implications for the Kiosk is the Campus-wide ID Card project. There, yet another task force is generating a recommendation for a single, multi-purpose ID card that can serve all needs on campus for student, faculty, staff identification. The project is based on the principle that a credit card-like ID with a standard, machine-readable magnetic stripe can be implemented to address the full range of identification requirements of all University offices. In addition to the traditional manual identification using the photograph and signature, the new card can be "machine read" by electronic card readers. Through network connections, the machine card readers can be fully integrated in with existing databases and electronically validate requests against existing information systems.

The Kiosk Development Group communicates regularly with both the Image Server Task Force and the ID Card group to ensure that the technology in all three is fully compatible. The benefits to the Kiosk are clear. The availability of institution-wide, network-based image servers mean that the ability to display graphics such as images of buildings, floor plans, and maps will soon become a practical option. The ID Card project will enable the Kiosk to serve as a true ATM for University services that require positive identification and, in some cases, charge for services. For example, in the future, students may be able to buy concert tickets or pay library fines and have those fees charged against the debit card stripe on their campus-wide ID cards.

V. MANAGING A CAMPUS-WIDE EFFORT

Role of the Steering Committee

Since its formation, the Campus-wide steering committee has met at irregular intervals and communicated frequently through e-mail to oversee overall project management, establish policy, and set priorities. The Kiosk project has benefited enormously from the experience and diverse backgrounds of committee members. They have been able to provide crucial advice and guidance on how to tailor systems for students. This was an issue of particular concern within the Data Processing Department since, until recently, our focus has been on services for administrative staff. We had not acquired the expertise of many of the offices represented on the Steering Committee in serving the large student population.

Below are examples of some of the issues handled by the Steering Committee.

- Selection of the on-campus sites where the Kiosk will be located
- Establishing policy on the types of services considered appropriate for delivery via the Kiosk

- Review of ADA compliance measures
- Review of testing and quality control measures
- Ensuring all effected campus constituencies are consulted regarding significant implementation issues
- Review and approval of implementation procedures and schedule
- Communications with campus constituencies and Executive Officers

Getting Input from 70,000 People

The Data Processing Department has generally employed users groups as the chief mechanism for promoting customer participation in the process of designing and refining administrative information systems. Traditional users groups were not practical, however, for a potential customer base of all 70,000 students, faculty, and staff at The University. Other techniques had to be found to evaluate how well the Kiosk would perform and be received in real-world situations. The techniques chosen were those now commonly used in the testing and evaluation of all types of commercial products which are intended for mass markets: focus groups, customer surveys, and observation.

Two successive prototypes of the Kiosk software have now been produced. Each prototype has been subjected to focus group analysis. The feed back from these groups has served as the basis for refinements incorporated into the next version. The focus groups for the first prototype were structured, but generally informal and not conducted according to strict scientific method. Specifically, the Students' Association was invited to send up to eight students each to twenty different sessions scheduled shortly after completion of the first prototype. No effort was made by the Kiosk Development Group to ensure that statistically random groups were selected. Each group met for 90 minutes in which they were given the opportunity to use the Kiosk, participate in a panel discussion, and fill out a survey questionnaire. The Development Group then generated a package of changes and enhancements for the second prototype based on their own observations of focus group participants using the first prototype, the suggestions made in the panel discussions, and the results from survey forms.

The evaluation of the second Kiosk prototype was significantly more structured and thorough. Once the second prototype was ready, it was set up for public access on an information desk in the student union. This unenclosed unit was used as the base for several different types of evaluation. At the same time a class in the Marketing department had requested permission to use the Kiosk as the basis for a class project on product testing. The project was approved, and the Marketing students have since conducted formal surveys of students who have used the public prototype. The class has also conducted telephone surveys of students and administrative offices to determine what types of services the campus would most want to see on a Kiosk. Members of the Development Group have periodically spent one to two hours a day unobtrusively watching students use the prototype. These observation sessions have been used successfully to identify elements of the Kiosk user interface that are confusing and difficult to use. The observations have served as the basis for a second round of refinements, and the Marketing class surveys will be reported to the Steering Committee for its consideration.

VI. CONCLUSION

It is too early to predict what overall impact the electronic Kiosk will have on University operations. At the time of this writing, two unenclosed prototypes are available for public access. These units are being used in part to assess the effectiveness of the overall Kiosk concept and to measure the costs associated with their operation. Bids are being taken for the construction of the first five Kiosk enclosures. These units will be installed in the early part of the 1994 Spring semester. The remaining 12 enclosed Kiosks and possibly more will be deployed as soon as the performance of the first five has been thoroughly evaluated.

Many important questions remain unanswered. Will we be able to fund and support enough units to have a significant impact on a campus community of 50,000 students and over 17,000 faculty and staff? Will administrative offices view the Kiosks as a cost-effective mechanism for delivering routine services? What will the operational and maintenance costs associated with the Kiosks be? Does the Kiosk concept represent a viable long term solution for delivering administrative information services in a large University environment? What is the Kiosk's logical relationship to information services delivered directly to user-owned client computers over the network or telephone lines?

It is reasonable, however, to draw at least four significant conclusion at this stage.

- Interactive multimedia technology has advanced to the point that it can be used to produce practical information systems which are both easy to use and well received.
- Multimedia Kiosks make it realistic to provide public information services that almost anyone can use with no prior training.
- Kiosks alone do not constitute a comprehensive campus-wide information system, but they can play a vital role as one element in an overall CWIS strategy.
- The concept of a multimedia CWIS at The University has attracted sufficient enthusiasm, support, and resources to produce a competent first version.

Track VI

Information Delivery to Support the Institutional Mission

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The success of information technology is ultimately judged by how well it supports the institutional mission. Dovetailing the direction of IT with the goals of the institution is increasingly important to those who plan for and manage technology, and those who evaluate its effectiveness. How can information professionals deliver a wide variety of information in support of teaching, learning, scholarship, and research?

Institutional Imaging: Sharing the Campus Image

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The University of Delaware's campus-wide information system, *U-Discover!* uses the Gopher client-server software developed by the University of Minnesota, to provide an easy-to-use, wide-reaching information service.

Delaware is currently integrating photographic and document imaging with *U-Discover!* text to provide an exciting and effective new level of service. One such application provides access to institutional photographic and historical records. A library of two-thousand 35mm color slides, depicting campus facilities, programs and activities, has found a home in *U-Discover!*

This library may be browsed by faculty, staff and students to locate and identify slides for use in publications or presentations. Text-to-image links allow full-text description searches to return color images across the campus network to PC, Mac and UNIX workstations.

Using inexpensive hardware and freely-available software, Delaware's campus-wide delivery of institutional images is easy, inexpensive and highly effective and has become a model for future multi-media services on our "electronic campus".

The National Information Super-Highway

In recent months, there has been a great deal of press regarding the National Information Infrastructure proposed by the Clinton Administration. Information technologists in institutions of higher education will certainly make important contributions to this ambitious endeavor.

For this national information network to properly serve the public interest it must be a "pedestrian" offering. That is, although this is to be a high-powered, high-technology data highway, it must reach out to our homes and offices, schools and industries in a "common, ordinary" manner. It cannot be reserved for super-scientists, well-heeled corporations, or those with technical or financial advantage. To meet its stated goals, this highway must be well travelled, by many, from all walks of life. It must deliver utility and services to student and farmer, teacher and law-maker, expert and novice alike.

The technical and logistical challenges of this undertaking will require a great deal of time and money invested at the national level. But another challenge requires more immediate attention. As institutions of teaching, research and public service, we must begin to understand the implications of our roles as information providers. While the details of a information infrastructure are debated, we must look inwardly to identify our valuable information holdings and to determine how they might be easily shared on a national network designed to serve the public interest.

Campus Information Highways

While the national effort will insure that the network is far reaching and "pedestrian", we must insure that the information content is useful and valuable. As "form follows function", even in terms of information technologies, then rich content implies the need for rich information types. We must be prepared to deliver more than record-oriented, character-based data. Our challenge is to capture, prepare and distribute information resources of many types; text, rich text, image, animation, audio, full-motion video and more.

There are many issues associated with the "care and feeding" of these information types. And while parallels may be drawn between the familiar, traditional information technology methods and the methods required by these newer technologies, there will also a great deal of new ground that must be broken. Where do we start?

Information Type: Image

The University of Delaware has begun to take steps to better understand what the future holds. To learn more about the delivery of "non-traditional" information services, we have initiated several institutional imaging projects.
An informal survey of imaging projects on today's campuses indicates that most fall into the category of document imaging; that is, storing images of paper-work; admissions applications, purchase requisitions, and the like. Furthermore, these documents are found to reside primarily on departmental servers; delivering service in support of departmental processing requirements.

Quite recently the cost of this type of imaging has plummeted... $1000 personal computers with $500 software on inexpensive local area networks can deliver document imaging services at a very low cost-per-seat. However it is difficult or expensive to "scale up" such applications to make these image services available to many or all members of the campus community. When planning for a digital highway of a pedestrian nature we must "start at the top" with a campus-wide distribution scheme and then, if necessary, hone in on departmental needs to focus effort, add security, and enhance functionality.

Pilot Project: Photographic Images

Our initial pilot project found it roots in a collection of 35mm, photographic slides owned by an administrative department, the Office of Public Relations (PR). The PR slide library holds over 20,000 photographic slides which are used in campus publications and presentations and chronicle the history and events of our institution. The scope of the initial project focused on a collection of 2,000 actively used, "exemplar" photographs, to be called the *"Campus Collage"*.

Prior to our pilot, the PR slide originals were filed in loose-leaf notebooks and indexed in a flat-file database. This single-user, PC database contained a short description and identifying information for each slide. In order for a campus user to locate needed slides, a PR staff member would perform simple keyword searches against the database to retrieve slide numbers.

These slides would then be physically retrieved from the collection of 20,000 for previewing. Once a needed slide was found, the slide number was recorded and slide copies were ordered directly from PR. This process was time-consuming, labor intensive, and restrictive, and required the physical handling of the original photographic masters.

Objectives of the pilot project included: opening the library to a wider audience, providing for remote access and self-service browsing, and reducing the amount of handling of the original slide masters. These objectives were to be achieved by digitizing the exemplar collection, loading the collection for accessibility on the campus network, and linking text descriptive and identifying information with the image collection to facilitate location of needed slides.

Establish Common Denominators For Wide-Spread Access

To reach the widest possible audience with an effective level of service, several common denominators were identified. *U-Discover!*, Delaware's campus-wide information system was already well established thanks to the many strengths of the University of Minnesota's Gopher protocol. Gopher client and server software was widely distributed among campus information users and data providers.

CompuServe's GIF (Graphics Interchange Format) was selected for the storage of campus images. The GIF standard was designed to be a public domain offering for low-overhead transmission of images to CompuServe subscribers. It is a commonly used format, supported by a following of free or low-cost software.

The Super VGA (SVGA) image resolution of 640x480 pixels, 256 color palette, was adopted as a display standard to take advantage of the large number of SVGA capable equipment on campus, while placing limitations on the reproduction of these copyrighted images. A GIF image displayed at this resolution looks nearly photographic and is suitably handled by lesser quality VGA and gray-scale monitors.

Digitize Photographic Slides

Two methods of digitizing slides are employed at the University of Delaware. A service bureau may be used to place digitized slide images on CD-ROM, or a self-service approach may be taken using PC-based slide scanning hardware.

The KODAK Photo CD service was selected for the *Campus Collage* pilot. The KODAK Photo CD process allows up to 100 35mm color slides to be stored on a single CD-ROM. This service is provided for under $1 per slide at nearly any local photography store.

The KODAK process stores a single, very-high resolution file for each slide. The file is formatted in such a way that it may be retrieved in any one of 5 different resolutions. This allows low quality versions of the image to be quickly retrieved while providing for the storage of large, publications-quality images. Advantages of the KODAK process include the outsourcing of the labor-intensive slide handling as well as the creation of permanent, image masters. The shelf life of digitized images is considerably longer than that of slides.

While the KODAK process targets home as well as commercial use, small jobs are easily handled. A collection of two dozen slides may be placed on a Photo CD on one occasion, and an additional slide collection may be added to that physical CD at a later date, up to the 100 slides limit. Turnaround for this service varies from three-days to one-week.

Nearly a quarter of the PR photographic library consists of 2 1/4" format, however the Photo CD process currently supports only 35mm format. KODAK has announced plans to support 2 1/4" format by the end of the year.

For small slide libraries, or those requiring a more hands-on approach, inexpensive, high-quality slide scanners are now available. The Nikon CoolScan slide scanner has been used with great success at our institution. At approximately $2300 the slide scanner provides an economical alternative, producing a high-quality digital image in about 5 minutes. Currently the Nikon scanners support only 35mm format.

Prepare Digital Images for Storage

We are pleased to be able to pay a service provider to do our digitizing, because even with a Photo CD in hand, there is still a considerable amount of work to be done to prepare 100 images for loading.

Each image is retrieved from the Photo CD in a mid-level resolution at 768x512 pixels, using Adobe's Photoshop software. The picture is visually reviewed for color, brightness, and contrast. Photoshop allows adjustments if necessary, but they are rarely required. The orientation of the image is confirmed. On occasion we have encountered images scanned upside down. The Photoshop software selects a 256-color palette that best meets the requirements of the picture and saves the image in a GIF file, reducing the resolution to 640X480 pixels.

A single image production station was configured to support the preparation of images. This modest workstation consists of a 33Mhz Intel 486sx with 8MB of RAM, 170MB local disk, a Toshiba CD-ROM player, a Nikon CoolScan slide scanner, Adobe Photoshop software and an ethernet connection. Most of today's CD-ROM drives support the Photo CD standard.

As the PR images are property of the institution, a copyright statement is added to the margin of each image. KODAK has announced plans for providing this service by the end of the year. In addition a black background is added to frame the picture and fill any unused portion of the screen. Both of these additions can be done manually, using software such as Photoshop, but we have automated this process. Both copyright and black mat are added programmatically after the image files are stored on the server.

The reviewed and edited image is stored on a shared network drive on a UNIX server to later be loaded into a Gopher directory. Each image is stored as a single file. These files are arranged in Gopher directories using pointers. Gopher allows several such pointers, or Gopher links, to reference a single information item. In this manner slide images may be organized in several different categories.

Prepare Associated Text For Storage

Each slide image is described in some detail in a brief narrative. Information such as subject, photographer, date, location, slide number, and CD-ROM number is included in this description.

A wordprocessor file is created documenting each image. Macros and scripts are used to automate the creation of an ASCII-text file for each image and build descriptive file names for both text and image files. These long UNIX file names consist of a 38-character slide title, date, and number. While both text and associated image files have identical names, they are placed in different Gopher directories.

WAIS indexing software, a tool commonly used by Gopher administrators, is run on both directories to create full-text indexes against the written descriptions and the image titles. A full-text search item is added to the slide image directory allowing these descriptions and image titles to be searched.

Load Images and Text on Server

Inexpensive workstations from Sun Microsystems are employed as text and image servers at Delaware. Such servers commonly range from low-end Sun IPC and Classic models priced in the $3500-$4500 range to larger, more powerful Sun LX and Sun 10 models. Magnetic disk capacity may be added to these servers for less than $1000 per gigabyte. At 100KB per image, 10,000 images require 1GB of image storage.

While the Sun workstations have become the standard for such servers on our campus, the Gopher software is suitable for other platforms, including inexpensive and popular MacIntosh workstations.

Software required to support the server function includes Gopher sever software and WAIS indexing software, both in the public domain.

Distribute Client Software

The University of Delaware supports Gopher client software for each popular campus platform. For DOS users; UGopher from the University of Texas. For Windows; Martyn Hampson's HGopher from Imperial College, UK. Mac users employ TurboGopher while UNIX users employ the UNIX Gopher client, both developed by the University of Minnesota.

Image viewers must be associated with each Gopher client to enable the display of GIF images. Public domain, or site-licensed viewers were selected to allow widespread distribution to students, faculty and staff. DOS Ugopher users employ CompuShow from Canyon State Systems, while Mac TurboGopher users have adopted JpegView developed by Aaron Giles. Users of the Windows HGopher client use LView, freeware from Leonardo Loureiro and UNIX XGopher users are running the XV X-Windows viewer.

To address software update and version control concerns, current versions of Gopher clients and GIF viewers are available to members of the campus community across the network using Gopher itself. Directories for DOS, Windows, Mac and UNIX users contain self-extracting archives which store the program files for each application in a compressed format. Selecting such an item from a Gopher directory causes the program files to be loaded across the campus network and uncompressed on the hard drive of the client machine.

Several local modifications have been made to the Gopher clients we distribute to our campus users. These range from authenticated access of student records information, to support for our campus-wide electronic forms system. Whenever possible these changes are made external to the Gopher client using "viewers".

Such changes have been made in support of the imaging effort and are exemplified by a modification to the UGopher text viewer that enables an automated linking of text with image. An index search returns text, the press of a key displays the associated image.

Limitations

While the goal of this information service is wide-spread access, there are most certainly limitations to the scope of service.

Connectivity--The Gopher client/server protocol is an Internet protocol so that an ethernet connection to the campus backbone is required of all clients. Character-based gopher clients are provided on campus for users of central time-share system, but image retrieval is not available to these users.

Resolution--As standard display monitors operate in the range of 70-90 pixels per inch, the SVGA image of 640x480 pixels, 256 colors provides an image that appears nearly photographic. The SVGA resolution of our digitized images cannot match the quality of original film images, however it is better than video and certainly suitable for today's personal computers.

Projection--When overhead projection of digital images is employed, the success or failure depends on the degree of loss of resolution, color and brightness. Currently available projection equipment is limited to SVGA resolution with loss of brightness being a common complaint. While projection of such digital images may not yet be appropriate for applications requiring detailed, true-to-color reproductions, many routine presentation needs can be met.

Generation Loss--Generation loss refers to the incremental degradation of picture quality that takes place with the making of each copy: a photocopy of a photocopy of a photocopy... While the digitizing process produces a loss in resolution and color, once an image has been digitized the file can be transferred, copied and reproduced digitally without further loss. It is important that, whenever possible, film originals are used to create the digital masters.

Network--At 100KB-200KB each, our *Campus Collage* photo images are quickly and effectively delivered across our current network. We have an 80MB fiber-optic campus backbone, with 10MB ethernets in each building. All residence halls are wired for ethernet and by the end of the year, the saturation wiring of classroom and offices will be completed.

One limiting factor of our current network is an older router technology that causes information to pass through our network gateways at less than 1000 packets per second. Currently available technology would allow this rate to approach 180,000 packets per second. The replacement of these slower routers is planned for the near future.

Compression--Compression is the process of reducing the file size needed to store or transmit an image. Larger images, or images of higher resolution require higher network speeds or data compression. Effective image compression is available today in image formats such as JPEG (Joint Photographic Expert Group). JPEG compression and decompression can be performed by software, or with the assistance of compression accelerator boards. Generally speaking this type software compression slows the file transfer process significantly, necessitating the use of JPEG compression boards. However, recent developments in JPEG compression routines have shown improvements in software compression.

While our "Campus College" is deliberately restricted to SVGA resolution images, if the future calls for the delivery of higher-resolution images our Photo CD masters ensure the availability of such images.

Security and Access--*Campus Collage* is accessible from any location on the Internet. Text and image collections may easily be restricted to on-campus-only access, or to access from a physical network subnet or node. Restricting access by individual user is not easily administered using current versions of Gopher software but it is possible to write Gopher servers to provide authenticated access.

Copyright--The slides in our PR library are property of the institution. We have opted for widest distribution and therefore retain little control. We protect our rights in two ways, one technical and one legal. The images made available on the network are moderately low-resolution images and therefore have little reproduction value. High-resolution images are kept off-line on the original CD-ROM for use by campus publications.

A copyright statement "Copyright UNIVERSITY OF DELAWARE, All Rights Reserved" is placed on every PR slide image and delivered across the network. Instead of preventing access to the images, we make our work available and expect property rights to be honored.

For images needing more protection there are several options. Access restrictions may be placed on servers limiting access to on-campus locations. Lower resolution, or "thumb nail", images may be distributed for browsing. Watermark statements, such as "PROOF" may be placed across the face of the images making them unusable.

Features--Minnesota's Gopher is a wide-reaching but general-purpose implementation. It cannot compete in the arena of image features, with LAN-based, vendor-produced image librarians.

However, the allure of Gopher lies in its ability to provide wide-reaching, democratic access. And, in fact, as Gopher clients are built on the principle of "object viewers", there is no reason more sophisticated image-aware gopher clients cannot be created. Special-purpose gopher clients could allow display of thumbnail images in directory format. Or a "Presentation Gopher" could be used to delivery "Internet slideshows" in the classroom. A "Touch-screen Gopher" could enable campus kiosk users to easily browse a collection of annotated photos for a tour of campus.

While current Gopher-based image libraries might be described as feature poor, they are distribution rich... distributing rich information resources to even the "poorest" of our network users.

Other Applications

While the *Campus Collage* was created to facilitate browsing of the PR slide library, it has already been used to deliver live, across-the-network presentations. Our president has made two such presentations, one to members of the Board of Trustees. Additional "administrative" imaging applications have been identified.

Internet Slide Show--Delaware recently re-engineered the student services business processes and in doing so, created a new student services building which has been widely heralded by the student population. Neighboring institutions have shown considerable interest in this successful project and we have hosted many visits.

An "Internet tour" was developed to allow interested institutions to learn more about the project without setting foot on campus. This tour, which includes annotated slide images, sample screen images from our student kiosks and text to providing an overview of our approach, was created in one afternoon. This is an "administrative" use of Internet delivery of image and text resources, however, similar use may deliver academic services.

Digital Photography--While our initial pilot targeted the conversion of 35mm slide to digital images, currently available still cameras can produce digital pictures more directly. The efficiency and utility of this equipment places it high on the list of "data capture" hardware for a campus photo-image service.

At Delaware product review has begun leading to the replacement of the current ID card production equipment with a digital-photography system. This would create a database of identifying photos of all students, faculty and staff that could be used in conjunction with many campus information functions.

The university's facilities and construction department conducts regular project reviews of campus construction projects. In addition, the president and other university executives share the progress of such projects with interested committees, parent and student groups. For the most part, the progress of the construction projects moves at such a pace that 35mm slide shows are quickly outdated. The use of digital photography would enable images to be disseminated on the campus network as a "same day" service.

Document Imaging--*The University of Delaware: A History by John A. Munroe* is a 448 page book that chronicles the history of our institution. As the University owns all rights to this text, there are no copyright issues preventing electronic distribution. The book was scanned twice, once to capture the actual page images, with photos and illustrations, and once for OCR (Optical Character Recognition) input to create a text-only version of the document. The text-only file allows full-text searching against the document and is linked to the page images. Therefore a topic search returns the text and the press of a key display the actual page image.

Academic Applications--While the first pilot projects at Delaware target "administrative" information, the methods and results may easily be transferred to "academic" applications. With ethernet connections in every dormitory room, classroom and public computing site, image delivery targeting students, faculty and researchers have great utility. Investigation of such applications are now underway with the preparation of slide libraries from several academic departments.

Summary

This practical application of technology delivers useful and significant service to members of our electronic campus. Institutional imaging is easy, inexpensive and wide-reaching. The pilot project serves as a model for the management of other non-traditional data types and has begun to lay the foundation for our digital future.

Electronic Paper Flow

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CAUSE 93 Abstract

A year ago, the University of Maryland at College Park began to automate the process for the appointment of faculty and academic staff. A major challenge that arose during system design was how to simulate electronically the flow of paper through the various stages of approval. With several hundred academic units and sub-units on the campus, and varying numbers of review and approval stages, the proposed mechanism would have to handle the most complex of situations.

Realizing that there would be other campus-wide applications requiring a similar flow of documents, it was decided that the routing mechanism developed for academic appointments should be generic enough for use in applications such as purchasing, travel, and payroll. It should also provide information across various platforms.

This presentation describes in detail the routing model developed, illustrating its use in the academic appointment process. It also addresses issues of implementation and maintenance.

ELECTRONIC PAPER FLOW

Every year the University of Maryland at College Park processes approximately four thousand faculty and associate staff level appointments. Each appointment is represented by a form that travels through a complex and exhaustive system for review and approval. As with any paper-based routing system, the academic appointment process encounters numerous delays due to various difficulties with communication, inadequate or incorrect data, unnecessary duplication and the typical problems associated with locating forms in transit. By the spring of 1992, it became evident that a paper-driven system could no longer serve all the appointment activity of a large institution. Thus, the Office of the Vice President for Academic Affairs and Provost charged Academic Data Systems with developing an on-line computer system known as the Academic Resource System (ARS) that would handle all aspects of the appointment process. A team consisting of a project manager from Academic Affairs and a technical manager and two systems analysts from Academic Data Systems began this undertaking.

From the onset, the developers understood that for an electronic appointment system to be successful, it had to incorporate the complexities of the paper system. This paper system included a routing structure that, depending on the department, was either simple or extremely complex. In many cases, forms did not just travel forward; rather they traveled through an intricate network of specific reviewers and approvers. The developers concluded that a successful electronic appointment system could not function without a versatile routing mechanism that could handle the current process yet be flexible enough to deal with anticipated re-engineered processes. Better yet, if a routing mechanism had to be developed, why not make it generic so that it could be applied to similar systems across campus? The result of these efforts is the Routing and Notification System (**RNS**).

The **RNS**, as applied to the Academic Resource System, has now been in use since May of 1993 and has been well received by the user community. Its generic properties make it an ideal system that can be easily applied to virtually any form-routing structure. The purpose of this paper is to discuss the development of the Routing and Notification System and describe the various applications that has made it a versatile and functional system.

How paper flows

To emulate, let alone improve, a form routing process, it is first necessary to examine how paper forms flow. In our case, this meant analyzing how the appointment papers route to the various levels for review and approval.

The University of Maryland at College Park is a large institution comprised of over one hundred and fifteen academic departments reporting to thirteen colleges. Within this structure, some departments are very small; others are very large and contain sub-departments (centers, research laboratories, etc.) that function as separate entities. Each sub-department has its own routing process tailored to its specific needs. For example, the Physics Department has fifteen different sub-departments that process hundreds of academic appointments.

Within a department or sub-department, forms may be passed back and forth between people at various levels. Each person normally has at least one back-up or proxy. Forms do not always travel upward; rather they may be passed backward to different individuals within the department for review or revision. Sometimes forms need to bypass departments or include additional stops. Depending on the application, forms may travel along simple or complex paths. In addition, people in the routing path also need to be informed that a form is ready for processing and may need to attach notes or instructions to the next person receiving the form.

Attributes

The **RNS** was developed to encompass these complexities. The attributes necessary for such a system are the following:

- It must be user friendly and allow the user to perform the same routing activities that were possible with the paper system.
- It must be flexible and easily adaptable to the variations existing within a large institution.
- It must be generic so that it can be applied to any form-routing structure.
- It must provide security by designating who has the authority to view, create, review, approve and/or reject a form.
- It must prevent the forwarding of any logically incomplete forms.
- It must maintain a routing history or path record of each form.
- It must provide notification information that is distributed to all users along the routing path.
- It must be able to inform users via electronic mail that there is a form waiting to be processed.
- It must allow users to send private or permanent notes to the next person along the routing path.

The Routing and Notification System possesses all of these attributes. The generic nature of the system allows it to be adapted to virtually any form-oriented structure. Generality in the **RNS** is achieved by using a table-based routing definition rather than a methodology that involves hard-coding. This technique allows the **RNS** to mimic accurately the complexity of the various academic units.

One important attribute of the **RNS** is that it allows for customization where needed. For example, in the faculty appointment application, a rejection feature available in the **RNS** was customized to attach a rejection reason to the form. An application-specific table of rejection reasons is used in this instance. Similarly, the "logical completion" of a form has one meaning in the context of academic appointments, but can represent something quite different within the context of another system.

Elements of RNS

The **RNS** was developed on an IBM 9021-500 using CA-Ideal as the programming language and CA-Datacom/DB as the database engine. This was done to make the system available to any campus-wide mainframe application. The **RNS** provides a set of tools that are available to any application that follows the standard system architecture developed by Academic Data Systems. This base architecture includes: navigation tools to move betwee screens, tools to minimize re-entry of key data between screens, security to manage access to the various applications, a text editor and note storage system to handle comments, and a subsystem that provides online help. The elements used in **RNS**, however, could be applied to other hardware and software platforms.

One of the main factors that went into the development of the **RNS** was incorporating levels of authority into the routing process. In a paper system, forms travel from individual to individual for different functional purposes (eg. creation, review, approval). However, in order to create an electronic routing system, this individual-based model had to be re-structured. What emerged was a new model based on the routing of forms from *group* to *group* rather than individual to individual where the group represents the functional structure. This group concept allows the **RNS** manager to place users in appropriate groups, and the system passes control of the form from group to group. Through a combination of user security, group definition, and user attributes, the system determines who can view, create, review, and/or approve forms.

The **RNS** is comprised of a database and a series of online programs and subprograms that are invoked by a specific application. The specific elements of the system include:

1. An On-line Program and Database Table For Defining Units and Groups (See figure 1)

   An **RNS** administrator is required to secure each application of the system and specify the following criteria for each group:

- The type of group being created. Groups may be defined as one of three basic types:

  Creator groups are restricted to creating new forms. They may not access any form they did not create or that was not forwarded to their group. Creators may not route forms to groups outside their department.

  Reviewer groups may review and reject forms within their department. They may also create forms if specified in their group definition. Reviewers may not route forms to groups outside their department.

  Approver groups, in addition to being able to approve or reject forms, may also pass forms to others within their department or another pre-defined office outside their department.

- The route the form may take, including the primary path and alternate forwarding locations. It is possible to use pattern matching and wild card characters to tailor intricate paths.

- An indicator to check if a group may be bypassed. This mechanism is used to skip specified groups along the path if they are not required to participate in the routing process.

- An indicator to check if forms are logically complete before forwarding to the next group.

- A processing level that may be used by the application program to protect or un-protect sensitive fields on the form as it moves through the various levels of the process.

- Notification Control to specify if notification should be sent to a group. This can apply to rejections, final approval, or final implementation.

2. An On-line Program to Assign Specific Users to a Group and Define Users' Attributes (See figure 2)

   The **RNS** administrator specifies the following criteria for each user:

   - Users are placed into a group or groups (as defined in the previous section) depending on their functional role in the department.

   - Individual users can also receive electronic mail notifying them of certain routing events pertaining to their group. For example, on our campus, the majority of our users do not receive email on the administrative mainframe. For each group assigned, a flag can be set to activate an email message notifying them that there is action to be taken on the mainframe.

- For each group, a restriction may be placed to prevent the group from updating or processing a form, yet still allow notification of routing actions and viewing of forms associated with the group.

3. A User/Group Selection Sub-Program

Although the majority of users belong to one group, a user may be a member of multiple groups. The **RNS** provides such a user with an online mechanism to select a specific group within the application.

4. A Transaction Capability Sub-Program

Based on the user's current group definition and the form's path records, only the group that has control of the form is able to process it. This security function is handled by the transaction capability subprogram. If path records do not exist, the processor verifies if the user belongs to a group capable of creating new forms. Any group along the routing path but not in control of the form may view it. For example, an application may allow all members of college groups to view forms created by their departments even before the forms reach the college.

5. A Processing Sub-Program (See figure 3)

This subprogram is called by the application program to allow users to approve, forward, hold, or reject a form. It also maintains path and notification records. In forwarding a form, the subprogram uses information stored in the group table to display a list of possible destinations ranked in logical path order. Below is a list of capabilities provided by this module:

- This module provides the ability to bypass up to nine units in the path definition. If bypassing is requested, the subprogram skips the specified groups and searches the path list for the next group that is not to be bypassed. For example, when handling faculty appointments, those for international applicants are sent to the International Education Services (IES) office before continuing to Academic Affairs. If the faculty appointment processor determines that the appointee is a U.S. citizen, then it directs the subprogram to bypass IES and forward the form to Academic Affairs.

- A component of this module also provides the ability to prevent the forwarding of a logically incomplete form. When groups are defined, the **RNS** administrator can set a flag indicating the level of logical completion. It is then the responsibility of the application program to determine if a form is logically complete at that given point. This information is then passed in the form of a parameter to the sub-program, which compares it with the flag in the group definition table. If the form is incomplete, the sub-program will return an error code which the application program attaches to the form indicating what action must be taken. This feature allows an incomplete form to be passed back and forth between several groups within a unit, yet insures that the form is complete and correct before it leaves the unit.

- This sub-program also gives users the ability to attach private and permanent notes to a form. Private notes are sent to the next group on the routing path and then destroyed when the recipient forwards the form to the next group. A user who rejects a form may attach a permanent note that can be read by anyone who has access to the form.

- When an action is taken, this sub-program also returns a series of parameters to the calling application containing notification information that is to be distributed to the appropriate groups by electronic mail. It is up to the calling program to use a suitable mechanism to initiate the electronic mail transmission. On the IBM MVS platform, SMTP provides this vehicle.

6. A Path Record Sub-Program (See figure 4)

This sub-program displays the path record or history for each form. The path record includes the name of each person who took action, the status (forwarded, approved, held, pending, or unread), and the date action was taken. The path record fosters accountability among users since any user with viewing capability can call up the form and see the path and status at any time.

7. An In-box Sub-Program (See figure 5)

This function allows the application program to alert the user that there are forms that need an action to be taken. An entry is provided that contains the following information for each form: date/time the form reached the user, note status, description, and group name of the sender.

Conclusion

This paper has described the various elements that make the Routing and Notification System a success. Efficiency, accountability and accuracy are all hallmarks of the **RNS**. The versatility and functionality of this "paperless" system has enabled the campus to overcome a number of delaying factors that occur when routing paper forms. Because the forms are electronic, there is no wasteful duplication of paper, forms are not delayed by campus mail, nor can they be misfiled or viewed by an unauthorized user. Most importantly, since electronic forms are easily tracked, they are never "lost" in transit; thus users no longer have to play "phone tag."

Using the **RNS** as a base routing system, the University of Maryland at College Park will have eliminated the manual routing and approval of over 4,000 academic appointment papers via the Academic Resource System. With the same base system we will shortly implement a payroll approval system that will eliminate over 50,000 pieces of paper annually. Likewise, we are also considering applications in the areas of travel approval and reimbursement and financial aid, both paper intensive processes with multilevel approvals.

Despite its obvious success and acceptance by the user community, we must face the fact that a totally mainframe-based routing system is only an interim solution to the routing of forms. Increasingly administrative systems are moving, under appropriate circumstances, to smaller distributed systems. Forms processing is certainly an application that does not require the power of a large mainframe, although limited access might be required for information validation. In addition, users would prefer to access any forms application directly from their desktop rather than the more traditional mainframe logon. Thus we will be looking at porting of **RNS** to a more open distributed systems environment so that we can take advantage of new technology maintaining our investment in a proven activity.

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APPENDIX

```
RNS201F1              UMCP/RNS Routing and Notification System              11/05/93
JKL-LB85                    Group Creation/Definition                       ARSGROUP
================================================================================
Group ID: System: ARS  Unit: 11A010    Group: ____

Group Title   : AGRIC ENGR Chair                        Status: _ (' '=OK O=Old)
Appl Level    : 20   (Used by the application for allowing access to fields)
Bypass Unit   : N    (Y/N Indicates if this Unit may be bypassed based on data)
Capability    : S    (C=Create R=Review S=Submit I=Implement A=Auto Implement)
Create Forms  : Y    (Y/N May this group create a new form)
Complete Req  : Y    (Y/N Form must be complete to goto Approver or next Unit)
Notify Reject: Y     (Y/N Notify group if form is rejected)
Notify Approv: N     (Notify on Approval       - N=No, A=All, F=Final Only)
Notify Implmt: F     (Notify on Implementation - N=No, A=All, F=Final Only)
Terminus      : N    (N=No, A=Last appr > Impl, B=Last appr stop, I=Last Impl)
Next Group    : System: ARS  Unit: 11A        Group: 1?    (Wild cards allowed)
Fwrd Group    : System: ARS  Unit: 11A010     Group: *     (Wild cards allowed)
Link Appl     : APTU        (Application menu item associated with this group)
                            Inserted: 03/29/93 Modified: ________ by JKL
==> ___________________________________________________________________________
F1=Help      F2=Clear     F3=Menu                                   F6=Print
F7=Prev Grp F8=Next Grp F9=Cmd Ln   F10=NewGroup                    F12=Cancel/Delete
Make changes to the group information.
```

Figure 1. Screen for Defining Groups

```
ARS201P1                    Academic Resource System                    11/05/93
JKL-LB85                  Notification Group Management                   GRPMGR
================================================================================
User ID: JKL Lemich, Jeffrey Keith (ADSJKL)
Email->JLEMICH@ADS1.UMD.EDU
                                                -----BLOCK-----
 Unit   SubGrp Translation                      Rcv Rej App Imp Level  Mod Dt   Usr
11C      ____  COLL ARHU Dean                    N   N   N   N   50   05/12/93 JKL
11K020   1001  CHEM&BIOCH Creator                Y   Y   Y   Y   50   09/13/93 JKL
________ ____
________ ____
________ ____
________ ____
________ ____
________ ____
________ ____
________ ____

==> ___________________________________________________________________________
F1=Help        F2=Clear      F3=Menu                               F6 =Print
                             F9=Cmd Ln                             F12=Delete/Cance
The last group record is displayed.
```

Figure 2. Screen For Assigning Specific Users to Groups

BEST COPY AVAILABLE

```
RNS905P1          UMCP/RNS Routing and Notification System          10/28/93
JM7-0003                       Process Form
============================================================================
                        1994-Kanobi, Ben Obi Wan
Forwarding Choice # ____
There is a note attached.
#### --- Possible Destinations ---------------------------------------------
   1  Approve and Submit to COLL LFSC Financial Officer
   2  Forward to CHEM&BIOCH Chair (Alternate)
   3  Forward to CHEM&BIOCH Reviewer
   4  Forward to CHEM&BIOCH Creator
   5  Forward to CHEM&BIOCH Creator (Alternate)
   6  Forward to CHEM&BIOCH Chair Reviewer




F1=Help  F2=Hold  F3=Return     F4=Read Note    F5=Send Note    F6=Print
F7=Prev  F8=Next  F9=Show Path  F10=Top        F11=Bottom      F12=Reject Form
Place cursor under selection and press ENTER.
```

Figure 3. Screen Of Possible Forwarding Destinations

```
RNS907P1          UMCP/RNS Routing and Notification System          10/28/93
JM7-0080                        Path List
============================================================================
                                           Press F8 for more codes...
                        1993-Adams, Abigail
  1  HUMAN DEV Creator 1               Forwarded 05/19/93 05/20/93
     McDermott, Jennifer Anne
  2  HUMAN DEV Bus. Mgr.               Forwarded 05/20/93 05/20/93
     Mattingly, Maribeth
  3  HUMAN DEVEL Chair                 Approved  05/20/93 05/20/93
     Hope, Barbara B.
  4  COL EDUC Reviewer 1               Forwarded 05/20/93 05/21/93
     Areu, Eloy
  5  COLL EDUC Dean                    Approved  05/21/93 05/21/93
     Lemich, Jeffrey K.
  6  ACAD AFFAIRS Approver             Approved  05/21/93 05/24/93
     Andrews, Sylvia B.
  7  HRS Personnel Office              Implement 05/24/93 05/24/93

F1=Help                  F3=Return                              F6=Print
F7=Prev       F8=Next              F10=Top       F11=Bottom
Use a function key to scroll through the data.
```

Figure 4. Path Record Or History For Each Form

```
ARS202P?                 Academic Resource System                10/28/93
JM7 0003            Notification of Appt. Activity               ARSNOTE
<<<< ============================================================== >>>>
Group: CHEM&BIOCH Chair

 Date      Time    Status   Description                     Note From
 -----    ------   ------   --- ------- -----------------   --- ------ ---------
10/26/93 10:03 AM New     Process - (G1) Kanobi, Ben Ob Yes CHEM&BIOCH Revie
10/26/93 08:25 AM New     ARS-Rejected Appt-Skywalker,  Yes COLL LFSC Financ
10/01/93 10:09 AM Read    Process - Solo, Han               CHEM&BIOCH Revie
10/01/93 10:09 AM New     Process - Darin, Robert           CHEM&BIOCH Revie

F1=Help        F2=Clear        F3=Menu    F4=<<<Groups F5=>>>Review  F6=Print
F7=Scroll Up  F8=Scroll Down              F10=Detail                 F12=Delete
Use the cursor key to select and F5 to review a note.
```

Figure 5. Notification of Appointment Activity

CAUSE '93
Networked Delivery of Multimedia Information

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Abstract

Multimedia information sources present exciting possibilities for increasingly sophisticated and evocative presentations of material in many fields of education. Widespread use of this technology has implications for the campus computing infrastructure, local network capabilities and the services provided by libraries. Dartmouth College is expanding its campus-wide information system beyond textual resources and is researching how best to provide broad-based access to and support for multimedia for a large community of users in a cost-effective manner.

This paper discusses current plans to incorporate image, audio and video media into a networked information system, outlines the technical and organizational issues that have been identified and describes work in progress toward this goal.

Networked Delivery of Multimedia Information

Networked Multimedia Benefits

For faculty and students, multimedia resources can add new dimensions to the learning experience. Most concepts are easier to present and comprehend when words are complemented with images and animations. Learners retain more when a variety of senses are engaged in delivering information. The "intensity" of the experience aids retention and recall by engaging social and emotional as well as intellectual responses.

Unlike paper books, networked electronic media can allow many people simultaneous access to the same materials. These resources are available all the time, from office or home. More sources can be consulted and relevant information can be obtained immediately. More time can be spent on content, not locating information.

Most topical special collections include material in a variety of forms such as drawings and photographs. This information has not been as readily available in computerized form since the technology has not yet been appropriate. Recent advances in workstations, networks and storage technologies are providing a new opportunity to create an even more sophisticated information system, one that will contribute to the widespread use of multimedia applications in the community.

These are the most important benefits we hope to realize in adding multimedia to the Dartmouth College Information System (DCIS).

Selecting a Multimedia Delivery Technology

Multimedia information can currently be delivered via broadcasting, analog cable TV, laser disks, digital networks or CD-ROM disks. For some data sources or uses, particularly long video programs, existing digital networks are not yet an adequate delivery method. However, technical, economic and political developments are all pointing in the direction of digital networks which will eventually integrate the capabilities of alternative delivery mechanisms.

Technically there is much interest and activity around the merging of television and computing devices for several reasons. On the end-user's desktop it is certainly preferable from the standpoints of cost, maintenance and complexity to integrate information delivery on a single screen and network connection versus having both analog and digital screens and networks provided in each delivery location. Once these capabilities are combined by common data formats and displays, many interesting applications become possible.

The need to equip each workstation with the proper players for CD-ROMs or laser disks as well as handling the disks when a large number of people are involved, makes these approaches relatively unattractive at present and into the near future. Analog television's current absence of uplink capability and the need for analog to digital conversion at each workstation makes this approach similarly unattractive relative to a digital network.

Cable television and telephone companies are plunging into the digital network business with huge deals, mergers and projects to capture part of the fast growth of networked information sources and delivery to homes and businesses. The attraction of an exponentially growing market is irresistible compared to their relatively mature and slowly growing primary businesses. This activity will certainly push forward equipment capabilities and hopefully reduce equipment costs. There is concern about what it will do to the cost of network access.

These factors and trends combined with the existing universal digital network on the Dartmouth College campus are focusing our development efforts around digital networking for the delivery of multimedia.

Organizational and Infrastructure Issues

Many organizational and infrastructure issues need to be addressed when deploying a campus wide information system. Adding the technical goal of delivering multimedia information over the campus network adds some new issues and additionally impacts some existing ones. The areas listed here seem to be the most important factors influencing what DCIS can reasonably do with multimedia in the near term. Of course, there is also a financial component to all of these problems as well.

- Acquisition and Preparation of Material
- Copyrights
- Access Control and Billing
- Data Storage
- Network Requirements
- Desktop Workstation Features, Performance and Availability

Acquisition and Preparation of Material

A few years ago, few materials were even available in electronic form. Often a work was added to the library's collection because it was the only one of that type available in an electronic form. As computers have become more prevalent in the publishing industry, many new works have become available by virtue of having been manipulated electronically in production. Now there are more sources of materials that are unfortunately in many formats, with occasionally erratic quality. The accuracy and edition identity of an electronic work is crucial for serious scholarship. Some standardization of formats would be a big improvement.

The labor involved in digitizing (by keyboarding or scanning) and organizing a collection is substantial. The DCIS project is identifying and at times developing small tools to automate tedious operations as we proceed. We try to use personal computers where possible to simplify transferring these tasks into the originating department.

Copyrights

The ownership of material is currently a primary concern in selecting projects for development. The pilot projects DCIS has undertaken have been selected in part because their source materials had clearly defined ownership and negotiable permissions.

The requirements of complying with copyrights are at times murky, particularly in deciding what is a "fair use" of certain materials already purchased in a paper format. The simultaneous-usage aspect of electronic media has many publishers struggling with how to control and retain fair value for their property. An electronic copy lacks printing costs and has lower distribution and transportation costs. Should an electronic copy cost more, the same or less than a paper one? Some publishers have been unwilling to discuss the possibilities. Others have been more creative in working out mutually beneficial experimental arrangements. These questions need to be addressed by working with publishers to help them develop new ways to derive fair return on their investment and ultimately by additions to copyright law.

A number of software refinements are being considered to help implement "fair use" policies. The possibilities include limitations on single-search data retrieval and limits on per-session data printing and electronic copying.

Access Control and Billing

At present the licensed data sources Dartmouth has made available have been site licensed for the entire campus. This is quite satisfactory for certain widely appealing resources. DCIS has developed a flexible and effective distributed access-control system. It is possible to limit access to either the entire campus or a subgroup. This has made it possible to adequately and efficiently control site licenses and to develop collaborative licensing arrangements with other organizations. The next iteration of the system will provide limits on the number of simultaneous users of a particular database to provide more flexibility in negotiating licences. The next step beyond that would be to incorporate a billing system into the access-control process to allow per-use types of pricing arrangements.

Data Storage

The demands on digital storage capacity depend largely on the type of data and how it is indexed. The following example should help provide a frame of reference. A typical typewritten page of text consumes 5,000 bytes of storage. A significant work such as the full text of Shakespeare's plays fits in 5 million bytes. The text databases already online at the Dartmouth library range in size from a few million bytes to almost 1 billion bytes. The indexing overhead for text is typically 100 percent; for example, the 500 million byte *Oxford English Dictionary* requires an additional 500 million byte index. Dartmouth's current text collection fills approximately 30 billion bytes.

In contrast to text, the storage requirements for images can grow several orders of magnitude more quickly. For example, an uncompressed 1,000 by 1,000 pixel monochrome image (roughly the size of a 2 page monitor) requires around 100,000 bytes of storage. To represent 256 colors in this same image, the storage requirement increases to 1 million bytes. The same size image with 16 million colors requires 3 million bytes. The raster image of a laser printer page at 300 dots per inch requires about 7 million bytes uncompressed. Fortunately there are a variety of compression techniques or higher-level descriptions of printer pages to reduce these requirements.

Digital video pushes the storage requirements even further. For example, 30 frames (one second) of video digitized at 300 by 300 pixels stored with 256 colors would fill a 20 million byte hard disk (the average personal computer hard disk of a few years ago).

The data storage requirements to provide networked multimedia are substantial. Cost-effective solutions will eventually need to incorporate a hierarchy of storage devices. Early system efforts will likely require some management of storage by the network media servers themselves. Eventually some of the required functionality will move into operating systems as the needs become more widely applicable.

Network Bandwidth

The demands on network bandwidth depend on the type of data, the network protocols used to move it, the rate at which it needs to arrive and the amount of traffic on the network. Measurements indicate that practical bandwidth can at times be reduced to one-tenth of the theoretical maximum when protocol overhead (such as addressing and error correction information) is included. The load variability is a large practical problem for data that must be synchronized (audio or video). The multimedia system software must provide methods for gracefully degrading performance on networks where bandwidth cannot be preallocated in order to cope with this problem.

Text or still-image data do not have real-time delivery constraints like video. When delivering text or still-image data, getting it to the user in an acceptable time frame is the constraint. Simple analysis estimates and practical experience confirms that fast modems (at 14.4 Kbits/sec) or local area networks like LocalTalk (at 230 Kbits/sec) are capable of transferring text and medium-sized images (e.g. 50 KBytes) in tens of seconds. Ethernet speeds (10 Mbits/sec) combined with current compression techniques are needed to transfer larger color images and low frame-rate video. To deliver high-resolution video will require networks capable of at least 100 Mbits/sec.

Networks need to employ compression technology at current bandwidths, and compression requires more workstation processing power. It is likely that the data demands will always stay ahead of the economically available bandwidth so compression will continue to be important. Additional network capacity is a key constraint in the widespread deployment of multimedia applications.

Workstations

The capabilities of a user's workstation historically have constrained what was possible to deliver in an information system. Early terminals and personal computers dealt only with text. A second generation of personal computers opened the richer worlds of graphics and typography. A new generation of machines is now making audio and video manipulation readily available.

The development of DCIS has followed this progression of workstation capability: initially text, and then typography and graphics, with the addition of audio and video now being considered.

There is a balance to strike with regard to workstation capabilities. Some basic requirements can't be gotten around. Each person needs a reasonably sized screen and local memory, adequate processing power and network access. However, all these resources can be stretched by implementation tradeoffs in the client/server division of labor and the amount of labor invested in software performance. The balance point is always changing as equipment capabilities increase, although workstation upgrades must compete with many other budget priorities.

Development Objectives

After studying possible applications Dartmouth has developed the following list of objectives to outline our plan to introduce multimedia into DCIS.

- To develop, or integrate when possible, a suite of applications that enable individuals to make use of these media for research and instruction.
- To implement a server architecture that allows applications to locate, retrieve, and manipulate media resources.
- To develop media resources and to make them available for such a server architecture.
- To develop an environment that will allow users to be both readers and creators of media sets.
- To study aids to retrieving, locating, and describing images and video clips.
- To develop the necessary maintenance tools and procedures.

Recent DCIS System Developments

The requirements of two new library services, an image catalog and electronic document delivery, have been used to focus the development of the basic software components required to support multimedia. The DCIS project's initial goal was to produce a image database that contained searchable textual descriptions of the image. In addition to the existing software, we needed image format readers, decompression modules, bitmap transforms, a suitable database manager, network protocol extensions and a client application to retrieve and display images

None of the database management systems DCIS is using inherently supported binary data fields. Extensions to our servers, which front-end these database systems, added the ability to link to external files of binary data. The server can either open this external file and pass the data through as a binary field, or deliver a reference to it which can be passed to another program. The network protocol was enhanced to allow data transfer to be segmented.

We modified an existing client application used to search text databases to handle image fields as well. This text client can also locate, start-up and communicate with other client applications built specifically to manipulate other media types.

A universal document identifier (UDI) protocol has been implemented based on design proposals being considered for the Internet. A UDI permits references to other media types to be stored in a text database. The text client application is able to retrieve these references from the text database and pass them on to another viewer program that will retrieve and display a particular type of multimedia object.

We have developed an image viewer application that can retrieve and display color and gray-scale images in TIFF, GIF, PICT, and JPEG formats. This application has an interface allowing it to open and display disk files of scanned documents distributed via electronic mail as well.

Multimedia enhancements have been added to several of the existing servers. Several applications have been prototyped including a Dartmouth College Photo Records catalog, an electronically published magazine which includes illustrations, and an electronic document-delivery service. The components produced are generalized enough to be applicable to several other related areas by supplying different data. For example, the same software can display satellite photographs and weather map images stored in a Wide Area Information Server (WAIS). The document collection of the WAIS source is searched using the text client application, which in turn passes on image references for retrieval and display by the image viewer application.

Experiences and Observations

The DCIS development effort has followed a phased implementation approach linking other media to the text database facilities developed earlier. The following discussion summarizes our experiences and some observations.

End-User Equipment

The balancing act between system functions and hardware requirements is a difficult one. Currently at Dartmouth most faculty and staff have a Macintosh. One hundred percent of the students have a personal computer, most of those are Macintoshes. The capabilities of the installed base is, however, relatively modest. The incoming class of students is always the best equipped. The current freshman class has workstations capable of handling the image capabilities we have developed, earlier classes mostly do not. The faculty and staff have difficulties keeping up with the pace. The DCIS team remains concerned about frustrating the end-users by requiring more computer power than they have available. The realization that computing equipment has a relatively short life span is slowly working its way through the community.

Networking is much the same problem; most buildings have LocalTalk networks. Certain locations and new buildings have at least Ethernet networks. A campus-wide network upgrade is planned, although funding has been hard to obtain.

Data Preparation and Maintenance

Multimedia data is mostly captured from other sources, such as scanners and video digitizers. Creating digital multimedia requires special equipment, higher performance workstations and relatively sophisticated computer skills. End users have typically required assistance and funding to get started digitizing and manipulating their source materials.

Construction and maintenance of the databases in the DCIS system are complicated by their delivery from UNIX workstations. The performance of these systems are necessary, although their user interfaces discourage less-sophisticated users. We have converted a number of the maintenance tools to run on the Macintosh, which has greatly simplified setting up the databases and preparing updates. The completed files are then transferred to the server workstations for indexing.

A complex set of tradeoffs surrounds image quality. In principle there is a need to store the originals in relatively high fidelity, perhaps to preserve them but also to facilitate the quality of their reproduction when employed in other work. The time and labor to handle and scan a large collection is a large cost which would be nice to avoid repeating. In contrast, it is desirable to conserve server storage and to produce fast delivery on finite bandwidth. An image scanned beyond screen resolution wastes both these resources for the majority of uses.

One desirable image-format feature in view of this dilemma would be the ability to deliver a base image rapidly, to which subsequent detail can optionally be added. Another possible approach is to generate image derivatives (e.g. a scaled-down size) on the server in response to certain queries.

Database Design

It has proved convenient for maintenance sake to store media objects in individual disk files. These can be manipulated easily with standard tools. Using standard naming conventions helps the maintainer manipulate them in groups. The separate text catalogs can likewise be easily edited.

Some of the image formats provide the capability to include textual descriptions of themselves, although this has not yet been widely exploited. This may allow catalog databases to be produced mechanically from a directory of annotated images.

It is difficult to describe all the different aspects users may be interested in when browsing an image database. Developing methods of viewing samples of many images quickly is an important feature to bridge this gap. Pre-computing certain locational aids, such as miniatures, may be a cost-effective approach. A thesaurus of terms seems to be an important aid in locating images while minimizing the amount of subject indexing. A fairly specific classification combined with a hierarchy of terms can allow an image to be selected for a variety of reasons.

A number of interesting computer programs attempt to analyze and describe the contents of images and to locate scene changes in video. These may develop into both cataloging and retrieval aids.

Building multimedia databases has an enormous up-front digitizing cost. It will be important to make it easy to incrementally add to collections. It may be necessary to set up some collections so an image is scanned and entered when it is retrieved for use the first time. The steps to do this will have to be simple to fit into the work flow.

Image Formats

The variety of image formats is a difficulty. There always seems to be one more you don't have that someone wants to use. At present DCIS has accommodated the most popular formats on the Macintosh. Developing efficient "readers" for these formats is a considerable amount of work because of the variety of coding and compression techniques. For example, different formats provide color maps, provide progressive detail buildup, are revisable in place, are byte order-independent or provide high compression ratios. Some of these features are handy for certain applications and some are incompatible with high compression.

Server Design

As mentioned in the discussion of workstation capabilities, the division of labor between the client and server and the design of the server's features can be used to moderate performance requirements of the workstation. Some additional server capabilities DCIS intends to develop will include result caching, format transformations, scaling transformations and compression transformations.

The network servers could be enhanced with the addition of several logical network services. Since the servers are distributed, static links in the databases and the resulting dependency chain are best avoided. Binding component names at server or session start up through a name-resolution service is much more flexible.

Client Design

Objected-oriented programming techniques have greatly simplified incremental development and code reuse. Access to source code is, however, essential and far too much effort is still expended in reimplementing similar functions and ideas.

It seems that every data provider also wants to be a user interface designer. This is a significant problem, since developing a complete, tested client application is more effort than anything else we do. The extreme of a different user interface to every database would not serve end-users well. The present system does allow the result displays to be customized by delivering a description language from the server to the client. This has proved adequate for a large class of information resources. The exceptions continue to inspire new ideas.

Future Directions

In using the computer to present data, the designer needs to apply all of the bookmaker's and graphic designer's techniques. Screen layouts should please the eye and guide the reader to the most important information, as does a well designed page. The subtleties of fonts and colors need to be used to encourage the reader and draw attention to important information. The object is to deliver the maximum amount of information in the minimum time. It is crucial that multimedia be well crafted since there is an even larger potential to create confusion when compared to paper materials. There is a basic dilemma in having the power to manipulate all these factors and the amount of time and effort one must invest in doing it properly. The ability to add to an already well-crafted framework is a significant need in creating high-quality work more quickly.

Easy access to vast amounts of electronic information causes some problems as well. Users will need help to make sense of and find their way around large collections. Large topical databases may be accompanied by "Guided Tours." A guided tour would be laid out by an expert in the field, highlighting the most important information and providing a main thread for new users to follow or return to while browsing a collection. The underlying information system provides the raw data behind the tour.

Humans are good at visually spotting an anomaly or patterns in data. Reducing large data sets into visualizations can be a powerful research tool. The user should also be able to gain access to the raw data in order to verify conclusions or pursue other questions or analyses. To generate new relationships while studying a data collection with searches, computational reductions and visualization graphics seems to be a desirable additional capability.

Conclusions

DCIS has deployed an information system on the large scale of the entire institution. Over 60 local databases and hundreds of external sources of information are reachable by the system. Five central computers running about a dozen different servers currently provide information services for more than 700 daily users. Portions of the DCIS system have also been installed at a number of other institutions. Well into the third year of production use, we are trying to cope with substantial growth in usage and demand for more information resources. Enhancing the system further with multimedia resources is consistent with many requests received.

DCIS is trying to introduce multimedia to the campus-wide information system in small steps in order to stay in touch with its audience. Up-front considerations of the existing installed base of equipment and stressing efficiency in the software to make best use of the available equipment has kept this fundamental problem in check. Fortunately the evolution in workstations and networks is moving in the right direction to make these new applications attainable. Delivering new applications that aren't too far beyond current practice can concretely demonstrate the benefits of further investment in infrastructure improvements.

Although better networks are certainly very desirable, Dartmouth's existing computing environment provides a unique laboratory for exploring the frontiers of distributed, network-based computing and for applying the benefits of technology to academic and other pursuits. Networked multimedia resources have great potential for having a significant impact on how people learn and work.

Lessons from the Berkeley Museum Informatics Project

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The Museum Informatics Project at the University of California in Berkeley is a collaborative effort to coordinate the application of information technology in the more than 80 museum and other organized, non-book collections on the campus. Faculty, collection managers, curators, librarians and information technology specialists work together to develop data models, system architectures, demonstration systems and network-accessible production databases of text records, images, sound, video and film. This presentation examines some of the early successes and difficult problems of the project and its predecessor activities, to show how the necessary political, administrative, financial and technical support for the project was created within the institution.

INTRODUCTION

Why is the Berkeley Museum Informatics Project of interest?

New alliances are needed so that we can share scarce resources internally on our campuses and leverage external resources. The Berkeley Museum Informatics Project is an example of a new alliance on our campus, and there may be lessons from the successes and problems of this collaborative project and its predecessor activities that apply to other cross-organizational and cross-disciplinary efforts. This examination will show how the necessary political, administrative, financial and technical support for this project was created within the institution, and what kind of leadership was needed to initiate a change effort of this magnitude.

Audiences

Audiences who might be interested in this topic, in addition to individuals embarked on similar efforts at other institutions, include university and college administrators who are responsible for many disparate units and who see promise in information technology for better management of their operations. In particular, people contemplating large-scale ventures to implement imaging systems for paper documents might find useful parallels with this Museum Informatics Project. The project may also be of interest to information technology professionals who are concerned about the problems of moving from fancy multimedia prototypes to large-scale production systems.

University of California at Berkeley

The University of California at Berkeley is part of the nine-campus University of California system, a public institution. We have 31,000 students (22,000 undergraduates and 9,000 graduate students) from 100 countries. Three hundred degree programs are offered in 14 colleges and schools. We have a law school and a business school; we have no medical school. There are probably about 17,000 computers on campus; about 12,500 are connected to the campus network.

MUSEUM INFORMATICS PROJECT

Summary

The Museum Informatics Project (MIP) is a collaborative effort to coordinate the application of information technology in the museum and other organized, non-book collections on the campus. The Berkeley campus has more than 80 collections, with 30 million artifacts, housed in 65 organizational units in all major academic disciplines.

A few examples of the many kinds of materials in these collections include costumes, bugs, forest products, kinetic art, Egyptian mummies, plant specimens, soil samples, fossils, maps, architectural drawings, temple rubbings and musical instruments.

The project was formally created in January 1992. The founding members were:

Jepson and University Herbaria
Museum of Paleontology
Museum of Vertebrate Zoology
Phoebe Apperson Hearst Museum of Anthropology
University Art Museum
Architecture Slide Library
History of Art Visual Resources Collection
Information Systems & Technology

MIP's goal is to broaden access to fundamental academic resources by scholars, students and the public. Participants in the project include faculty, collection managers, curators, librarians and information technology specialists.

MIP has collaborative relationships with other University of California campuses, especially those at Davis and Riverside, and with the University of California Office of the President. Berkeley participants are also collaborating with people working on similar activities at Harvard, Cornell, MIT, USC, the University of Washington and the Australian National Botanical Gardens, among others.

Activities and architecture

The Museum Informatics Project has these major activities:

+ Produce a campus strategic plan for museum informatics;
+ Develop guidelines for information systems in museums and other collections;
+ Maintain an information clearinghouse;
+ Operate a demonstration and development facility;
+ Evaluate, select and implement information tools for scholars and curators;
+ Develop data models, system architectures, demonstration systems;
+ Develop network-accessible production databases of text records, images, sounds, video and film;
+ Assist museums migrating from legacy systems;

+ Obtain extramural funding for campus museum informatics efforts;

+ Provide a forum for serious discussion of intellectual property issues and other matters related to scholarly databases;

+ Produce a comprehensive catalog of campus collections.

The project has a strategic architecture (shown in the diagram at the end of this paper). The network is the key element. The campus high-speed network connects every collection and every user, and the Internet connects the collections to other scholarly institutions, public agencies, private non-profit organizations and the general public.

Collections are grouped intellectually in terms of their relationship to biological diversity, cultural diversity, and physical diversity.

Client-server architecture and distributed systems imply that each function is carried out where it can be done best and is most needed. Each resource is managed by the parties most immediately responsible, but access, including use of shared services and systems, can be granted from any location.

Strategic support is provided by the Academic Senate, the campus administration, the central computing organization, and the Library. "Cooperative autonomy" is enhanced by planning and guidance from advisory committees and functional working groups.

Management and funding

Administratively, the Museum Informatics Project is a department of Information Systems & Technology (IST), the central computing organization. It is directed by a faculty member, Professor Thomas Duncan, who also has an appointment in the Department of Integrative Biology.

The project has a Scholarly Uses Advisory Committee (composed primarily of faculty interested in research and instructional uses of the data in various collections), and a Collections Management Advisory Committee (primarily for curators and collection managers).

Functional Working Groups have also been created in 11 different areas, to work on technical, operational and policy issues. Examples include:

Imaging and electronic multimedia
Geographic information systems
Shared authority and reference files
Intellectual property rights

The Museum Informatics Project core staff (six FTE), and its Development and Demonstration Lab, receive State funding as a unit of Information Systems & Technology. Staff from other units of IST who are participating in the project, as well as staff and faculty from the departments housing the collections, are also paid by various campus funding sources. The National Science Foundation is providing substantial support for one of the MIP projects; the U.S. Department of Education has also provided some funding. Several grant proposals to State and Federal agencies are pending. Many hardware and software companies have supported the project; additional corporate support is being pursued. The Museum Informatics Project has been one of many campus groups involved in planning for a major new fundraising campaign for Berkeley.

HISTORY AND LESSONS

At this point in discussing the Berkeley activities I would normally describe some of our current projects, show some examples of materials from our electronic collections, and comment on our successes and difficulties, with suggestions about pitfalls that other groups might avoid. However, for this CAUSE Conference, I have been thinking about how this ambitious effort came about and what lessons there might be for similar efforts at other universities.

Preliminary work actually began in 1987, almost five years before the Museum Informatics Project was formally announced to the campus. Staff members working with three collections, the Architecture Slide Library (Maryly Snow), the Geography Map Library (Daniel Holmes) and the University Art Museum (Howard Besser), came to the chief campus computing officer (Raymond Neff) for help in creating "image databases" of their materials. Dr. Neff agreed to fund a collaborative pilot project, but only if the images were digital and the collections could be accessible on the campus network. A group I direct, called Advanced Technology Planning, was formed in 1988 and became responsible for image-database software development activities.

I am not going to recount the interesting events that have happened in the last six years. Instead, I want to talk about factors that came together to make it possible for the campus to create this large-scale, cross-disciplinary, cross-organizational, multi-year effort to provide access to the resources in our museum and other organized object collections.

It seems to me that at least eight elements of support had to be present to create the conditions for the Museum Informatics Project. This complexity turned out to be a strength; different entities were active at different times so that, when support weakened in one area, it increased in another. This project and its predecessor activities show the synergy that can come about from administrative commitment, government support, commercial support and individuals who believe in what they are doing and are willing to work very hard.

Sustained high-level administrative interest

The single most important factor supporting the Museum Informatics Project has been the personal interest and consistent support by our Provost for Research, Joseph Cerny. Information Systems & Technology has been reporting to Dr. Cerny since 1990, but his interest pre-dates that arrangement. He has made additional resources available to other campus units besides IST, most notably the Hearst Museum of Anthropology, and he has been a strong advocate of museum informatics since before we knew what to call it.

The central computing organization has made this cluster of activities a priority for more than six years, through four different information technology management arrangements (three different heads of computing, plus a faculty committee). Our current Vice Provost for Information Systems & Technology, John McCredie, is a strong supporter of the Museum Informatics Project, and it reports directly to him.

The right technology

We needed enough network connectivity and bandwidth to make both the earlier image database and the current museum informatics activities possible. We needed software portability (provided primarily by Unix, by the X Window System and by SQL database software). The cost of equipment has been coming down dramatically, of course (especially digitizers, workstations, and storage devices). We are now seeing interesting new developments in cost-effective CD-ROM tools that are likely to make it possible to do both network-accessible databases and subsets on CD-ROM for special purposes or special audiences.

Another aspect of "right technology" has been important: there is now enough technology in place on our campus, as a normal part of everyone's daily work, so that it is easier for people to think of computers as being helpful, to imagine sharing ideas and data, and to believe that disparate groups might have similar "information" problems.

Image databases are attractive applications, and the prototype databases we developed have had broad appeal: many people who don't think much of computers or networking can imagine the possibilities.

Good programmers

We had an excellent programming team working on the original prototypes, with a particularly brilliant and productive team leader (Steve Jacobson, now with Franz Inc.). We have been able to continue a strong programming team (currently led by Randy Ballew) through several personnel changes.

In addition to prototypes, the Advanced Technology Planning group has been designing and implementing production databases for some of the collections. We are in a slow process of turning those databases over to programmers working for the Museum Informatics Project and to programmers paid by grant or departmental funds to work with particular collections.

Faculty leadership

In spite of successful prototypes, the Museum Informatics Project would not have become a major campus activity without the leadership of a dedicated faculty member (Thomas Duncan), who was willing to make enormous personal and professional commitments to the project.

We had difficulties in the early years of the image database work because we did not have faculty "champions" for most of the prototype projects. Our small teams of curatorial staff and computer center programmers were sometimes in awkward positions relative to the priorities in academic departments, with problems obtaining resources from deans and provosts, or from external funding agencies.

Professor Duncan has been much more effective than staff had been in persuading other faculty to participate in strategic planning, grant writing and data modeling activities. Increasing faculty involvement continues to be a high priority for the Museum Informatics Project.

Vendor interest

We have had support from many hardware and software companies since the earliest days of the image database project. Support has meant much more than just encouragement: we have received donations and loans of hardware and software, been sponsored at conferences, and had frequent opportunities to talk with corporate software development people.

Early supporters were Image Understanding Systems, Ingres, Sun Microsystems, Apple Computer and IBM. Modest support was also received for the image database work from Digital Equipment, MIPS, NeXT, Oracle and Pacific Bell. At one point Carlyle Systems licensed the Berkeley image query software, under an agreement involving the Museum of Anthropology collection; although that arrangement did not work out, the experience was instructive for all concerned.

Sun Microsystems has been our most consistent supporter. A large donation to the fledgling Museum Informatics Project in early 1992 helped put equipment into eight different departments on campus. This donation proved to the potential MIP campus participants that collaborating can have tangible results, and the timing was helpful in obtaining National Science Foundation support for one of the MIP projects.

Discussions are currently underway between MIP participants and several companies, mostly notably Apple Computer, Eastman Kodak and Silicon Graphics.

Government support

The National Science Foundation (Biological Research Resources Division) has provided substantial, multi-year funding to the Specimen Management System for California Herbaria (SMASCH). We believe that the campus commitments to the Museum Informatics Project and to collaboration with the national (and international) botanical community were major factors in NSF's decision to make this award.

The U.S. Department of Education (College Library Technology and Cooperation Grants Program) was our first Federal supporter, with funding in 1991 for a 40-gigabyte image server for the Architecture Slide Library collection.

Proposals have been submitted recently by Museum Project participants to the National Endowment for the Humanities, the National Endowment for the Arts, the National Science Foundation and the California State Library. The next two years should see a substantial increase in grant-writing activities.

People who own the data are willing to work together

The original request for computer center help in 1987 came from campus individuals who cared about the data in their collections and who were willing to work together to try to create something mutually beneficial. The belief that campus groups need to come together to try and leverage scarce resources has been especially strong among staff curators and librarians for special collections. Recently we have seen increasing acceptance from both faculty and staff of the idea that collections in different disciplines may have common information management problems and opportunities. In addition, many interesting new relationships have been established among groups and individuals who had never worked together in the past.

In 1989, 25 individuals from 12 campus organizations participated in an evaluation of collection management software. Eight organizations founded the Museum Informatics Project; 18 were represented at the first formal meeting in the winter of 1992. There was an excellent response to MIP's call for expressions of interest in early 1992. Thirty-six campus groups responded within two months, and almost 80 collections are represented in the extensive survey of the campus collections that MIP has been working on for the past year. Many individuals are participating in the Functional Working Groups, which began meeting in the fall of 1993.

Many of the collections participating in the Museum Informatics Project are part of the campus Library organization. Library management has been supportive of the image database and museum software evaluation activities since 1988. In 1992, representatives from the MIP core staff, the Advanced Technology Planning group, and the Library began meeting monthly to talk about supporting "scholarly databases" and to make sure that each group's activities are coordinated and difficult development work is not duplicated.

Visibility

Berkeley people (both information technology professionals and the people with the data) have been willing to make presentations, demonstrate software, help other groups with demos, and write about the work we are doing. Most of us always say yes to opportunities to present in academic settings, and we will present in other settings if there is a potential benefit to the campus.

Descriptions of the Berkeley activities by software and hardware companies which publicized our work have also been helpful.

Visibility helped legitimize the Museum Project on campus, and it also brought us external collaborators: people engaged in similar activities and those who are interested in sharing data as well as design ideas.

OPPORTUNITIES FOR THE FUTURE

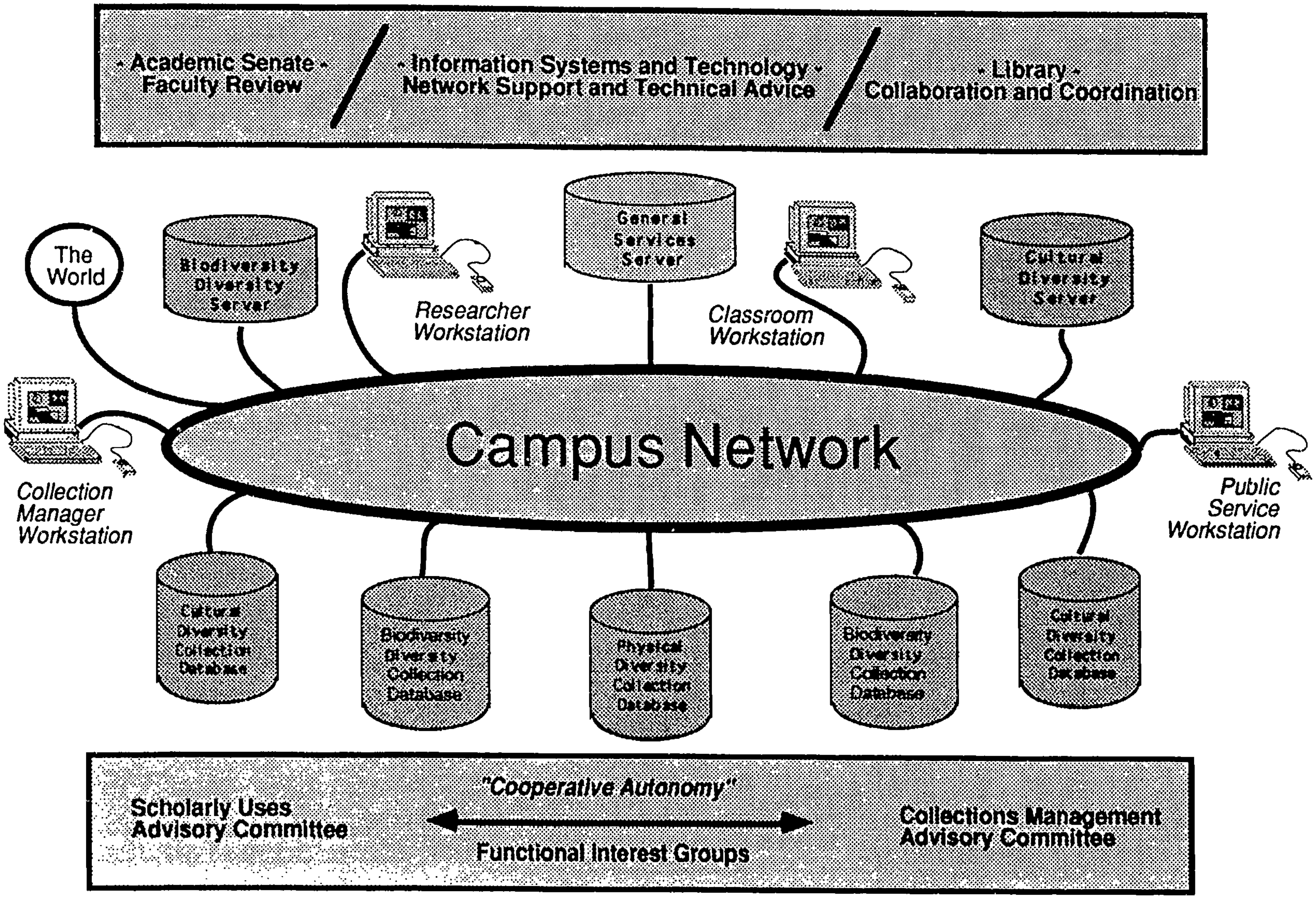
Now that the Museum Informatics Project is underway, where are we going?

We are assuming that fast, high-capacity, easy-to-use computing technology will become available all over the world in the next decade. Technology will become affordable for most institutions and scholars, as well as for others who wish to access data from museums and other collections.

By providing access to the data, images and sounds contained in our collections, we make the collections themselves more valuable, we get to use them more intensively, and we can also do a better job of conserving the artifacts and specimens.

We can "liberate centuries of captive information," in the words of one of our participants: we finally have an opportunity to access information that traditionally has been ignored and inaccessible to many scholars, teachers and students.

We can unlock the wealth of our collections. Most collections are underutilized. Many cannot be used for multiple kinds of study because of the extreme cost of finding pertinent materials. Museum informatics technology provides the way to exploit our campus intellectual resources more thoroughly.



Museum Informatics Project

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CAMPUS-WIDE DEGREE AUDIT

By Emil O. Hanson
Weber State University
Ogden, Utah
December 9, 1993

Abstract:

Weber State University's Degree Audit system is accessible across campus and is used to advise students, as well as to evaluate program progress for degree candidacy. Departments have access to screens where they electronically input program requirement waivers, substitutions and/or exceptions. They also use the Degree Audit screens to clear or sign off students.

Advisors can perform "what if" functions for students who are trying to decide among two or more majors. By printing several program of studies or Degree Audits, the student can determine the courses needed to complete any program, compared with courses in the system they have already completed, and which are stored in their electronic transcript file.

The Degree Audit system reduces confusion about program requirements for students, and reduces time and the problem of misadvisement for faculty advisors. Secretarial work/time is reduced significantly because memos are no longer sent between departments and the Graduation Office.

CAMPUS-WIDE DEGREE AUDIT

By Emil O. Hanson
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Ogden, Utah
December 9, 1993

Preface

The Weber State University Degree Audit program is unique in many respects. Most degree audit systems across the country are printed to a blank sheet of paper and the requirements and data meeting those requirements usually look alike, making them difficult to read. The STAARS system prints to a partially pre-printed form making the requirements stand out and are more easily read. The system is based on a comprehensive file of program requirements spanning a seven-year period, based on the changing requirements in annual catalogs.

The variable program requirements are input into the file using a unique screen format allowing a great deal of flexibility (Appendix A), and at the same time providing the necessary logic to make the requirements machine readable as it compares those requirements to the transcript record. The transcript is also formatted in such a way as to provide uniformity of data and yet the flexibility to record all types of achievement and different courses, some of which may be equivalent. The system not only reads the Transcript File, but it pulls data from several data files, including the Transfer Course file and the current Registration File, so that it prints current enrollment data on the Degree Audit form, placing asterisks in the grade column to distinguish them from completed courses which have a letter grade in that column.

I. Graduation Office

A. **Application** - Students are encouraged to apply for graduation a year in advance of the time they think they will complete requirements. An application form is completed, and a $25 application is paid. The fee covers all of the expenses related to a student's graduation and Commencement exercises, including the diploma cover, insert, cap and gown, and the after-Commencement luncheon social, etc. The Graduation information is then input to the Graduation Input screen (Appendix B).

B. **Input Procedure** - From the application a Graduation Office clerk calls up the Degree Audit screen (Appendix C) from the Graduation Menu Screen. If there are several applications that need to be processed, they can all be keyed in at once or they can be input one at a time. After the data is input and "return" is keyed, Degree Audits can be printed off on request. The following data is input to initiate the Degree Audit from the application form: SS#, degree, year, major, minor.

C. **The Degree Audit System** - As "return" is keyed the system compares the course ID numbers of the program requirements with the course ID numbers in the student's Transcript File. If any match, the grade is put in the grade column of the Degree Audit form indicating the requirement is done or complete. Those courses without grades are courses that haven't been completed. Double asterisks in the grade column are currently enrolled courses.

D. **Checks** - When the Degree Audit form(s) is printed off, it is reviewed for possible errors, and all graduation deficiencies are highlighted.

E. **Mailing** - The Degree Audit is double-checked for accuracy and then is either handed or mailed to the applicant with a letter of instruction.

F. **Clearance** - Students take the evaluation to their major, and if appropriate, minor department advisors, who review the requirements and transcript data to review major/minor deficiencies with the student. The major/minor course requirements are listed on the form, and if any of the courses have been completed, a grade appears in the grade column. If everything looks correct, the major/minor department chair will clear the candidate based on their completing the remaining requirements as outlined on the form. The Graduation Office then has the responsibility to follow up and verify that everything on the contract is done before the student is allowed to commence and receive a diploma.

G. **Transfer Course Equivalencies** - Approximately 60 percent of transfer students transfer from other institutions in Utah. We are in the process of loading and annually updating those institutions' course masters into the STAARS Course Equivalency tables. When transfer courses are input to the Transfer Maintenance screen (Appendix D) they are compared against that particular institution's equivalency table, and if a course is identified as equivalent to a WSU course, it is given an equivalency number and will slot throughout the system wherever the equivalent WSU course was identified as a requirement.

When we finish coding EDI, then the transfer courses will come in and be matched electronically, and the product will be a degree audit form that will be sent to the student, hopefully before the term they applied for begins.

H. **Major/Minor Substitutions/Waivers** - If the student negotiates to use a substitute course and/or have a course waived, the department must call up the Graduation Log Screen (Appendix E) and log in the substitution course name and number, and the course name and number for which it is substituting; or in the case of a waiver, they would identify the course being waiv^d. The next time the Degree Audit is run those waivers or substitutions show up on the form where the requirement was previously listed that is now waived or substituted. If the exception approved is other than a waiver or substitution, the exception is typed out on the Graduation Comments screen (Appendix F).

I. **Committee Action and Institutional Requirements** - Students sometimes request a waiver or substitution of requirements which are considered <u>institutional requirements</u>. They include general education, specific course requirements, total hours, GPA, upper division hours, etc. Exceptions to these requirements must be approved by the administrative Admissions Credits and Graduation Committee. If the student's request is approved, the secretary of that committee logs the waiver and/or substitution into the Graduation Log File; and when the student's Degree Audit form is printed electronically, the log notation is printed in the appropriate place on the Degree Audit form.

J. **Final Clearance** - Once the department has cleared the candidate, the dean of the school must clear them. The student reviews the Degree Audit with the dean or the dean's designated official, and if everything appears satisfactory, they clear the student electronically by calling up the Deans Signoff screen (Appendix G). The student is never required to return the hard copy form used to verify graduation status and clearance. All exceptions, if any, and the dean's clearance, are done electronically. In the former procedure, students took the Degree Audit form to the departments to obtain the necessary clearances, and every once in awhile discrepancies were found. It was decided that in the STAARS system, hand carried clearances would be avoided.

K. **Diploma Processing** - Each quarter candidates, who have indicated that quarter as their completion date, are checked for completion of requirements. The degree is then systematically posted to the Transcript File (see below). The degree information is downloaded to a PC diploma file which is set up to produce diplomas. Diplomas are printed, checked for accuracy, and mailed.

L. **Graduation Input Screen** - The Graduation Input screen controls all graduation reports. (See Appendix B at the end of this section.) There are two fields on the screen--one is for the student's estimated date of graduation, and the other is the actual quarter the student graduates. When the quarter code is input to the Actual field, degree information is systematically posted directly to the Transcript file and the next time a transcript is requested, it will show the degree information in the designated place (Appendix H).

M. **Graduation Reports** - Each spring a variety of Graduation reports are requested by department chairs, deans, the College Relations Office, etc. The report formats available in STAARS include: graduates by major, minor, school or college, by degree type, alpha order by degree, etc., ranked by college, by major. The Commencement program has a specific format, and one of the reports prints the names according to the Commencement program order. One report calculates Summa Cum Laude, Magna Cum Laude, and Cum Laude. These are then printed in the Commencement program, honoring these students. The above designations are stored in the Gradadd File, and the diploma is printed with the various honors identified.

II. Campus-Wise Advisement

A. The Degree Audit program is accessible to academic and support departments all across campus. They use it exactly the same way that the Graduation Offices uses it, utilizing the same screens and form.

B. When students come in for advisement at whatever level of achievement and regardless of major or minor, students have access to a complete and personalized Program of Study to guide them through their academic career.

C. The primary advantage of maintaining everything electronically, including waivers, substitutions, or any other commented exception is that all offices are looking at the same data. The hard copy programs provided students are guidelines only; the official record is the electronic record which may be modified weekly with a waiver or substitution. No paper is passed between departmental advisors/chairs and the Graduation Office.

D. Departments also have access to a display only Transcript screen (Appendix I), even though every course that is printed on the transcript also comes out on the Degree Audit screen/form. If students question a grade or hours, they have access to the transcript to verify. This access includes options to display just WSU work, transfer work, and/or experiential credit, such as challenge exams, CLEP, AP, etc.

E. Departments have access to each student's current Registration Display screens (Appendix J), as well, in order to verify current enrollment that is displayed on the Degree Audit form with asterisks in place of grades.

F. **What if** - Departments can assist undecided students in selecting majors by printing various programs showing how the student's completed courses compare with required courses for the programs in the system. That is not the most effective way to select a major, but it is nevertheless one of the factors.

G. Personalized training is available on request to each department or when new secretaries are hired, etc.

III. Future Modifications

A. The Graduation software will have a Tracking Screen programmed to track a candidate's status and specific data necessary to print their diplomas. When this program is completed the Graduation Office will no longer use the hard copy application to track students. The 3" x 8" card is currently the only paper in the Graduation Office and we want to get rid of that.

B. Stage II of the Degree Audit program will evaluate deficiencies and print them in summary form at the bottom of the electives column. Rather than print a narrative of the requirements, it will merely print the number of the requirement that is deficient. Therefore in the Stage II format each requirement on the form will be given a unique number. This information will save time for Graduation clerks and further reduce advisement errors across campus.

C. EDI (Electronic Data Interchange) implementation will provide electronic transfer of credit between institutions, which will make it possible to complete evaluations and assign equivalencies electronically before the transfer work is ever touched by a staff member.

APPENDIX A

WSU CAT/LOG - SPECIFIC REQUIREMENTS

```
                    +---------------------------------------+
Optn _              |Year ___-__     Major ___    Minor ___ |
                    +---------------------------------------+
+--------------------------------------------+ +-----------------------------------+
|Req ___  Core _   Adv Stnd _                | |Req  Abbrev Course  and/or  Grp|
|                                            | |___  ______  ___ _   ___     _ |
|Select __              numbered ___         | |___  ______  ___ _   ___     _ |
|Hours/Classes/Grps _   or above/below _     | |___  ______  ___ _   ___     _ |
|from grp _ through _   in dept ______       | |___  ______  ___ _   ___     _ |
|with __ Hours/Classes _ excluding grp _     | |___  ______  ___ _   ___     _ |
|or more/less _         elective  grp _      | |___  ______  ___ _   ___     _ |
|from _ each/# grp(s) _ grp _ must/can _     | |___  ______  ___ _   ___     _ |
|                       repeat _ times _     | |___  ______  ___ _   ___     _ |
|                                            | |___  ______  ___ _   ___     _ |
|Track ___________________________________   | |___  ______  ___ _   ___     _ |
|      ___________________________________   | |___  ______  ___ _   ___     _ |
|      ___________________________________   | |___  ______  ___ _   ___     _ |
|      ___________________________________   | |___  ______  ___ _   ___     _ |
|                                            | |___  ______  ___ _   ___     _ |
+--------------------------------------------+ |___  ______  ___ _   ___     _ |
  PREV- Cursor req    INSERT- Open line        +-----------------------------------+
  NEXT- Cursor abbrv  SELECT- Toggle screens   REMOVE- Delete   DO- optn
```

APPENDIX B

WSU GRADUATION INPUT

```
SSN _________   Optn _   Name _________________________________

Address _______________________________________________
Sex _______                                     Phone(___)-___-____
+--------+ +-----------------------------------+-----------------------------------+
|____-__|  |Degree ___     Expected ________   |Degree ___     Expected ________   |
+--------+ |               Actual   ________   |               Actual   ________   |
           |Major          Post     ___        |Major          Post     ___        |
           | ___  _________________________    | ___  _________________________    |
           | ___  _________________________    | ___  _________________________    |
           | ___  _________________________    | ___  _________________________    |
           | ___  _________________________    | ___  _________________________    |
Comment    | ___  _________________________    | ___  _________________________    |
Degree ___ |Minor                              |Minor                              |
Honors ___ | ___  _________________________    | ___  _________________________    |
GPA ___    | ___  _________________________    | ___  _________________________    |
           | ___  _________________________    | ___  _________________________    |
 Catalog   | ___  _________________________    | ___  _________________________    |
 ____-__   | ___  _________________________    | ___  _________________________    |
           +-----------------------------------+-----------------------------------+
```

APPENDIX C

GRADUATION EVALUATION

```
      SSN _________   Optn _   Name ________________________________

      Catalog Year ______     Degree ________________________________
+-------------- Major ----------------+ +-------------- Minor ---------------+
|___ ________________________________| |___ ________________________________|
+-------------------------------------+ +------------------------------------+
                                 DECLARED
      Catalog Year ______     Degree ________________________________
+-------------- Major ----------------+ +-------------- Minor ---------------+
|___ ________________________________| |___ ________________________________|
|___ ________________________________| |___ ________________________________|
|___ ________________________________| |___ ________________________________|
+-------------------------------------+ +------------------------------------+
                                                          Page __ of __
 Del   SSN          Student's Name                  Degree Year Major Minor
  _  ________  ________________________________     ___   ___  ___   ___
  _  ________  ________________________________     ___   ___  ___   ___
  _  ________  ________________________________     ___   ___  ___   ___
  _  ________  ________________________________     ___   ___  ___   ___
  _  ________  ________________________________     ___   ___  ___   ___
```

APPENDIX D

```
                    T R A N S F E R   M A I N T E N A N C E
                                                                  VERIFY _
SSN _________   OPT _  NAME ___________________________________
UNIV-CD ____ CD _ COLLEGE ____________________ CITY-ST ______________________

CD SCH-YR  QTR ABBRV  NUM SUF   COURSE-TITLE     HOURS GRD GE  UP W-ABBR W-NO D
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _
_  ____ __  _  ______ ___  _  __________________ _____ __  __  _  ______ ___  _

+--------- STUDENT'S OVERALL ----------+ +--------- CURRENT SELECTION ---------+
|TOT-HRS GRD-HRS GPA-HRS GPA-PTS GPA | |TOT-HRS GRD-HRS GPA-HRS GPA-PTS GPA |
|______  ______  ______  _______ ____| |______  ______  ______  _______ ____|
+--------------------------------------+ +--------------------------------------+
```

APPENDIX E

```
                        GRADUATION LOG MAINTENANCE

      SSN _________   Optn _   Name _____________________________________

          +------ LOG TYPES -------+    Type _  ___________________
          | _  __________________|      Coll ___ ______________________________
          | _  __________________|      Major ___ ____________________________
          | _  __________________|      Hours ___  SUBSTITUTE          FOR
          +------------------------+                Course _____   Course _____
                                                    Num    __      Num    __
                         Page __ of __              Suffix _       Suffix _
+---------------------------------------------------------------------------+
| Entered   Del Type Maj  Coll   Substitute        Course Num   GE  Hours|
| _________  _   __   __   ____  _____ ____ ___    _____ ____   __  ____  |
| _________  _   __   __   ____  _____ ____ ___    _____ ____   __  ____  |
| _________  _   __   __   ____  _____ ____ ___    _____ ____   __  ____  |
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| _________  _   __   __   ____  _____ ____ ___    _____ ____   __  ____  |
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APPENDIX F

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                 GRADUATION REQUIREMENT COMMENTS MAINTENANCE

          SSN _________    Optn _    Name ______________________________
                           Line ___  Lines ___
+------------------------------------------------------------------------------+
| Line      DATE                      COMMENT                  INS/DEL   DEPT |
|  ___    ________   ______________________________________      _      _____|
|  ___    ________   ______________________________________      _      _____|
|  ___    ________   ______________________________________      _      _____|
|  ___    ________   ______________________________________      _      _____|
|  ___    ________   ______________________________________      _      _____|
|  ___    ________   ______________________________________      _      _____|
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APPENDIX G

DEAN SIGN-OFF MAINTENANCE

SSN ________ Optn _ Name ________________________________

Degree __ ________________ ________
Major __ ____________________________
Minor __ ____________________________

Page __ of __

Del	Deg	Major		Minor		Entered
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______
_	__	__	______________________	__	______________________	_______

APPENDIX H

D E G R E E   M A I N T E N A N C E

SSN _________ OPT _ NAME ______________________________ SCREEN-OPT _

SCH-YEAR QTR DEGREE DATE TEACH

______ _ __ __________________________ ____________ _

UNIV-CD COLLEGE CITY-STATE APPRV

___ _________________ ____________________ _

MAJ	MAJOR	MIN	MINOR
__	____________________________	__	____________________________
__	____________________________	__	____________________________
__	____________________________	__	____________________________
__	____________________________	__	____________________________
__	____________________________	__	____________________________

HONORS

____
____
____

APPENDIX I

TRANSFER WORK

SSN ________ OPT _ NAME ______________________________

CODE _ COLLEGE ________________ CITY/STATE ______________

CD	SCH-YEAR	QTR	ABBRV	NUM	COURSE-TITLE	HOURS	GRADE	GE	SUF	W-ABBR	W-NO

STUDENT'S OVERALL					CURRENT SELECTION				
TOT-HRS	GRD-HRS	GPA-HRS	GPA-PTS	GPA	TOT-HRS	GRD-HRS	GPA-HRS	GPA-PTS	GPA

APPENDIX J

REGISTRATION DISPLAY

SSN ________ Opt _ Yr-qt ____-__ Qtr _ Administrative Deferment _

Name ____________________________ Athlete _

Address ___________________________ Veteran _

Phone ___-___-____ Student Directory _ Financial Aids _

COURSE INFORMATION

CR-ID	Dept	Crs	Time	Crs Type	OB	Hours	GRD	Type	Last Atnd	PD

The Information Arcade:
A Library and Electronic Learning Facility for 2000 and Beyond

Anita Lowry
University of Iowa
Iowa City
Iowa

This paper describes the planning and development of the Information Arcade in the Main Library at the University of Iowa. A collaborative effort of the University Libraries, the Office of Information Technology, and the academic faculty, the Information Arcade is an ambitious facility designed to integrate electronic resources and methods into research, teaching, and independent learning. Organizational relationships, facilities, resources, and staffing will be discussed, along with examples of innovative teaching efforts in the Arcade.

THE INFORMATION ARCADE

UNIVERSITY OF IOWA LIBRARIES

by
Anita Lowry
Head, Information Arcade

Planning for the Future

When the Information Arcade in the Main Library at the University of Iowa opened its doors in August 1992, it marked the culmination of nearly two years of planning for an ambitious new library facility designed to support the use of electronic resources in teaching, learning, and research across the curriculum of a research university. In the words of University Librarian Sheila Creth: "The goal of the Center is to bring new information technologies into the teaching and research process of the University of Iowa campus, using the library as the primary focus in order to link traditional print materials to the electronic information sources."[1] The original name of the center was to be the Interactive Information Learning Center -- not nearly as catchy as "Information Arcade," but indicative of the emphasis on teaching and independent learning in the conception of the Arcade.

Established with a three-year, $752,432 grant from the Roy J. Carver Charitable Trust supplemented by $400,000 from the University and $50,000 from the University Libraries, the Information Arcade is a cooperative effort of the University Libraries, the Office of Information Technology, and the academic faculty. Over 50 people, drawn equally from these three groups, were involved in the planning process, which was designed not only to draw on the diverse expertise of faculty and staff from around the campus but also to ensure that the major stakeholders in the project would be represented and committed to it from the start.

Two major advisory bodies, the Steering Committee and the Advisory Council, were established for the entire three-years of the Carver grant and are likely to continue to in some form even after this initial developmental period. The Information Arcade Steering Committee comprises Sheila Creth, the University Librarian, Lee Shope, the Director of the Weeg Computing Center (formerly Acting Director of the Office of Information Technology), and John Huntley, professor of English; this is the group that provides guidance on long-term goals and major policy issues. The Information Arcade Advisory Council is a much larger group, with members drawn from the Libraries (representing Reference; each of the three subject divisions: Humanities, Sciences, Social Sciences; the Library Systems Analyst), Academic Computing Services (representing Second Look Computing, the multimedia development studio; the Personal Computer Support Center; and the Personal Computer Information Center); the academic faculty (currently we have representatives from English, Library and Information Science, Political Science, Biology, and Nursing); and a representative from the University Video Services. The purpose of this group is to contribute a variety of perspectives and expertise to discussions of issues and policies and to facilitate communication with their colleagues.

In addition, during the planning period prior to the opening of the Information Arcade, task forces on space utilization, databases, instructional software, tool software, and operations, along with a Technical Advisory Committee, worked together to develop the specifications for the Arcade. These task forces did an extraordinary amount of work in a relatively short time and have since been discharged, their duties now being the responsibility of the Arcade management and its advisory bodies. I hasten to add that I cannot take any credit for this initial planning process and its coming to fruition, having been hired after the Information Arcade officially opened and arriving to take over the reins as Head of the Arcade in January 1993.

Needless to say, these groups all served, and in the case of the Steering Committee and Advisory Council continue to serve, important political as well as practical aims in reinforcing a collaborative ethos and in strengthening the institutional position of the Information Arcade.

A Blueprint for Collaboration

What is the blueprint for collaboration that makes the Information Arcade a reality?

> **The Library** is responsible for managing and staffing the Arcade; for selecting and purchasing appropriate electronic resources; for helping faculty and students to use these resources and to integrate traditional and electronic resources into their research and teaching; for assisting faculty in the development of curricula that incorporate electronic materials; and for assisting students in developing class projects.

> **The Computing Center** is responsible for managing the Arcade servers, network, and networked laser printer; for providing and supporting the "core collection" of Information Technology Center software on the Arcade server; for assisting in the selection of tool and instructional software; and for providing multimedia and instructional software development support for faculty.

> **The Academic Faculty** is responsible for developing courses to be taught using electronic resources; for teaching in the Arcade; for evaluating courses and methodologies; and for assisting in the selection of information sources and software.

The full-time staff of the Information Arcade consists of the Head, who reports to the Libraries' Director for Information Systems and Technology. The Library Systems Analyst, who has a masters degree in Instructional Technology, devotes approximately 25% of his time to the Information Arcade providing technical support and participating in management and planning. "Front-line" information and instructional services are provided by six half-time graduate assistants and a number of undergraduate and graduate student lab monitors. The Arcade has formal collaborative relationships with the managers of the Distributed Systems Group, the Network Services Group, and the Information Technology Centers, as well as informal relationships with the managers of Second Look Computing (the multimedia development group) and the Instructional Software Development Group -- all these units are part of the Weeg Computing Center. And, of course, the staff of the Arcade work closely with the staff of the University Libraries, especially those in Information and Instructional Services, Library Automation, and with library selection officers.

And what happens after the grant-funded period is over? The University administration has made major commitments to ongoing funding for the Information Arcade, including supporting the six graduate assistantships as well as providing substantial funds for upgrading equipment and for acquiring software and databases. The

Libraries have re-allocated a permanent professional line to the position of the Head of the Arcade and will provide funds for lab monitors, facilities, and resources, while the Office of Information Technology will continue the technical support and cost-sharing that it currently provides.

The Environment

Let me briefly sketch for you the environment of the Information Arcade. Located just inside the door of the Main Library and adjacent to the Main Reference Department (with its full complement of printed and electronic bibliographic and reference tools), the Information Arcade is approximately 6,000 square feet in size. The electronic classroom covers approximately 1,400 square feet. It is equipped with 24 Macintosh student stations and seating space for two students per station (Quadra 700s); the instructor's station has two computers, a Macintosh Quadra 700 and an IBM PS/2 Model 57slc, to which are attached Apple and NEC CD-ROM drives, a Pioneer Laserdisc player, a Sony VCR, a SyQuest drive and Spin read-write optical drive. Images from the instructor's computers and/or peripherals may be projected to the front of the classroom using a Sony Multiscan Projector or a Sharp LCD panel (e.g., in cases where simultaneous projection from both computer screens or from a computer screen and a laserdisk are desired); sound is projected via an amplifier and a system of built-in ceiling speakers. One wall of the classroom is floor-to-ceiling "privacy glass;" with the touch of a button the wall can be made opaque (to shut out distractions from the rest of the Arcade) or clear (to enable Arcade staff to monitor the room when classes are not using it) -- this is always a big hit with visitors!

The Information Stations located outside the classroom are used to access the Internet, CD-ROMs, and other local and remote information databases, as well as instructional software; at present, there are ten NeXT Stations, five IBM PS/2 Model 56sx's, and three Macintosh IIci's (there are relatively few Macs because the Macs in the classroom can be used as Information Stations when a class is not in session). There is a cluster of Multimedia Stations designed to enable students and faculty to use existing multimedia databases on CD-ROM and laserdisk and to create their own multimedia presentations and programs; this cluster has 7 Macintosh Quadra 700s (4 of them equipped with 21" color monitors), one Macintosh IIci, and one IBM PS/2 Model 57 slc, along with a color scanner, 2 black and white scanners, VCRs, CD-ROM drives, laserdisk drives, and removable storage media (SyQuest drives and Spin read-write optical drives).

The Course Preparation Lab, with 2 Macintoshes and an IBM and IBM-compatible, CD-ROM drives, and a laserdisk player, is used mostly for consultations with faculty and by librarians and faculty preparing instructional materials -- though it is not meant to be a full-service multimedia or software development lab.

The Information Desk is prominently located -- that's where patrons come for all manner of assistance in using the resources of the Arcade -- and it houses the growing collection of manuals, reference works, newsletters and journals, and other information sources. The offices of the Head of the Arcade and of the Graduate Assistants and a good-sized equipment/work room complete the visible picture.

The network infrastructure is invisible but just as crucial to our operations. All the Macintosh and IBM computers are networked to the Information Arcade file server, an IBM PS/2 Model 95 located in the Weeg Computing Center across the street and managed by the Distributed Systems Group at Weeg; the NeXT Stations are connected to a NeXT Station server, also at Weeg. We use an Ethernet network, the server software is

Novell Netware 3.11, and all the microcomputers in the Arcade have access not only to the local resources, but also to the campus network and to the wide world of the Internet!

Beyond Bibliographies

Information technology has penetrated nearly every aspect of the modern research library, so what is unique about the Information Arcade? In a nutshell, the Information Arcade is without precedent in its emphasis on:

- **non-bibliographic** electronic source materials in the humanities, social sciences, and sciences, including **electronic texts, image and multimedia databases, numeric data, courseware, information access and management tools, software for analysis and simulation, and programs for multimedia authoring and for collaborative work**;

- the **analysis, manipulation, and creation** of information in electronic formats;

- the **integration of computer-based resources and techniques into the undergraduate and graduate curricula** as well as into library instruction;

- the provision of **expert, in-depth information and instructional services** to support computer-aided teaching, learning, and research.

To date, the application of information technologies in libraries has been directed primarily towards the creation, management, and access of bibliographic records, whether in the library's online public access catalog or in the collection of bibliographies and indexes on CD-ROM or in facilitating access to remote library catalogs via the Internet.

But in recent years there has been an explosion in the creation and publication of **primary source materials** in electronic formats. Initially this occurred in the sciences and social sciences with the development of numeric databases, like censuses, or voting records, or economic time series data, and special databases, like chemical structure databases. But the humanities have now gotten into the act as a number of scholarly electronic text projects have made major primary source text databases and sophisticated and user-friendly text analysis software available to scholars in the humanities. To give just a few examples, there are the *Thesaurus Linguae Graecae* database that includes thousands of ancient and classical Greek texts, the *American and French Research on the Treasury of the French Language Database* that includes over 2000 literary, philosophical, religious, political, and scientific works from the 17th through the 20th centuries, the *Past Masters* series of British and European philosophical texts, and the *WordCruncher Disk* that includes the *Complete Works of Shakespeare*, the King James and New Revised versions of *The Bible*, selected texts from the Library of America series of American authors, and a large number of historical documents relating to American constitutional history. And, increasingly, primary source image databases and multimedia databases are enabling scholars and students to have ready access to rare or difficult to locate images, for example, the *AVIADOR* laserdisk database of architectural drawings from the great Avery Architectural and Fine Arts Library at Columbia University or the *Videodisc Encyclopedia of the Twentieth Century* that reproduces over 80 hours of clips of news footage from the turn of the century to the present -- a veritable gold mine of sources for students in history, political science, literature and the arts, journalism and mass communications, education, the history of science, and interdisciplinary cultural studies. And it is worth noting that the materials in the *Video Encyclopedia of the Twentieth Century* are all licensed for re-use so that students and faculty may use it to create their own video compilations on video tape or in digital multimedia programs, so long as it is for non-commercial, educational purposes.

With the increasing importance and availability of electronic primary source materials, today's scholars and students must learn not only how to identify and locate, but also how to analyze, manipulate, evaluate, and even create a wide variety of sources in printed and electronic formats. The true electronic library of the future is one that facilitates not only information retrieval, but also information analysis, enabling its users to bring computer-based tools and methodologies to bear on the data at hand; it also provides means for them to incorporate digital information directly into research documents and teaching tools of their own. Accordingly, the resources of the Information Arcade include:

- electronic source materials, with an emphasis on scholarly electronic texts and image and multimedia databases;
- text analysis software (e.g., *WordCruncher, TACT, TALLY, Micro-OCP*);
- information access and management programs (e.g., Internet navigation tools like *MOSAIC* to help people make better use of the resources available on the Internet, *EndNote Plus, FileMaker Pro*);
- scanning, OCR, and sound and image-capture and manipulation software (e.g., *Ofoto, Photoshop, AccuText, TypeReader, Premier, SoundEdit Pro*);
- hypertext and multimedia authoring and presentation software (e.g., *HyperCard, SuperCard, Storyspace, Persuasion, Passport Producer Pro, and interText,* developed at Second Look Computing at the University of Iowa)
- statistical and mathematical analysis and simulation programs (e.g., *Minitab, Maple, Excel, and MathCad*);
- graphics and desk-top publishing applications (e.g., *PageMaker, SuperPaint, Corel Draw, Morph*).

Teaching and Learning in the Information Arcade

And in a world in which computer-based interactive learning is changing the ways that teachers teach and students learn, the educational applications of electronic resources figure prominently in the mission of the Arcade. Our collections include high-level instructional software and courseware designed for use in the classroom and for individual and independent learning. For example, we recently acquired a CD-ROM called *Think for Yourself,* which contains many large data sets of statistics on the environment, health, economics, and demography from a variety of U.S. and international sources; it is designed as a teaching tool, bringing together many different kinds of data and providing a menu-driven graphing program and over 10 hours of self-paced tutorials to teach students how to select, analyze, and evaluate numeric data. The instructional software in our collections also serve as models for showing faculty what kinds of programs exist and for giving them ideas about materials that they could develop for their own teaching purposes. Hypertext and multimedia instructional programs are particularly interesting, and, with the advent of easy-to-use multimedia authoring software like *Passport Producer Pro*, the development of such programs is not beyond the reach of an enterprising faculty member or graduate student.

The centerpiece of the Arcade's educational facilities is the electronic classroom, though one-on-one consultations and small-group instructional sessions take place throughout the Arcade. Librarians and other library staff, Information Arcade graduate assistants, faculty, and professional staff from other parts of the university all participate in the Arcade's educational enterprise by teaching here. For example, the Data Archivist of the Iowa Social Sciences Institute teaches workshops on data manipulation and analysis, while staff from Second Look Computing, the multimedia development group in the Weeg Computing Center, teach workshops on various software programs for multimedia work.

Information Arcade lab monitors and graduate assistants (GAs) provide "front-line" reference and instructional assistance to patrons in the Arcade during all the hours that it is open. The GAs hold half-time graduate assistantships comparable to a teaching or research assistantship and are chosen for their subject knowledge and service skills as well as for their technical expertise. The competition for these positions is keen, and they represent a creative solution to the staffing challenges presented by a high-tech facility in which students, faculty, and staff with varying levels of computer literacy work with sophisticated equipment, software, and source materials.

In addition, librarians from throughout the Libraries give demonstrations and teach "hands-on" classes on information retrieval, the Internet, and electronic source materials and tools; some of the special sessions scheduled to date for this academic year cover electronic texts in the humanities, electronic primary sources in the social sciences, and electronic resources in history, medieval studies, classics, music history, mass communications, Spanish, and education. Librarians and Arcade graduate assistants provide in-depth, one-on-one consultations for students and faculty who are using or creating electronic resources for research and teaching. Librarians also work in teams with Information Arcade graduate assistants to develop new electronic information sources and teaching tools. For example:

- a librarian in Special Collections is preparing a multimedia presentation, incorporating both digital images and sounds, on Old English manuscripts and modern artists' books from the Libraries' collections;

- a reference librarian is combining text and images from the *1492: An Ongoing Voyage* exhibit at the Library of Congress (retrieved via ftp over the Internet) with additional images, sound, and text that she digitized and wrote in order to create a sophisticated hypermedia program on the diversity of peoples in the Americas;

- the bibliographer for European history developed a multimedia instructional module on the political geography of Renaissance western Europe for an undergraduate history course that she taught this semester;

- another reference librarian, who is teaching a senior seminar next semester on the impact of the civil rights movement on African-American culture, plans to have her students present portions of their primary source research as multimedia programs that can be integrated into a class hypermedia database on the topic;

- and librarians are participating in the design and development of the new University Libraries "gopher."

But the Information Arcade has even more ambitious goals for its new environment for teaching and learning. In order to encourage and facilitate the integration of electronic resources and interactive methods into the curriculum, the

Information Arcade promotes the use of its facilities, including the electroı c classroom, for academic courses and special class assignments that take advantage of these new resources and methods. Faculty in many disciplines teach classes in the electronic classroom of the Information Arcade. In the words of Professor Gregg Oden, who teaches a course on problem-solving:

> ...the Information Arcade classroom has turned out to be ideal for this class. Nearly every class day makes use of the classroom's special facilities in one way or another. Some days, the instructor's workstation and the screen projector are used to provide multimedia lecture support. On other days, these same facilities enable me to show techniques for using the computer in helping to solve problems, with the students following along on their own individual workstations. Or, the students may work independently on applying class principles using their workstations while the TA and I are available for tutoring and trouble-shooting as needed....Although the course is still undergoing considerable development and evolution, it already seems clear that it has the potential for being a model of how technology can help in teaching general intellectual skills.[2]

"Literature and Culture in Twentieth Century America," taught by professor of English Brooks Landon, is another particularly innovative course that makes heavy use of resources in the Information Arcade and throughout the Libraries. In this course, the students do not write term papers but instead create their own multimedia projects on some aspect of the Columbian World Exposition of 1893. This was the Chicago world's fair that was a seminal event in the transformation of American mass consciousness about technology. It is noteworthy that in his evaluation of this course, Professor Landon was particularly excited by the fact that students in this class, inspired by his large multimedia database on the Exposition and by their opportunity to contribute to it, did much more bibliographic and historical research in contemporary primary sources (e.g., newspapers, magazines, exposition publications, eyewitness accounts) than is usually the case with undergraduates. In the words of one of his students: "The open-ended nature of the assignments is what excites me. We need to research information from virtually everywhere, employing all the resources available at the university: scanners, advanced software..., electronic mail and Internet, and even real books! We have the opportunity -- the responsibility -- to add to a large, growing base of information in such a way to illuminate the previous data in a non-trivial way."[3]

This Fall semester, ten academic courses met weekly in the electronic classroom; ten more met there occasionally to take advantage of the presentation and interactive capabilities of the room. These classes all have assignments that make use of special software or electronic resources in the Arcade, and in at least five of them the students prepare hypertext or multimedia projects. Letters and evaluation forms from our faculty bear eloquent testimony to the impact of the Information Arcade on teaching and learning. Thanks in large part to the Information Arcade, at the University of Iowa the library is seen as a major player in the campus efforts to enhance the quality of undergraduate education -- a concern shared by institutions of higher education throughout the nation.[4]

Challenges for the Future

Lest you think I'm looking at everything through rose-colored glasses -- a rosy mauve being prominent in the color-scheme of the Arcade decor -- let me assure you that there is much unfinished business in the Information Arcade. And there are real challenges here, some of which will sound familiar to managers of campus computing facilities and some of which arise from the particular situation and goals of the Arcade.

- **Security of equipment and data**: We feel fairly confident that our fiber optic security alarm system will discourage theft of machines, but accidental, mischievous, or malicious damage to files on hard disks is impossible to eliminate in spite of our vigilance. Regular hard disk clean-up and file-replacement is the best we can do, but it is very time consuming, especially in a place where the wide variety of applications and peripherals results in many different system configurations -- and where the configurations are constantly changing as new resources are acquired.

- And that very **diversity and dynamism of our resource collections**, which is one of the great strengths of the Arcade, complicates our information management tasks and our efforts to provide ready access to the materials in other ways. Many of our programs and information sources are produced by small scholarly publishers, even individual scholars, and while they may be wonderful resources, they often pose special installation problems, cause configuration conflicts, won't run on our server and network, etc., etc. -- as one of the computing center consultants who works with us said: "You're trying to run a lot of unusual stuff in here!"

- **Staffing and service:** We have set high standards for ourselves in terms of expertise and "user-friendliness," but because of the breadth of our mandate it is increasingly difficult for staff to keep up with the burgeoning collection of software and resources available in the Arcade and over the Internet and the demands of a growing user population. So we are seeking to set clear priorities and guidelines for support, to develop formal and informal training programs for Arcade staff and librarians, and to involve ever greater numbers of librarians in providing reference and instructional support, especially for electronic source materials and courseware within their particular areas of language and subject expertise.

- **Promotion:** At the same time, we must continue to promote our resources and services to faculty and students, especially to those not already familiar with electronic resources and teaching tools beyond the opac and CD-ROM indexes.

- One measure of our success to date is the **heavy demand for the electronic classroom** making it impossible to accommodate all requests. Fortunately, this has stimulated some academic departments and the computing center to begin planning and creating additional electronic classroom facilities, but it remains to be seen if the supply can keep up with the demand.

- **Remote access:** At present, Information Arcade resources are accessible only in the Arcade. The technical and licensing issues involved in providing remote access are formidable and will not be easily or cheaply resolved.

- **Evaluation:** And finally, how do we evaluate the Information Arcade? We can keep statistics to measure our usage and can collect surveys and anecdotal data, but it is very difficult to quantitatively and definitively answer questions about the impact of electronic resources and methods on research and teaching.

A Model for the Future

But so far, the anecdotal data looks very good! Although the Information Arcade is only a year old, it has already generated extraordinary interest and enthusiasm locally, regionally, and nationally, as reflected in a steady stream of invitations to participate in conferences and meetings and in requests for information, site visits, and formal and informal consulting. The Information Arcade has a high profile on campus and has hosted special presentations for the Iowa State Board of Regents, the University of Iowa President's Club (group of major donors), and numerous other groups and visitors; it has been featured in all the major campus publications and in recruiting programs, and its Head is a member of the campus-wide Computer-Based Education Committee. In addition, because of its location in a public institution that is prominent in its state and region, the Information Arcade regularly hosts visitors from and serves as inspiration for primary and secondary schools and even commercial concerns, as well as community colleges, four-year colleges, and universities.

As a member of the Research Libraries Group and the Committee on Interinstitutional Cooperation (CIC, the Big Ten universities plus the University of Chicago), the University of Iowa and its Libraries participate in many national and regional cooperative ventures, including the Research Libraries Information Network and CICNet. So as it begins its second year of existence, the Information Arcade looks forward to participating in new cooperative efforts to provide access to and support for electronic source materials in research and teaching.

Notes

[1] "UI Libraries Receives Carver Grant." University of Iowa News Release. May 1991.

[2] Prof. Gregg Oden, a letter to the author, March 12, 1993.

[3] Chris Mortika quoted in an information sheet prepared by Prof. Brooks Landon on his course "Literature and Culture of the Twentieth Century." University of Iowa, February 1993.

[4] C.f., Joanne Fritz, "Playground for the Mind," Iowa Alumni Review 46, Spring 1993, pp. 22-26.

The Digital Textbook: A Look at the Next Generation of Educational Materials

by Don Hardaway
Faculty, School of Business
St. Louis University

The rapid advancements in digital technology is creating a whole new arena of educational opportunities. Now that multimedia is emerging as the next revolution in personal computers, there are abilities to author creative educational materials and frameworks that would not have been possible several years ago. Some of the common concerns that educators and administrators of computing share are: (1) the form that educational materials will take with the advent of multimedia, (2) the format that education will take to exploit the new technology and (3) the computer technology infrastructure necessary to support new educational environments. This presentation will address these concerns by demonstrating a prototype of future educational materials called "The Digital Textbook" followed by a presentation of how these new materials will allow for different educational formats and the necessary technology to support future settings in education.

Outline

- I. Multimedia on the PC
  - A. Analog vs Digital Technology
  - B. Hardware vs Software Solutions
  - C. Authoring
  - D. Storage Technologies
    1. Magnetic Disk
    2. Magneto Optical
    3. Optical
    4. CD-ROM

- II. Educational Materials
  - A. Traditional Materials
    1. Textbook
    2. Exercises
    3. Testing
    4. Lecture
  - B. The Digital Textbook

- III. Flexible Formats for Education
  - A. Logistics of Conducting Education
    1. Same Time Same Place
    2. Same Time Different Place
    3. Different Time Same Place
    4. Different Time Different Place
    5. Any Time Any Place
  - B. Global Telecommunication Networks

- IV. Technology Infrastructures for Education
  - A. Technology Needed to Support Education
    1. Classroom
    2. Labs
    3. Campus
    4. Offices
    5. Computing Centers
  - B. Future Technology Trends

Introduction

The acceleration of PC technology has created an environment of both opportunity and confusion. The latest PC technology, with multimedia ability, has provided educational institutions and publishers with a new set of tools that can be used to reengineer the educational process. With the multimedia elements including audio, video, pictures being produced using PCs in a digital form instead of the traditional analog form that used expensive analog equipment, virtually anyone can be a multimedia content producer. Recents trends indicate that the additional hardware that was necessary to bring multimedia to the desktop has been being replaced by software solutions (QuickTime) and/or with hardware in the machine out of the box (i.e. Quadra av). The continuance of this trend would suggest that in the future all machines will have full multimedia resources builtin at a affordable price. With all these changes in technology there is a new playing field for everyone. The following sections will discuss: (1) some of the technology developments that help enhance the technology tool box, (2) the impacts that new technology is having on educational materials, (3) how educational formats might change and (4) technology infrastructures that can embrace new technology and accessibility.

Multimedia on the PC

New technological developments have been the driving force in the creation of new PC technolgy. These developments are evidenced by the new PCs using RISC processors, increases in disk space and speed and the floppies that have much larger storage space that is necessary to store multimedia work. The recent developments in RISC processors such as the DEC alpha chip and the IBM 601 will allow for an entirely new generation of computers to be built at lower prices. These processors provide the needed processing power to support multimedia. The processors that follow (IBM 603, 604, and 620) will continue to push the envelope with staggering performance at relatively low prices. Parallel to the move in processors is the enhancements in disk technology. Disks are becoming smaller, faster and with more capacity. This can be seen in magnetic disks by the move from 5.25 to 3.5 inch disks. In fact, many of the new generation magnetic disks will have performance that rivals that of some disk arrays. Other developments have centered around the development of the 3.5 inch magneto optical disk. This would be the logical replacement for the current 3.5 inch floppies (capacity 1.44 MB) since the magneto optical floppy can hold approximately 128MB. This and even larger spaces would be needed to hold multimedia work and make it easily transportable. Another version of removeable disk is the optical disk. This type is not as popular as the magneto optical but could become popular if certain technological advancements are achieved. What is quickly become the most popular media for distributing multimedia and other content is CD-ROM. Today's CD-ROMs can hold about 650MB of information and costs about $1 per disc to reproduce in quantity. Many of the newer computers come with a CD-ROM drive built in. This trend will continue until all computers come equipped with CD-ROM. Additionally, recent developments have produced a CD-ROM with five time the capacity of today's CD-ROM. We should also expect that CD-ROMs will become smaller. One of the limitations of CD-ROMs have been their speed (access time and bandwidth). CD-ROM drives have changed from having a thru put of 150KB/sec to 300KB/sec and this fall NEC has announced a 450KB/sec and 600KB/sec drive to be available by the beginning of the year. Within a few years all machines will have much faster CD-ROM drives with much larger capacities. Again, this is necessary to hold the new multimedia creations that are forthcoming. We can expect to see the impact of all of these technological developments in the form that future educational materials will take.

Educational Materials and Educational Formats

Educations materials that take advantage of the new technology will all use multimedia components to produce a package for self study or as a audio/video support in the class room. Most developments today include basic textbook content, exercises and testing augmented by some video and/or audio. These materials are presently available on CD-ROMs but with advancements in networking will soon be accessible over networks. The content of the educational material may be reorganized so that the student explores topics in a random fashion or may be organized like today's textbooks where there is a sequence to covering the material. Both of these formats can be housed on a CD-ROM or be played back over a network. The main difference between using a network or a CD-ROM is in logistics. With future PC notebooks and personal digital assistants (PDAs) likely to have RISC processors and CD-ROM drives having materials packaged on a CD-ROM will allow much more mobility due to it's portability. Networks can only be accessed from designated locations whereas PC notebooks and PDAs can be carried anywhere and played anytime. Examining the different arrangements for experiencing learning yields the following possibilities.

1. Same time same place (today's classroom)
2. Same time different place (teleconference)
3. Different time same place (lab use at the discretion of the student)
4. Different time different place (portable materials or ISDN networks from home computers)
5. Anytime any place (portable computer with portable materials or wireless communications)

The trend will probably produce future scenarios that include more different time different place and anytime any place activities than the traditional same time same place style of learning currently used. As industry is currently undergoing much reorganization to stay competitive, education is addressing similar conditions. It will become imperative to use innovation with new technology to stay competitive as the educational market continues to tighten. As with industry, computer technology can be a strategic weapon for educational institutions.

Networking will continue to advance both on campus and nationally. Just recently several vendors were advertising FastEther boards which boost the data transfer rate to 100Mb/sec. This speed can make video over the wire much more feasible. Currently the IEEE standards committee is reviewing some proposed standards for FastEther. In another effort Internet is being investigated as a possible medium for high speed transfer over long distances. This network coupled with ISDN that is surfacing in some parts of the country would provide a viable method for linking society up over a global network structure. All of these efforts will move rapidly to achieve a high capacity networked society by the turn of the century.

Campuses are now moving toward a more networked environment to support the innovative use of computers in education. Dorms, offices, classrooms, libraries and more are all becoming networked. With the feasibility of multimedia only well planned infrastructures will be able to take advantage of the latest technology. The technology base at every campus is vital to the institution being able to be innovative and to achieve more efficient and effective educational environments. A campus with leading edge technology is needed even before the faculty and staff think of ways of fully utilizing it. It is the technology rich campus which serves to motivate members of the campus to try new methods. Only through providing the right atmosphere will people think to try new ideas.

TRACK PRESENTATION:

Providing Students and Visitors with Kiosk-Based Campus Information System

Prepared For:

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Background

"I don't keep regular hours: I work and I go to a community college and a university. I don't necessarily need to see a person every time I need information. I expect that there will be some sort of system in place so that I can access information at my convenience. That doesn't mean that it's available just during the day. I can be at home, at work, and I take night classes as well. I need to have the information when it is convenient. Some may say that this is difficult, but this is the way that I need to have it to continue my education. I'm in a different generation than my parents: the slacker generation, Generation X, the MTV generation, whatever you call it. We want things differently; it has to be slick, captivating, visually appealing, pleasing. Society is pumping all these images at me that really catch my attention so its kind of difficult to focus in on a static type of media. I really like getting good service when I need it; most of the time I need to know something to continue on and if I have to go through a bureaucracy to get to it, I may never even both to do it or be frustrated as I try to get that service."

Does Fred sound like a student on your campus? He represents a new generation of students to enter higher education:

- they are computer literate, if not fluent;
- they have an urgency about them in obtaining information, services, and instruction, based upon their personal obligations, work commitments, and academic goals; and
- they expect the same or better level of service from their campus environment that they are able to obtain in their commercial world.

How do the faculty and staff feel who work with this type of student as well as the more traditional students? Many of those who were attracted to their professions are frustrated by the amount of time that they must spend in "search and retrieval" non-professional activities. For example, advisors must take time in searching through various text files and making several phone calls for current information regarding which support services may be available to their students: at what time, in which location and whom to contact. As advisors provide guidance to students regarding their course of study, they typically must take time to search through the many hard copy versions of catalogs to find the appropriate one for a particular student and then make a "judgment call" regarding an exception to the prescribed curriculum to accommodate the students "unusual" circumstances. The time taken for search and retrieval is time that could have been devoted to advising students with specialized circumstances and to designing expert systems that could serve more students.

You may have reduced the number of staff in your office, perhaps through an early retirement program. While your enrollments may be steady, there are more part-time students who place increased demands for information upon your staff. The work week is in excess of forty hours not nearly long enough to offer students the level of service that you would like to provide. Have you recently determined how much time a staff person spends in providing a duplicate class schedule to students during the first week of class; how many students request an official transcript during the semester; and do staff in the Financial Aid office spend most of their time answering inquiries regarding the status of students' awards?

With issues of this nature confronting higher education, many institutions are looking for effective strategies to respond. One source of expertise is the business and industry community. Stan Davis and Bill Davidson, in their book, 2020 Vision, suggests that organizations can renew themselves by creatively using a plentiful, but unrecognized, resource within higher education. He states,

"In every economy, the core technology becomes the basis for revitalization and growth. Information technologies are the core for today's economy, and to survive all businesses must "informationalize." From small mom-and-pop stores to giant global corporations, the point to grasp is not merely that all economic activities will depend upon information to create and control their destiny. We've heard that

already. And while it's true, this truth manifests itself so slowly - over decades - that people have tired of it. For many, it is the unpoured honey. Instead of focusing on its not-so-newness, we must focus on the growing power and consequences of this truth. The point is that the economic value from generating, using, and selling information is growing significantly faster than the value added by producing traditional goods and services. ...The value of any product can be increased by incorporating intelligence, information content, and services." [1]

The authors maintain that the assumptions in 2020 Vision are applicable in the higher education context. To make the advice relevant, however, one must assume that the "products" of higher education are service, instruction, and research. The consumers of these products are students. To respond to the current and emerging needs of these consumers, the authors suggest that institutions improve the information content of services provided to students, allow students to conduct their own business transactions using information technology, and provide students with an information-enriched and accessible, learning environment.

The purpose of this paper will be to illustrate how institutions can create new, service-related products based upon the effective use of information resources. The authors first, will identify the factors that accelerate or decelerate the process of creating new products by optimizing information resources; second, will present a model to "informationalize" colleges and universities; and third, will describe how one institution, Sinclair Community College, has begun to informationalize its campus environment and creatively design a new product: an expert system for advising. The paper is organized into the following sections: (1) Problem Statement, (2) Conceptual Model, (3) Application, and (4) Summary and Conclusion.

Section One: Problem Statement

There is growing evidence that higher education is in a paradigm shift, although there is great variability among institutions as they accelerate/decelerate the process of change. The factors that contribute to the process of change are organized in this paper into the following categories: social, political, economic, and technological. Some factors pertain to the vestiges of tradition and others are the harbingers of the future "enterprise." These latter factors are the catalysts creating a paradigm shift within institutions who are transforming from an "industrialized" single entity organization to an informationalized, "enterprise-wide" educational network.

Social

There are at least three social factors that stimulate the informationalizing process. The first is the heterogeneous student body. For a number of years, higher education has acknowledged the changing demography of its student body. To reiterate these characteristics, the students of today are older, more ethnically diverse, more part-time, and more diverse in their learning styles than were their predecessors. The implication of this heterogeneous student body is that institutions must offer information more conveniently, easily, and use more than one medium of communication and instruction.

The second factor is that the high school graduates now entering higher education are a "product" of the "media generation." They learn from "infotainment." When these students sit in a large lecture class with only the professor at the front of the classroom, the student's attention wanes, despite the expertise and experience of the professor. Many of these students have become accustomed to communicating electronically, performing simulations using Nintendo games, and are heavy users of desktop software tools. However, one must also recognize that there are many other students who are not a part of the media generation and are not comfortable with technology. They seem to prefer large, anonymous lecture classes; but, like their younger counterparts, they too have other personal and work demands that require more accessibility to information. The implication of this second social factor is that institutions must be prepared to provide multi-media in both its services and instruction as well as

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[1] 2020 Vison, Stan Davis and Bill Davidson, Simon and Schuster, 1991., p. 17

 facilitate the transition from text to image processing of information to those whose "first language" was text-based information.

Political

The social factors identified above accelerate the process to informationalize a campus. The political factors to be identified in this section, however, tend to "decelerate" the informationalizing process. The first political factor is referred to as "the security shield." The turf battle between and among offices regarding who owns the data is well known in higher education. To explain the basis of this battle, one must view information as a resource of power. The person who controls the information, therefore, has power. While data security is a legitimate requirement, data security should not be used inappropriately as a shield to fend off the "information aggressors," since these aggressors are the students and faculty and staff who work with these students. For example, why must someone in the Registrar's office have sole responsibility to update a student's address when the student, who actually "owns" this information should be able to directly input this information into the computer, via voice and/or a kiosk?

The second political factor is the "reluctant giver." The recipients of higher education are the students and the communities in which they reside. These communities, as formalized in governing bodies and governmental agencies, want to know more about the colleges and universities that they support. The Student Right to Know legislation is just one example of their need for information. Although not publicly acknowledged, there is an undercurrent of reluctance among the information-rich. They respond with legitimate excuses such as "they won't understand the context of the information; they will be comparing apples and oranges, and it will take one FTE six months just to provide the information." While there is merit in each of these statements, one cannot discount the reluctance of colleges and universities to "charitably" donate information to their "publics."

Economic

There are four economic-related factors that can accelerate or decelerate the informationalizing process. The first factor that could accelerate the change is the ability of institutions to optimize their current information resources. The investment that has been made in building a robust database could be optimized; perhaps using the business model of "creating new products and markets." For example, an institution could provide new ways to access the data such as through voice technology and multi-media kiosks, thereby extending the use of the data to "new users," students and the community. An institution also could use these data in new ways, transforming the data into information that is interactive and rule-based. Using this strategy, institutions could extend the lifespan of their existing information resources while creating new products to informationalize the campus.

The second factor that could accelerate the process of change is the willingness of institutions to leverage their current and future investments by forming partnerships with other institutions and organizations. To do so, an institution must be willing to migrate out of its homogeneous environment into a heterogeneous one that includes other higher education institutions, K-12, governmental agencies, and business and industry. The network, or highway of communication, now offers institutions the capability to share information resources that traditionally might reside in a single facility at a single institution. Institutions may collaborate with hardware and software vendors to jointly develop new applications.

The third economic factor is the ability of institutions to creatively diversify their revenue portfolio. These institutions are expanding their portfolios from the traditional sources of revenue: public appropriations, tuition, and endowments. The information resources in an institution may constitute a new source of revenue if creatively and appropriately "packaged." For example, businesses, such as fast food providers and copy services, may wish to advertise on campus kiosks and will pay, or at least purchase, the kiosk to do so. Promoting campus events and services to the community through kiosks located in shopping malls, as one possible high visibility location, may generate increased attendance at these events and utilization of these services on a fee basis. Another example pertains to the expertise available in higher education. Traditionally, professors have written and published books and received royalties for these works. Cannot this same model be used to share other sources of expertise and information in the institution? Some may regard such a notion as antithetical to the values and tradition of higher education; for some it may stimulate them to creatively and appropriately use all of the expertise and information resources of higher education to generate new sources of revenue to support innovation.

The fourth economic factor, interrelated with social, political, and technological factors, is the ability to rethink and restructure business processes. The status symbol of today is not how many new staff you've hired this year, but rather, how much have you reduced your staff . The administrator who is able to do more with less is the one to be envied, not the administrator who has the largest staff. An example of one of the areas in which an institution may restructure is in the admissions and records offices. As a starting point, simple questions can be asked: how much time is spent, by how many staff, accessing, copying, stuffing envelopes, and mailing information such as transcripts, class schedules, and grades? How much time do advisors and counselors spend in accessing information, such as the course catalog, referral services for students (including their location, office hours, and type of service) compared to time dedicated to focused, one-on-one counseling and advising of students with specialized interests and needs?

The capability for students to personally and directly access relevant information through voice and kiosks can immediately relieve staff and faculty of these time consuming, routine tasks. As the business world says, "time is money." Thus, not only can the use of information be optimized but also the amount of time can be reduced. A formula can be derived to analyze the cost effectiveness of these tools, based upon the amount of time and number of people required to provide a given piece of information.

Technological

There are three technology-based factors that can accelerate the process of informationalizing the education enterprise. The first factor is the availability of a campus-wide, externally linked, network. This important institutional lifeline must connect all physical locations of the campus and extend the lifeline to the entire academic, governmental, and business communities throughout the world. For many institutions, however, there still are "small, remote communities" within the campus and organizational structure that do not have access to the "interstate highway system" (e.g. faculty offices, classrooms, and local area networks). Until all of these communities are connected to the campus and broader educational enterprise, institutions cannot fully informationalize their organizations.

The second technical factor pertains to an institution's information technology migration plans. Those institutions who, in the eighties, were regarded as "technologically advanced" because they had comprehensive mission critical systems operating on large mainframes accessible by staff from their terminals, now find themselves faced with becoming "technological dinosaurs." To survive in this emerging environment, institutions are confronted with the following challenges: migrating their mission critical applications to a client/server architecture; equipping all faculty, staff, and student labs with a minimum of 486 class personal computers, all with network cards; building their campus backbone; wiring all offices and classrooms, many with voice, data, and video; connecting all their local area networks to the backbone; offering access to and training all users in the use of Internet; acquiring desktop software and training all employees in these productivity tools; and reorienting and retraining technical staff from "data processing" personnel to designers, network navigators and managers, and user consultants. A number of institutions are taking an incremental approach to creating a client/server architecture. For example, they have developed/acquired value-added applications that reside on servers but are linked to administrative systems that operate on the mainframe. To provide benefits to users as the institution is migrating, some institutions are using new and existing technologies in creative ways to optimize the use of information available in their current mainframe-based administrative systems.

The third technology-based factor is the creative use of existing and new technology. One example of the tools they are using is voice response technology, a capability that institutions have been using since the early eighties, but typically the application was limited to the registration process. The trailblazer institutions are reconsidering and now offering students access to information using voice technology in a multitude of ways, among them the following: grades, admissions status, financial aid status, graduation check. They also are facilitating the conduct of business through credit card voice response registration and providing daily updates as to campus activities.

A second example of the creative use of existing and new technology, and the focus of this paper, is a campus information system accessible on kiosks. The concept and use of kiosks has been in existence for many years and in many countries. In its original form a kiosk, or "kioski" was a closet sized, stand-alone structure that carried convenience items. The technology-based kiosk enclosures became popular with the advent of Automatic Teller Machines (ATM). Today we see kiosks that can present information in multi-media form using CDs or laser disks, can print screens for which the requester would like a copy, can include a telephone, debit card/ ID card, and offer other features such as a membrane keyboard and voice activation. The convenience that students experience in their commercial life with ATMs increasingly is being offered to students and visitors on college and university campuses. Institutions are beginning to "unearth" their embedded information resources by completing their networks, developing a client/server architecture, and by creatively using existing and new technology.

Section Two: Conceptual Framework

The conceptual framework has two components. The first pertains to the evolving potential of the information resource and the second pertains to the integration of tools to optimize the potential. The first component is based upon a model that assumes an interrelated continuum that commences with simple, quantitative data and concludes with complex, qualitative wisdom. Table 2-1 depicts the model graphically.

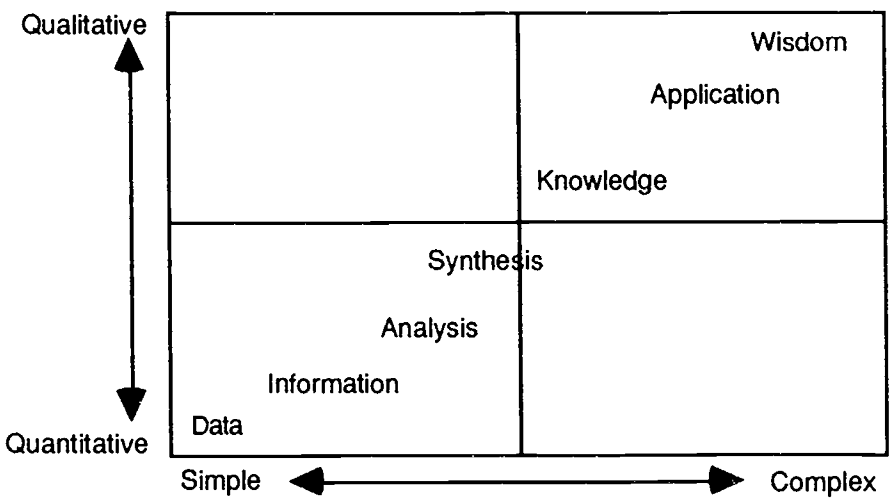

Table 2-1
Information Resources Continuum Model

The definitions used for this model are as follows:

Data:	numerical information suitable for computer processing
Information:	the act of informing or the state of being informed
Analyze:	to separate into elemental parts or basic principles so as to determine the nature of the whole
Synthesize:	to combine as to form a new, complex product
Knowledge:	comprehension acquired by experience or study

Application: the act of putting to a special use or purpose

Wisdom: good judgment, common sense

When this model is adapted to the higher education context, the more common application relates to instruction and research. For purposes of this paper, however, the authors have applied the model to other information-related aspects of higher education. For example, in the area of advising, there are data that are appropriate for computer processing. such as calculating a GPA. The data can be used as information when they are made available to students in a meaningful context such as their applicability toward students' educational objectives. An advisor can analyze information regarding students and the choices that they make by determining some basic principles that apply to students generally. Advisors also may synthesize the information by combining it with their own experience in working with students so that a new, enhanced understanding of student behavior can be derived. The understanding acquired by an advisor working with students is referred to in the model as knowledge. When students translate the advise into action, or application, the advisor is able to measure the effectiveness of his/her advise. and further develop wisdom, or good judgment, regarding the most effective way in which to advise students. Those institutions who are recognizing the potential of the information resource are those who are translating information into its more advanced forms of knowledge and ultimately wisdom.

The second component of the conceptual framework pertains to processes and technologies to store, manipulate, access, and disseminate the information resources. The first model illustrates the traditional way in which students access information. As noted in the graphic, students typically have relied on family and friends for information. When they request information from their institution it is either through hard copy written response or with a secretary or other staff member. The secretary typically must obtain the information from her personal computer or terminal linked to the mainframe or from hardcopy stored in files. Her supervisor, generally not available for direct student contact, "supervises" the process. To obtain instructional information, the student has access through books and classroom instruction. This model, or paradigm, reflects many of the principles of the industrialized society such as a bureaucratic organizational structure. --see Appendix A: Traditional Model

The new information model graphically depicts the student at the heart of the enterprise, accessing information through various tools such as his pc, phone, kiosk, or personal contact. In this new model, the students have direct access to information and do not have intermediaries--or barriers-- to obtain the information he needs or to conduct business transactions. The mainframe applications can be accessed through a server networked to personal computers. Voice response technology can reside on a server and provide students with simple access to all the information-related resources of the model. Networked kiosks, linked to the mainframe through a server, provide additional integrating technologies such as multi-media presentation of information resources, particularly the sharing of knowledge and wisdom. The kiosks also can integrate related businesses processes with a single student ID/Debit card. With these tools and the expertise available in higher education, institutions can optimize all of their information resources to create an informationalized, educational enterprise.

When this model is combined with the Information Continuum Model described above. the information can be shared with students in the form of knowledge and wisdom using such tools as multi-media kiosks where the experts are visible in full-motion video. Students also could use the kiosk to access an expert system for advising that would be either a substitute for or complement to an advisor, depending upon the student's particular needs. Family and friends still play a key role, but they are integral to a students way of life and they can be accessed using technology as well. Technology becomes the integrator and facilitator of optimizing the information resources in colleges and universities. The institutions who use it well are consumer drivers, not consumer driven, providing a student-centered, educational enterprise. --see Appendix A: New Information Model

To test the premises stated in this conceptual framework, the authors present an example of one institution, Sinclair Community College, which is aggressively moving along the continuum from data to wisdom, using applications, tools, and technology to integrate all of its information-related resources.

Section Three: Illustration

Overview

Sinclair Community College, located in Dayton, Ohio, is an example of an institution that is working aggressively to restructure its information systems and supporting administrative processes. Sinclair has recently replaced outdated administrative software with the Colleague system, a comprehensive student information software package marketed by Datatel, Inc. Colleague is accessible campus-wide at Sinclair through an ethernet network with a fiber backbone, using TCP/IP protocol. The campus network provides the Sinclair community with access to Internet, the library system, and to many software packages for office productivity, in addition to Colleague databases.

With these computing facilities and a strong dose of imagination, Sinclair has moved rapidly toward a student-centered, informationalized campus environment. A centerpiece of this transition is the InTouch kiosk system, which offers Sinclair's students convenient access to data, information, knowledge, and even wisdom (or at least very specialized expertise).

Developed in partnership with The Robinson Group, Sinclair's InTouch kiosk software merges several disparate technologies into a smoothly integrated system for information delivery. Multimedia adds appeal and ease of use; relational databases provide rapid access to small collections of data that are relatively stable, while the campus network provides real-time access to highly volatile information in the extensive Colleague databases.

Artificial intelligence adds an entirely new dimension to kiosk functionality; through an interactive dialog with the student, the kiosk's Intouch Counselor gives personalized recommendations and suggestions. While traditional databases deal with the questions, "Who? What? When? Where?", the counseling expert system helps Sinclair students explore "What if?", "So what?" and "What does that mean to me?"

The concept of a "smart kiosk" grew out of a Sinclair project called CWEST ("Counseling With Expert Systems Technology" -- pronounced "quest"), which was initiated in the summer of 1990. CWEST was funded primarily by a grant from the State of Ohio to promote the use of artificial intelligence and expert systems; the underlying objective was the transfer of technology from military to civilian applications. To this end, a team of Sinclair faculty and staff worked with the Center for Artificial Intelligence Applications (CAIA), an organization funded by the Air Force, to develop an expert system prototype.

Application for an Expert System

The Sinclair team selected academic advising for its expert system domain for several reasons:

1. Academic advising is inherently rule-governed and logical; the team felt that "if-then" rules could be defined for much of the knowledge domain.
2. Academic advising is an area that is familiar to almost everyone on campus; rather than selecting an esoteric topic, the Sinclair team preferred a project in which many faculty, students, and staff could participate.
3. Like most community colleges, Sinclair has an insatiable need for counseling services (both academic and personal) due to the increasing numbers of under-prepared and non-traditional students, the diversity of its student body, and the complexity of its program offerings, which include a full gamut of vocational and university-parallel options.
4. Recent budget cutbacks make it unlikely that Sinclair will add more counselors to meet the increasing demand. An automated academic advisor could expand access to counseling resources without adding more staff.

Phase One: Design

During the first year, the CWEST team created a prototype of an expert system that could assist students with the selection of courses for the next term. Although the prototype operated with only small and simplified data files, the team was convinced that a full-scale system could be implemented. At that point, the CWEST team turned its attention to the question of an appropriate delivery platform.

The team decided to pursue the idea of a touch-screen kiosk, possibly with multimedia, so that the expert system could be made available in convenient locations, and the system would be appealing and easy to use, even by students who are not computer literate. However, the decision to field the system on a touch-screen kiosk platform had an unexpected impact on the project. Almost immediately, the team realized that a CWEST kiosk could be used for many other applications, such as maps and general campus information, access to mainframe information, and (perhaps) on-line registration.

As the team sorted through kiosk application possibilities, the definition and scope of the CWEST project went through alternating cycles of expansion and contraction, accompanied by rising and sinking levels of enthusiasm, anxiety, and confusion on the part of the team members. One fact was emerging clearly, however: the team's vision of CWEST had become too large an undertaking for the Sinclair team to complete on its own.

Phase Two: Development

The difficulty of scope and resources was resolved in December of 1992, when Sinclair formed a partnership with The Robinson Group (TRG) to combine the CWEST advising expert systems with TRG's Intouch kiosk software. The TRG/Sinclair partnership was formed after a single meeting at which demonstration software was exchanged. It was immediately apparent to both parties that the products were complementary and compatible in concept and function.

In the knowledge engineering phase, the CWEST team used a sophisticated expert system shell for rapid prototyping. However, to field test the system it was necessary to rewrite all the rules and algorithms in other languages (ToolBook script and C, specifically) so that the modules would be compatible with the Intouch kiosk software and the touch-screen interactivity. The AI modules were also redesigned internally to be primarily table-driven, so that they can be modified with relative ease to fit another institution's programs and course load factors.

Phase Three: Implementation:

The software merge was accomplished during the winter and spring of 1993. In May of 1993, Sinclair installed six kiosks (in six different buildings on campus) running the combined TRG/SCC Intouch software, initially in stand-alone mode. In August the kiosks were connected to the campus network for access to Colleague databases. Since then, new features and enhancements are continually being added in response to suggestions of administrators, staff, and students, and additional kiosks will soon be installed on campus and at off-campus locations. Sinclair is also in the process of implementing a telephone registration system, and is working on an interface between the kiosks and the telephone system.

Implications

The CWEST project, which began as an AI initiative, has evolved in directions unanticipated by its authors. This is not at all unusual for an AI project. In recent years, many software developers working with AI and expert systems are recognizing that AI cannot be a stand-alone technology; to be successful, AI must be integrated smoothly into comprehensive information systems that include many other components, such as relational databases, graphical user interfaces, multimedia, and traditional non-AI programming. In the Intouch system, the AI modules make up only a small portion of the total program code, yet they contribute dis-proportionally to the value of the kiosk.

Based upon Sinclair's experience, the authors conclude that integrating expert systems and traditional software is fairly difficult to accomplish. There are two fundamental reasons why this is the case: 1) the development process for an expert system is usually quite different from traditional software development process; and 2) the software tool kits are not usually compatible. The expert system tool kits (or "shells") have been designed to support the non-traditional style of development preferred by the artificial intelligentsia.

A traditional software application is designed to satisfy a very specific purpose which is clearly and precisely defined, usually in formal specifications. Typically, every aspect of the application is discussed carefully with the client, and all decisions meticulously documented before the programmer writes a line of code. A typical expert system, in contrast, is not exactly designed. The process of design starts out as a fuzzy, ill-defined idea and then grows exponentially into a larger fuzzy composite of ideas. At some point during its non-linear development cycle, the expert system begins to acquire a shape and purpose, and the authors and domain experts suddenly understand what it was that they meant to be doing all along.

This is a process called "knowledge engineering," and the development style is "iterative," which is another way of saying "trial and error." It is an exploratory style in which the authors begin with a few "if-then" rules to solve a problem, and then add more and more refinements until the system behaves, more or less, as desired. For example, one could start with the rule: "If you have a full time job and five children at home, you should not take any more than one class at a time." Then one could add more rules to advise the student about his/her credit hour load: level of job stress, ages of children, grade point average, the level of support received from home for school work, etc. While this might seem to be a straight-forward process, the designers found out what it is not.

The first challenge (and sometimes the primary challenge) is to articulate clearly what the question is that the designers are trying to solve. For example, the CWEST team began with the question, "What courses should I take next term?". It soon became apparent that the scope of that question was so large and complex that it needed to be broken down into a series of smaller chunks, such as:

"What courses do I have left to take?"

"How many credit hours should I take?"

"What courses are required for my major?"

"What courses have I already taken?"

"Which of these are offered next term?"

"Which of these have I had the pre-reqs for?"

It might be obvious that steps two through four above are identical to the steps required to do a degree audit -- that is, matching degree requirements and completed courses to determine remaining requirements. While a degree audit is a very challenging data processing problem, it is not necessarily an AI problem. However, the first chunk, "How many credit hours should I take?" is exactly the kind of "squishy" and elusive problem best suited to an AI solution. This question became the first chunk that the CWEST team set out to solve.

As many advisors are aware, credit hour load is a very critical question for the majority of students at community colleges -- the older students trying to balance their commitments to jobs and families along with college classes. Although it is posed as the simple scheduling question, "How many credit hours should I take?", the credit hour load question serves as a spring board into an exploration of complex personal and academic issues that will have a bearing on the student's success. Knowledge engineering, in this case, involved codifying the judgment and expertise of several academic counselors who have worked personally with hundreds (or probably thousands) of students.

Another AI module addresses the question "What major should I choose?" To develop this module, the authors researched materials used by career counselors, such as the Strong-Campbell Interest Inventory, the Myers-Briggs test, and job classifications used in the Dictionary of Occupational Titles, published by the Department of Commerce. After studying these and several other instruments, the CWEST team decided that none of the existing question sets was appropriate for the CWEST application. Most were much too long; kiosk users would not have the patience to answer more than about 20 questions. Further, the kiosk application should be specific to Sinclair programs, rather than a comprehensive career advisor such as the DISCOVER system marketed by American College Testing Program, or SIGI PLUS from the Educational Testing Service. Finally, the questions should address academic interests as well as career interests, since the module is to suggest possible Sinclair majors, rather than job titles.

After many weeks of work, a list of relevant questions was narrowed down from a few hundred to about twenty. Careful consideration was given to the wording of each question, so that the student would give as honest a reply as possible. Then Sinclair's academic advisors were asked to rate each degree program on each of the factors, such as the program's emphasis on writing or math or scientific problem solving. All of the ratings were entered into a database, and a matching algorithm was developed to match the student's responses with the ratings for each of the various degree programs. When the student runs the module, the kiosk asks the student to rate himself on each factor, usually on a scale of one to ten. The output to the student is a list of the five best matches.

Validation and Verification

Expert systems are notoriously difficult to test, since they deal with "squishy" factors, and the accuracy of the recommendation is a usually a matter of subjective opinion. Further, making adjustments to the rules to fix one "wrong" case will frequently cause problems for other cases that were working correctly.

Another challenge is finding appropriate human subjects. The CWEST team felt that it was very important to test the advising modules with many different groups of students who represent the diversity of our student population. Initially our volunteer beta-testers came from the Accounting Club and Student Government. However, we found that these students tended to represent the higher levels of academic achievement and ability. To find more representative samples, we used students who were waiting for appointments with counselors, and also students from first-term English classes.

The credit hour load module has been tested exhaustively, using written surveys and live beta tests. The "major choices" module has also been tested extensively in beta mode, and its actual use is being tracked in log files where responses and recommendations are recorded. These log files will be used for continuing evaluation of the module's recommendations.

Results

Sinclair's six kiosks have been running continuously since late May, 1993. The volume of use varies from 10 to 100 users per day per kiosk, with the peak activity (to date) during the registration period for Fall Quarter. While all of the main menu options are getting steady use, the most popular function is the access to personal records in the Colleague system, which currently includes unofficial transcripts and class schedules.

Each of Sinclair's Intouch kiosks with automated advising is currently providing the following services to students, based on activity recorded during September 1993:

41 hrs/month - academic advising

42 hrs/month - access to personal records

15 hrs/month - financial information & assistance

2 hrs/month - employment information

11 hrs/month - general campus information

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111 hrs/month - total time in use

If performed by humans, these services would cost the institution about $1,542 per month. This figure is based on salaries (plus fringe benefits) of people who would typically provide equivalent service:

 academic counselors (41 hours), clerical staff (59 hours), and student employees (11 hours). The total cost of a kiosk, including installation costs (spread over four years) plus annual maintenance, is estimated as about $600 per month, or less than 40% of the "equivalent" human cost.

Future Applications

At Sinclair, the Intouch kiosk system marks the beginning of a revolutionary shift in the use of institutional database systems, from exclusive use by administrators and staff to direct, hands-on access by students. In fact, it is not difficult to imagine that students eventually will become the primary users of administrative systems. This drastic shift in the user base will have important implications for the structure and contents of administrative computer systems. As direct access by students becomes more prevalent, the institutional information systems can be expected to evolve along several dimensions:

1. Database content

Institutions typically maintain items of information about courses, sections, students, and personnel which are critical to the administration of the institution, and much of this is useful to students. However, a student's need for information goes far beyond the data about class schedules and program requirements. Students are hungry for more qualitative information. Which courses in biology are really tough and time-consuming? What is Professor Jones' teaching style? Does she emphasize lectures, class discussion, research papers, weekly exams? What is the syllabus for ENG 219? What percentage of students dropped out of CHEM 312? Should I take calculus along with physics? This is "consumer-oriented" information that students, as customers, want to know when they are making choices about the educational products of the institution. Currently students are obtaining this qualitative information almost entirely from other students.

2. Presentation of Information

Screen displays, as well as the navigation through a computer application, are typically designed with a particular type of user in mind. As students become direct users of institutional databases, the designers of screens will need to consider aesthetic appeal, ease of use, and especially the comprehension of information, from the students' point of view. Much of our current database information is stored in the form of codes which are meaningful to administrators and staff (and very efficient to store), but meaningless to students.

3. Security and Integrity

While read-only access by students is becoming fairly wide-spread, few institutions are yet allowing direct updates of their databases by students, except through scripted telephone registration systems. In the future, most student information in administrative databases will be input directly by students. Security issues will need to be developed for adequate protection of privacy and data integrity. Processes developed for personal identification and PIN handling in telephone registration systems are a start.

4. Inter-Institutional Information Exchange

The electronic exchange of information between institutions could significantly improve services to students. In the future, Electronic Data Interchange (EDI) will facilitate the transfer of student records, and also many other types of information. The need for EDI is especially evident in community colleges, in which significant numbers of students are either transferring credits into the institution or planning to transfer to a four-year school after graduation. It is often difficult and frustrating for students to obtain information about the transferability of specific courses between specific institutions. Electronic exchanges of articulation agreements and course-by-course equivalencies could certainly reduce the level of students' frustration and confusion.

5. Multimedia Databases

Student access to institutional information could also provide the impetus for developing multimedia databases, which would be accessible through kiosks and the electronic highway of the future. These might include images and voice recordings of faculty and staff, campus maps, multimedia campus tours, and pictures of labs, classrooms, and residence halls.

6. Crossing the Course Section Boundary

Traditionally, administrative systems have treated the course section as an atomic unit -- an indivisible chunk recorded in the student's transcript with a grade, credit hours, and course title. In course scheduling and faculty load assignments, the section is also treated as an atomic unit. The management of entities larger than sections (that is, courses and degree programs) have traditionally fallen under the jurisdiction of the administration, while record-keeping below the section level -- the syllabus, sequence of topics, assignments, test scores -- have traditionally been regarded as the domain of the professor teaching the class. Students obviously have an on-going need for information both above and below the course-section boundary. Access by students to administrative information could generate pressure for institutions to look at ways of integrating instructors' class records into the central information systems, although the political implications could be formidable.

7. Feedback from our Customers

In the future, devices such as kiosks, telephones, and desktop computers will facilitate two-way communication between the institution and the student body by means of surveys and polls, as well as direct communication. As students become a primary user base of administrative systems, it will also be critical for software designers to obtain input from students regarding their information needs and the usability of information systems. Institutions will need to develop processes for organizing student focus groups and volunteers for beta testing, as Sinclair has done throughout the development of the expert systems and other components of the Intouch kiosk software.

In summary, Sinclair's Intouch kiosk system provides a glimpse (if not a comprehensive vision), of things to come in the evolution of computing in higher education. As an institution, Sinclair feels strongly that the driving force of the revolutionary changes ahead will be the student as the primary user of our institutional information systems.

Section Four: Summary and Conclusion

The purpose of this paper was to illustrate how institutions can create new, service-related products based upon the effective use of information resources. The authors identified the social, political, economic, and technological factors that accelerate or decelerate the process of creating new products. The authors presented a conceptual framework to illustiate the potential of the information resource, ranging from data to wisdom. They also illustrated the capability of technology to optimize the information resources through the integration of technology and revised business processes. Finally, the authors shared their experience in informationalizing an institution, Sinclair Community College. They described how Sinclair is informationalizing by advancing the information contintunuum to wisdom, using technology such as an expert system for advising, accessible through campus kiosks.

The authors conclusion draws from the "wisdom" of the student who was cited in the introduction:

"The most helpful tools are those that let me get the information when I need it without having to stand in long lines. I don't necessarily feel that I have to ask people questions to get simple information. If I have a genuine problem, then I will go through the process of seeing someone like an advisor. But if I just want to get simple information, like where is something on campus, I can to go to the touch screen system on campus and just punch it in and find it out. I can go back as many times as I have to, and I am not embarrassed talking about it. First week of class, I can walk up to a kiosk and find out where my class is instead of walking around campus like a goof ball carrying it around. "

STANDBY PRESENTATIONS

In the event that one of the track presentations selected for the CAUSE Conference must be cancelled, a standby presentation replaces it in the program. At CAUSE93, one standby paper was presented, and papers from the other standby sessions are included here. CAUSE offers particular thanks to these presenters for their time, efforts, and adaptability.

The Process of Re-Engineering from Mainframe Systems to a Distributed/Client-Server Environment

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ABSTRACT

The Catholic University of America has recently completed converting 10- to 20-year-old legacy systems from a mainframe to a distributed/client-server environment using a common, integrated database. The solutions utilize a mix of institutionally developed software and purchased packages, including an ad hoc reporter/distributor. The paper describes what went right and what went wrong during the re-engineering process, including:

- establishing that the re-engineering is an institutional issue and not a technical problem
- building vs. buying issues
- choosing the right tools
- securing critical data resources
- the necessity of user involvement
- the need for standardization
- issues of staff training and turnover
- the applicability of Murphy's Laws

The objectives of the paper are to share CUA's re-engineering experience with other schools that are facing major system conversions to integrated systems, a common database and/or a distributed/client-server environment.

I. INTRODUCTION AND OVERVIEW OF CUA

The Catholic University of America (CUA) is a private, religious affiliated, "Doctorate I" institution located in Northeast Washington, D. C. CUA has approximately 6,500 students, 60% of whom are graduate students; 400 full-time faculty and 1,100 staff. The computer center supports academic and administrative computing; voice and data communications units also report to the executive director.

Beginning in 1969, CUA used mainframe computers from Digital Equipment Corporation's DECsystem-10 family. In 1972, CUA was believed to be one of the first universities to run its administrative computing functions on a PDP-10. Support to academic and administrative users grew and improved through the years.

In 1983, Digital Equipment Corporation announced that there would be no more computers produced in the DECsystem-10/20 family, but that technical support would continue through December 1993. CUA formed a committee to make a proposal for replacement systems, which resulted in the purchase of Digital VAXes. The first VAX arrived in early 1986. All academic users were successfully moved off of the DECsystem-10 to VAXes and microcomputers in calendar year 1986.

The administrative conversion/re-engineering and the move to an integrated database of student and financial information was much more complex. Decisions were made early in the process that existing systems would be converted "as is" into a common, relational database, with only minor system modifications.

By 1989, after nearly four years of effort, it was evident that the conversion was stalled as only one administrative system had been transferred to the VAXes. Changes in personnel at both the executive director and the director of management information systems level got the process back on track and led to the completion of the re-engineering process and the decommissioning of the DECsystem-10 in July 1993.

II. INSTITUTIONAL ISSUES VS. TECHNICAL ISSUES

Support from the highest levels of the institution is probably the single most important factor in any re-engineering effort; it is critical for setting priorities and resolving issues between different offices. Having adequate resources is crucial to accomplishing the task.

The process of integrating data from many sources required CUA to answer some questions that it probably would have preferred were never asked! For example, before the move to a common database, a student who was never admitted could register; a student who had never registered could pay a bill. Offices responsible for billing students were often also generating the charges as well — a conflict of interest, at best. One of the best allies during the conversion process became the Internal Auditor.

During the re-engineering, the business of the university did not stop — students still needed to register; employees needed to be paid. It was necessary to maintain continuous operations in each administrative office and in the computer center. This placed a larger burden on the user offices than it did on the computer center since operations are done in production mode, with programmer intervention only required when a problem occurred. In only one or two offices was it possible to justify additional staff during the parallel operations phase of the effort.

Major problems occurred when the offices involved viewed the re-engineering as merely a technical problem. Too often, the users regarded the conversion effort as an intrusion upon their work. In a few departments it was difficult to get users to provide such basic systems fundamentals as a requirements definition. It was often necessary for computer center management to elevate issues of non-cooperation to the executive vice president, who would then address those issues with the cognizant vice president for the area. The net result was delays and a few missed deadlines. Often, MIS staff were in the driver's seat for what should have been user decisions.

One of the successes of the academic conversion had been the moratorium placed on new development on the DECsystem-10. This was not done early in the administrative conversion and significant effort was expended modifying dead-end DECsystem-10 systems. In 1990, agreement was reached with the support of the executive vice president that only mission-critical changes and/or problem corrections would be done to DECsystem-10 software. This allowed the MIS staff to focus on the new systems for the first time in four years.

Issues of interoperability between some offices, such as sharing data and creating common procedures, are still being resolved. With the creation of a common database, responsibilities within some offices shifted. Because three vice-presidential areas are involved, some of those staffing issues still need to be addressed.

III. BUILDING VS. BUYING ISSUES: A COMPROMISE

The building vs. buying decision is one that often generates a tremendous amount of controversy. There is consensus among people who are willing to take an unbiased view that build vs. buy is not an "either/or" decision. At CUA, a split approach was taken. Software was developed in-house to enter the information into a data warehouse, which is the accumulation process. Software to extract information from the data warehouse, known as the usage process, was purchased. The HRS payroll/personnel package, purchased from Information Associates (now SCT), was the only exception to this rule.

As was discussed earlier, the primary constraint on the conversion effort was the lack of time remaining before vendor support was dropped for DECsystem-10 computers. Thus, when issues affecting the conversion were considered, parameters impacting the time line received greater weight than issues that did not. One of the primary factors of a build/buy decision is the proportion of resources that must be dedicated by the development staff vs. the proportion of resources that must be dedicated by the user staff. With a build decision, the heavier load falls on the development staff; with the buy decision, the heavier load falls on the user staff.

At CUA, it was often the case that there was more institutional knowledge about departmental processes within the computer center than there was within a department. This was particularly true concerning the issues of integrating the functions of the individual departments into a process that would operate on a common database. For example, implementing the payroll/personnel package was tremendously difficult. Through no fault of its inherent capabilities, this package took over five years to implement and the effect caused an extreme amount of stress in the user community. All of its major features are still not being used. Thus, although it would seem counter-intuitive, it was determined that systems could be custom built faster and maintained with less effort than if they were bought.

The general philosophy adopted by CUA was to build the core portions of a system and then to find microcomputer-based packages to handle specialized functionality within offices. As client-server technology evolves, a decline in the monolithic "do-everything" packages that are priced for large centralized systems is anticipated. Instead, there will be discrete modules that can exist in a distributed environment, and are priced in a more appropriate manner. For example, it does not make sense to pay for a university-wide license on a centralized financial system when there are only two or three people accessing various functions within that system. An example of the microcomputer approach is American Fundware's FINALYZER package. It is a NACUBO-approved package that creates specialized month-end reports, performs financial analysis, and creates standardized year-end audit reports. Similar plans are in place for the needs-analysis portion of the financial aid system. In addition, as previously mentioned, the ad hoc retriever/reporter already performs data extractions that feed into standard microcomputer packages such as WordPerfect and Quattro Pro from the database.

A decision will probably be made to purchase a system to support the Offices of Development and Alumni Relations. Currently they are operating with a rudimentary, home-grown, microcomputer-based system. In these offices, there is strong user support for implementing and learning a purchased package. Also, this is such a specialized area that it would make little sense to reinvent the wheel. Because of the strong user commitment, the buy decision heavily outweighs the build decision.

IV. TOOLS BEING USED

One of the reasons for the success of the academic conversion was the willingness to learn from the successes and mistakes of other institutions that were further ahead in their conversions. This lesson, plus keeping abreast of the availability of software development tools and other changing technologies, became part of the administrative effort.

At the start of the re-engineering process, all of the programming expertise within MIS was in COBOL. As a result, the first two systems that were converted — facilities management and registration — were written exclusively in COBOL, both the on-line applications and reports. This approach to writing interactive applications was very labor intensive and the results were sub-optimal. In the on-line applications, much of the screen navigation, scrolling in particular, required tremendous amounts of code and the resulting screen performance looked primitive. For the reports, COBOL programs were being developed to perform the function of commercially available ad hoc query tools[1].

When the current MIS director was hired, the facilities management system was complete and the registration system was about 50 percent complete. Graduate admissions was also operational, but was not in the relational database. The new director decided that stopping to retool the development process for the registration system could not be justified from the time-to-completion perspective. However, before the next system (admissions) was started, the approach was changed.

First, the development approach to on-line applications was altered. The basic on-line application was split into four conceptual parts:

- The user interface (screen handling)
- The manipulative engine for performing calculation and enforcing the business rules

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[1] It should be noted that CUA participates in Digital's Campus-wide Software License Grant (CSLG) program. This allows CUA to use most of Digital's software at no cost unless the product is royalty based, in which case it is deeply discounted. This heavily influenced some of the software choices that were made.

- I/O modules for data transfer to and from storage
- The database

DECforms, Digital's forms package, was chosen as the tool for developing the user interface modules. Because it was the 1.0 version of the product, this choice was not without an element of risk. However, Digital indicated a firm, long-term commitment to DECforms. It was decided that coping with an early product release of this powerful product was a better use of time than to continue writing user interfaces in COBOL. One of the missing features of DECforms (since corrected) was that it could not do any mathematical functions. And, although at that time the product was written for character-cell terminals only, part of Digital's long-term commitment was future incorporation of graphical user interface (GUI) capabilities. As evidence of this commitment, there was a significant amount of GUI "look and feel" to the character-cell implementation. It should be noted that three years ago client-server was a new buzzword, so the GUI issue was nowhere near as large as it is today.

COBOL was retained as the tool of choice for coding the business rules and performing calculations. In addition, the early DECforms applications required more coding in the COBOL portion than was desired. Though other languages were briefly considered, it made little sense to abandon the in-house expertise of COBOL. Plus, COBOL still fit this space well. The learning curve on DECforms has proved large and made management leery of too many additional changes.

The I/O portions of the applications were moved to independent SQL modules. The database of choice remained Digital's Rdb.

The second change was to find and implement a commercial ad hoc query tool. The search for an appropriate tool yielded a product by Software Interfaces, Inc. called SQLASSIST. One of the defining features of this product was its tight coupling with Rdb. It was the only ad hoc reporting tool that did not require a separate, proprietary data dictionary. In general, it has proven to be a successful choice. The admissions system, the first system to be undertaken with the new design approach, was completed without converting or writing a single COBOL report.

This pattern, for the most part, held true for the remaining systems. A few reports were written in COBOL but this was due to limitations of SQL itself and not SQLASSIST. An added benefit to this approach was that selected members of the user community could also be trained to use this end-user tool. In certain areas this has resulted in a significant reduction in task requests to MIS for report development. In addition, the product has the capability to do data extractions, thus giving users the ability to produce extraction files to feed microcomputer-based products like WordPerfect, Lotus, Quattro Pro, dBASE, etc.

As time progressed, staff turnover brought individuals onto the MIS staff who were not steeped in the COBOL tradition. This provided an opportunity to introduce a fourth generation (4-GL) product, Digital's RALLY, into the development cycle. The financial aid system was targeted as a pilot project for this technology and a three-member team was formed to develop the system. Development on the other systems continued to follow the DECforms/COBOL/SQL-module/database hybrid, or 3-GL, approach.

The jury is still out on the RALLY decision. On the positive side, a relatively inexperienced team was able to create and install a system at least as fast as experienced developers were doing with the hybrid approach. In addition, the prototyping capabilities of RALLY allowed for significant user participation in the initial stages of development. Very soon after the initial design meetings had been completed the users had a product that they could touch and feel. This created among the users a very strong feeling of project ownership, which proved to be invaluable during the inevitable stresses of systems development and deployment.

On the negative side, RALLY performance is slower than the performance of comparable systems written in the hybrid style. In addition, because RALLY generates its own code, it is difficult to get an exact grasp of what the application is doing; it is difficult to optimize performance; and it is difficult for a developer who is not familiar with a particular application to maintain it.

On small, simple projects, RALLY is a clear winner. However, when a project reaches a certain size and complexity, it is better to develop it with the hybrid approach. After a certain point, the development time needed to make RALLY do complex processing is greater then the development time using the hybrid approach, which is also easier to maintain. Determining the switch-over point is a matter of judgement and the process for making this type of decision is still being refined.

When a clear decision cannot be made initially, one approach being considered is to start the project in RALLY. If the project moves easily to completion, it is kept in RALLY. If the project bogs down due to complexity, then it should be switched to the hybrid method. If this decision is made before an excessive amount of time is spent wrestling with RALLY, the prototyping and user participation advantage of a 4-GL is retained while gaining the performance advantage of a 3-GL. This positions RALLY more as a prototyping tool then a production tool. However, experience has shown that quite often the prototype and the production product can be one and the same. This "prototype as production model" has proven very useful in developing screen-based inquiry applications. An example of such an application is a budget inquiry application that provides the user with line-item budget information in both summary and detail form. It has proven to be one of the most popular applications and had a development time of about two weeks.

Looking into the future, both of these approaches have positioned CUA for the client-server architecture. RALLY can run in client-server mode today, though CUA has not made use of this functionality. One of the powerful features of the product is that one can develop a RALLY application on a non-client-server platform and then convert it into a client-server application simply by changing a few setup parameters.

The DECforms/COBOL/SQL module/database model also is well positioned for the client-server world. Each of the four components could potentially be made to run on a separate platform with very little modification to the existing application code. The most likely approach to switching to a client-server environment would be to move the DECforms portion to the desktop and leave the remaining three components on a central processor. A (true) pilot of client-server projects will be attempted within the next 24 months.

V. SECURITY

The security issue is divided into two components. The first is determining who has the authority to grant or deny access to the applications that access the common database. The second is determining how to implement these access restrictions in a secure manner.

CUA has used the "data trustee" concept for at least 15 years — user departments could decide who had access to what information. However, the computer center had to perform the functions that granted user access to data. It was felt that this was no longer an appropriate situation and that there should be a least one person within each major office (for example, the registrar or dean of admissions) who was responsible for the data that related to that office.

In 1986, a "one-user-one-password" philosophy was adopted. In keeping with this philosophy, it was felt that after a user logged in to his/her personal area on the computer, the system should be smart enough to know what that person could or could not do relative to the administrative systems.

To meet these parameters, a security package called ADMENU was developed. It is a menu-driven package that presents each user with a customized view of the administrative systems and the applications that are available on each system. For example, when a user types the command ADMENU, s/he might see the registration and admissions systems listed. Other systems would not be listed because this user had not been granted any access to them. The user would then select a system, such as registration. A new menu appears, showing only those registration applications to which the user has been granted access. The user then selects the desired application.

The user's process is now put into a captive state: the default directory is changed to an appropriate location; access identifiers to the executables and the database are dynamically constructed; process quotas are dynamically increased; and appropriate logical name tables are assigned to the process. The user's process then runs the requested application. When the user exits this application the setup is reversed and the user is returned to the ADMENU screens.

Three special applications have been created within ADMENU to administer this system. *System* trustees have the ability to create new systems in the administrative suite of applications; the computer center executive director and the director of MIS are system trustees. *Application* trustees have the ability to create new applications within an existing system; systems analysts in charge of each of the systems are the application trustees. *Data* trustees have the ability to change the list of who can access existing applications within a system. Data trustees are usually the highest-level administrator within a functional area and include the registrar, dean of admissions, treasurer, controller, director of financial aid, etc. In addition, all the trustees have the ability to create a peer trustee. This allows an upper-level administrator to share the responsibility with a trusted colleague. As a final level of security, should there be a security problem that needs immediate attention, the system trustees have the ability to remove a user from anywhere in the system with a single command.

VI. THE NECESSITY OF USER INVOLVEMENT

The importance of user involvement in a development project cannot be overemphasized and conventional wisdom states that one should not start a major project without it. This holds true when the cost of proceeding with weak user involvement is potentially greater than the cost of delaying the project until user involvement can be assured. CUA did not have the option of delaying its re-engineering project. Support for the DECsystem-10 was going to be dropped whether systems were converted on time or not. It was only an issue of whether or not CUA would still be able to do business after December 1993.

Many of the users viewed the re-engineering process as a computer problem, not their problem. Also, because each department had been working in its own stand-alone system for so long, there was a low level of interest in the issues of other offices. Oftentimes, issues that did not pertain to a specific office were viewed as someone else's problem. Systems analysts often heard the phrase, "Well, I don't know what they do with it [the data] over there but...." In a number of offices this attitude was coupled with resistance to computing as well. For example, the admissions office only entered data into their DECsystem-10 applications to avoid being reprimanded by upper-level administrators. Their real system was on intricately designed 3X5 cards. In spite of this environment, MIS was able to proceed because of the cumulative institutional knowledge of the MIS staff and because of receptive employees who were targeted as champions within each of the departments.

In the build vs. buy section, it was mentioned that MIS could both develop and deploy systems in a shorter time frame than would be possible with purchased software. For any major development project to succeed there has to be strong expertise in either the development staff or the user staff. In CUA's case the user environment was weak and fragmented. However, within the twelve (now eleven) member MIS staff, six members of the staff had an excess of ten years experience at CUA and had also developed many of the existing DECsystem-10 administrative systems. Hence, much of the necessary knowledge to integrate the disparate systems existed in-house.

Within the user environment there were a few areas that advocated new technology. The financial aid office was a good example of this. They consistently supported MIS within the user community. Having a least one large department as an ally was extremely important and MIS, of course, made every effort to nurture these relationships. In addition, receptive individuals were found and supported in the other areas. Within the registrar's office, that person was the assistant registrar. In the financial area the vice president was unsupportive, but the controller was very supportive. Within the admissions office the receptive person was a newly-hired employee who was responsible for doing enrollment analysis. This individual's obvious need for accurate data made him a natural ally and he was the first user to make extensive use of the ad hoc query tool SQLASSIST. MIS supplied extensive support and encouragement. In return, he proved to be an invaluable resource within the user community. As the other departments started to notice the information and resources that he was able to access and use, they developed a natural desire to have the same capabilities.

VII. STANDARDIZATION

CUA seized the re-engineering effort as an opportunity to develop universal codes. The legacy systems had often been developed without the consistent use of codes between systems. A Universal Codes Committee held numerous cross-campus conversations on standardizing the codes. The result was not only better codes, but improved communication. The move to a relational database also afforded the opportunity to store address records for students, for example, in one common place with definitions of who had authority to make changes. Previously, a student's address had to be changed individually in each system.

Because CUA is moving to a client-server environment connected via a campus-wide network, the tools to support this environment are very important. CUA now has a policy in place that the computer center will review all administrative hardware purchases. (The academic review is the next step and that goal appears closer on the horizon.) Site licenses and quantity purchases have also encouraged users to stay with software that is commonly used and more easily supported.

VIII. ISSUES OF STAFF TRAINING AND TURNOVER

One of the biggest, single factors in the entire process was the amount of staff turnover inside the computer center, within the administration, and in the user community. For example, during the conversion/re-engineering, CUA had two executive vice presidents, two computer center executive directors, three MIS directors, three vice presidents for finance and treasurer, two registrars, three controllers, and many, many programmers.

The computer center was fortunate that its senior-level technical staff (systems analysts) was stable during the process. Many of the analysts as well as the MIS director and executive director had worked for CUA for 10 or more years and had a wealth of institutional knowledge. This was a double-edged sword however, as it required changing numerous "but we've always done it that way" mind sets. Training and a mandate (with constant reminders) by the current MIS director to look for new solutions, rather than to reuse old ones, made the difference in the ultimate outcome of the project.

As stable as the senior staff was, the programming-level staff had a significant amount of turnover. Computer center management eventually came to accept the turnover as the norm rather than as the exception. Previously, the MIS director had trained new people on both systems. The current MIS director quickly abandoned this concept, assumed that entry-level programmers would not be with CUA more than two years, and worked toward quickly getting them to be as productive as possible within the limits of their capabilities.

The turnover in the university community provided another set of joys and concerns. The new managers that joined CUA all tended to be more "computer literate" than their predecessors. This was another double-edged sword — they were more knowledgeable, but they were also more demanding. The turnover also meant that much institutional knowledge was lost — again, a good news/bad news situation. It impacted the conversion in several ways: Computer Center personnel were frequently training office staff; they were also often in the position of having to tell users "no" or to expect a long wait for changes requested by savvy, new users. All too often, computer center personnel provided the details of how an office operated rather than the office itself specifying how it wanted to operate.

IX. THE APPLICABILITY OF MURPHY'S LAWS

Murphy worked overtime during both the academic and administrative conversions. Several of the problems were unexpected events in the lives of the staff: two people had to have unplanned major surgery; one was involved in a serious automobile accident; deaths occurred within extended families; one staff member (hardly unplanned) had a baby. These events provided challenges to management as they attempted to keep schedules and meet deadlines.

There was also a false start in the selection of the relational database. Nearly a full year was lost selecting and trying to implement a third-party database. At that time, the database selected had been recently ported from an IBM system. It did not take advantage of the features and functionality of the VAX architecture. Further, staff found themselves one step ahead of the vendor's trainers who were supposed to be the experts.

One of the biggest problems occurred in a user office. Three months had been allocated for parallel operation. During the first month, nothing was entered in parallel into the new system. When this was discovered by computer center staff, the office users were convinced to begin using the new system. The good news/bad news was that they liked the new system so much that they stopped entering data into the old system. At the point this was discovered, the audit trails had been lost and it was impossible to bring the data in the old system up to date. It took the controller several months to reconcile the new and old systems into the financial accounting system. Procedures were put in place to ensure that this did not happen when later systems entered the parallel testing phase.

The previously stable hardware also began a series of failures about nine months before the project was complete. Given the age of the DECsystem-10 and its complexity compared to today's systems, a week-long outage with lots of power interruptions started a downward spiral of crashes and repairs that caused long periods of system unavailability. A power outage even took the system down the day of the decommissioning party.

X. CONCLUSIONS/RECOMMENDATIONS

CUA is now in the happy position of having its student and financial information in a common, relational database. The legacy systems are gone and, among other things, there is no need to worry about systems breaking at the turn of the century because dates have been expanded to four digits. The effort to accomplish this task was a major one. As it was being accomplished, the demands for enhancements and improvements, not to mention the inevitable problem corrections, continued to build. MIS is now in the process of addressing these issues. Still remaining is the need for a good development/alumni system that will work with the common database. This system will probably be identified and bought within the next year.

There is no question that CUA did not "do it by the book." However, the job was complete six months before vendor support ended. Although the expertise of the MIS staff was a large factor in the success, the effort could not have been accomplished without finding and nurturing interested individuals within the user community. These individuals not only helped make the re-engineering a success but they have provided an even greater service by raising the expectations for information use within their respective offices. During this process there has been extensive staff turnover in the administrative offices. Many of these champions within the departments have had the opportunity of serving on the search committees for new employees. This has helped to bring about a consistent improvement in the computer literacy of the newer employees which has also increased expectations of computer literacy on the existing staff. The last three years have seen a demonstrable change for the better in the relationship between the MIS department and the user community. A true collaborative process is starting to emerge for the first time and it holds great potential for the future.

In summary, other institutions who undertake the complete redesign of their legacy systems, whether to another mainframe or to a client-server environment should be aware of, prepare for, and do the following:

- Make sure the president and vice presidents all understand that the effort is an institutional one and not simply a technical change.
- Get support from top management.
- Establish a moratorium on all but absolutely necessary changes and development to the old systems.
- Accept that the unexpected will be the rule and not the exception.
- Keep current and force the staff to keep current with the tools and technology.
- Enlist the support of the user community — even if it is at a "grass-roots" level.
- Empower the user community with desktop tools so they can perform as much of their own work as possible.
- Learn from the mistakes of others.

University-Wide Client /Server Applications:
A Case Study

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Abstract

This paper describes client-server applications developed and implemented at Université du Québec à Montréal (UQAM), for the management of students' academic records. Although the Registrar's Office initiated these developments, the Registrar's Office receives full support and cooperation from UQAM's Computing Services in the development of client/server applications, as well as in their ongoing maintenance.

Our two departments' joint experience in this regard is an illustration of a general trend and of a new division of labor and responsibilities among users and MIS organizations in North American universities, in the context of scarce resources, downsizing and distributed computing.

Background

The Université du Québec à Montréal (UQAM)

The Université du Québec à Montréal (UQAM for short) is one of four universities in Montreal. It is a large, degree granting university, located in downtown Montreal and registering more than 42,000 students. It was founded in 1969, as part of the province-wide Université du Québec. In 1989 it was granted status of associated university with the Université du Québec and the right to confer its own degrees. The Université du Québec à Montréal is the largest constituent of the Université du Québec, offering 120 undergraduates programs of study and 50 graduate programs of study, in 30 different academic departments. Although the majority of the student population is concentrated at the undergraduate level, the graduate programs and the research activities are developing fast: in 1992 the faculty was granted 25 million dollars in research funds.

The Registrar's Office at UQAM

At UQAM the Registrar reports to the Associate Vice-president for Academic and Student Affairs. The Registrar's Office is comprised of sixty-five positions and administers a budget of 2 million dollars, excluding salaries. Its mandate is

- to recruit and to admit candidates to the programs of studies;
- to register students for courses;
- to update and to certify students' academic record;
- to collect and to disseminate information on programs and courses offered;
- to develop information systems supporting the management of services such as admission, academic advising and degree auditing;
- to support the users of student information systems.

UQAM's Computing Environment

The Student Information System and the administrative systems run on a cluster of VAX/VMS. All mainframe based information systems are home grown and make little use of commercial software. They were developed and they are maintained by a Computer Services organization which supports both academic and administrative computing. The following diagrams illustrate the hardware (Figure 1), the networking (Figure 2) and the SIS software (Figure 3) components of UQAM's computing environment.

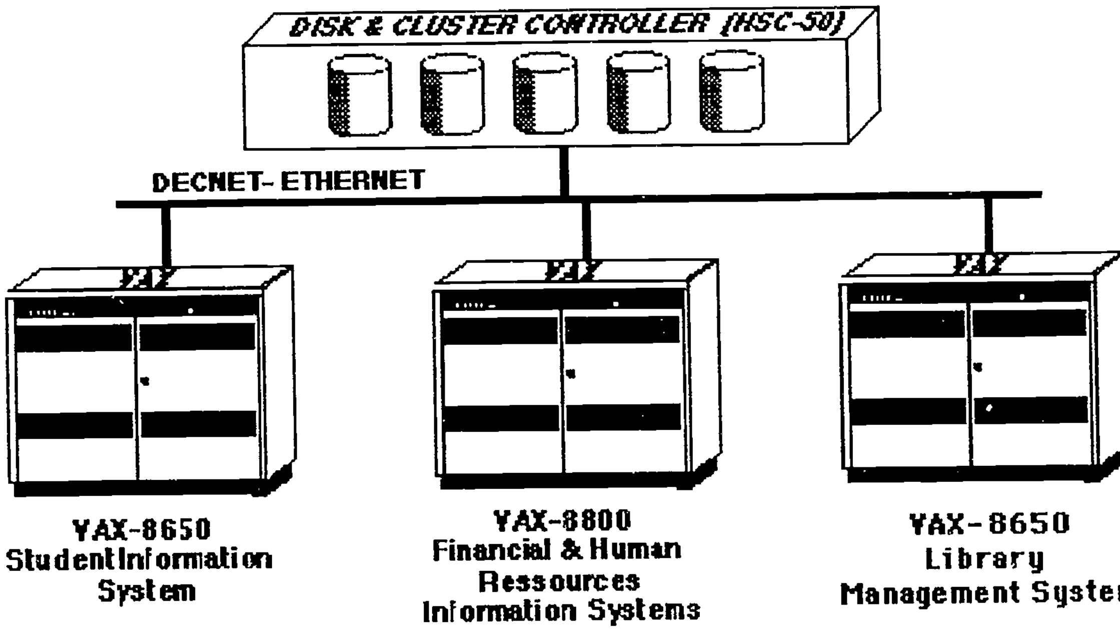

Figure 1: Hardware configuration

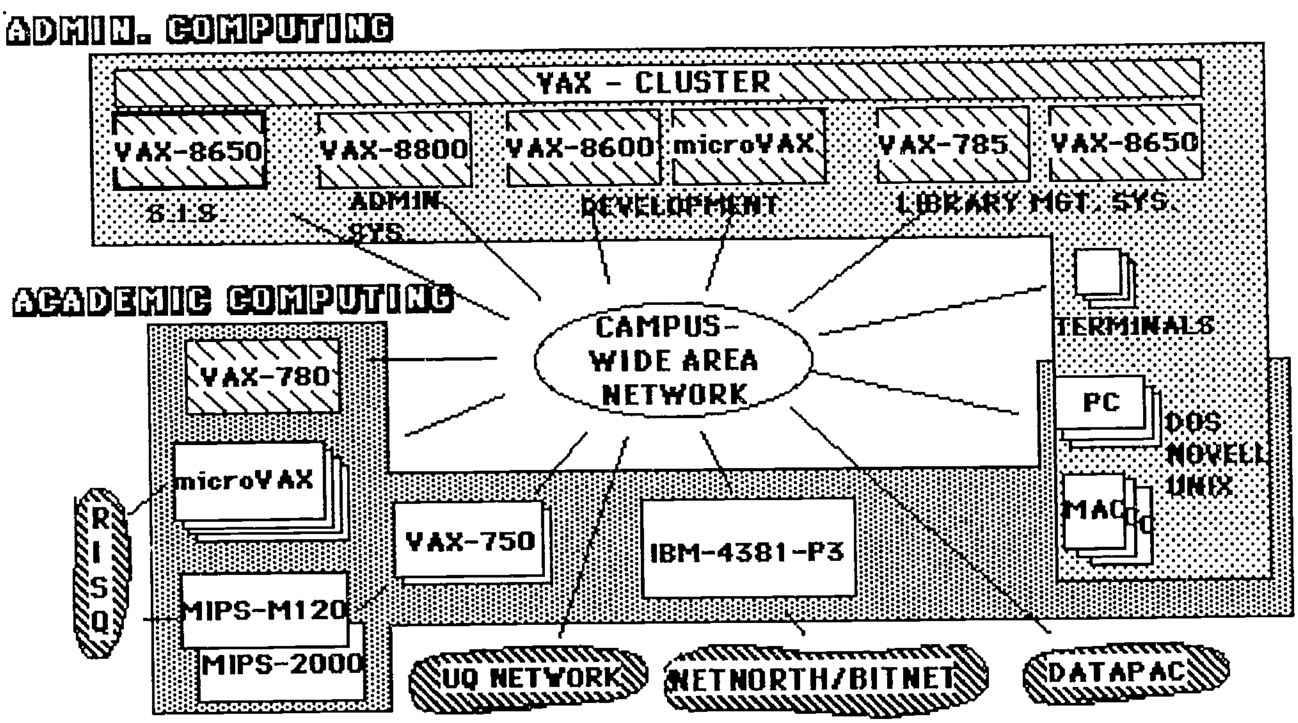

Figure 2: Network configuration

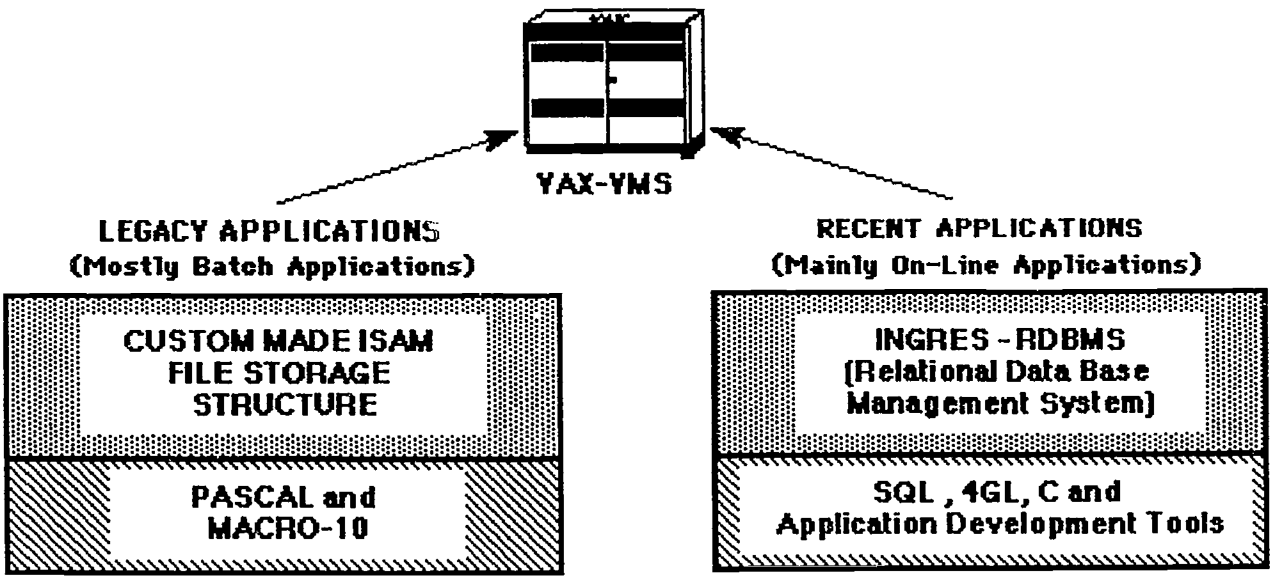

Figure 3: SIS software configuration

What problems do we have?

UQAM's Student Information System is based on a legacy system, that is to say on a system which has developed through the years by additions. It is a system which is limited by old technology, but which cannot be changed radically because of operational constraints. Like in many other organizations, our legacy system has all the advantages and the inconveniences of mainframe based systems:

- it is optimized for performance in the present mainframe environment: any significant change, such as conversion from a sequential file to a relational database management system, would require to increase the mainframe's capacity;
- it is a closed system;
- although it allows for on-line access, most of the transactions are in batch mode;
- it offers limited access to data;
- it does not allow easy query: even when one has access, one gets data which has to be tweaked in order to transform it onto meaningful information;
- the data model is outdated, and cannot be changed easily;
- security is far from being fool proof;
- it is not integrated with the other administrative systems;
- Computer Services is spending its time maintaining it and keeping it in tune with new academic regulations and requirements, instead of developing new applications or a new data model;
- the backlog of applications is such that knowledgeable end-users tend to develop systems locally, which in turn creates problems of data integrity and information accuracy.

Our Solution

When we began our conscious effort to change the approach towards computing in our university, we sought the following changes:

- to replace a home grown student information system with one based on a commercially supported relational database management system;
- to replace batch processing with on-line transactional processing;
- to distribute data and processing cycles among mainframes, departmental servers, and personal desktop computers;

- to offer users an integrated *single image system*, irrespective of computing platform, operating system or the place of residence of the data.

We undertook this effort without realizing the full implications for future development and without any guarantees that technology would grow to allow the accomplishment of these plans. Fortunately, as we kept moving along, solutions appeared which seemed to be tailor-made to our needs and to offer help in overcoming our difficulties, such as distributed computing, and graphical development and user tools. Among these, the client/server technology which the market adopted as the preferred architecture of the 90's plays a key role. Moreover, the appearance and the widespread adoption of theoretical conceptualizations such as Apple Computer's VITAL, which seek the peaceful integration of legacy systems within new enterprise based computing models, seems to justify retrospectively our intuitive approach.

Client/server SIS applications at UQAM

Because of the need for an efficient registration method, the Registrar's Office undertook in 1987 to develop jointly with the Computer Services our first campus-wide client/server application, the Touch Tone Registration System. The Computer Services developed the "registration server" on the mainframe, while the Registrar's Office developed the client telephone interface. The Touch Tone Registration System was the engine which brought about the first massive on-line transaction processing in UQAM's SIS - registration transactions. The successful implementation of this application led to the development of two other applications described below.

Touch Tone Registration System

Based on the voice processing technology, UQAM's Touch Tone Registration System (*Système d'inscription par téléphone* or for short *SIT*) is an interactive transactional system, allowing students to register for courses by directly and securely entering courses into their student record, via a Touch Tone telephone. The choices are validated according to academic and administrative criteria and, if available, the space is reserved for the student. The same system allows students to change courses. The system is operational since 1990. Approximately 36,000 students, or 90% of the UQAM's undergraduate student population, are using this system every term.

Touch Tone Grade Consulting System

Also using voice response technology *NOTEL* (*Système de consultation des notes par téléphone*) is UQAM's Grade Consulting System: students call *NOTEL* to learn what grade they obtained in their courses. Available around the clock seven days a week, *NOTEL* checks the identity of the caller and then declines, with a human voice, the grades registered in the student record. All UQAM's 43,000 students are using *NOTEL* at the end of every term.

Graduate Studies Information and Management System

The aim of this application is to provide information and record management for UQAM's graduate studies. It is a client-server, distributed database, allowing graduate studies program managers to access official student record information and combine it with local data, residing on departmental workstations, in order to advise students on their progress. The application allows complex queries on the status of the student progress through his or her program of studies. Its user friendly graphical interface provides a working model for the UQAM's student record interface. Operational since January 1992, the application will be gradually implemented in all of UQAM' s graduate programs. Eventually, the application will be adapted for the management of UQAM's undergraduate student records.

Although the data model of these applications use alternatively either two, in the case of the telephone interface, or three layers, our preferred architecture is three layered, such as the one we are using in our Graduate Studies Information and Management System. This architecture is described in figures 4, 5 and 6.

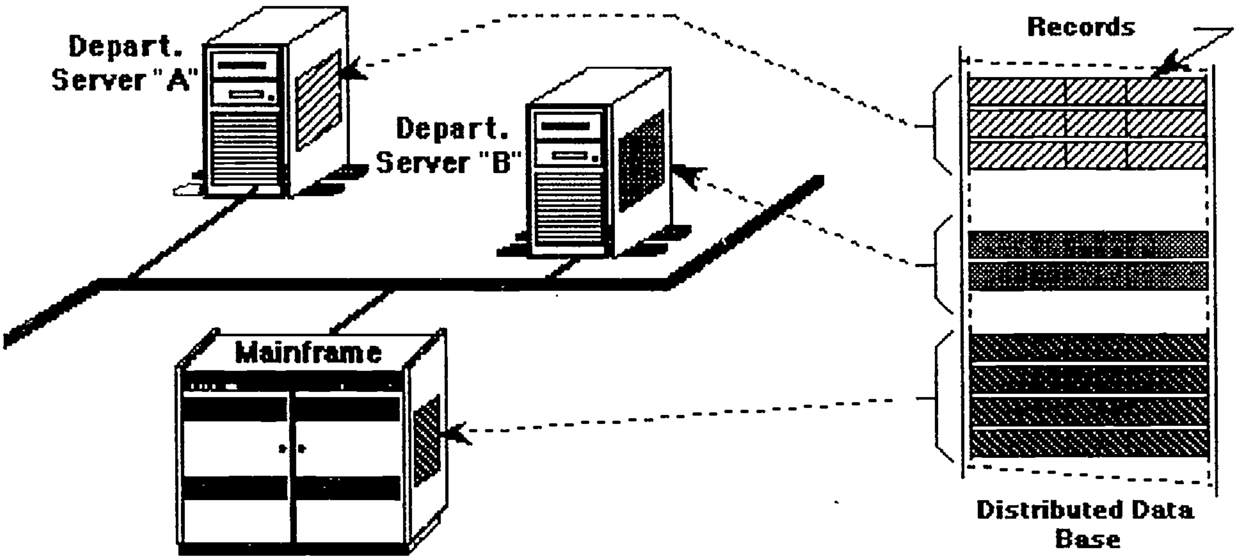

Figure 4: Global view of UQAM's campus-wide distributed computing

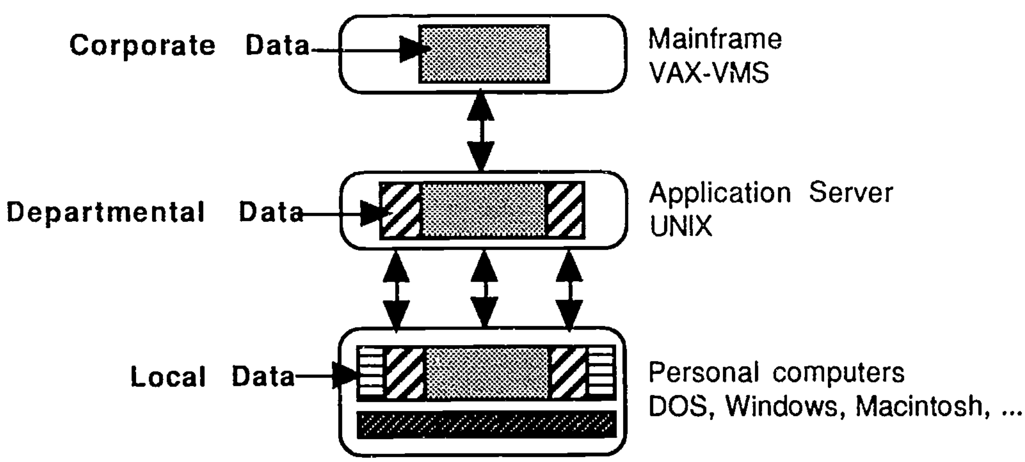

Figure 5: UQAM's three layered data model

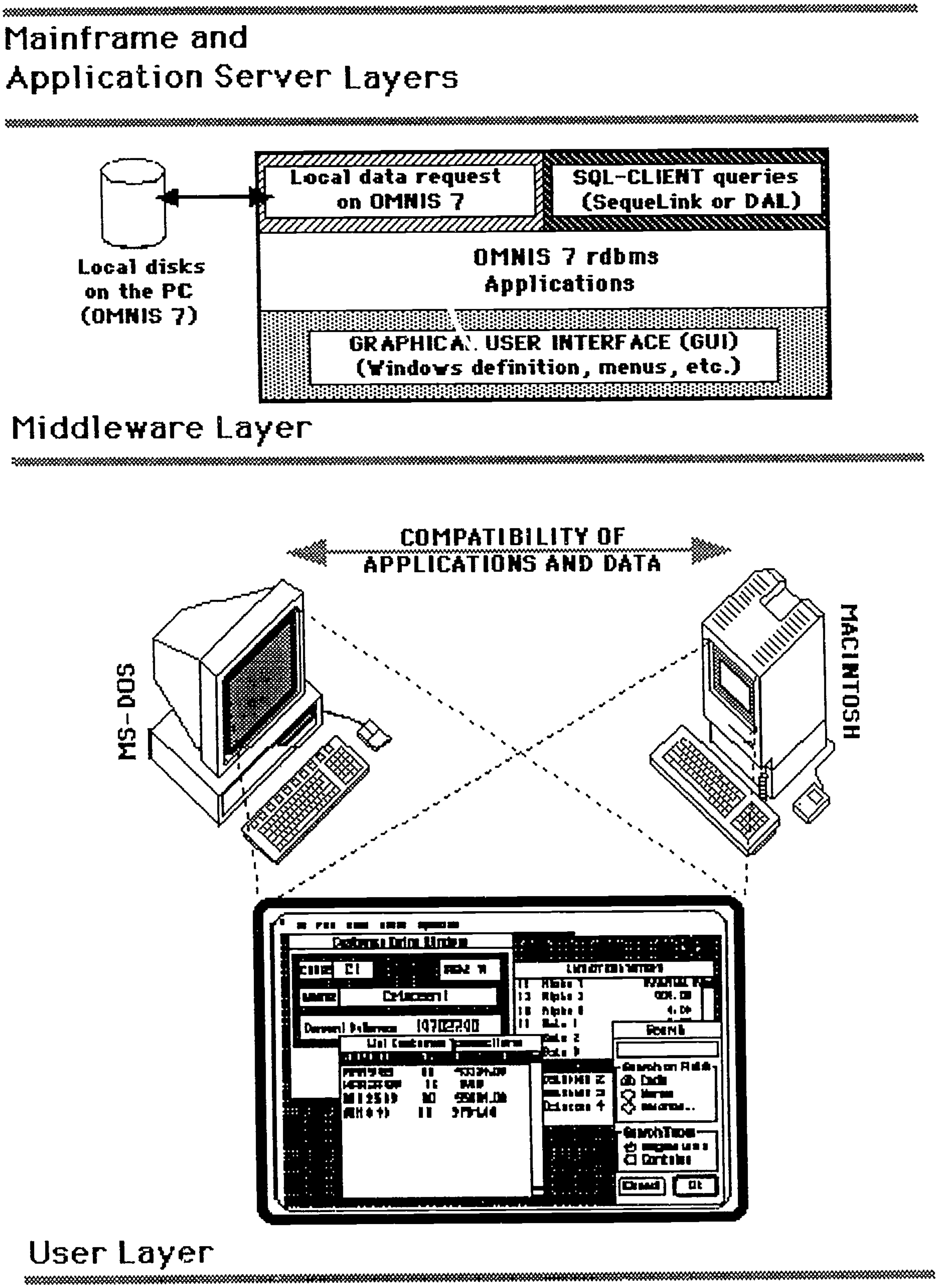

Figure 6: Platform independent SIS user interface

What Lies Ahead

Our ultimate goals for UQAM's SIS are simple:

- to insure secure and universal access to UQAM's student information systems of all legitimate users, including students themselves;
- to implement sophisticated applications such as Degree Audit, which will give academic advisors and students all the information they need to measure progress or lack of it;
- to implement applications which help management decision making, in order to make better use of scarce resources.

During the next three years, while we are developing two new client/server applications (an Admissions information and management system and an Undergraduate Studies information and management system) and we shall seek:

- to define security profiles for every user and implement security policy and procedures;
- to give every user connected to the campus-wide high speed network transparent access to the Student Information System if his or her task requires it;
- to extend to students the secure access to the SIS, both from within the campus and remote access, both via micros and ATM type machines;
- to integrate at the desktop level in a graphical user interface all information contained in the student records and eliminate character based coded information;
- to give users a coherent, intuitive and consistent interface, where information is in plain French rather then in computerese, irrespective of the application accessed or the operating systems under which it is accessed;
- to make maximum use of the departmental servers and the desktop processing power in order to off load processing cycles from the mainframe.

Planned Student Data Access Architecture at UQAM

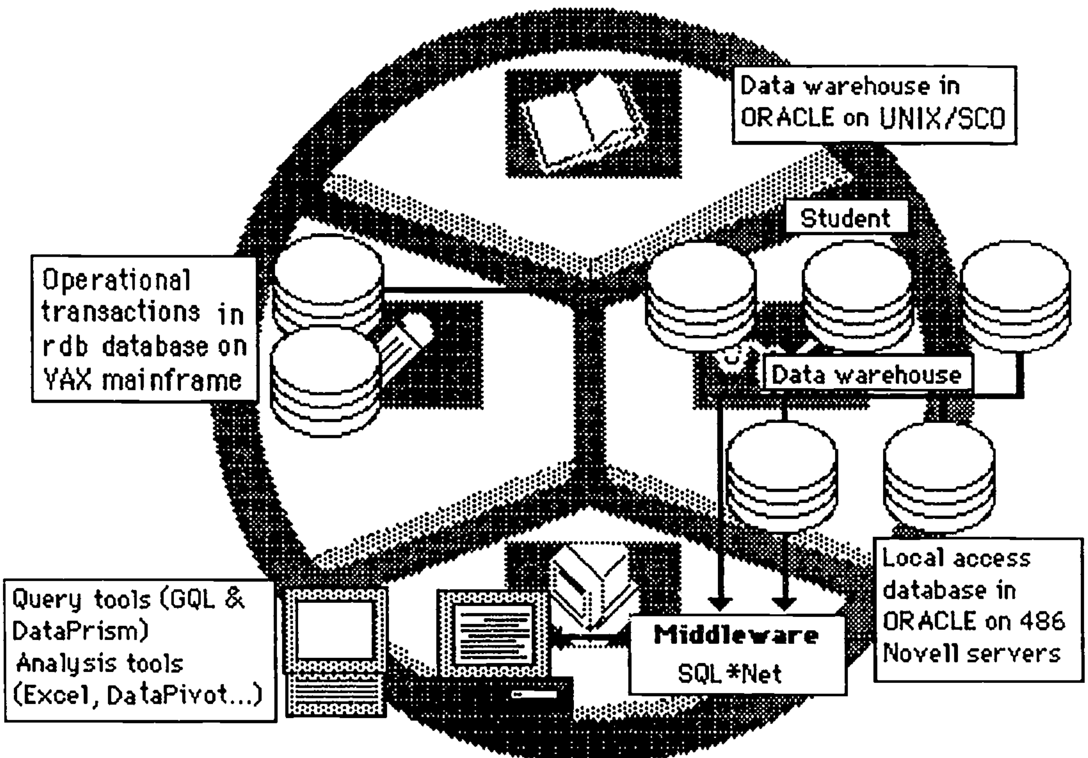

Figure 7: UQAM's student data access architecture

This architecture was inspired by the information harvesting architecture implemented at the University of Michigan. Information harvesting is a concept contained in VITAL, the Virtually Integrated Technical Architecture Lifecycle, designed, experienced and evangelized by Apple Corporation.

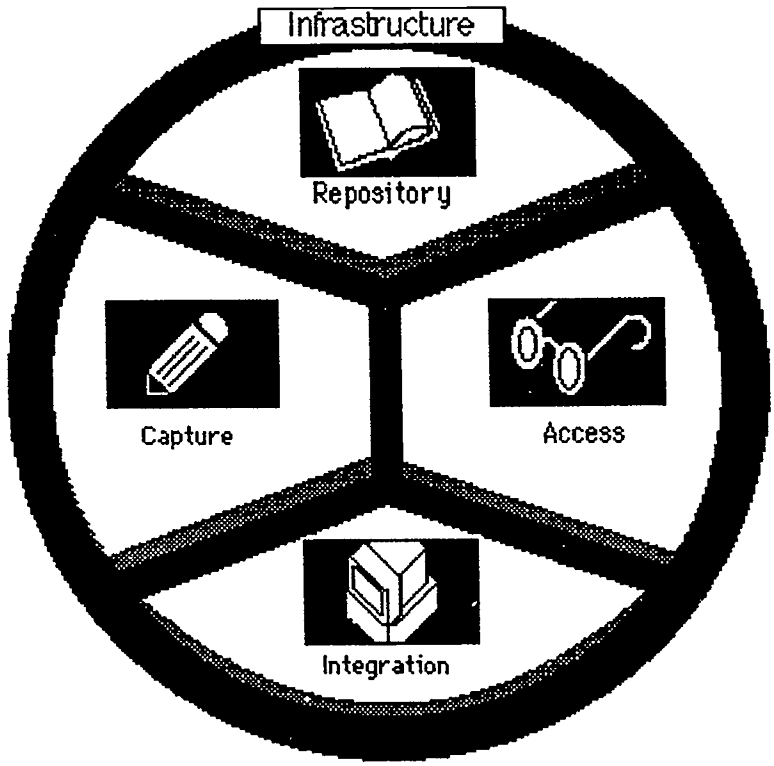

Figure 8: The VITAL model

VITAL is not hardware, and it is not software. Rather it is a 1500 pages blueprint, representing over 15000 hours of effort to overcame *Apple's own... department-centric, incompatible and mainframe-based legacy systems*. Since it was made public, VITAL, a platform and product independent architecture blueprint, was embraced by major organizations worldwide.

Half Way Conclusions.

Five years and several thousand hours of efforts later, what have we learned from our adventure in harnessing the power of information technology to improve services to students and to their faculty advisors?

The bad news, in the present financial context of most universities in North America, is that organizations have to invest in new technologies. Some of these investments such as in relational database management systems or new technologies such document management systems are quite significant and even risky given the competing emerging standards. Higher management will be reluctant to make these investments if the immediate benefits for a great number of users are not obvious and if payoffs cannot be demonstrated. Hence a very convincing case has to be made, not only technical but also on qualitative and economic grounds, that these investments are indispensable.

The good news is that technologies such as high speed public domain networks, graphical user interfaces, distributed database management systems, client/server architecture have matured during the last three years to the point where viable commercially based products exist. This dispenses us from reinventing the wheel, an business in which universities excel but which is terribly costly. These products allow us to shorten considerably the development and implementation cycle, to shorten learning curves both for developers and end-users, to optimize overall performance, to maximize the use of desktop computing power, to transparently transform data into information, and, in the final analysis, to deliver better quality information based services to students and to faculty.

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The "Bottom Line" on Networking

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ABSTRACT

Fear not! The world has not passed you by. Nor has your mind pulled a Rip VanWinkle on you. Networking has not been around forever. Ten years ago, the networking of computers was for techies--another of their black arts. But, as we look around we find that networking is very popular. It is estimated that ***75 percent of our PCs are networked***. And, the number is going up annually. What made networking explode? Well, the computer and the communciations industries finally got it.

As the PC took off in the '80s, u***biquitous networking*** will mark the '90s.

This paper will bring you up-to-date on networking in the '90s. We'll highlight the business and hit on some of the new things.

In some respects, you are faced with learning a whole new set of acronyms and "technical" phrases. But, you've got lots of company. It is new for many of us. Yet, the networking train has left the station and you need to ***jump on*** that moving train. Time is a wastin! Oops, I forgot to warn them. Experts need not attend!

An Introduction

New technologies are enabling the interconnection of computing resources via campus-wide backbone networks to create a "meshed" environment. This new environment requires redefining the role of the local area network (LAN) and wide-area network (WAN) technologies. At the same time, network connections are changing from hierarchical to peer-to-peer as traditional nonintelligent, terminal-to-host, wired networks that require human intervention give way to intelligent networks that enable programmed and automated switching, management and reconfiguration. These new ***intelligent networks*** use integrated access servers and router-based internetworks, and eventually will use higher-speed connection-oriented network facilities, such as ***frame relay***, ***cell relay***, and ***asynchronous transfer mode*** (ATM). This ***multiprotocol, open backbone*** will serve as the migration vehicle to ***opens systems*** and the ***client/server architecture***.

"But!" you say. I can't deal with all this *CHANGE!* Why don't you just tell me what I need to know? You know sort of like a "one-minute manager's approach." Maybe you could just give me the ***bottom line*** and skip all the technical stuff. OK?

OK! Let's try to give you just what a manager needs to know. Skip the background, ignore those step-by-step explanations, and figure that if you want more, you'll find it in a book. ***Right!*** This paper will consist of the highlights of what is going on in networking and ***your bottom line*** in each area. How simple can it get! Well, let's see.

First, I'd like to know, how did we get into this mess?

Colleges and universities have had computers for decades. Big suckers! Why they filled rooms.

But, now its a chip on the desktop. And, people began to want to connect them and talk to colleagues. How dare them? So, we started building them some networks. Now, many managers are concerned with managing a ***heterogeneous*** environment of user-built, non-campus-wide, "roll-your-own" networks which are sprawling out of control because networking products evolved on separate paths and were based on different goals.

But as we wrap up 1993, there is hope. Vendors are presenting us with more and more ***interoperable*** products that allow these separate entities to be pulled together to communicate. Yes, users are demanding global connectivity and ***interconnectivity*** of department and workgroups.

So, let us take a few minutes out and work our way through the mechanics of networking and see what is new. Indeed, we want to find out what is ***your bottom line in networking!***

What do you mean, "Copper is fast enough?"

LANs are typically cabled with copper and it comes in many varieties. But, one observation at the outset. ***There is no one best cable for LANs.*** As suggested earlier, the medium for your campus may be a matter of historical consequence or thoughtfully chosen, based on present and long-term requirements for data, text, graphics, voice, image, and video.

The most widely used transmission media is ***unshielded twisted pair (UTP)*** of copper wire. This familiar type of cabling is found in most phone systems and is already installed in most campus buildings. UTP offers several advantages as a LAN cabling medium. It is the ***least expensive***. The technology is ***mature***. Installation is ***quick***. And, little advanced technical training is required. The installed cost of a workstation with UTP is about $150 compared to $250 to $400 for other copper media.[1]

Your Bottom Line for Copper

Twisted copper pairs will continue to be the basic method for delivering services in the office during the 1990s. With our campus buildings full of old phone copper phone cables, UTP represents a valuable resource for networking that is ***cheap, light weight, flexible***, *and* ***easy*** *to install. More importantly, it will support most of the popular networking protocols and configurations.*

However, the expanded use of ***10BaseT***, that's 10 Mbps speed over twisted pairs of copper, is causing a resurgence in the use of ***copper wires*** as a medium, at the expense of ***coax*** (Ethernet) and ***fiber*** (FDDI). The industry standard, ***Category 5 UTP*** is known as "datagrade" or "supertwist" cable is rated to 100 MHz and intended to support 16 Mbps token ring and FDDI-over-copper initiatives.[2]

Your "SuperTwist Copper" Bottom Line

The IEEE standards now exist for 4, 10, 16 Mbps. The emerging TPDDI(twisted-pair distributed data interface) and CDDI (copper distributed data interface) standards reinforce the belief that ***unshielded twisted pair (UTP)*** *will continue to be an appropriate choice for* ***horizontal wiring*** *for years to come.*

But, What about fiber? Isn't it the ultimate transmission technology?

There is no question that ***optical fiber*** cabling is a runaway best seller for campuses where "keeping up with the Joneses" is in vogue. Fiber provides the unlimited bandwidth, low attenuation, and low security risk. We're talking about fiber systems of over a thousand simultaneous, two-way conversations and pushing data at speeds of over 100M bps. The tremendous capacity of fiber has caused many campuses to jump on the fiber bandwagon. Even though many will even admit that they felt it was wise to put in fiber whenever the campus was dug up for wiring. But, many campuses are asking the question of whether fiber is necessary or does it fall into the "nice to have" category.

Hey, is wireless for me?

The purpose of wireless networks is to ***extend*** wire, ***not replace*** it. However, if you are in a situation where you can't use copper wire, or if you have a connection problem that wire can't solve, perhaps a wireless solution is for you.

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[1]Gary A. Howard & Frank X. Mara. "Design a Copper Network for PDS and LANs Using UTP." Cabling Business, October 1992, p. 8.
[2]Electronic Industries Association/Telecommunications Industry Association 568/569 Commercial Building Telecommunications Wiring Standard of 1991.

The major benefits of wireless come from ***reliability*** and ***low-cost reconfigurations.*** Reliability results from fewer cable faults. And, reconfigurations are inexpensive because typical users can relocate networked computers on their own.

Wireless LAN adapters cost between $200 and $800 each. Yet, implementation costs -- no cabling system -- could cut installation costs by 75 percent and end up saving between $100 and $150 per network connection.[3]

Your Wireless Bottom Line

*Remember that the reason wireless networking products were developed was to provide users with **flexibility**. The wireless-LAN market is driven by the limitations inherent in copper cabling. Wireless LANs can lessen the costs associated with typical LANs and they can give mobility to hand-held computers. As standards mature and applications continue to grow, wireless technology will become a common way to connect computers. **Copper is still faster and more reliable.***

What do you mean, we need a plan for topology?

More frequently, people like the phrase ***wiring topologies***, so that will be our title for this section. The basic topologies are: ***bus***, ***ring***, and ***star***. However, in practice, we find a number of wiring schemes that are mixtures of these basic topologies.

Your Bottom Line on Topologies

Topologies look good on paper. But in the real world, each campus will use the strengths of several topologies to match the capabilities of the entire system and its communications needs.

Let's talk SPEED!

Thanks to the inventive nature of electrical engineers, we now have several new technologies looking for an application. These technologies are methods to transmit a faster and faster speeds. First, there was ***ISDN***. Then, the telephone companies began to tease us with ***SONET*** and we wondered about ***FDDI*** for the campus. Today, there is much talk about ***SMDS*** and ***ATM***. Let's take a few moments and explain some of these technologies.

Integrated Services Digital Network (ISDN)

Some would say that ***Integrated Services Digital Network*** or ***ISDN,*** is just a much maligned "technology looking for an application" since 1980. Put simply, ISDN is a modest set of broad technical recommendations for a common user interface to digital networks. Its purpose is to one of breaking out ***64 Kbps*** channels for all types of transmissions from voice to slow-scan television.

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[3]Jim Geier. "Critical Access for Mobile Users," LAN Times. July. 26, 1993, pp. 77-85.

Frame Relay

A *frame* is a group of bits sent serially. As a self-contained unit of "data" with its own addressing and error checking, it is used in all bit-oriented protocols. A frame is similar to a block. In video, one frame is usually 525 electron scan lines or one TV picture.[4] ***Frame relay*** technology lets users access greater amounts of bandwidth on an as-needed basis to help support the growing number of applications generating bursts of traffic such as LAN interconnection. The ***relay*** refers to how frames are relayed across a series of predetermined switches. As a switching interface, ***frame relay*** operates in packet mode (individually addressed frames, statistically multiplexed on a port or trunk,) with less processing than *X.25* packet switching.

Fiber Distributed Data Interface (FDDI)

It's a little early to get overly excited about ***FDDI***. But, it won't hurt to know enough to ask the hard questions. FDDI is a standard for ***large backbone LANs*** that is configured as a counter-rotating ring operating at 100 Mbps. It is intended to support up to 1,000 connections and support a total fiber length of 200 kilometers.[5] FDDI was designed to provide ***high-speed interconnection*** between low-speed departmental LANs, such as Ethernet and Token Ring.

Your FDDI Bottom Line

Today, FDDI network interface cards (NICs) are selling for several thousand dollars per workstation. Chip development is proceeding at a pace that we can expect NICs to be below $1,000 by late 1993. Therefore, for high-performance users, FDDI implemented over copper directly to the desktop will be in vogue until switched-LAN hubs become available.[6]

Asynchronous Transfer Mode (ATM)

Despite its relative infancy, **ATM**--the emerging high-speed switching technique that uses ***53-byte cells*** to transmit large bursts of data, voice, video, and images over networks--already has spurred heated debate. Some dub it ;a holy grail for high-speed networking; others believe true implementation is a decade away. Possible reasons for rejecting it include:

Your ATM Bottom Line

In the next few years, we can expect to see ATM implemented on backbone links between switching nodes. So, imagine these fast cells zipping between nodes in local telco systems or even nodes of PBXs.

Switched Multimegabit Digital Service (SMDS)

SMDS is a 1.544 to ***155 Mbps*** public data service which complies with the IEEE standard for MANs (802.6). It is envisioned that the network flow could typically be from a customer's system through a carrier's SMDS and then connect to Ethernet, token ring, or make FDDI connections.

[4]Newton. loc. cit.. p. 182.
[5]Jerry FitzGerald. Business Data communications. 3rd ed (New York: John Wiley & Sons. 1990). p 347
[6]F McClimans. "Is FDDI Still the Promised LAN?" Local Area Comunications Research Note. The Gartner Group. Inc.. October 12. 1992, pp. 1-2.

Synchronous Optical Network (SONET)

SONET is the standard the evolved out of the carrier industry to provide for the interconnection of high-speed networks via ***single-mode optical fiber***. This "transport vehicle" starts with a building block of 51+ Mbps and will be capable of delivering data at gigabit (that billions, folks) speeds or ***Gbps***. As our future ***backbone*** technology, SONET will seamlessly interconnect with a variety of current and emerging carrier services, including Broadband ***ISDN*** and Switched Multi-megabit Data Service (***SMDS***) and high-speed LANs by transporting ***FDDI***.[7] By the way, MCI already has ***thousands of miles*** of DS-3 of SONET transport in place.

Backbones, Collapsed and otherwise!

As our "local" networks grew to be "wides," ***distributed backbone network architectures*** grew to provide connectivity from the departments to the ***"host"*** or mainframe computer, giving LAN users access to mainframe files, data and often applications. Most importantly, the central networking resource gave users access to national networks. These campus ***traditional backbone architectures*** were configured in either a ***bus*** topology, such as ***Ethernet***, or ***ring*** topologies, such as ***Token Ring***.

More recently, the ***collapsed backbone*** architecture takes a bus or ring topology and collapses it into a single, centralized "device." In a collapsed approach, the device is referred to a "backplane," a fast router or even a switching hub, and serves as the ***backbone*** offering each LAN a high-speed, say 100 Mbps FDDI connection. This collapsed approach eliminates the need for individual routers attached to each LAN. They are replaced by a single multiport centralized device.

Your Bottom Line for Backbones

If you are considering major rewiring of the campus or major buildings or established a backbone, it would be wise to consider this high-speed ***collapsed backbone approach****. The switching and routing technology is moving us in this direction.*

Yes, LANs have operating systems.

It is normal to describe ***client/server network operating systems*** as ***departmental*** LANs or systems. When the network application goes up the next level in the organization, it is often referred to as the ***enterprise*** system. These enterprise systems normally operate on host machines called mainframes. Yes, we are now calling mainframes "servers." Isn't that enough to make your old big iron salesmen roll over in their graves!

The chasm between the mainframes and the PCs is being filled by client/server technology. So, as mainframe popularity declines, ***middleware*** for servers becomes OUR operating system. Thus, it is timely to mention some of the LAN operating systems.

Novell's Unix Operating System

[7]Nathan J. Muller & Robert P. Davidson. "Building Private SONET Networks: Design and Management." datapro (Delran, NJ: McGraw-Hill, April 1991), pp. 101-102.

Novell has acquired the ***Unix*** Systems Laboratories (USL) from AT&T. And, at this time, it is not clear what Novell will do with Unix. Hopefully, it will accelerate its development. Officially, the legal descendant for AT&T Bell Laboratories--originator of the initial Unix--is ***Novell's*** Unix System Laboratories (USL) Univel is identified as ***Unix SVR4.2,*** as in System V, Release 4.2. To add to the users' confusion, computer manufacturers, in an effort to give an "open" appearance have marketed their own version of Unix, for example, Apple's ***A/UX,*** Digital's ***Ultrix,*** Hewlett-Packard's ***HP/UX,*** IBM's ***AIX***, Sun Microsystems ***X/Open***, and even Next Computer's incorporates elements of Unix in ***NextStep.***[8]

Microsoft's Windows NT

After much pre-release hype, ***Windows NT*** finally made it to market in the latter part of 1993. So, how's it going?

First, it takes a horse of a machine to run NT. As a volume, ***power-user*** platform, the minimums include a 486 50 MHz system with 12 Mbytes of RAM and 300 Mbytes of hard disk. Fortunately, NT comes along at a time when this type of horsepower is not an unusual item on many desktops.

Then, NT can be used as the ***application server and file/print server*** in a departmental LAN situation. Building on the success of Windows 3.1, it can be that departmental platform for relational databases, Lotus Notes, SNA gateways and e-mail.

Your Server Operating System Bottom Line

Unix *is predicted to grow by over 20 percent through the next five years. IBM's MVS operating system will continue to shrink in the market place to a point that Unix will pass it by 1994.*[9] *Microsoft's* ***Windows NT*** *will probably enjoy success in the low-end application server and LAN NOS market next year. Novell's* ***NetWare*** *will lead as the server middleware in its battle against Windows NT. Novell with work with IBM, DEC, and HP to unify the* ***Unix*** *movement forward to openness. So, even with Unix as our best hope for "open" systems, its several versions cause us to realize that there is* ***no single solution*** *out there today. However, we can expect it to take several years for NT and Univel or NetWare 5.? to mature and face up to the demands of* ***enterprise-level NOS.*** *In the meanwhile, users will watch the* ***Microsoft-Novell war*** *go on and each of us choose the real products available today, not "futures."*

Oh! You do need to decide on a LAN architecture.

Once you get past the server operating system, attention need to be focused on the type of ***LAN architecture*** used in the network.

One of the oldest is ***ARCnet*** which was actually developed to connect minicomputers. It uses a *token passing bus or star* architecture. Originally implemented at speeds of 2.5 Mbps over coax, it now adds twisted pairs and fiber to its media schemes. Its speeds have been boosted to 20 Mbps for coax and *ARCnetplus* offers even a higher speed version.

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[8]David Fiedler. "Unix Operating Environments." UNIX Networking: A Supplement to Communications Week. September 1993. pp 8-12

[9]Ibid (Latham)

If you are an all Macintosh workplace, it's a no brainer. Apple builds its Macs with internal network interface cards and the software to support what it calls ***AppleTalk***. Using either Apple-provided twisted pairs or coax, this unique "standard" supports up to 32 Macs or printers at a relatively slow speed of 230 Kbps. Designed with a CSMA/CD type of access protocol, its workstations can be arranged in a *bus* or *star* configuration.

Ethernet, is one of the three oldest ***architectures***--token bus, token ring, and Ethernet. The original implementation was with coax or thick Ethernet. Today, in addition to shielded "thick" coax, which supports devices up to 500 meters, Thinnet or Cheapernet coax is about half the size of regular coax. This architecture runs at 10 Mbps using collision to sense the presence of other packet of data.

IBM's major LAN product is the ***token-ring***. It generally conforms with IEEE 802.5 using *baseband* transmission on either shielded or unshielded twisted pairs. Competition has caused the transmission speed to go from a 4 Mbps offering to 16 Mbps.

Your LAN Architecture Bottom Line

*One need not look too far to find evidence of the effect that **unshielded twisted pairs of copper** has had on the LAN marketplace. Recent market reports show that over 60 percent of all new **Ethernet** sales are using UTP cable. Imagine, over 6 million Ethernet connections are projected for 1993! The **10BaseT** standard has worked its way ahead of **token ring** with price driving the buying decision. 10BaseT can be purchased for approximately $275 per port compared to $500 to $700 per port for Token Ring.*[10]

Ethernet networks have always outsold token rings, with Ethernet adapters holding 60 percent share versus 20 percent for token ring adapters in 1992. As hubs get "smarter," look for Ethernet to continue its dominance over token ring with at least a two time pricing differential. The current cost of including an Ethernet chipset on the motherboard is only $25. So, cutthroat pricing wars between PC vendors might make an Ethernet chipset a standard "feature."[11]

Now, we need a LAN operating system.

Over the past decade or so of growing complexity in networking, users have quietly hoped for network control that doesn't appear to "control." But, rest assured, the more usage and users, the more control and management is needed. A ***LAN*** or ***network operating system*** or ***NOS*** provides a certain transparent "manager" of the system's resources.

Novell's NetWare

We might as well start with the leader in the industry. ***Novell*** offers at least seven network operating systems (NOSs), as well as custom server hardware on which those NOSs run. Five of these run on IBM/IBM-compatible systems, one is for Macintoshes, and one for DEC VAX systems. One significant feature of Novell is its *system fault tolerance (SFT)*. It provides an environment in which if certain hardware failures occur, the network does not necessarily go down

[10]Gary A. Howard & Frank X. Mara. "Design a Copper Network for PDS and LANs Using UTP." Cabling Business. October 1992, p.10

[11]David Passmore, "Ethernet vs Token Ring Revisited." GartnerGroup Continuous Services. April 26, 1993, p 1

DEC (Pathworks)

For years, DEC has offered its own NOS, but competition has been stiff. Consequently, Digital has quietly introduced a product called ***Pathworks*** that walks the fine line between a NOS and DECnet. Using client and server software, Pathworks accomplishes this balancing act on the client side with PCs, Macs, and ULTRIX users getting basic mail application, network transport software, terminal emulation, and VMS application support. Server software provides users with print, file and mail services and support for TCP/IP, DECnet, and OSI. And, the server can be VMS, UNIX, or OS/2 based. The Digital strategy with Pathworks is to provide a corporate NOS to integrate all popular LAN technology and support all standards.[12]

Banyan's Vines

Banyan 's Vines is recognized for its support for large networks and network interconnections. One of the very few to run on Unix-based servers, Banyan has a distinct advantage in the market place because many WANs contain nodes that run Unix operating systems. Few can match Banyan's multi-user, Unix-based machines support. The latest version, ***Vines 5.5***, features enhanced global directory and wide area connectivity. Here is another example of a LAN OS moving up to the next layer to wide area networking (WAN). In this case, server-to-server option is available to support LAN-to-LAN communications over high-speed T1 and fractional T1 connections. Another available option is for ISDN.

IBM's LAN Server & OS/2 Operating System

The latest versions of IBM's operating system or *OS 2* not only provides for data communications but multi-tasking and presentation services. IBM versions support only IBM token rings, not IEEE standards. An *extended OS 2* version has enhanced capabilities such as the *LAN Server* and a communications manager.

3COM (3+, 3+OPEN)

Founded by the inventor of Ethernet, ***3Com*** has been a leader in LANs from its very beginning. 3Com's latest offering, ***LAN Manager***, runs under Microsoft's OS/2. 3Com's ***3+Open*** is the OS/2-LAN Manager product sold directly by 3Com. Microsoft also provides its own version of LAN Manager. 3+Open goes beyond just supporting Ethernet and handles token ring architecture as well. Like Novell, LAN Manager provides fault tolerance via mirrored disk drives And, like Banyan Vines, 3Com has announced a name directory service.

Your LAN Operating System Bottom Line

Novell has steadily increased it percent share of user connections over the past 5 years to the point in 1991 were ***Novell owns 67 percent of the installed base****. In fact, it has more connections nodes than all competitors combined.*[13]

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[12]Kimberly Patch, "Digital's New Path for Pathworks." Datamation. June 1. 1992. pp 73-76

[13]Baldwin. loc. cit. p 19

You mean I have to worry about Peer-to-Peer LANs too?

Peer-to-peer networking enables users to share files and printers without a file server. Products to serve this market have been provided by about dozen vendors for years. For a "who's who" in the peer-to-peer market the following are THE primary products: Apple's System 7; Artisoft's LANtastic; Microsoft's Windows Workgroups; Moses' MosesAll!; Novell's NetWare Lite; Sitka's TOPS; Tiara's 10Net; and Webcorp's Web.

Alright! Let's connect up to the whole world.

The ***Internet*** is a collection of heterogeneous host computers communicating via the ***TCP/IP*** suite of protocols, often referred to as the IP or Internet Protocol network. The rapid growth of the Internet defies precise statistics, but a recent count indicates:

-- 2 million individual users

-- 1,800 domestic and 600 foreign networks

-- 25 percent are business users[14]

After a decade of success, the National Research and Education Network (NREN) is designed to be the next-generation Internet.

Well, have you any parting words?

The Information Superhighway! What, when, where, how, and why? The typical reporters questions are on the lips of many of us on the campus today. There appears to be a mega-opportunity from the convergence of ***computers***, ***communications***, and ***entertainment***. Will this ***"digital convergence"*** create markets worth trillions of dollars?

There is no way to predict where or how far technology's evolution will take us, but this is a given: it will be ***extensive, expensive, and inevitable***.[15]

[14]"Planning and Purchasing Internetwork Services." GartnerGroup Conference Presentation. October 1992. p. 4.
[15]"What Presidents Should Know...About the Integration of Information Technologies on Campus." HEIR Alliance Executive Strategies Report #3, October 1993, p. 4.

Campus Perspectives

There were two Campus Perspectives Sessions presented at CAUSE93. At these sessions, two or more college and university campuses focused on common topics in IT management. Following are the names of the panelists and abstracts of their topics of discussion.

Chief Information Officers: The Small College Perspective

Martin Ringle, moderator
Director, Computing and Information Systems
Reed College
Karen Leach
Associate Provost & Chief Information Officer
Colgate University
Les Lloyd
Director, Computing Services
Lafayette College
Thomas F. Moberg
Vice President for Information & Computing Services
Kenyon College

During the 1980s, many large universities re-organized their computing and technology groups under the leadership of chief information officers. The creation of these senior administrative positions was often justified by citing the potential savings and improved services that could be derived from a coordinated, campus-wide approach to technology. Within the past three years, some small colleges have begun to make similar organizational changes, though with a good deal of hesitation. Many colleges seem to be reluctant to group all technology resources into one organization headed by a single, senior-level administrator.

The purpose of this panel was to examine the suitability of the CIO model for small schools. Representatives of four small colleges who have adopted the CIO approach discussed the costs and benefits of this type of organization based on their experiences. Among the issues addressed were the impact of CIO organization on budget, staff size, user support levels, inter-departmental coordination, technology integration, and strategic planning. The overriding question discussed was: Does the CIO approach really make sense in a small college, or is it just another way to increase the size of the administration?

The IT Infrastructure and Distance Education

Jan Baltzer
Director of Computing & Communications
Maricopa Community Colleges
Spencer Freund
Assistant Vice President, Telecommunications
California State University/Sacramento
David Johnson
Director, Administrative and Academic Computing Services
Washington State University
David Lassner
Director of Information Technology
University of Hawaii System

As "access" becomes more important in higher education, many new distance education programs are being developed. Interactive television often receives primary attention in technology planning for these programs. But the traditional institutional IT infrastructure can be crucial in providing the ancillary services that are required for successful and high-quality distance education. This session considered the often-overlooked aspects of distance education support and described the experiences of several types of institutions in providing this support through information technologies.

Current Issues Sessions

Nine Current Issues Sessions provided informal opportunities for conferees to meet and exchange ideas on topics of special interest or concern. The topics were chosen from issues that have been of interest to the profession in the past year.

Academic Productivity: Can 'IT' Improve It?
Moderator: Carol Twigg, EDUCOM Visiting Fellow

Building Library and IT Partnerships
Moderators: Susan Perry, Stanford University
Gerald Bernbom, Indiana University

The Changing Nature of Vendor Relationships
Moderators: Michael Dolence, California State University, Los Angeles
Marty Smith, University of Massachusetts

Client/Server Computing: The Need for Standards
Moderator: Ken Blythe, Pennsylvania State University

Groupware: Supporting New Ways of Working
Moderator: Con Dietz, Illinois State University

Information, Not Computing
Moderator: Chuck Blunt, SUNY Central Administration

People Issues: Retraining/Redefining IT Staff and Positions
Moderator: Carole Barone, University of California/Davis

Small Colleges: Building Infrastructure with Limited Resources
Moderator: Ellen Falduto, Hartwick College

Smartcard Technology: What Are the Management Issues?
Moderator: Bill Norwood, Florida State University

Academic Productivity: Can IT Improve It?

Moderator: **Carol A. Twigg**
EDUCOM Visiting Fellow

Sixteen CAUSE attendees (including the two college presidents who participated in Friday's Current Issues Forum Panel) came together to discuss how information technology can be used to improve academic productivity. Despite representing diverse institutions and professional backgrounds, each participant was acutely aware of—and to some degree has been affected by—the public criticism being directed at higher education:

- anger over price increases that outpace the rate of inflation;
- loss of confidence in our ability to deliver what we promise;
- concern about how faculty spend their time and effort;
- worry that administrators have somehow lost control of the process; and,
- a sense that few substantive proposals exist to address these problems.

While each recognized that in the business world improved productivity is generally associated with the introduction and continued application of information technology, thinking about how IT can help improve productivity in the academic world proved to be difficult. The discussion revolved around the need for a definition of academic productivity. Without a common understanding of what we mean by academic productivity, we will continue to have difficulty in knowing how to improve it or whether we have succeeded in doing so.

Some of the issues discussed were:
MEASUREMENT: What is a fair measure of academic productivity? Participants struggled with the concept of a fair measure. Several cited measurements currently used by State government such as counting the number of credit hours generated; others criticized the validity (and value) of these measures. The group tried to come up with a standard of measurement, but like many discussions of how to measure the educational process, this one failed to reach consensus.

RESPONSIBILITY: Who should create and administer productivity measures? Current measures are largely imposed from outside our institutions. Rarely do institutions employ and monitor their own measures of productivity.

NEW IDEAS: What are some new ways to think about academic productivity? Examples included reducing the waste of resources created by student failure and consequent repetition of courses (i.e., improve the quality of learning); moving away from a "one size fits all" approach to learning to one that takes into account individual differences in student preparation and ability; using alternative learning environments (e.g., chemistry laboratory simulations) that can help control costs.

FACULTY/IT ROLES: What are the appropriate roles and responsibilities of the faculty and of IT professionals in improving academic productivity? Should the faculty have sole ownership of this issue with IT playing a supporting role? Or can IT professionals work with faculty and administrators in helping them to understand how to take advantage of the potential and power of technology in the teaching and learning environment?

The group concluded that this topic is worth continuing discussion since responding constructively to the issue is absolutely critical to the future of both our institutions and our profession.

Building Library And Information Technology Partnerships

Moderators: **Susan Perry**
Director, Data Center
Stanford University

Gerry Bernbom
Assistant Director, Data Administration
Indiana University

This session was proposed by Anne Woodsworth, Dean of the Palmer School at Long Island University. Anne posited that "as more and more information is accessible through campus wide networks, management of information resources often becomes a shared responsibility of librarians and information technologists. Collaborative strategies are needed to ensure optimum use of resources and services to meet client needs effectively."

When Anne was unable to attend CAUSE93, Susan Perry from Stanford University and Gerry Bernbom from Indiana University were asked to facititate the discussion. Susan has experience on both sides of the information resources house. She has been a librarian and library director and is now a director at the Stanford Data Center. At Indiana, Gerry works closely with librarians in his role as Assistant Director, Data Administration and Access for University Computing Services.

Approximately 60 CAUSE conference attendees participated in the discussion. They were split just about equally between librarians and information professionals. Group members identified themselves and their interests/concerns. Several members were involved in collaborative planning or actual implementation of collaborative work. Several were getting ready to work collaboratively and expressed concern about the difference in cultures. Those who had collaborated successfully seemed to be very positive about the shared responsibility. Some of the successful projects mentioned were the development of a campus-wide information system, Internet training, the development of a new high technology information space, and mutual goal-setting and planning activities. Others had had experiences that were not quite as successful and attributed that to the differences in the cultures. The group did some interesting stereotyping of librarians and/or information technologists. Some members of the group felt that it was time to move past the differences discussions and others did not.

Much of the discussion time dealt with problems and obstacles to Library/IT partnerships. Among the issues raised:

Human resource practices and policies

- Different pay scales for librarians and technologists.
- Librarians and technologists doing the same work, but with different job descriptions and receiving different compensation.
- Faculty status available to (some/most) librarians, but not to technologists.

Financial and budget issues/contentions

- How technologists are consistently better paid.
- ...and, conversely, how librarians are typically better paid.
- How library budgets grow when the rest of the college or university may be decreasing budgets.
- ...and, conversely, how computing centers get their budgets increased regardless.

Differences among the various institutions
- It's difficult to compare notes among institutions.
- In areas of funding and personnel practices, there are significant differences from one school to another.
- What many schools have in common: the feeling that one of the partners (IT or the Library) is doing better than the other. But where they differ: the perception as to which of the partners has a more favored status.

Stereotypes
- Are frequently the way technologists and librarians view one another.
- Are an obstacle to understanding and collaboration.
- Promote or prolong the sense of competition between IT and the libraries.

Areas of potential partnership and means of enabling partnership were also discussed:

Training
- User education and training is often a mission of both the library and the computing center.
- Librarians and technologists can pool their resources in the area of training; each has something unique to offer, but they're not in competition with each other.

Internet training
- This is the area of promise for collaboration.
- Technologists can help librarians become Internet educators.
- Librarians have access to and credibility with the faculty; they also have subject area knowledge, and can evaluate the quality of Internet content.
- Technologists can support this role by training librarians in network tools, search and retrieval, etc. and by helping them stay current—since the technology is changing so fast.

Faculty involvement
- Library and IT both have services missions to support the teaching and research faculty.
- Library/IT partnerships should involve a three-way collaboration: librarians, technologists, and faculty.
- Faculty involvelment can help both IT and the Libraries be more effective. It can focus both partners toward common goals. It can also help build institutional support for the Libraries and the IT organization.

We announced that the Coalition for Networked Information is developing a workshop to assist library and IT administrators to better understand the benefits of collaboration and asked the group if they thought this was a worthy endeavor. All agreed that it was a good idea.

Several members of the group suggested that CAUSE establish a discussion list with the e-mail addresses collected at the session, so that this discussion could continue. CAUSE staff agreed to set up the list.

The Changing Nature of Vendor Relationships

Moderators: **Marty Smith**
Assistant Vice President, Information Management
University of Massachusetts

Mike Dolence
Strategic Planning Administrator
California State University, Los Angeles

This current issues session discussed the changing nature of vendor relationships and the relationships between technology vendors and higher educational systems. Each participant presented their views on the topic and their concerns for the future. The group stressed the need for changing relationships; relationships in the future need to be beneficial to both parties.

Historically, institutions were looking for deep discounts, salesperson relationships and free equipment/software. Each party needs to assess its status and determine the benefits and reasons for entering these long term partnerships.

The discussion involved both vendors and higher education, so an interesting discussion developed as to responsibilities on each side. The discussion evolved into a higher level "strategic" plane as to why we need these partnerships, the need for higher education to be involved in the economy and broad K-12 and adult education issues that need to be addressed for our new information society.

A major educational revolution needs to take place in all levels of education to effectively use new technologies and survive the future in order to become competitive at the individual, educational and business level. Topics such as new sources of revenues, campus investment in technologies, financial and economic incentives were discussed, with a strong consensus that these are national issues and all of our problems that must be jointly dealt with.

The group ended the discussion by indicating that it was the main theme for CAUSE next year, and the topic is both pertinent and timely.

Client/Server Computing: The Need for Standards

Moderator: **Ken Blythe**
Director, Office of Administrative Systems
Pennsylvania State University

The Current Issues Session at CAUSE93 on Client/Server Computing Standards was well attended. Among those that were in attendance, there was general agreement that the more we learn about Client/Server Computing, the more we understand that standards are the only way of achieving true heterogeneous interoperability in a network. The attendees also agreed that only when dissimilar vendors agree to and adopt standard interfaces will we be able to have any brand client machine communicate with any brand server machine.

Through the course of the discussion there were a number of references to the fact that the vendor community today tends to pay lip service to standards, while at the same time, deliberately does not deliver those standards. There is a routine practice among the vendor community of claiming that they offer open computing solutions because they "publish their API's." What they are saying when they say that they publish their API's is that they are open because they make their API's publicly available. This is different from open in the true sense of open by adopting commonly shared standard solutions. Although the vendor community is quite vocal about openness, it is not nearly as vocal about standards.

Standards are, in fact, an issue that customers have to bring to the attention of vendors before they will pay much attention to them. The vendor community invested considerably in the OSI standards several years ago only to be burned. After making the investment in OSI, the vendors discovered that their customers did not have a sincere interest in implementing it. For this reason OSI has not been adopted on a wide scale, and vendors have lost the money that they invested in the OSI solutions. There is a tendency to look at other similar investments with a bit of skepticism. If customers want open standards, they need to be vocal in their advocacy for those standards.

If it is true that client/server computing requires standard interoperable interfaces between dissimilar vendor equipment, then higher education must become much more proactive in its demands for standards. The first step in accomplishing this is to have higher education become more aware of the critical/essential role that standards play in client/server computing.

The attendees of the Current Issues Session recognize that CAUSE, as an association that is concerned about the management of information technology in higher education, should play a larger role in the professional development and education of the higher education user community regarding standards. The attendees also believe that CAUSE could play a much stronger role in sharpening the focus on this critical issue. Therefore, by unanimous consent, the attendees agreed that they wanted a recommendation passed to the CAUSE Board in behalf of the membership which stated, "TO ASSIST HIGHER EDUCATION INSTITUTIONS IN THEIR SEARCH FOR CLIENT/SERVER SOLUTIONS, THE CURRENT ISSUES SESSION ATTENDEES REQUEST THAT THE CAUSE BOARD TAKES A LEADERSHIP ROLE IN THE DEFINITION, ARTICULATION AND DISCLOSURE OF WHICH VENDORS ARE ACTUALLY SUPPORTING OPEN COMPUTING STANDARDS THAT ARE RECOGNIZED BY INTERNATIONAL STANDARDS ORGANIZATIONS."

Groupware

Moderator: **Con Dietz**
Executive Director, Computing and Information Systems
Illinois State University

The session was attended by about 20 persons, and a good discussion was held. The moderator distributed news clips and advertisements describing the increased interest in and therefore development and use of groupware products. To the surprise of some, specific workshops and even conferences on groupware products are widely available.

Several members in the audience were presently involved in investigating groupware products. These include the University of Michigan, SUNY in Albany, Princeton, and others. (This author apologizes to those he has omitted due to his inadequate notes and memory.) Contributions from representatives of these institutions were invaluable and made the session a success. This is what was intended by CAUSE in sponsoring the sessions.

Some discussion centered around an appropriate definition for groupware. There seemed to be agreement that any software whose purpose was to assist in collaborative effort or development (such as writing) could be considered groupware.

There was a general feeling that groupware was growing in importance to higher education and in fact had considerable promise for real productivity improvement in both instruction and administration. Lotus' Notes in particular seems to have promise. Limited experience with Notes has proved satisfactory.

It was also noted that there was a groupware discussion taking place on USENET. Those interested can learn more by participating in this.

"Information, Not Computing"

Moderator: **Chuck Blunt**
Associate Vice Chancellor, Information Technology
SUNY Central Administration

The convergence of digital technologies offers users access to an increasingly larger scope of data and information in all forms (sound, image, text, graphics, data) through communications networks. This convergence offers both new challenges and opportunities in organizing campus supporting services such as telephone operations, data communications, audio/visual (media) services, ... including also broader functions such as Library Services and Academic Computing. Because the underpinning technologies are often very similar (or the same), there are some advantages in consolidating the technical support for these "different" operations. As users/patrons/clients access these services, however, important functional distinctions between these areas may need to be preserved. Quality standards, for example, can vary widely in the consideration of "printing" across organizations such as the University Press and the Administrative Computer Center.

Perhaps the most important issue is that in this evolving networked environment, the "client" can not always "mine" information from the data that can be accessed. Also, in some instances, MAY not realize that further context or interpretation is needed to understand the selected materials. It was suggested that some information systems require "experts" who can post "information" from the data bases that are available; hence, could act as information or knowledge sources on the network. These individuals might maintain a "frequently asked questions" file with the posted answers.

As networks, like the Internet, continue to grow, there will be a need to "package" information with context (perhaps also providing some indications of quality) and to develop the means for alerting "locator" systems to these information resources.

Two closing issues were raised, but not examined, i.e.,
(1) As we move into the "Information Marketplace," where information could be an important commodity, should Public Sector Education give away information that could stimulate Private Sector growth (perhaps as a "value added resupplier")?

(2) As more and more information is created that may exist only in electronic form, how will Colleges and University Libraries be able to preserve (archive) these materials for use by future generations?

People Issues: Retraining/Redefining Staff

Moderator: **Carole A. Barone**
Associate Vice Chancellor, Information Technology
University of California, Davis

The participants in this Current Issues Session came prepared to discuss the challenges they face trying to redirect their staff members to be better able to function effectively in the new roles demanded of them in today's and tomorrow's organizations. The focus of the discussion was on the need to develop the so-called "soft skills" in technicians.

Participants offered some helpful suggestions for building team work in organizations. There was general agreement that simply stating that people will work in teams does not produce the desired results. A number of participants reported success with more subtle approaches. For example, circulating memos as drafts and soliciting comments and lots of coaching, rather than formal training sessions. With respect to coaching, the group noted that it does not have to be face to face or one on one. Alternatives include using email and staff meetings to pass on helpful advice.

Several participants are engaged in formal Total Quality Management (TQM) programs. They described the process of developing such a program and the results that they have experienced thus far. One individual reported that he had not really understood what it meant to work as part of a team until he went through TQM training. All indicated that even with a formal TQM program, it is extremely difficult to reorient staff members to a team approach.

There was some discussion of the value of using consultants to assist with the process of redirecting staff. However, those who had tried that approach reported mixed results.

The group acknowledged the value of formal training programs and exchanged some useful information about how to leverage existing campus resources, e.g., ask faculty to help, add information technology staff to sessions that are funded from another source or developed for another purpose, like training for departmental experts, ask the campus personnel office for assistance. They also mentioned the importance of making training resources, such as video tapes, cassettes, periodicals easily available to all staff so that they can take individual responsibility for staying current.

The consensus was that we are all facing the same challenges with respect to these people issues. Furthermore, there are no simple answers when one is dealing with people, many of whom selected technical careers because they preferred to work individually in a setting in which they could visualize and produce their optimal solution to a problem. Now we are redefining their positions and asking them to collaborate and to settle for a solution that is acceptable to the group, whether or not that solution is the most technically elegant. Such formidable people challenges do not lend themselves to a single, all purpose solution. As they were leaving the session a number of participants mentioned that they needed to apply the multiple techniques discussed over an extended period of time to experience any lasting change in their organizations.

Small Colleges: Building Infrastructure with Limited Resources

Moderator: **Ellen F. Falduto**
Chief Information & Planning Officer
Hartwick College

Twenty-seven individuals participated in a lively discussion about issues facing small colleges when it comes to information technology.

To open the discussion, moderator Ellen Falduto of Hartwick College briefed the group on the issues under discussion in CAUSE's Current Issues Committee. She noted that of the more than 20 issues ranked by the Committee, "building infrastructure in small colleges" ranked 13th. She then asked participants to introduce themselves to the group, and describe one issue that each was facing on his or her campus on which other members of the group may be able to provide advice.

The two issues that emerged and generated the most discussion focused on networking and administrative systems/software. The issues identified by the group included:

- Networking
  - standards and policies
  - what should small colleges do?
  - how should networking be implemented?
  - how can networking meet faculty and student needs?
  - dealing with growing networks
  - finding institutional funds for networking and demonstrating cost effectiveness and potential for revenue generation
  - integrating academic and administrative networks
- Finding administrative software
- Providing services with limited staff resources
- Developing multimedia applications and the implications of multimedia for hardware acquisition planning (concern about early obsolescence of equipment)
- Providing text and data resources over campus networks
- Fund raising support for technology
- How to get an Internet connection
- Staff development
- Coordinating growth of information technology on campus
- Shifting our thinking from tactical to strategic
- Providing administrative data access to students and faculty
- Coping with technology changes
- Classroom computing
- Clarifying and developing the relationship between computing and the library

Near the close of the session participants were asked what CAUSE could do to assist them. Suggestions included:

- Encourage small colleges to put their strategic plans in the CAUSE Exchange Library
- Set up a mail reflector for small college members
- Encourage presidents who have embraced the importance of information technology in small colleges to "enlighten" their colleagues at other institutions; use these presidents strategically to advance the cause of information technology in small colleges, perhaps getting a few of these presidents to write on issues that matter to small college presidents
- Provide a greater focus on smaller institutions: track sessions, hospitality/gathering places for conference attendees from small colleges, etc.

Smartcard Technology: What Are The Management Issues?

Moderator: **Bill Norwood**
Associate Director, University Computing
Florida State University

Approximately fifty-five CAUSE members attended the session on Smartcard Technology and the related Management Issues. The focus of this current issue session was to briefly review where various institutions were in their review of smart card technology and how they envisioned management utilizing this technology in the future.

It was apparent after the initial opening discussions that many of the attendees had thought about smart cards but very few had actually worked with them. Also apparent were the good ideas relating as to how they might be used in their individual university environments. These ideas focused around the following subject groups:

1) Information Transportation
Since the chip could contain 2K of memory or more, the card could be used to transport specific information on the card holder from one office to another across the campus. This information could be updated in one department, such as an advising center, and then other departments would know of the change when that card was read in their areas.

2) Secured Information
Due to the high level of access security to information stored in the chip, personal information such as medical treatment, or psychological counseling, could be stored avoiding paper documents which might be accessible by unauthorized parties.

3) Financial Information
Various kinds of financial information could be transported via the chip. Once students paid their tuition that information would be stored on the chip and then used to allow them to participate in activities campus-wide. These events could include athletic events, meal plans and health care.

4) ON/OFF Line Information
Due to the fact the chip could contain decision information such as fee payment, etc, computer applications could avoid having to always reference university master files for validation.

5) Building Access Information
Access to buildings, labs, facilities, etc, is a major issue and chip card technology could be the real "key." Chip cards could have various personal identification numbers (pins) allowing access to different facilities and even record in the cards chip when access was granted to those areas. Readers using chips to operate doors could even be off-line reducing installation costs, etc.

In summary, there was a real interest in exploring the use of this relatively new technology and apparently there are numerous applications. Questions still remain such as 1) how will lost cards and the encoded data be handled? 2) is the higher cost of the chip card justified by the applications? 3) and will students feel confident that their information is secure on the chip?

Perhaps these issues and others regarding chip card technology will be answered at a future Current Issues Session.

Poster Sessions

Poster sessions were a popular feature of CAUSE93. At these informal, stop-by sessions conferees shared campus experiences with colleagues on a one-to-one basis. Session hosts used posters to display an overview or outline of the experience they were prepared to explain. Following are abstracts of information presented at each session. Longer summaries of the session material are available as a document in the CAUSE Exchange Library, CNC93PS, and on the CAUSE Gopher, under CAUSE93.

Access Card Technology: A Primer of Basic Concepts, Applications, and Planning Tips

Peter J. Bonasto
Director, Administrative Systems
Temple University

Emerging trends influencing enhanced service and safety to the university community include a focus on the development and use of access card technology. This poster session included information on understanding the various types of access cards available (stripe, chip, debit); required network, hardware, and software configurations; central station security; kiosks; preparing an RFP and project plan; and working with access card vendors.

Automating the Library, Beginning to ...

Dennis Self
Director, Computer Services
Samford University

Samford University is a private institution of eight colleges located in Birmingham, Alabama. Samford is over 150 years old, has a main library and a separate law library, with four smaller libraries. Samford University automated its library operations for the first time beginning in 1990. Most of the project is complete, with two remaining items under way. Automation had been under consideration for several years. The full cycle began with consulting and automation team formation. The analysis phase concluded with development of a requirements document. Review of product included vendor contact and response, review of Request For Information results, vendor list reduction, vendor presentations and demonstrations. Selection included evaluations, site visits, final proposals, and the vote. Management approval included report preparation and presentation, and culminated in administration approval. Kickoff and implementation followed immediately. The story is brief but focuses on key issues and reasons why it is a success story.

CASPAR: A Database of Higher Education Statistics

Denise Hammon
Director of Research
Association of Independent Colleges and Universities in Massachusetts

Do you want to know how your institution compares by peer group or nationally in enrollment, federal funding, or in earned degrees? Using CD-ROM technology, CASPAR allows you ready access to a large volume of data which is consistent over time and comparable across data sources. Learn how CASPAR can be used to respond to inquiries ranging from very simple to the most complex requests.

CAUSE Management Institute

Jan A. Baltzer
Director of Computing & Communications
Maricopa Community Colleges

Cedric S. Bennett
Director, Applications Support Center
Stanford University

The CAUSE Management Institute began in June of 1990, providing a unique professional development opportunity to managers of information technologies in higher education. Since the start of the Institute one session has been held in Boulder, Colorado, every summer until 1993 when, in response to an unprecedented demand, a second session was held in August. In 1994, the CAUSE Management Institute program will be expanded to add an entirely new program focused on the management issues faced by directors of information technologies in higher education. This poster session allowed conference participants to learn more about the Institute by quizzing the directors for the two programs.

Centralized Problem Management through Implementation of a College-wide Help Desk and an Information Technology Help Line

Bruce Longo
Assistant Vice President, Administrative Affairs/Information Services
Monroe Community College

Barbara Robinson
Technical Support Programmer, Information Services
Monroe Community College

Helping a college community stay in tune with ever-changing computer technology, while at the same time adhering to strict budgetary constraints, is a challenge universal to institution operations in the 1990s. An Information Technology Help Line and an Information Services Help Desk utilize a centralized problem management approach as a means to help leverage people with technology. This service effectively provides the end user community with a single source of contact for technical resources within separate departments of the College. The concept of centralized problem management as a means for efficient and cost-effective end user support in information technologies can be applied within all institutions regardless of size and budgetary constraints.

The Information Services Department of Monroe Community College has successfully streamlined operations in a cost-effective manner by utilizing existing computer and telecommunications equipment and its non-technical personnel, together with purchased problem-management software to create centralized problem management through its Information Technology Help Line/Help Desk. The main objective of this presentation was to help other institutions achieve the same success.

Changing Budgets on the Fast Track

Roberto J. Hernandez
Programmer V/Lead Programmer
Miami-Dade Community College

A college or university budget is rarely static. Daily requests to amend the budget are both numerous and varied, and immediate response is often required. These budget amendments must also satisfy strict accounting requirements as well as government regulations. Manual procedures are often slow and inaccurate.

The online Budget Amendment system developed at Miami-Dade Community College eliminated most of the manual approval procedures, reduced the amount of paper flow, increased the quantity of budget amendments that could be processed daily, and allowed decentralization of input from one college-wide office into multiple campus administrative offices. This presentation reviewed the working conditions prior to the system implementation, presented an overview of the mechanics of the online Budget Amendment system, discussed a brief time-table of the project life cycle, and offered an analysis of the new system impact and effectiveness.

Cleaning up the Act: Implementing a Help Desk for Improving Support

Sherrilyn G. Hromas
Help Desk Manager
Amarillo College

In the last five years Amarillo College, a two-year community college (6000 FTE), has experienced a proliferation of personal computers and networking among its faculty, staff, and student labs. The institution now must support this rapidly expanded technology. Support efforts have been hampered by a lack of sufficient coordination and communication among the various support elements in academic and administrative branches. In addition, there are no funds for hiring more support people.

In the spring of 1993, widespread dissatisfaction led to the decision to implement a help desk to centralize the support effort. The help desk was seen as a way to improve efficiency of the current staff, to encompass and capture the computer knowledge of non-support people, and to provide information for coordinating computer purchases and installations. This session detailed the process of setting up the help desk, its problems and successes, and its status after the first six months in operation.

Considerations in Moving Applications Off the Mainframe

Tracy Scharer
Senior Systems Engineer
University of Virginia

Moving work from a mainframe running near capacity to a distributed processing environment is a timely idea. It can save money for the institution and offer improved service to the users. But is it always a good idea? At the University of Virginia staff considered moving ad hoc reports coded by administrative end users to an RS/6000. This poster session showed how their data is stored, maintained, and used, and explained why downsizing was not the answer in this situation.

Disaster Recovery Planning

Bruce Longo
Assistant Vice President, Administrative Affairs/Information Services
Monroe Community College

Barbara Robinson
Technical Support Programmer, Information Services
Monroe Community College

Disaster recovery planning plays a vital role in managing information systems in the 1990s. As organizations become dependent on computer technology to carry out critical business operations and store critical data, it is imperative that measures be taken by the organization to ensure against the loss of availability of critical hardware, software, and data.

For the purposes of disaster recovery planning, a disaster is defined as any occurrence which interferes with the normal operations of a mainframe, network, microcomputer, or telecommunications system such that the functions of a department or group of departments is seriously impaired, and the department or group of departments is unable to perform their assigned duties. Disaster recovery planning is necessary to minimize the damage caused by unexpected and undesirable occurrences in and about computing centers and/or telephone switch rooms as the result of a disaster.

The main objective of this poster presentation was to convey the necessity and importance of disaster recovery planning in computer technologies, and to outline the necessary steps which lead to implementation of an effective disaster recovery plan for an organization, and the ongoing maintenance of a disaster recovery plan once it is in place.

Downsizing? Go All the Way!

Stephen Patrick
Director, Computing Services
Bradley University

Joel Hartman
Associate Provost, Information Technologies and Resources
Bradley University

Bradley University is moving away from mainframe computing. The staff first planned to move to a minicomputer environment, but as they studied the problem and the costs, they decided to downsize all the way to microcomputer networks. Bradley is now moving its administrative applications from a home grown, COBOL-based, mainframe environment to a distributed combination of purchased and internally developed systems in a client/server microcomputer network. The first components of the new systems were implemented in June 1993 with final completion planned for 1995.

Electronic Advising Notes Using the Client/Server Paradigm

Tripti Sinha
Programmer/Analyst
University of Maryland, College Park

The University of Maryland at College Park has developed an application to allow advisors to record electronically public and private notes during advising sessions. The system, which operates in a client/server mode, gives advisors access to advising notes of students. This component is part of an automated advising system developed in-house, which was presented at a CAUSE conference five years ago.

A Federated Approach to Information Resource Management

Raymond F. von Dran
Dean, School of Library & Information Sciences
University of North Texas

Paul Gandel
Associate Professor and Senior Director of Academic Computing
University of North Texas

The responsibility for managing information resources at the University of North Texas is shared among the schools and colleges and centralized service agencies, such as the computing center, the library, and the instructional technology center. Roles, responsibilities, and services are coordinated through a representative university council, the Information Resources Council (IRC). The IRC is responsible for making recommendations to the university vice presidents and for participating in university planning processes. Key to the success of this model is the cooperation and teamwork of all participating organizations.

This presentation showed how this federated system of information resources management successfully responds to a diverse constituency, and how a federated model—which necessitates the development cooperation and sharing—can overcome traditional organizational barriers and boundaries. For example, user services at North Texas is a shared area of concern reporting to two directors and supporting multiple organizations—network managers, academic computing, data communications, and administrative computing.

Granting Application Access and Authorizing Online Transactions in a Distributed and Paperless Administrative Computing Environment at UCLA

Greg Partipilo
Manager, Special Projects, Administrative Information Systems
University of California/Los Angeles

To help expedite information flow on campus, Administrative Information Systems (AIS) has begun offering campus departments both online update and inquiry access to key online mainframe application systems including budget, purchasing, and payroll. These distributed and paperless system efforts are highlighted with the introduction of two new and unique AIS in-house-developed software products called DACSS (Distributed Administrative Computing Security) and ASAP (Application

Systems Authorization Process). These new online DB2 tools allow for a significant reduction in overall transaction processing time by introducing a radical departure from traditional approaches to online system access security and transaction authorizations. Specifically,

- local departments now update mainframe application access security files themselves;
- a post-authorization method of transaction review using e-mail and not requiring any electronic signatures is in effect; and
- central offices are monitoring departmental online transaction activity on a post-audit basis by selectively searching an online transaction audit file database at their convenience.

Implementing New Technologies Through the Effective Use of Teams: Tapping Everyone's Abilities Means Success

Sharon Setterlind
Director, Computer Center
Eckerd College

More and more institutions of higher education are experiencing a demand for new technologies along with an effective and efficient way of implementation. Consider the following scenario:

You have just been notified that the funding for the proposal you submitted to the administration three years ago has been approved. How will you install and implement a new administrative and academic computer system; install a fiber optic network campus-wide; convert the administrative database to a new operating system; install a new student computer multimedia lab and upgrade two existing labs to LAN's; and provide continuing support services without additional personnel?

Information Technology Forecasting Project: Technology Planning in Support of Long-range Institutional Planning

Noam H. Arzt
Director, Special Projects Data Communications
University of Pennsylvania

A common problem with five-year university planning efforts is lack of consideration for or consensus on the likely availability—and impact—of new information technology. At the University of Pennsylvania, the central Office of Information Systems and Computing tried a new approach by launching a project to conduct a series of panel discussions and presentations describing the potential landscape of information technology over the next five years. Arranged in a very short period of time, these sessions brought together campus experts, outside experts, planners, and end-users to discuss the role of technology in Penn's future. This project also fed Project Cornerstone, an ongoing effort to develop a principles-based architecture for Penn's next generation of administrative systems. The poster session host discussed why this project was undertaken, the process followed in arranging and delivering the forums, what was learned, its impact on the campus, and implications for future work in this area.

Internetworking—A Campus Guide

Gene T. Sherron
Professor, Information Studies
Florida State University

Internet, Gopher, Archie, FTP, e-mail, CWIS....?~*@&#!!! All newcomers to the campus are bombarded with this barrage of acronyms and strange words—even before they turn on a PC. Yet we know that survival in the 1990s will require a certain mastery of electronic networking.

To help incoming students, the Graduate School of Library and Information Studies at Florida State has developed Version 1.0 of "The Technology Guide." It is designed for self-study rather than the inconvenience of waiting for a course on the Internet and other networking services. The philosophy of its design is that if you cannot explain accessing an information resource in one page, rewrite it! Thus, the campus-wide information system, the school's LAN, the State-wide network, and the Internet are all single pages in the Guide. The Guide will be available on the Internet—take part in its revision and be instrumental in Version 1.1.

The Journey to Client/Server from Mainframe Computing

Jane Berg
Application Development Manager
North Carolina State University

This session showed the journey from a batch financial/inventory system to an online client/server system. The application is a Capital Asset Inventory System (CAMS) originally written in COBOL using sequential files on an IBM3090. The new application resides on a RS6000 running SYBASE and the clients are DOS PCs running Windows sitting on a token ring LAN. The application was developed using the POWERBUILDER software. The users are accountants previously familiar only with a batch application, and the developers are analyst programmers previously familiar with mainframe experience and network database experience.

Poster materials covered a description of the old system (batch, hardcopy reports, data entry from data sheets) vs. the new system (online, relational database, windows for viewing data, data available to user for use with many third-party report writers), the iterative development (pros and cons for the analyst, pros and cons for the user), the training which prepared staff for the new development, a list of tools used for development and implementation (SYBASE, POWERBUILDER, WINQUERY, Q + E), and a description of plans for the application (campus-wide access by school and document imaging software interface). A demonstration was onsite for review.

M.A.P.P. to the Finish Line

Victor Yellen
Director of Academic Support Systems
University of Florida

Karan Schwartz
Coordinator, Student Academic Support Systems
University of Florida

The Monitored Academic Progress Program (M.A.P.P.) predicts and monitors academic success for all majors. Each student's progress is programmatically evaluated upon completion of 30, 45, and 60 hours. Electronically generated letters inform students of their progress, and M.A.P.P. automatically removes students from their intended majors if progress is not satisfactory. The intention is to increase student retention by forcing students to select realistic goals at attainable stages so that they may indeed make it to the finish line.

A Model for Managing Communications Technologies, or Integrated Voice, Data, and Image Communications Management

Janet Smith
Assistant Director, Telecommunications and Network Services
Thomas Jefferson University

Thomas Jefferson University is a major academic healthcare institution in the heart of Philadelphia. Its voice and data communications environment is large and complex. Two years ago, the Department of Information Systems integrated its voice and data communications groups, in an effort to deliver communications services more efficiently. The new Telecommunications and Network Services group offers a single service point for voice and data communication requests. The group handles voice and data network design, consulting, installation and problem resolution. As one of the first to undertake a true consolidation of voice and data management, TJU shared the successes and limitations of this new management structure.

Power to the People: Delivering an Optimized Reporting Database for University Advancement

Donna K. Freddolino
Director of Administrative Services
Michigan State University

Michiel Westerkamp
Vice President
Business Systems Resources

Institutional advancement offices are notoriously demanding consumers of systems support. For Michigan State and many other comprehensive public institutions, today's high political profile fundraising campaigns share center stage with mandated institutional budget reductions. How do you deliver cost-competitive alumni/development information system capabilities while concurrently improving the effectiveness of fundraising staff?

One solution implemented at MSU has been to create and populate a subset alumni/development database on a minicomputer located in the advancement offices. Advancement staff perform both standardized and ad hoc retrievals in a client/server environment using off-the-shelf reporting facilities and applications developed with PowerBuilder against a Sybase database optimized for analytical reporting needs. This presentation described the internal pressures which led to this solution, and the cooperative arrangements between Business Systems Resources (BSR) and MSU. Acquisition and maintenance costs, comparative metrics for report development and query performance and user satisfaction improvements were highlighted.

Process of Identifying an Administrative Computing System

Ron Smith
Director of Business and Accounting Services
University of Idaho

This presentation described the process and direction taken by the University of Idaho to identify and select an administrative computing system. The institution struggled with the steps necessary to bring users to the realization of newer and improved methods of doing business by using improved technology. Following the methodology described, they were able to gain support and buy-in from administrative users and the academic community to select and convert to a new administrative system. The process was completed and software purchased within nine months.

The Process of Reengineering from Mainframe Systems to a Distributed/Client/Server Environment

Ardoth A. Hassler
Executive Director, Computer Center
The Catholic University of America

Leonard Mignerey
Director, Management Information Systems
The Catholic University of America

The Catholic University of America has recently completed converting ten- to twenty-year-old legacy systems from a mainframe to a distributed/client/server environment utilizing a common, integrated database. The "solutions" utilize a mix of institutionally-developed software and purchased packages, including an ad hoc reporter/distributor. This session showed what went right and what went wrong during the reengineering process, including:

- establishing that this is an institutional issue and not a technical problem
- build vs. buy issues: a compromise
- placing a moratorium on change to the old systems
- the necessity of user involvement
- the need for standardization
- securing critical data resources
- issues of staff training and turnover
- the applicability of Murphy's Laws

'Right-Sourcing' as a Systems Development Strategy

Patricia Croom
Student Information Systems Manager
Michigan State University

Scott McGill
Director, Administrative Information Services
Michigan State University

Bruce Alexander
Assistant Director, Administrative Information Services
Michigan State University

Michigan State University initiated plans for an integrated Student Information System (SIS) in the early 1980s. After several design phases, intense work began on SIS in the fall of 1990 in order to coordinate system implementation with a 1992 change to a semester calendar. MSU used an outsourcing strategy, with Coopers and Lybrand as the prime contractor, to successfully implement a massive, mission-critical system in this accelerated timeframe. This presentation reviewed the approach and organization used in the outsourcing effort, and then considered the advantages, disadvantages, and lessons to be learned from the MSU experience. The experiences at MSU extend to outsourcing of client/server, distributed systems, and other new technologies as well as more traditional mainframe systems such as SIS.

Strategically Restructuring the IT Organization

C. Edward Mathay
Director, Computer Services
Marquette University

Many campus information technology organizations retain the same structure as when they were established to support a mainframe environment. Our users may experience problems determining which unit in our organizations to contact for assistance with distributed computing needs and departmental networks. The Computer Services Division of Marquette University found itself in that situation as staff members attempted to grapple with the strategies needed to provide IT support in the 1990s. A task force concluded that developing a new organizational structure was an important and necessary action to enable the division to achieve the other strategies identified. This presentation described the process used to align people, positions, and organizational goals.

A Success Story of In-House Development of a State-of-the-Art Student Information System at the University of Maryland/College Park

Jacob Lee
Systems Analyst
University of Maryland

Barbara Riggs
Assistant Director
University of Maryland

Buy or develop? That's a question many directors and administrators of University data processing shops confront under dwindling resources and shrinking budgets. Five years ago, Academic Data Systems at the University of Maryland/College Park began to develop a student information system on a new IBM mainframe. As of this fall, the office has developed over 2,275 programs, an average of 38 programs per month, with 12 programmers. In the process, seven existing systems were upgraded and nine new ones were developed. With CA-DataCom/DB as the database engine and CA-Ideal as the programming language, the objective was not simply the migration of 1,500 programs residing on UNISYS and HP hardware, but a total redesign and upgrade. Everyone including students, user offices staff, and programmers emerged as winners with improved student services and office productivity.

This poster session outlined the benefits of in-house software development and detailed some of the applications, including online transcripts, online enrollment verification, and elecronic transcripts (SPEEDE) systems.

Teaching Old Dogs New Tricks: Introducing IT to a Traditional Academic Department

Carl R. Steinhoff
Chair, Education Administration and Higher Education
University of Nevada, Las Vegas

The purpose of this poster session was to inform the practice of academic chairpersons regarding the introduction and use of instructional technology to enhance the academic performance of faculty and students alike. Particular attention was paid to the development of an integrated department-wide approach to technical change within the context of an uneven and underfunded institutional plan.

Teaching Students to Write Discipline-Specific Internet Guides and Other Customized Software Manuals

Warren J. Wilson
Director, Regents Informations Systems
South Dakota Board of Regents

This session described how a required upper-division technical communications course has used its writing and speaking assignments to supply the campus with a range of customized software manuals, Internet guides, and other training experiences. Documentation and training seems to awkwardly intrude into many college courses: manuals aren't readily available to students in a network environment, documentation is too general and voluminous, and faculty are hesitant to take valuable course time to do much training. But given a color LCD panel and a live connection to Internet resources and network software, students can be taught to demonstrate FTP resources to students, faculty, and members of the community. They can also be taught to write discipline-tailored guides to Internet resources, and user-friendly and application-specific software manuals—especially if they've suffered through courses without them.

A Team Approach to Administering Campus Information Services: The Realignment of Administrative Computing, Academic Computing, and Library Services Organizations

Morell D. Boone
Dean, Learning Resources and Technologies
Eastern Michigan University

S. Alan McCord
Executive Director, University Computing
Eastern Michigan University

In a 1987 CAUSE presentation, "Learning Resources and Technologies: A Unified Organizational Reorientation to Administering Educational Support Services," Morell D. Boone described Eastern Michigan University's approach to administering these services. In 1991, after four years of study and experimentation, a new organizational structure was successfully implemented. This poster session provided an opportunity to discuss EMU's approach to organizing, planning and implementing information services. Participants heard the history of the initiative, discussed the planning and organizational structures, and evaluated the issues and impact of realigning administrative computing, academic computing and library services.

Thriving in a Distributed Computing Environment

Louise Marie Schulden
Assistant Director, Business and Financial Systems
Cornell University

It started with the IBM PCs in the early 1980s. Business managers were programming in dBase and creating macros in their Lotus spreadsheets that would scare any sensible person with a computing background. The mainframe ivory tower shook a little, but remained impenetrable to anyone who did not know JCL and ALC. Mainframe application programmers calmed themselves with the knowledge that there were no serious databases available on the microcomputers.

Now in the 1990s, there are serious databases on micros and powerful UNIX workstations that for a mere $50,000 can support 50 users. This presentation discussed one university's experiences with downsizing—the up-sides, the down-sides, and some recommendations for managing the transition without jeopardizing your institution's information asset, or losing all the entering class's applications for admissions, or failing to meet the Thursday payroll. This session discussed distribution of office support functions to micros, distribution of operational systems to minis and workstations, and decentralization of data process staff and computer expertise to the departments.

Voice Processing Technology—An Effective Means for Improved Productivity

Andy Holden
Director, Higher Education Market
Periphonics Corporation

Many colleges and universities have had their first voice response experience with the automation of their registration process. There are many other applications that can help service students better. The presenter of this session reviewed these options and was available to discuss new ideas along with some of the rules to implement an efficient, user-friendly dialogue.

SPECIAL SESSIONS

In addition to the Track Presentations at CAUSE93, eight Special Sessions were presented. The names of session participants and abstracts of these sessions follow.

Best Networking Practices from the 1993 CAUSE Award for Excellence in Campus Networking

The CAUSE Institution Database (ID) Service: The Source for Information

The Coalition for Networked Information: A Three-Year Retrospective

EDUCOM'S Teaching and Learning Initiative

How One Association Is Coping with Change

Outsourcing: A Viable Business Alternative

Research Libraries Chart a New Future: Strategic Planning at the Association of Research Libraries

Writing for *CAUSE/EFFECT*

Best Networking Practices from the 1993 CAUSE Award for Excellence in Campus Networking

MARICOPA COMMUNITY COLLEGE DISTRICT
Jan Baltzer
Director, Computing and Communications

BROWN UNIVERSITY
Don C. Wolfe
Vice President
Computing and Information Services

CEDARVILLE COLLEGE
Dave Rotman
Director, Computer Services

GETTYSBURG COLLEGE
Dennis Aebersold
Associate Provost for Computing

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Peter Roden
Senior Project Manager
Distributed Computer & Network Services

PENNSYLVANIA STATE UNIVERSITY
Steve Updegrove
Administrative Director
Telecommunications

STEVENS INSTITUTE OF TECHNOLOGY
Leslie Maltz
Director
Computing and Communications Resources

Winners of the first CAUSE Award for Excellence in Campus Networking provided a brief overview and history of the planning, management, and use of networking on their campuses. They reviewed project descriptions, historical perspectives, and how the plan impacted the teaching and learning processes and improved administrative processes on their respective campuses. They also addressed network accessibility and how network services are currently being provided and used on campus.

THE CAUSE INSTITUTION DATABASE (ID) SERVICE: THE SOURCE FOR INFORMATION

Michael Zastrocky
Vice President for Information Resources
CAUSE

Since 1980, CAUSE has been surveying members and collecting information about the campus computing and information resource environment. This session presented results from the 1993 CAUSE Institution Database (ID) survey and provided practical information on issues of concern to those responsible for the management of information technology in higher education. Results were presented and broken out by Carnegie classification, size, and control. Some of the topics covered include strategic planning issues, staffing and salary information, innovative applications and technologies in use on campuses, financial and budget information, information on outsourcing, networking, microcomputers and workstations, policy issues, academic and library information, and administrative computing applications.

THE COALITION FOR NETWORKED INFORMATION: A THREE-YEAR RETROSPECTIVE

Richard P. West, moderator
Associate Vice President, Information Systems and Administrative Services, University of California
Carole Barone
Associate Vice Chancellor for Information Technology, University of California, Davis
Brian L. Hawkins
Vice President, Academic Planning and Administration, Brown University
Leslie Maltz
Director of Computing and Communications Resources, Stevens Institute of Technology
Paul Evan Peters
Executive Director, Coalition for Networked Information

The Coalition for Networked Information was established in March 1990 as a joint project of the Association of Research Libraries (ARL), CAUSE, and EDUCOM with the aim of advancing scholarship and intellectual productivity by promoting the creation and use of networked information resources and services. ARL, CAUSE, and EDUCOM have just completed a very thorough review of the first three years of the Coalition and its program. This session presented the key findings and outcomes of this review, and discussed the Coalition and its program as a model for collaborative undertakings at the campus, state and regional, as well as national and international levels.

EDUCOM'S TEACHING AND LEARNING INITIATIVE

William Graves
Associate Provost for Information Technology,
University of North Carolina at Chapel Hill
EDUCOM Visiting Fellow

Carol Twigg
EDUCOM Visiting Fellow

This presentation addressed the nature and current status of EDUCOM's new plan to facilitate collaborative institutional, curriculum, and product development activities designed to show that technology-mediated learning can increase educational effectiveness (quality of learning) and efficiency (ratio of result to cost) in a way that is nationally significant and scalable.

HOW ONE ASSOCIATION IS COPING WITH CHANGE

James Cross
Secretary, ACUTA Board of Directors
Vice President, Research & Information Systems, Longwood College

Patricia Searles
President, ACUTA Board of Directors
Assistant Director, Network Resources, Cornell University

The Association of College and University Telecommunications Administrators (ACUTA) is one of many professional associations dealing with the rapid changes occurring in technology. Patricia Searles, president of ACUTA's Board of Directors, and Board Secretary James Cross discussed the hot issues facing ACUTA and its membership, and how their Board and staff are dealing with them. They explained how ACUTA is coping with necessary changes in the governance, management, and operation of the association itself, as well as how it is attempting to serve the rapidly changing needs of its diverse membership. The speakers are also deeply involved with the same issues and challenges in their day-to-day work at their respective institutions.

Outsourcing: A Viable Business Alternative

A. Jerome York
Associate Vice President, IST
University of Medicine & Dentistry of New Jersey

This presentation discussed various approaches to installing technology solutions and providing services. It compared the alternatives from a financial perspective and described the circumstances where outsourcing is a viable alternative. In addition, it highlighted the role and importance of the CIO as the initiator and leader of the evaluation process.

Research Libraries Chart a New Future: Strategic Planning at the Association of Research Libraries

Duane E. Webster
Executive Director,
Association of Research Libraries

The Association of Research Libraries enjoys a distinct niche in the ever-changing mosaic of organizations representing higher education and scholarly communication constituencies. As the representative of 119 research libraries, it draws on a key information executive in research institutions throughout North America and can focus attention on issues affecting the future of the university.

Many issues confront research libraries. The message from the recent landmark report on scholarly communication and research libraries by the Andrew W. Mellon Foundation is well understood: the traditional mission of these institutions must undergo a transformation. The skyrocketing cost of information is forcing research libraries to identify new, cost-effective means for accessing and using required information. The events unfolding over the next decade call for rapid action on the part of research library leaders to change the fundamental character and nature of research library services and capabilities. The Association of Research Libraries convened a strategic planning process five years ago that identified pressures for and against change, completed SWOT analysis, developed alternative futures and a preferred vision, and identified key result areas.

The strategic planning process strengthened ARL programs and influence. It provided a renewed vision and a refocused statement of mission and objectives. A list of challenges was prepared to guide ARL committee efforts. ARL co-sponsored the Coalition for Networked Information with EDUCOM and CAUSE in order to address the growing range of opportunities with telecommunications networks. ARL established two new capabilities: the Office of Scientific and Academic Publication to analyze and influence changes taking place in scholarly communication, and the Office of Research and Development to create an agenda of research and change projects. The Association also expanded efforts to analyze and describe performance of research libraries.

WRITING FOR *CAUSE/EFFECT:*

A ROUND-TABLE WORKSHOP

Gerald Bernbom
Assistant Director, Data Administration and Access
Indiana University
1993 CAUSE Editorial Committee Chair

Janet Whitaker
Instructional Media Faculty
Mesa Community College
1994 CAUSE Editorial Committee Chair

Julia Rudy
CAUSE Director of Publications and Editor

Members of the CAUSE Editorial Committee

A round-table workshop for those interested in learning about writing for *CAUSE/EFFECT* magazine was held at CAUSE93. Participants brought ideas for articles to the workshop for informal discussion with members of the CAUSE Editorial Committee, who shared their experiences as reviewers for the magazine, and answered questions about what makes an article a good candidate for publication in *CAUSE/EFFECT*.

Constituent Group Meetings

A number of CAUSE members and conferees met at CAUSE93 to focus on issues unique to their shared work environments. These Constituent Groups are organized to encourage communication among professionals who share specific problems and functions. The groups meet during the annual conference and occasionally at other times during the year. A number of these groups operate ongoing electronic discussion groups. The number and focus of the groups change according to members' needs.

Some of these groups have provided summaries of their conference discussions.

Administrative Systems Management
Coordinator: Darrel Huish,
Arizona State University

Chief Information Officers
Coordinator: Kenneth G. Pollock,
Wright State University

Coalition for Networked Information
Coordinator: Leslie Maltz,
Stevens Institute of Technology

Community and Two-Year Colleges
Coordinator: Gordon Mathezer,
Mount Royal College

Data Administration
Coordinator: Ronald K. Spangler,
University of Kansas Medical Center

Executive Information Systems
Coordinator: James M. O'Neill,
Boston College

Higher Education Users of Computer Associates Products
Coordinator: Nathaniel L. Felder,
Xavier University

IA Systems Executive Users Group
Coordinator: James L. Morgan,
Pepperdine University

IBM Higher Education Software Consortium
Coordinator: Douglas E. Hurley,
University of Kentucky

Institutional Researchers and Planners
Coordinator: Richard Howard,
University of Arizona

Medical/Health Science Schools
Coordinator: Arthur J. Krumrey,
Loyola University Chicago

Small Institutions
Coordinator: Clyde R. Wolford,
Le Moyne College

User Services
Coordinator: Carolyn Livingston,
Tufts University

Users of Software AG Technology
Coordinator: Ken Blythe,
Pennsylvania State University

MINUTES of CAUSEASM annual meeting

The CAUSEASM had its annual constituent group meeting on Dec 8, 1993 in San Diego. We had at least 48 people in attendance at the meeting.

The first topic of discussion was business process reengineering. Mark Olson from Columbia shared his experiences with the group. He mentioned that they had initially targeted "registration" as a pilot activity, but this had proven too large for a pilot. They stumbled across the business process of placing "holds" on a student's records for various infractions. This became the initial pilot. They are using Coopers and Lybrand for some external consulting help.

Wayne Donald of Virginia Tech also shared the experiences of their institution. The net result is that 4 units were merged into one to provide better service to students. No employees were displaced, and almost all those affected had a positive feeling about the changes. Virginia Tech did not use consultants in their effort.

We then had some general discussion. Comments that I noted are:

How do we differentiate process improvement (TQM) efforts from BPR?

Others noted that there is a real need for outside help because they are better positioned to "blow up" processes than internal folks. It was agreed that *full* upper level administrative support is needed. One interesting comment was that you know you have true executive support when they are willing to do BPR *instead* of another project. Too often it is undertaken as simply an add-on activity.

We talked about who should drive BPR. Someone suggested looking at who owns the processes. IT should be involved, but is often not best positioned to be the driving force. On the other hand it is crucial that IT be invited to the table, because they often have the "inside scoop" on technology assisted process innovation. Jill Tuer from Michigan challenged us to think about what business is IT really in? Is it just providing MIPS and systems analysis or is it genuinely our business to improve the business processes -- WHATEVER they are, whatever is required. (?)

Crisis is the best driver for re-engineering, whether that be competition, aging systems (year 2000, etc.), or budget cuts.
****

The second topic was that of client/server computing. What are people thinking, what are they doing?

Bob Eaton from University of Saskatchewan remarked that client/server is more expensive, but that doesn't really matter anymore. The money IS being spent on client/server style technology. The best way to get out in front of this expenditure of money is to have a technical architecture.

Wayne Donald remarked that we can think of the funding as an upside-down
pyramid, with IT having the *LEAST* amount to spend on new technology and
customers (in total) having the most to spend.

We talked a little about distributed computing vs. de-centralized computing.
There seemed to be some level of concern about the potential loss of control associated with truly de-centralized computing styles. Charles Seymour mentioned the idea (I think it was you Charles!) that networks need to establish lines of trust, and if an application is outside the line of trust (not in the control of an authentic IT source) then transactions have to be reverified when coming back inside the line of trust.
****

The third and last topic was that of the future of CAUSEASM. We noted that the listserv had grown during the past year from 250 subscribers to 350. The past year hasn't seen the same focused bite-size discussions that we had seen before that. We discussed alternatives including disbanding the listserv in favor or other more specialized lists, or maybe creating a more comprehensive gopher-styler access to indexed information. The bottom line is that people aren't ready to see CAUSEASM go away, but really did like the bite size topics that ran during 1992.
We came to an understanding that moderated discussion requires moderators
and several people volunteered to do part of the work required. Bob Eaton is looking for a couple of people to partner with him, and I think there are others who are also interested in leading a discussion in an area of their own particular interest.

COALITION FOR NETWORKED INFORMATION

Coordinator: **Leslie Maltz**
Stevens Institute of Technology

The Coalition for Networked Information held a Constituent Group session as a means of providing an overview and update of the Coalition's program to the CAUSE membership. The session was convened by Leslie Maltz, Director of Computing, Stevens Institute of Technology, who is a CAUSE representative to the Coalition Steering Committee.

Paul Evan Peters, Executive Director of the Coalition, opened the meeting with a description of the mission of the Coalition, an overview of its formation by the three founding associations (CAUSE, EDUCOM, and the Association of Research Libraries), and an update on the national networking scene. He reviewed some of the Coalition's projects in the areas of electronic publishing and the economics of networked information.

Joan Lippincott, Assistant Executive Director of the Coalition, described initiatives in the areas of management, teaching and learning, and government information. She also asked for suggestions for topics to be included in a regional conference that CAUSE and CNI are jointly planning.

Craig Summerhill, Systems Coordinator of the Coalition, described developments in the network services offered by CNI. These include access to the Coalition via gopher (gopher.cni.org 70) and the availability of databases that can be searched using the BRS/ Search software. Information available on the Coalition's server include meeting and project reports, archives of CNI's discussion forums, the TopNode database, a database of projects on teaching and learning, and documents relating to the National Information Infrastructure. He reminded attendees that they can keep up to date on Coalition activities by subscribing to cni-announce (send an e-mail message to listproc@cni.org and type: subscribe cni-announce first name last name.)

MEETING NOTES

CONSTITUENT GROUP ON TWO-YEAR & COMMUNITY COLLEGES

CAUSE '93 - SAN DIEGO

The group identified a long list of issues it was interested in, but due to lack of time discussed only the following:

1. **STRATEGIC PLANNING:**

Everyone agreed that this was a critical first step for any IT organization. However, there were several fundamental questions about how best to do it. For instance;

- How best to start it? (Use of consultants vs. internally develop vision was discussed).
- How to involve users? (Definition of user expectations, developing partnerships, IT credibility through tangible results were considered).
- How to keep the plan up-to-date? (Continuous living process, directly tied to budgeting seemed to be the consensus).
- Does reengineering of processes fit into the strategic planning procedure (yes, but not sure how).
- What form should the plan take (Attention was drawn to models available in the exchange library and to the upcoming CAUSE monograph on the subject)

2. **MANAGING WITH DECREASING RESOURCES:**

There was no time to develop well researched conclusions on this topic either. However, there was a healthy discussion of the following:

- How best to incorporate one's approach into the strategic plan.
- How to recover costs of voice/data network? Does chargeback save money for the institution?
- Drawing attention to problems that are really serious.
- Outsourcing and/or partnerships.
- Using students to do some of the work.
- Discontinuing some lower priority services.
- Recycling older desktop equipment.

3. **NETWORKING:**

This was identified as another key area of interest. Attention focused on:

- Required support staff levels.
- Management tools.
- Best approach to increasing bandwidth.

4. **SUPPORT FOR INSTRUCTION:**

This was an issue of interest for many. The question of how best to provide it was not fully answered. All agreed that we needed to do better in this area.

5. **FUTURE INTERACTION:**

It was agreed that exchanging ideas between Annual Meetings on the above (and other) issues would be helpful.

Denny indicated that a LISTERV-facility was available. Those interested should call him or send him a message at [DFARNS@CAUSE.COLORADO.EDU]

DATA ADMINISTRATION CONSTITUENT GROUP

Coordinator: **Ron Spangler**
University of Kansas Medical Center

Thirty persons attended this annual meeting of the CAUSE Data Administration Constituent Group. Introductions consisted of each person stating their name and institution and briefly describing their involvement or interest in the area of data administration. There was a mix in levels of experience with data administration, from novice to advanced.

The meeting began with a quick overview of the counterpart DA Special Interest Group at the AIR annual meeting in May, 1993. It was noted that 20 persons attended with a primary focus on learning more about the topic of data administration.

The DASIG listserv was described and opportunities were provided to sign-up to have their names added to the distribution list. DASIG is the electronic mail distribution list devoted to the discussion of data administration in higher education. DASIG currently has 288 subscribers representing over 160 countries around the world. The DASIG listserv communications are also posted on NETNEWS. Sue Borel, the owner/manager for DASIG, was at this meeting. Those attending also expressed thanks to Sue for her continued efforts to maintain this listserv as a service to those of us interested in data administration.

The CAUSE Exchange Library was identified as another good source for information about data administration. Currently, this source has over 70 documents on the topic of data administration, including: presentations on specific issues, policies, and a limited number of position descriptions. Copies of these documents may be purchased in printed form from CAUSE. Electronic copies may be obtained by any member representative of institutions or organizations belonging to CAUSE through the use of the LIBSEARCH facility. For further information regarding LIBSEARCH, call 303-939-0310 between 8am-5pm Mountain Time, or send e-mail to:

search@cause.colorado.edu

In the body of the message type the line:

help libsearch

To order a hard copy of any document, please contact CAUSE, 4840 Pearl East Circle, Suite 302E, Boulder, CO, 80301. Attendees were encouraged to submit any of their own documents related to data administration to CAUSE for inclusion in the Exchange Library.

The Data Administration Management Association (DAMA) has created its final copy of the "Model Data Administration Standards Manual" which had been circulated in draft form for the past two years. It has been published as the "Manual for Data Administration" in March 1993. Unfortunately, the sources for the printed document are somewhat limited: the Government Printing Office is down to less than 15 copies and the NTIS price is $27.00. Fortunately, the National Institute of Standards and Technology (NIST) will probably give permission to CAUSE to include both printed and electronic copies in the Exchange Library. As soon as it becomes available, a notice will be posted to the DASIG listserv.

The majority of the meeting was devoted to answering two questions:
(1) What are the major issues that are, or will be, challenging the field of data administration?
(2) How can CAUSE, as a professional association, help us to meet those challenges?

The issues identified are listed below in the order of discussion by the group; the sequence is not intended to represent a priority order.

1. methods for data quality control
2. data stewardship policies
3. use of benchmarking to identify essential data elements
4. techniques to demonstrate progress in "cleaning up the data", a common role for new data administration units
5. generic reference models, both
   a. enterprise-wide, and
   b. project specific

6. examples of integrated data models:
   a. for the enterprise, or
   b. integrated from models for separate projects
7. standards for data models, considering the emphasis on:
   a. object oriented models (over entity relationship models), and
   b. ISO standards
8. standards for CASE tool use
9. methods to access metadata, such as:
   a. data element dictionary (DED)
   b. repository
10. exchange of success stories/vignettes/anecdotes at different institutions
11. clarification of the relationship of data administration to reengineering
12. strategies for advising users regarding DA policies and procedures
13. justifications for the creation or continuation of the data administration function in higher education
14. documentation of business rules, both declarative and operational
15. strategies for file storage:
    a. strategic, aggregated, or planning data (e.g., data warehouse)
    b. operational data
16. emphasis of data as an asset and distinction between institutional and departmental data
17. compliance with FOI/POP regulations and policies:
    a. freedom of information
    b. protection of privacy
18. clarification of security and privacy roles, e.g,
    a. development of standards - data administrator
    b. implementation of standards - data base administrator
    c. authorization for access - data steward
19. identification of security policy statements
20. development of a comprehensive data administration bibliography

Throughout the discussion, the group considered how CAUSE could help us address these issues.

A. Consider adding a limited number of questions to the CAUSE ID Survey which would help identify institutions which have knowledge or expertise which they would be willing to share, such as: data models for major systems, established data administration functions, expertise in specific CASE tools. Ron Spangler and Gerry McLaughlin will work with Mike Zastrocky of CAUSE regarding this suggestion. (Issues 5, 6, 8, and 13)
B. Collect more documents for the Exchange Library, particularly: data stewardship policies (Issue 2), success stories/vignettes/anecdotes from different institutions (Issue 10), and security policy statements (Issue 19)
C. Support maintenance of a comprehensive data administration bibliography. Such a bibliography would likely be a dynamic document, somewhat different than the standard fixed document in th.. Exchange Library. (Issue 20) These suggestions will be forwarded to the CAUSE office for their consideration and further action.

The meeting concluded at 6:30 pm. To facilitate further contacts and discussion, an attendance roster will be sent by e-mail to all attendees who provided an e-mail address. Thanks to all who attended for sharing your ideas and generating an enthusiastic and productive discussion. Please remember to provide copies of any of your data administration documents to the CAUSE Exchange Library.

EXECUTIVE INFORMATION SYSTEMS SPECIAL INTEREST GROUP (EISSIG)

Coordinator: **James M. O'Neill**
Boston College

This session was attended by 29 people representing a broad cross-section of schools all over the U.S.—public, private, large and small. Also present were representatives of schools in Canada, Northern Ireland and South Africa, and one representative of a "for-profit" corporation. The session was also attended by an author gathering information for a new book in the field of management information systems. Many of the participants were not aware of the EISSIG listserver and Jim O'Neill provided them with information about how to join the list.

The participants introduced themselves and gave brief remarks about their level of involvement in EIS/DSS and the status of any projects at their schools. Most of the participants were at the stage of gathering information or planning for the implementation of EIS systems, and had come to the meeting in hopes of learning from the experiences of other institutions. Many had some form of DSS, usually involving end-user SQL tools for accessing campus data in SQL relational databases.

Chuck Thomas of NCHEMS gave a demonstration of a prototype system called E-Guide, developed by Tod R. Massa of St. Louis University. The system works as an "electronic fact book" to display data and associated text or graphs. It runs in the Microsoft Windows environment and uses Microsoft Excel, the Microsoft Windows Help facility, and Visual Basic. The system features the high presentation quality of Excel along with easy navigation elements to move from one display to another.

Some of the issues discussed at this session included:

- **The Role of the Executive Sponsor:** without a high level sponsor, EIS projects tend to founder for lack of a precise vision of what management wants and for lack of the institutional clout to get cooperation from data providing departments. Some indicated that with a committed, involved executive sponsor, special purpose, focused, executive applications can be designed relatively quickly and successfully.
- **DSS versus EIS:** several participants indicated that they saw greater institutional payoff from supporting data sets and tools aimed at staff analysts and middle management (traditionally called DSS—Decision Support Systems) rather than executives (traditionally called EIS—Executive Information Systems). Many felt it was difficult, if not impossible, to provide data sets which were so unambiguous that executives could use them safely without running the risk of misinterpreting the resulting reports. Data sets, particularly multi-year, time-series data, are often full of traps that are only apparent to those who use the data frequently and are aware of its limitations. Some also indicated that they feared that executive systems would require large amounts of staff time to maintain them.
- **Tools:** several participants indicated that they concentrated more on providing the data sets and less on providing the end-user tools. They try to let the end-user choose the tools that they are comfortable using. Since many were storing data in SQL, relational databases, the tools discussed tended to be those which enabled end-users to compose and submit SQL queries with little knowledge of SQL syntax and to move the resulting data subsets easily to their preferred desktop tools, primarily spreadsheets or local databases.

John Minter described the National Cooperative Data Share (NCDS), a new initiative of his firm (JMA, Inc.) in cooperation with the University of Virginia Library. The NCDS allows schools to submit the data from their IPEDS surveys to JMA, Inc. via diskettes provided free by JMA, Inc. The data is then processed and loaded into a gopher server at the University of Virginia Library. Any school contributing data can then retrieve data from any other participating school for comparative analysis. There are no fees for these services. The project aims at reducing the long lag time in processing data by the U.S. Department of Education which is the collecting agency for the IPEDS surveys.

IBM HIGHER EDUCATION SOFTWARE CONSORTIUM

Coordinator: **Douglas E. Hurley**
University of Kentucky

Once again, the Higher Education Software Consortium (HESC) met during the CAUSE annual conference. This year's meeting was an informative opportunity for participants to learn more about recent HESC announcements and directions, and to talk directly with IBM ACIS regarding this program. Mr. Harlan Hunter (IBM ACIS coordinator) led an active and informative discussion.

The meeting began with an overview of the May, 1993 product announcements, which included 118 new products added to the HESC program. In addition, several software groups were restructured and pricing changes were made for several groups. A major change announced in May was the removal of the CAEDS software from HESC. Most of the meeting focused on pending charges to the pricing structure of the HESC. Since its inception, HESC software offerings have been organized into groups, with annual changes associated with each group. The HESC has grown dramatically since 1988, both in numbers of institutions and in numbers of products available. According to IBM the group pricing methodology is no longer viable. In 1994, the HESC pricing structure will shift from group pricing to individual line item pricing. IBM suggest that for the average HESC member institution, there will be no cost impact resulting from the change. IBM expressed intent to work with HESC institutions to moderate any budget increases resulting from this change. Other basic terms and conditions in the HESC program should not change.

The attendees also discussed the role of the constituent group and its future. The consensus was that this CAUSE forum should continue and that it provides useful information to both IBM and conference participants.

All HESC members are again urged to discontinue any licenses under the HESC program that are not being used. This action will help to keep costs down for all HESC members.

This constituent group continues to be a useful forum for providing information about HESC offerings and directions. It also provides an opportunity for CAUSE attendees who are HESC members, to voice concerns and needs directly with IBM ACIS personnel.

A Listserv has been established for the HESC. To subscribe, send mail to:
IBM-HESC @PSUORUM.BITNET.

ISSUES AND CHALLENGES:
1) HESC - price structure
2) HESC - product structure
3) HESC - customer advice and feedback

Discussion:
Probably the most important issues facing HESC member institutions are the program costs and the availability of software in the program. Given that the HESC is a contractual relationship between IBM and a subset of CAUSE members who subscribe to the HESC, there probably is little assistance that CAUSE can directly offer. However, the CG meeting continues to be a helpful forum to offer CAUSE members an opportunity to speak directly with IBM ACIS about the HESC program.

MEDICAL AND HEALTH SCIENCE SCHOOLS

Coordinator: **Arthur J. Krumrey**
Loyola University Chicago

The group reviewed current issues in medical school applications of information technology in the areas of instruction, research, and student records and administration. It found the following common themes in each of these areas:

Instruction

Almost everyone reported a sense of being "behind" others in the use of information technologies; no one reported that they had realized close to the full potential of computing in instruction. An open question lingered: who is really ahead, and what is its secret?

There was a common need for videoconferencing and distance learning technology, and a common question as to what was appropriate.

Another common issue was the search for the appropriate level of technology in planning a new classroom.

Research

The need to provide a robust, easy to use network was the major theme. Planning for higher bandwidths and planning for broader services were on most constituents lists.

Another common item was a need for standards in communicating medical research information.

The need for common interfaces to research data, such as patient data of affiliated institutions, was next on the list.

Student records and administration

Again, network access was the major need.

Cost allocation to research was another major issue.

Issues of the constituents that may help CAUSE plan future professional activities

Cost allocation and recovery. Again a major concern given the need to reduce costs.

Teleconferencing and distance learning, as described above.

The need to provide electronic-based services to a broad base of external constituents, such as a state medical consortium.

The need for standards for content, after networking provides very high bandwidth.

USER SERVICES

Coordinator: Carolyn Livingston
Tufts University

Approximately 20 people attended this annual meeting to discuss strategies used to meet the needs of their users. Participants identified a number of issues for discussion:

- organizational models of support
- effectiveness of the Help Desk
- how to deal with the demand with decreasing resources
- roles and responsibilities of central support staff
- network administration
- chargeback
- PC hardware/software support

The discussion focused primarily on the Help Desk issue. All attendees agreed that the Help Desk was an important area of support. Even though many institutions don't have the resources to provide sufficient support, there were success stories. For example, Heather Grigg, McMaster University, has a good Help Desk. Two full-time people answer 3,000 calls/month. They forward calls to the onsite people.

Considerable discussion addressed the needs of the Help Desk. Attendees shared various methods for keeping the Help Desk personnel trained:

- include all of the Help Desk personnel in the changes
- don't support changes until the Help Desk is trained
- require the top 10 questions that will be asked regarding the changes
- allocate so many hours a month for training the Help Desk staff
- rotate experts through the Help Desk
- set up an expert system for frequently asked questions

Some attendees suggested using expert systems to support the Help Desk. Helmut Becker, Mt. Allison University, has a home-grown work-order management system in operation while the Help Desk answers questions.

Attendees also discussed two types of user support: centralized and decentralized. Dorinda Giles, Xavier University in Cincinnati, assists users by centrally setting up service agreements. Tracy Scharer, University of Virginia, noted that there are local units to assist their users. Central's job is to bring these groups together. Bob Nordstrum of the University of New Mexico directs a user support unit in the Finance area that includes programmers. At some institutions, local units build their own expertise. Also, users are more willing to call local units for assistance rather than the central unit because they prefer to develop relationships with the same people. Emergency calls are forwarded to the person who can deal with them.

USERS OF SOFTWARE AG TECHNOLOGY

Coordinator: **Ken Blythe**
Pennsylvania State University

The constituent group meeting was well attended. Nick Cannistra (VP Software AG) used part of the meeting to update the attendees about Software AG's present and future IT directions. Mr. Cannistra explained that Software AG considers higher education to be a very important business segment. More than 150 institutions rely on NATURAL, ENTIRE and ADABAS to support their critical business processes. Client/server computing and software engineering are high priorities for Software AG in the future.

Ken Blythe (Director of Administrative Computing at Penn State) shared information about the Software AG higher education user group called CAUCUS and invited everyone to attend the annual CAUCUS meeting in Arkansas, April 24-27, 1994. Ken also provided information about EXEMPLAR, a consortium of universities that have agreed to share "best practice" student and business applications written in NATURAL. There was a lot of discussion about CAUCUS, EXEMPLAR and Software AG's commitment to client server computing.

CORPORATE PARTICIPATION

Coordinator: Deborah Stedman

Participating in CAUSE93 were 59 corporations that offer solutions to higher education information technology needs. A list of these corporations appears on the next page, followed by descriptions of some of the products and services they offer, and their participation in this conference. Their offerings at CAUSE93 ranged from corporate presentations, workshops, and exhibits, to sponsorship of special conference activities and hospitality events.

PARTICIPATING CORPORATIONS

CAUSE appreciates the participation of the following corporations in CAUSE93:

American College Testing
American Management Systems, Inc.
Anixter Brothers, Inc.
Apple Computer, Inc.
Applied Business Technologies, Inc.
Applied Collegiate Systems
Boling, Orahood & Associates, Inc.
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ACT

AMERICAN COLLEGE TESTING NOW -- AND FOR THE FUTURE

Timeliness, accuracy, and dependability are critical requirements for any financial aid administration software. At CAUSE '93, ACT featured software that will meet these needs of the institution now and continue to serve in the future.

ACT SOFTWARE WORKS FOR YOU!

PROVEN PERFORMANCE ACT has served the education and financial aid needs of 1 institutions and agencies across the country for more than thirty years. As the largest national provider of need analysis and financial aid management services, we have a complete understanding of the regulations and formulas that control the financial aid process. You can be confident that all our systems are in strict compliance with the latest requirements. Our products are backed by ACT's well-earned reputation for excellence.

INCOMPARABLE EXPERTISE Our software is designed by financial aid administrators for financial aid administration. We understand the challenges institutions face in the delivery of financial aid. That's why our programs are powerful and flexible but still easy to use.

INCREASED STAFF PRODUCTIVITY ACT software helps you accomplish work faster and more efficiently. We form a partnership with you to help you manage your resources.

CUSTOMER SERVICE At ACT, customer support is an organization-wide commitment. You receive professional and competent service from all members of the ACT staff.

COMMITMENT TO INNOVATION ACT has an ongoing commitment to development. Thanks to suggestions from users and staff, our products get better and better every year.

FLEXIBILITY Our financial aid software is designed to meet **your** needs--not someone else's image of your office. And several of ACT's software products can be used together which further enhances their flexibility and functionality. For example, SARA and TelePell--each powerful by themselves--combine to form an even stronger tool. The diskette-generating capability of TelePell also enables form-neutral data entry in AllCalc Tools.

FORM NEUTRAL Our software does not require the use of a specific application form or process. Your institution can use any application procedure without being assessed additional charges.

A TOTAL PACKAGE The same care that we put into our systems development goes into documentation, user manuals, and customer service. With ACT software, you get a total package that works for you.

NO HIDDEN COSTS The license fee covers the whole product. We don't lead you on with extra charges for add-on features, manuals or midyear updates resulting from government changes.

ACT OFFERS SOFTWARE PRODUCTS TO SERVE A WIDE RANGE OF ADMINISTRATION NEEDS

COMPREHENSIVE MANAGEMENT SYSTEMS

The SAFE® System	Mainframe-based financial aid management system
SARA	Microcomputer-based system in single station and networked versions

CALCULATION TOOLS

ReCalc	Mainframe subroutine that provides Federal Methodology, Pell Grant and state grant recalculation capabilities.
AllCalc	Microcomputer-based software that provides Federal Methodology and Pell Grant recalculation capabilities

EDE PARTICIPATION

TelePell	Microcomputer-based software that enables institutions to participate in the Department of Education's Electronic Data Exchange (EDE)

WHEN YOU ADD UP ALL THE BENEFITS, YOU'LL SEE THAT ACT FINANCIAL AID SOFTWARE PRODUCTS REALLY WORK FOR YOU!! FOR MORE INFORMATION CALL OUR STAFF AT 1-800-525-6930

AMS: Improving Productivity Through the Intelligent and Practical Application of Technology

American Management Systems would like to extend our appreciation to *CAUSE93* participants for your continued interest in our products, technologies and services. AMS was pleased to have the opportunity to highlight examples of our current projects and client partnerships. Our demonstrations provided an opportunity for *CAUSE93* participants to discuss the broad scope of AMS offerings and explore the potential for using AMS resources to meet their needs.

Description of Exhibit

In this exhibit we showcased a variety of current projects and partnerships with higher education clients including Indiana University, Columbia University, and Northwestern University. We also demonstrated our Facilities Management System that is being developed in conjunction with Bowling Green State University and Columbia University. In addition to our exhibit, Dr. Fred Forman, Executive Vice President of AMS, conducted a strategic planning seminar for advanced technologies. Mike Titmus, Vice President of AMS, and John Kemper, Senior Principal of AMS, delivered an AMS corporate presentation on Object Technology in the Development of Client/Server Administrative Systems. Below are descriptions of the specific applications on display at our exhibit.

Indiana University: AMS and Indiana University have teamed to develop a Client/Server Financial Management System. The system will be deployed across Indiana University's TCP/IP network. Client workstations will include IBM compatible personal computers running Windows and OS/2, Macintosh personal computers and other devices performing terminal emulation. UNIX servers will be used to manage the distributed databases, and a DB/2 Enterprise Server will be used to synchronize the distributed databases. The system will be one of the key elements in a university-wide initiative to streamline key business processes across all of the various schools and campuses of Indiana University.

Columbia University: In 1991, Columbia University launched a five year program to replace its administrative information system and re-tool its data center for new technologies. Its goals were to: improve information access, improve service to students and faculty, increase efficiency of service delivery, and increase flexibility of external reporting compliance. Columbia chose AMS as its strategic partner. A key initiative was the redesign of student financial aid information processing. One result of this effort is a product, jointly developed by Columbia University, AMS, and IBM, called FA View/LEGEND. FA View/LEGEND improves the management of paper, work flows, and servicing of financial aid applicants through the introduction of document imaging technology.

Northwestern University: Northwestern University implemented AMS' College and University Financial System (CUFS) in 1983 to replace a manual accounting system. In the ten years since the initial CUFS implementation, Northwestern has engaged AMS to develop extensions to CUFS and to do extensive work in the student loan billing and collection areas. As part of a current initiative to distribute data access to departments and better serve their clients, Northwestern has partnered with AMS in a project to provide a Graphical User Interface (GUI) for purchasing and other financial system data. Ultimately, the GUI will be gradually rolled out to 1200 users on both DOS and Mac desktops.

ams® American Management Systems

Facilities Management System (FMS): FMS is being developed in conjunction with a consortium of leading universities including Columbia University and Bowling Green State University. The consortium environment ensures that FMS meets the real life needs of a variety of institutions, not just one institution's particular way of doing business. To build upon the functional and technical insight that can be drawn from actual users of the system, the consortium members contribute the expertise of their facilities and computing staff to tailor FMS capabilities to meet the critical business challenges facing university facilities managers. FMS includes a GUI in a Client/Server architecture comprising RISC-based database servers linked to Windows, OS/2, Unix, and Mac clients using an SQL-based RDBMS.

Feature Presentation

Topic: Object Technology in the Development of Client/Server Administrative Systems

Presenters: Michael Titmus, Vice President
College and University Systems Group, AMS

John Kemper, Senior Principal
Facilities Management Systems, AMS

Abstract: Mr. Titmus and Mr. Kemper discussed AMS' experiences in the application of Object Technology to the development of Client/Server administrative systems for colleges and universities and the difference between Object Technology and conventional approaches. They concentrated on the technology support for iterative development and the implications for the usability and flexibility of the system when delivered. They examined the link between the technical architecture and the strategy for evolution to a full suite of Client/Server administrative systems and the interactions of AMS' Facilities Management System with existing mainframe and other legacy systems in the long and short term.

Object Technology offers significant improvements in software development productivity, maintenance, quality, flexibility, and usability. The development of a large administrative application for higher education was used as a case study to illustrate the differences between Object Technology and traditional software development.

American Management Systems, Inc.

- Founded in 1970
- Serving Colleges and Universities since 1982
- 3600 Employees
- $350 Million in 1993 Revenues
- Management and Technology Consulting Services
- Custom System Development
- 100+ AMS Client Colleges and Universities
- Software Products and Implementation Services

To Learn More, Contact AMS Today

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Business Development Manager
American Management Systems, Inc.
4050 Legato Road
Fairfax, Virginia 22033
(703) 267-8147

Anixter, Inc.
Products for Voice, Video, and Data Transport

Anixter, Inc., is proud to have participated in CAUSE93 in San Diego. This was our first participation in a CAUSE event, and we were pleased to meet the membership.

Anixter, Inc., is a $1.5 billion stocking reseller of **voice, video, and data communications equipment.** We serve educational institutions from 140 locations worldwide. We are your local source for structured wiring, intelligent hubs, routers, fiber optic and twisted pair cable, and video communications equipment.

Our CAUSE93 booth was a busy place.

1) We demonstrated Picasso, **AT&T's still-frame video communications system** that operates over voice telephone lines. The video image can be displayed on a TV screen or on an attached computer's monitor. Users can store the video images in the telephone or on the PC. Both users can mark the image displayed on the screen with a mouse attached to the telephone or the computer.

Picasso is an excellent tool for collaborating researchers who have access only to voice lines, but who need to be able to transmit still NTSC (common TV) video across the campus or overseas. It is also useful for administrators who need to present budgets or architects who need to discuss renderings.

Anixter also supplies products for cable TV style broadband video from **Jerrold** and **Scientific-Atlanta**, premises video for security from **Burle** and **ImproCom**, and compressed digital video for **Distance Learning** and **Video Teleconferencing** from **VTEL**.

2) We showed **Synoptics'** stackable hubs and handed out Anixter/Synoptics "stack the deck" playing cards. Synoptics workgroup hubs can be stacked to provide manageability, security, troubleshooting, and facilities for moves, adds, and changes to academic departments or to small group dorms of up to 50 users.

Anixter is a leading reseller of **intelligent hubs.** We sell and support hubs from **Synoptics, 3Com, Chipcom, IBM, DEC, ACSYS, Farallon,** and **Allied Telesis.** Anixter supplies hubs that can manage networks of thousands of users.

In addition to being hub specialists, Anixter provides **internetworking** capabilities with **router** products from **Wellfleet, DEC, 3Com, Retix,** and **IBM** and with EtherSwitches from **Kalpana.**

3) CAUSE93 attenders learned that Anixter salespeople are physical layer specialists. We talked with many members who want to install cable infrastructure that will support voice, video, and data networking into the 21st century.

Anixter was instrumental in developing the "levels" or "category" scheme for classifying unshielded twisted pair (UTP) cabling. At CAUSE93, we handed out hundreds of copies of the abridged **1994 EIA/TIA 568 Structured Wiring Standard** that helps you **"future-proof" your campus network.**

We also helped members with some network design questions. Anixter network planners and technical support engineers are available across the country to solve schools' networking problems.

4) Finally, we had a lot of fun. We collected business cards and entry forms for a daily drawing for a helicopter phone and a show-end drawing for a personal organizer. And we handed out nearly a thousand Anixter flashlights.

Anixter is your local one-stop source for networking equipment for voice, video, and data. Our specialty is "the nuts and bolts" of networking and video. With Anixter you get the benefit of working with a $1.5 billion global company who happens to be local.

As you saw if you stopped by our booth, Anixter works with a variety of vendors in networking, so we are not locked into a single vendor's solution. The school gets the product that is best for its application.

Anixter keeps over $200 million in inventory positioned around the world so you can generally get the product you need tomorrow.

If you have any questions relative to Anixter's offering to the higher education market, please call your local Anixter office or

Lew Brashares
Anixter, Inc.
4711 Golf Rd.
Skokie, IL 60076

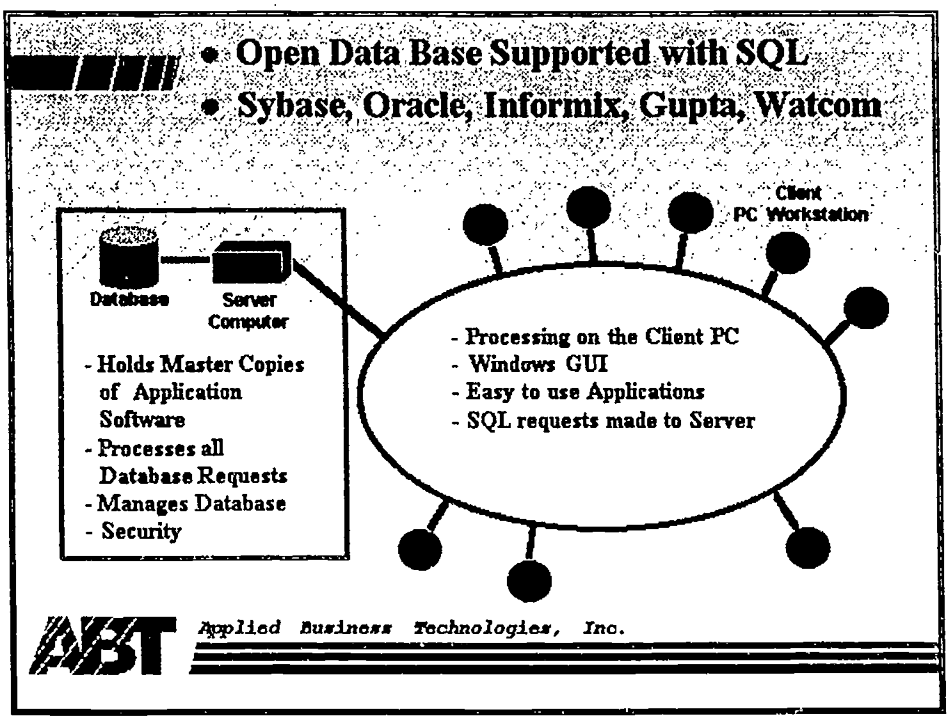
phone: (708)677-2600 x-2401
fax: (708)673-9053
lew_brashares@anixter.com

ABT Campus® *for Windows*

Your Partner in Progress at CAUSE93

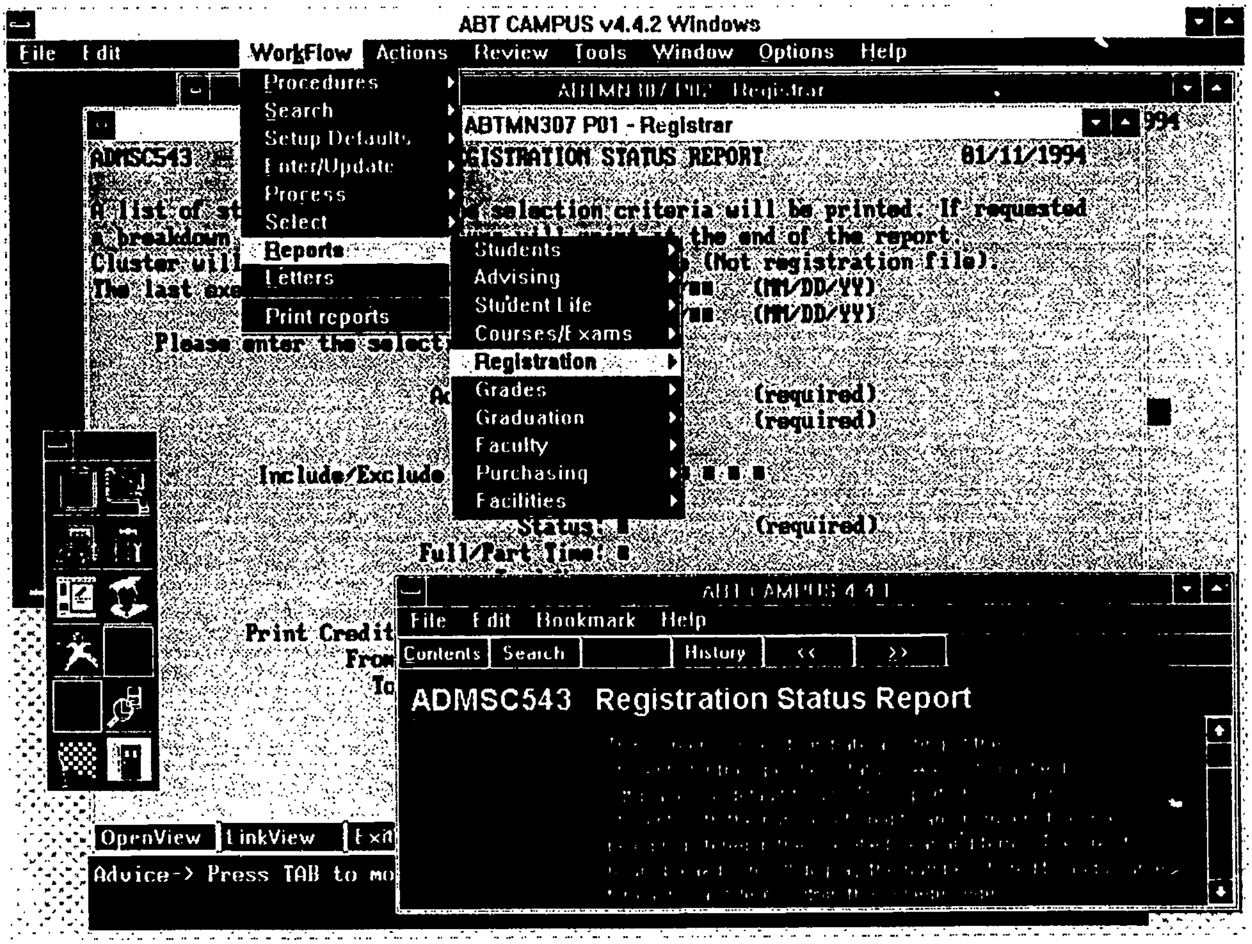
Applied Business Technologies, Inc. (ABT) is a leading provider of administrative information management systems for higher education institutions nationwide. During CAUSE93, ABT featured client/server technology with Microsoft Windows and an open database. This combination provides a myriad of benefits including broad scalability with the best price/performance combination possible today.

At the CAUSE93 conference, ABT showcased the ABT Campus *for Windows* product which offers a very user friendly GUI, and excellent performance due to the client/server environment.



ABT Campus has been operating in a network environment since 1984, and then started to focus on other enhancements of the system. The Microsoft Windows version was delivered in 1992 and has made a tremendous improvement in user effectiveness. The open database was added to ABT Campus *for Windows* in 1993. The attendees at the conference expressed tremendous interest in having the freedom of an open database.

The primary benefits of an Open Database are easy data access via a wide variety of third party tools including report writers, query tools, spreadsheets, and Executive Information Systems (EIS), the freedom to use any report writer, and not being restricted to a proprietary database.



The highlights of the CAUSE93 conference for ABT were:

- The announcement of a new release containing on-line help in full hypertext.
- ABT was the only vendor of administrative management systems able to do full demos on-line at the show on a laptop.
- The hospitality suite was a success with a two hour presentation to major schools in the L.A. area.

The Contest Prize of a cellular mobile phone was awarded to Mr. Ernest G. Marshburn, Manager of Academic Computing, East Carolina University.

BOA

"Making Information Technology Work" at CAUSE93

Boling, Orahood & Associates, Inc. (BOA) is a leading full technical services firm serving higher education with the most modern technologies available to Manage Information Technology in today's changing environment.

BOA, at CAUSE93, shared a 30' display area with Texas Instruments and Encore Computer Corporation. The excitement was high as the three corporations demonstrated how the products and services of each can be combined to accomplish the migration of legacy applications with BOA's use of the "TI" INFORMATION ENGINEERING FACILITY™ I-CASE/EF™ technology and the ENCORE's INFINITY 90™ Series of massively scaleable UNIX™ CPU. The demonstration showed how this combining of available products can be utilized by an experienced integration firm to provide a solid, cost effective solution to today's information technology management challenges. The display also featured several other BOA migration and integration partners such as ZORTEC's System Z™ and TranZform™ products, used to reengineer UNISYS legacy systems, and VISystem's VIS/TP™, used to reengineer legacy CICS™ applications to UNIX™, ORACLE™, as the recommended RDBMS, and AutoTester™, as the perfect testing software to test all mission critical software and hardware throughout the entire re-engineering process.

"BOA Business Affiliate Products and Services Demonstrated at CAUSE93"

Texas Instruments Corporation, Plano, Texas

BOA serves as the higher education consulting firm to "TI", to provide technology transfer of **I-CASE/EF.** BOA also assists "TI" in their efforts to promote **IE/IEF** to the administrative and academic organizations in the higher education and K-12 education markets.

Encore Computer Corporation, Fort Lauderdale, Florida

BOA is **certified** by Encore as a member of their **VALUED INTEGRATION PARTNER (VIP)** for the education and government markets. BOA provides consulting and integrator services to Encore for the **"INFINITY 90 SERIES"** of massively scaleable UNIX computers.

AutoTester, Inc., Dallas, Texas

BOA is the exclusive marketing representative for all **AutoTester** products and services to educational institutions in the United States. **AutoTester** has an **interface to the TI IEF** and is **available in Windows™, DOS,** or **OS/2™** versions. **AutoTester** is the most advanced testing and verification tool available in the "GUI" testing industry.

Oracle Corporation, Redwood Shores, California

In 1992, BOA received Independent **Oracle Consultant's Alliance (IOCA)** status from Oracle. Being admitted to IOCA gives BOA worldwide support and the latest technical information, education and resources needed to provide a full range of Oracle services. BOA can convert your existing DBMS to an Oracle RDBMS. Many of BOA's Oracle professionals are experienced in hard to find skill areas such as, tuning, benchmarking and performance engineering and testing.

Zortec, Inc., Nashville, Tennessee

BOA is an authorized distributor of ZORTEC's popular **TranZform** group of products. These products provide the tools needed to convert existing UNISYS (Cobol and Mapper) and Wang VS applications to UNIX platforms. ZORTEC's popular **SYSTEM Z** is a powerful 4GL tool which operates on many different platforms and is database independent.

VISystems, Inc., Dallas, Texas

BOA is the distributor for all **VIS/TP "CICS COBOL ON UNIX** "products and services for the U.S. and Canada education markets. **VIS/TP** is ported to and currently **available on the IBM RS/6000™, SUN, DEC Ultrix and DEC ALPHA™, Data General AviioN™, HP 9000™, and Motorola hardware platforms** and allows existing IBM proprietary mainframe applications to operate on UNIX platforms in the client/server environment.

THE BOA SERVICES .... "THE POWER OF EXPERIENCE"

More than a phrase, experience is our hallmark. With 70+ Associates, whose backgrounds range from networks to mainframes, consulting to project management, design to implementation, BOA has the knowledge to insure the successful completion of your next systems integration project in:

Conversion, Migration, Re-engineering

BOA uses advanced methods, including the above valued business partners, as well as traditional methods of moving from one type of hardware , operating system, or from one DBMS to another. We can migrate your applications and data from and to virtually any platform and greatly reduce future maintenance efforts.

Telecommunications

Many of today's system integration projects include capabilities of communicating not only in a local area but also over a wide area with voice, data and video. Several BOA Associates are **Registered. Licensed Telecommunications Engineers (RLTE)** and **Certified Network Engineers (CNE)**. We can help you design and implement the most sophisticated of local networks or a wide area network of communications, including worldwide microwave systems.

Programming

We have programming professionals, experienced in nearly all of today's technical environments, with direct experience working with the leading administrative and academic applications systems. We can help you make modifications, perform annual maintenance, or develop new systems to meet your specific needs. We can make this expertise available to you at very reasonable per hour, daily, or long term rates.

For more information about BOA's services for higher education, please call, fax, e-mail or write to:

BOLING, ORAHOOD & ASSOCIATES, INC.
2701 West 15th Street, Suite 508
Plano, TX 75075-7595
Tel: 214-867-6134 Fax: 214-867-0845 Internet: boa@metronet.com

BOA is a trademark of Boling, Orahood & Associates, Inc., INFINITY 90 is a registered trademark of Encore Computer Corporation; Engineering Facility and IEF are registered trademarks of Texas Instruments Incorporated; UNIX is a registered trademark of American Telephone and Telegraph; IBM, OS 2 and Customer Information and Control System(CICS) and RS/6000 are trademarks of International Business Machines Corporation; WINDOWS is a registered trademark of Microsoft Corporation; VIS/TP is a trademark of VISystems Inc.; AutoTester is a registered trademark of Software Recording Corporation of America; DEC Ultrix and DEC Alpha are trademarks of Digital Equipment Corporation; HP9000 is a trademark of Hewlett-Packard Company; Data General AviioN is a trademark of Data General Corporation

BSR

The Advance System

January, 1994

Business Systems Resources (BSR) would like to thank the CAUSE93 staff and participants for the continued interest in our institutional advancement products. During the conference the ADABAS, DB2 and Sybase versions of the **Advance** alumni and development system were featured. Additionally, the new Micro Focus COBOL/Sybase UNIX version of **Advance** was demonstrated on an IBM RS/6000.

BSR also provide demonstrations of its new Executive Information System (EIS). The **Advance** EIS is a client/server Powerbuilder/Sybase based application. Its function is to create a desktop workstation enviornment that can be easily used by senior staff to manage major institutional capital campaigns, annual funds and prospect tracking. Using the Windows GUI, the EIS allows the user to review high level aggregate and summary information and then drill down to the underlying supporting detail using a standard pointing device. The EIS is being installed at both UCLA and the University of Virginia.

BSR was also pleased to participate in an afternoon poster session with Michigan State University. Here BSR discussed how it is participating with the MSU Development Office in a project to offload management reporting from the University mainframe to a client/server network environment.

Business Systems Resources

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310 434 2925

Campus America®

Meets Your Changing Technology Needs

Participating at CAUSE93 with the theme "The POISE Advantage," Campus America highlighted the Digital-Campus America-Ross Systems advantage. As you know, educational technology is hardly static. . . it changes with every new innovation and idea. The way to keep abreast of the latest changes is through Campus America. The Campus-Ross-Digital advantage is designed to meet your changing technology needs.

Campus America ★ Advantage ★ *January 1, 1994* Digital ★ Ross

Demonstrating our triad of products (Administrative, Instructional, and Library Systems) as well as Ross Systems' Financial Series, Campus America enjoyed showing conference attendees new and exciting worlds of opportunity for their institutions. Also featured in Digital's booth was our POISE-CIS (Curriculum Information System) product.

For eight consecutive years, Campus America has appreciated the opportunity to share and discuss software systems with convention attendees. One of Campus America's foremost goals is to continue supporting CAUSE in its efforts to influence the profession of information technology management in higher education.

Campus America's executive office is located in Knoxville, Tennessee. Additional offices are located in Roswell, New Mexico; Merrimack, New Hampshire; Columbus, Ohio; Mobile, Alabama; Lubbock, Texas; and Calgary, Alberta Canada.

900 Hill Avenue, Suite 205, Knoxville, Tennessee 37915-2523 Phone: (615) 523-9506 FAX: (615) 525-5628

CARS
INFORMATION SYSTEMS CORPORATION

CAUSE93

CARS Information Systems Corporation was pleased to attend CAUSE93. Consistent with the conference theme of "Managing Information Technology as a Catalyst of Change," CARS sparked pre-registrants' interest in client/server by asking, "Want to Know What We're Serving Up?"

CARS Practical Path to Client/Server

CARS served up some exciting developments at CAUSE93. CARS introduced its practical path to client/server. Conference attendees and clients enjoyed personal demonstrations in the CARS suite. Simulating the administrative computing environment, the demonstrations were performed on a network using PC workstations, UNIX workstations, and a Novell File Server. CARS showed how users can experience this new technology on three tiers: using the existing CARS System with a graphical interface, expanding their access to a host of PC applications, and utilizing the new client/server applications — according to their comfort level.

Thanks for Checking Us Out!

If you pre-registered for CAUSE, you received two free tickets redeemable for a prize for checking us out at our booth, as well as entry to our daily drawing. We want to thank everyone who stopped by our booth and attended personal demonstrations at our suite.

Solid Technology Today - Your Foundation for the Future

CARS provides quality administrative computing solutions for higher education through open systems technology and strategic alliances. For over 16 years of thoughtful planning, we have created a product grounded in solid technology which is ideally positioned for future developments. Following are the CARS System components:

Integrated System Components

System-Wide Management
- **Database/General Utilities**
- **Communications Management/Tickler**
- **Software Control System**

Student Management
- **Recruiting/Admission**
- **Financial Aid**
- **Financial Aid Packaging**
- **Registrar/Academic Records**
- **Program Auditing/Advising**
- **Student Affairs/Housing**
- **Student Accounts/Billing**

Financial Management
- **General Ledger/Financial Reporting**
- **Financial Budgeting**
- **Fixed Assets**
- **Purchasing/Accounts Payable**
- **Payroll/Personnel**

Alumni Development Management
- **Alumni/Development**
- **Alumni/Student Placement**

Third-Party Interfaces

CARS
INFORMATION SYSTEMS
CORPORATION

Systems: The Difference an Integrated Software System Makes

The CARS System was developed and continues to be enhanced with a singular purpose in mind: to coordinate and facilitate the administrative management of your institution at every level. Built on an SQL Relational Database System, the CARS System includes a comprehensive suite of fully integrated application modules for each area of management, from Admission through Alumni/Development. Equipped with poweful system-wide features, the CARS System enhances the effectiveness of every user.

Services: Our Commitment to Your Success

CARS will assist and support you before, during, and after implementation. From the data entry level to the president's office, it is important to us that all users get the most from the CARS System. Partnership is more than a word at CARS. From the moment implementation begins, you will enter into a working partnership with CARS that addresses your evolving needs. For more information about the CARS System, contact any of the following CARS representatives:

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Regional Sales Manager
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Phone: (513) 563-4542
Fax: (513) 733-8990
E-mail: info@carsinfo.com

Dataguard Recovery Services, Inc.

For the third consecutive year, Dataguard Recovery Services was proud to be a part of the CAUSE national meeting. As a Corporate Sponsor at the conference in San Diego, California, representatives of Dataguard were available to discuss their expertise as a premier supplier of Disaster Recovery and Contingency Planning Services for Higher Education. Dataguard looks forward to continuing and strengthening the much valued relationship with CAUSE and its members.

A NOTE OF THANKS!

You've made us the recognized choice for Contingency Planning in Higher-Education and we'd like to say "Thank You".

- Penn State
- University of Pennsylvania
- University of Connecticut
- Kentucky State University
- Morehead State University
- Northern Kentucky University
- Wayne County Community College
- Rutgers University
- University of Tennessee
- University of Louisville
- Murray State University
- Eastern Kentucky University
- Cuyahoga Community College
- Western Kentucky University

At Dataguard, we maintain our commitment to providing you with a complete range of Contingency Planning Products and Services to meet the needs of your institutions.

PRESENTING . . .

Dataguard's own Charles Kendell, Senior Planning Consultant, presented yet another memorable and insightful discussion. Mr. Kendell's presentation, "Too Many Decisions -- Not Enough Time", addressed the various approaches available to universities today for recovering mission critical applications in the event of a disaster or systems interruption. In addition to leading attendees through a discussion of the multitude of possibilities available (alternate site vs replacements vs leasing vs none), this presentation explored the variables in deciding among the options, their costs, and user impact. Recent planning efforts of some major universities across the country were analyzed.

Mr. Kendell also presented an overview of user-department planning.

Having spoken at both CAUSE91 and CAUSE92, the San Diego conference represented Mr. Kendell's third opportunity to address CAUSE members and their concerns regarding Contingency Planning.

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Having spoken at both CAUSE91 and CAUSE92, the San Diego conference represented Mr. Kendell's third opportunity to address CAUSE members and their concerns regarding Contingency Planning.

"We Can. We Will. We Promise." ...the Datatel theme at CAUSE93.

"We Can. We Will. We Promise." served as an extension of Datatel's CAUSE92 theme **"We Will"** and set the stage for Datatel biggest splash ever at a national show. The Datatel team wanted to communicate a message to CAUSE attendees. A message that was clear and clean. A message that told a story -- a message with a beginning, a middle, and an end. **"We Can"** establishes Datatel's position as a technology player. **"We Will"** reflects Datatel's commitment to the future: To people. To technology. **"We Promise"**, the emotional component, touches the People Behind the Promise (Datatel Employees); Promises Kept (Datatel Clients); and a Promising Future.

At each program juncture, Datatel's campaign of what **"We Can. We Will. We Promise."** to do rang true...from registering CAUSE93 attendees for our charity drawing during our Hospitality Party, to talking with attendees about our software and services offerings, to demonstrating our Executive Information System (EIS) product, to sponsoring our client during Datatel's vendor presentation slot.

Datatel's announcement at CAUSE93 was its Executive Information System (EIS) product. This product was seen running on all four workstations located in the Datatel booth; each workstation featuring one of the four Datatel domains -- Student System, Financial System, Human Resources System, Alumni and Development System.

CAUSE93 is a great networking opportunity for Datatel but it also gives Datatel representatives the opportunity to interact with clients. To this note, Datatel hosted a Client Reception prior to the CAUSE Opening Reception on Tuesday evening. This reception took place in the Datatel suite with approximately forty Datatel clients in attendance.

On Wednesday evening, "Planet Datatel" came to earth - A Planet that promotes Datatel's continued corporate commitment to the environment and community service. The Planet landed for approximately four hours and entertained a few hundred CAUSE93 attendees with food, drink and music. It was at this party that Datatel's president, Russ Griffith, announced Charles F. (Skip) Kirby, Jr., Senior Associate for Planning and Institutional Research, East Carolina University, as the winner of the charity donation drawing. As the winner, Skip Kirby will have a $1,000 Datatel donation made in his name to the National Wildlife Federation, his favorite charity.

Datatel was pleased to sponsor its client, Louise, Lee, Assistant Vice President of Data Services, Barry University, during Datatel's vendor presentation slot. Louise Lee's presentation "Reengineering Admissions Recruiting with Correspondence Control" featured how Barry University, with the use of Datatel's Correspondence Control software, was able to develop the ideal system for their institution. A system with ease-of-use in day to day operations; a system that could easily be modified when expenses needed to be cut; a system that could analyze trends in Barry University's recruiting efforts.

Datatel has been in the computer industry for over 25 years and has provided quality software and services to more than 700 corporate and institutional customers. Datatel expresses appreciation for the relationship it shares with prestigious higher education organizations, such as CAUSE, and looks forward to future success in assisting colleges and universities in their administrative and fund-raising goals.

If you would like more information about Datatel and its software and services offerings to higher education, please contact Dr. Laird Sloan, Director of Marketing and Product Planning, at Datatel's Fairfax, Virginia, office (703) 968-4626.

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digital™

Digital Equipment Corporation's involvement in CAUSE93 explored the CAUSE93 theme of "Managing Information Technology as a Catalyst of Change" in a variety of ways.

Pre-conference seminar

To help institutions identify the right solutions for their particular needs, Digital Consulting Services presented an important pre-conference seminar entitled: Business Process Reengineering: Making Sure the Right Need is Being Met. A large audience enjoyed a thought provoking presentation by Fred Traversi, Director of Business Process Reengineering for Digital.

"Ports of CAUSE"

As has become the custom over the years, Digital again sponsored the CAUSE Welcoming Reception entitled this year "Ports of CAUSE." The ballroom at the Sheraton on Harbor Island was transformed for an evening of exotic cuisine, music, and entertainment. The crowd lingered late into the evening without a trace of the many delicious desserts remaining!

Digital's "Imagination Theatre"

The popcorn was hot and tasty at Digital's Imagination Theatre exhibit booth which showcased the newest Alpha AXP based administrative solutions from Digital, SCT, Campus America, Ross Systems, Universal Algorithms and PeopleSoft. The traditional CAUSE/Digital mug proved again to be a highly requested item!

Digital Consulting Services' education specialists were also available daily to discuss a variety of information solutions and services, including: business management, client/server computing, computer downsizing, application migration, data warehousing, and information access.

Vendor Track Presentation - A Business and Technology Planning Framework for Institutional Renewal

Financial pressures and changing technology create many challenges; they also create confusion and opportunity for costly failures. This presentation, presented by Pat Gillogly, was designed to demystify the jargon while outlining a decision-making framework and action plan for creating computing environments that support real operational improvement.

Imagine the possibilities . . .

ENCORE Infinity 90 SERIES

"Affordable Massively Scalable Technology" at CAUSE 93

Encore Computer Corporation, a worldwide company headquartered in Ft. Lauderdale, Florida, is a leading supplier of open, scalable computer systems for data center and mission critical applications. At CAUSE 93, Encore and Boling, Orahood & Associates, Inc., announced a strategic alliance appointing BOA as an Encore Valued Integration Partner (VIP). The companies team their respective organizations to deliver computing solutions to Higher Education clients.

Encore and BOA shared a large display area at CAUSE 93 to demonstrate and promote the availability of affordable massively scalable technology to solve Higher Education data center needs. Encore and BOA demonstrated how Higher Education clients can benefit from an outstanding price/performance computing solution utilizing Encore's Infinity 90 Series in an open systems, client/server environment, and especially mainframe-scale processing capabilities to maximize institution-wide administrative data processing. In addition, capabilities were presented showing BOA's integration services in legacy migration, re-engineering and CASE tool development of applications, Oracle Parallel Server, UNIX, and cost effective rightsizing of the data center.

The combination of Encore's Infinity 90 Series Enterprise Server and BOA's Integration Services offer Higher Education traditional mainframe users the immediate opportunity to "downcost" through rightsizing, thereby realizing significant savings - of up to 80% - over current traditional mainframe costs.

For more information about Encore's open systems for Higher Education please call, fax or write to:

Enterprise Marketing MS 719
Encore Computer Corporation
6901 W. Sunrise Boulevard
Ft. Lauderdale FL 33313

Tel: 800-726-2230 x 5728
Fax: 305-797-5793

ENCORE COMPUTER CORPORATION 6901 West Sunrise Boulevard, Fort Lauderdale, FL 33313-4499 • (305) 587-2900

IBM

IBM, a corporate sponsor of the CAUSE organization since its inception in 1971, is proud to have participated in the CAUSE93 conference held in San Diego. IBM's participation in CAUSE93 included a booth in the corporate exhibit area, a corporate presentation and a hands-on workshop.

HANDS-ON WORKSHOP

IBM EXPRESS AUTHOR: MULTIMEDIA DEVELOPMENT AND PRESENTATION TOOLS FOR NON-PROGRAMMERS

This hands-on workshop focused on how to develop multimedia presentations and courseware with an easy-to-use set of tools. During the workshop, participants discovered how easily video, audio, graphics, animation and text can be combined into powerful teaching modules and presentations -- in a short amount of time and with minimal effort using IBM's Express Author.

CORPORATE PRESENTATION

INFORMATION PLANNING STUDY: A STRATEGIC PLANNING METHODOLOGY TO FACILITATE CHANGE

Ilee Rhimes, Associate Vice President for Business and Finance, Kent State University
Beth Baxter, Academic Consultant, IBM Academic Consulting and Services

This presentation highlighted the strategic planning methodology that IBM has used for the past 20 years on college and university campuses from an implementation perspective as well as from a campus executive's perspective. Beth Baxter reviewed the Information Planning Study, the strategic planning methodology that has been used for both academic and administrative planning projects at numerous colleges and universities. Ilee Rhimes described his experiences with this methodology at Kent State University and identified the benefits received from the methodology.

CORPORATE EXHIBIT

The exhibits in the IBM booth highlighted the latest technology available from IBM for universities and colleges as well as some of the outstanding solutions available from our business partners to address the everyday tasks on college campuses.

- **COMPUTING ON THE GO**
  The ThinkPad 750C is a slim, high-performance desktop and portable notebook computer featuring audio that is suitable for both in the office and on the road. The ThinkPad 750C features everything from wireless communications to multimedia with built-in audio.

- **CHARTING THE RIGHT DIRECTION**
  IBM ACADEMIC CONSULTING AND SERVICES
  IBM academic consultants offer assistance to your institution in managing the challenges and opportunities created by new demographics, technology and thinking. Academic consultants can assist your institution in the following areas:
  - Strategic Planning
  - Institutional Effectiveness
  - Fundraising and Partnerships
  - Instructional Effectiveness
  - Campus Infrastructure
  - Libraries and Information Access
  - Campus Administration

- **EVERYTHING IN ITS PLACE**
  UNIVERSAL ALGORITHMS, INC.
  SCHEDULE25 from Universal Algorithms is a fully automatic, bulk optimizer for college and university classroom scheduling. It allows institutions to reduce their scheduling time from weeks to minutes. 25E is an on-line, multi-user, events scheduling program with a sophisticated security system through which the privileges of each user can be precisely tailored. MODEL25 provides a uniquely powerful environment for projecting space requirements for renovations, enrollment changes, consolidations and expansions

- **JOIN THE TEAM**
  COMPUTER MANAGEMENT AND DEVELOPMENT SERVICES, INC.
  The TEAMS2000 software package is a comprehensive, easy-to-use relational database system designed specifically to meet the needs of colleges and universities. The TEAMS2000 system includes: admissions, registration, development/alumni, advising/degree audit, financial aid, purchasing, accounts payable, accounts receivable, payroll, general ledger and fixed assets. Decision support tools provide a graphical interface to the on-line student historical data that can be used for institutional research or preparing customer reports.

- **THE POWER OF PARTNERSHIP**
  A product of the historic alliance of IBM, Motorola Inc. and Apple Inc., the PowerPC microprocessor is the basis for a range of new desktop workstations and servers from IBM. PowerPC technology allows users to cost effectively address a whole new range of capabilities, from high-function graphics to multimedia, on the same desktop computer they use for their everyday computing tasks.

- **TAKE THE EXPRESS**
  IBM ACADEMIC CONSULTING AND SERVICES
  Using an express multimedia authoring tool, faculty can create effective courseware quickly, easily and, best of all, with no computer programming. Rather than preparing lectures and handouts in the traditional fashion, educators can evoke the same amount of time to creating a customized multimedia curriculum that appeals to the visual learning style of today's generation of students.

IMRS

The Leader In Providing Enterprise-Level Software for Complete Financial Management Solutions

IMRS Corporate Headquarters
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Stamford, CT 06902
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fax: (203) 321-3893

IMRS was proud to be a participant in the 1993 CAUSE Annual Conference in San Diego. Featured at the IMRS exhibit was *Hyperion*, the leading financial information management package for Microsoft Windows running in a client/server environment. When combined with *IMRS OnTrack*, a Windows-based Visual Information Access product, IMRS software solutions provide fast, accurate management of large volumes of financial data on PC-LANs. IMRS products are used at over 1,200 corporations and institutions worldwide, including Clemson University, the University of Minnesota, Indiana University, the University of Florida School of Medicine, and the Tacoma School District.

IMRS develops enterprise-level financial management applications for client/server environments. Headquartered in Stamford, Conn., IMRS software addresses the diverse accounting, financial consolidation, management reporting, budgeting, planning, and information access needs of large organizations worldwide. Founded in 1981, the company designs products specifically for network implementation, providing fast, multi-user access to centrally controlled and secure data. The IMRS organization represents the best talent in the industry. Involved in the development, implementation and support of thousands of systems, our financial and technical specialists are uniquely qualified to resolve the complex financial management challenges of today's large organizations.

Our Products
Hyperion, one of the company's key products - installed at major organizations since 1991 - is a financial information management application using Microsoft Windows. Other products include *Micro Control*, the most widely used enterprise financial reporting solution; *Fastar*, for spreadsheet-based financial reporting; *FinalForm*, for controlled data collection; and *IMRS OnTrack*, a Visual Information Access software product. *Hyperion Financials*, a line of integrated accounting management software for client/server environments, and *IMRS Forms*, a Windows-based data collection product, will round out our family of complete financial software solutions.

(continued)

IMRS - The Leader In Providing Enterprise-Level Software for Complete Financial Management Solutions

Technology, Worldwide Service and Support
Value lies in taking the best that technology can offer and applying it to real business needs. Our strong competitive edge comes from a comprehensive understanding of the technology advances that shape our industry. IMRS solutions are open, adhere to standards, and provide upward compatibility from one generation of technology to the next. Through Microsoft Windows, high performance time-series databases, high speed data access capabilities, and appropriate integration of leading technologies such as client/server architecture and SQL databases, IMRS is applying innovative solutions to the need for timely and accurate information management. Our comprehensive program of quality service and support is designed to ensure customer satisfaction at every level. We work closely with clients to develop and enhance information solutions that will maximize their success in the 90s and beyond. It is our total package of software, design services, training, implementation and support that makes a difference in today's competitive marketplace.

FOR MORE INFORMATION, CONTACT:
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Downsizing and Network Computing

JANET PERRY
MANAGER, HIGHER ED PROGRAMS
NOVELL, INC.

Today institutions of all sizes face tremendous pressures: they need to become more efficient, more productive, and to do all this with less money. Many universities are looking to downsizing as a way to save money and resources while improving the level of support provided to users. For most campuses, mainframes are becoming a thing of the past as the main source of computing power. But switching to a multi-platform, protocol-independent, and networked environment can lead to many problems. These pressures are coming together to form computing environments which are more complex, wide-ranging and robust than the networks of today. As IT professionals, the challenge is to improve productivity while giving the central computing organizations more control. We call this idea "boundless computing", where users are able to use the information and resources they need, as they need it. Boundless computing also provides centralized IT with the resources and control it needs to insure the security and validity of the data made available to those users.

Novell's three business lines have the breadth to provide solutions in this brave new world. NetWare, UnixWare, and AppWare combined have both flexibility and integration which will use resources well today and build for the future. Novell's goals are to go beyond connectivity to build an information infrastructure that combines the technologies of the past, present, and future to run your campus.

In this environment, NetWare acts as a foundation for computing, becoming the main interface for end users within the computing environment. Integration of NetWare with legacy systems, like IBM mainframes, and new application environments, like UnixWare or Oracle, will provide consistent access to information for the end user. Support of industry standards, like TCP/IP, and multiple desktops will allow centralized manageability of these resources, down to the desktop. NetWare sits at the core of a universal infrastructure which will allow you to use your legacy systems today while you build applications for the future.

Most major organizations planning downsizing projects look to Unix as the platform for these efforts. Unix has many benefits for use in application development, by working with the broadest range of computers and applications, and because networking is built in. The close connection between UnixWare and NetWare will allow Unix to become an equal citizen on workgroup LANs and create a strong environment for UnixWare as an application server. UnixWare combines the application services of Unix with the strengths in networking and user access of NetWare to create a robust platform for downsized applications that work across existing infrastructures. But we still need to go beyond this to create a consistent application infrastructure. Rapid development and deployment of applications will be the key to transferring computing power into the power to transform our organizations and improve our lives. But how can we create those applications?

Today application development is a time-consuming craft. This makes it difficult for IT staffs to be responsive to changing business needs and to provide the kind of support programming which makes campus faculty and staff more productive. Changes must be made to this environment. AppWare, Novell's application development system, provides a shield from the complexity of program development while delivering the value of network computing. Applications developed with AppWare will be able to take advantage of different client OSes, GUIs, and network services without additional hand-finishing on the part of the programming staff.

AppWare is made up of three components: AppWare Foundation, AppWare Bus, and AppWare Loadable Modules (ALM). AppWare Foundation provides a cross-platform development environment which can be used in traditional programming environments as well as within AppWare. It uses standard APIs to create applications independent of client OS and GUI, network services, and development tools. AppWare Bus allows the programmer to use a visual model of building applications; in effect, the flowchart becomes the program. It provides an overall structure in which pre-written components (yours or others) are plugged together to make a working application. These components are called ALMs and can range from simple read/write calls to complex support of network services like security, messaging or directories. These applications are compiled for different platforms using the AppWare Foundation and run independently of the AppWare environment.

Using a combination of NetWare, UnixWare, and AppWare it is possible to build an information infrastructure which will support the goals of campuses while providing both flexibility and manageability. The effect of this kind of boundless computing will be to: improve user efficiency, minimize the cost of ownership of hardware, maximize our investment in computing, leverage our programming staff, allow for freedom of choice, and provide a flexible infrastructure that is able to respond to change.

For more information about Novell products, please contact Novell at 1-800-NETWARE. For more information about Novell's education programs, please contact Ms. Perry at 510-975-4480 or through email at janetp@novell.com.

ORACLE®

ORACLE AT CAUSE'93

Oracle Corporation's participation in CAUSE'93 focused on demonstration and discussion of Oracle technology and services for higher education and centered around Oracle's CASE Templates and Oracle Industries' focus on higher education.

Oracle CASE Templates for Higher Education

As was discussed with CAUSE'93 attendees, CASE templates represent a preferred alternative to traditional "build" or "buy" choices for large institutions with complex and changing administrative systems needs. A "CASE Template" is a system which has been built using Computer-Aided Software Engineering (CASE) tools and methods and re-used. Oracle CASE Templates contain:

1. A high-level enterprise model containing data entities and process dependencies

2. A detailed business-level model with function hierarchies and business rules

3. Application source code which provides a fully-working prototype of the system

An institution can re-use any or all of the template; installing and running the system "as is" or customizing the system model and then re-generating the necessary source code. Because templates are built using CASE tools and reside within an automated tool, they allow full customization of the system model rather than just the application source code.

When CAUSE'93 participants visited the Oracle booth in the Corporate Exhibit Area, they had an opportunity to view a demonstration of how Oracle CASE tools have been used to design and develop student system applications. They viewed a demonstration of application functionality for marketing and recruiting, admissions, financial aid, registration, student accounts receivable, and student records.

As the application templates were demonstrated, Oracle representatives point out some clear advantages of the CASE template approach over traditional "build" or "buy" alternatives. For example:

- Templates serve as an excellent starting point for confirming or initiating Business Process Re-Engineering (BPR) efforts within your institution.

- Templates allow end-users to "see..touch..and feel" a working system almost immediately after template installation.

- Templates offer more flexibility, easier customization, and better long-term maintainability because they are based on automated tools. These automated CASE tools allow both end-users and system builders to concentrate more on business process improvements and less on technical details.

- Templates can stimulate and support increased end-user involvement in Business Process Re-Engineering, system customization, and installation. They also encourage faster delivery of results and help maintain momentum of your BPR efforts.

Many CAUSE'93 participants who viewed the demonstrations said that they see significant strategic value in the Oracle CASE Template approach because it provides higher education institutions with a long-term foundation for linking continuous quality improvements and BPR activities, with ongoing improvements in underlying administrative information systems.

Oracle Industries' Higher Education

A key question asked by CAUSE'93 visitors to the Oracle exhibit area was: "What type of commitment is Oracle making to the higher education community?"

Oracle is already building a major commitment to the higher education community and has recently created a separate Higher Education Group within "Oracle Industries". Oracle Industries is a new organization within Oracle which combines industry-specific expertise with Oracle's data base and multi-media server, development tools, and applications technology.

Another way in which Oracle Industries, as a whole, strengthens this commitment is by providing colleges and universities with a broad range of technology services focused on specific higher education needs. These include Business Process Re-Engineering; Enterprise Architecture Planning; Client/Server Migration Strategies: CASE Training and Support; Capacity Planning; Technology Performance Tuning; and IT Management Consulting and Strategic Planning, to name only a few.

As many CAUSE'93 participants learned during the recent conference, Oracle Corporation is fully committed to meeting the unique requirements of the higher education community. Our conference discussions and demonstrations--including other private conversations with numerous institutions--stressed the message that Oracle is focusing the power of its outstanding technology and services on developing solutions for the academic, administrative, and research challenges faced by colleges and universities during the decade of the 1990's and into the 21st century.

Oracle's participation in CAUSE'93 provided an opportunity to talk with technology leaders in the higher education community and share with them Oracle's vision and enthusiasm for the future. Oracle looks forward to continuing that sharing process throughout the next twelve months and to again demonstrating our commitment to higher education at CAUSE'94.

ORACLE

P.S.S. TAPESTRY

P.S.S TAPESTRY, Inc. was pleased to have participated in CAUSE93 and to have had the opportunity to meet with so many of the attendees at our booth. The conference was particularly exciting for us, as it coincided with the initial release of TAPESTRY, our new integrated information library system based on advanced technology, as noted in the CAUSE Daily Bulletin. As a business partner of Software AG of North America, we also had the pleasure of meeting several of you at the reception held by Software AG.

Attendees were given live demonstrations of this exciting new technology, including looks at the online public access catalog, with its powerful search capabilities, and the powerful bibliographic and authority control system. Our library experts were available to answer questions and provide information on several topics and TAPESTRY facilities.

We also shared information with attendees on other technologies that form the foundation of mission-critical applications around the world. This included our enterprise office and information solution, which provides end user query and reporting facilities, text retrieval, document management, e-mail communication, and resource management.

Information was provided on the unique underlying technology of TAPESTRY, which makes the system a portable, flexible, expandable, and highly functional one. TAPESTRY is a universally portable system that has the ability to reside on the mainframe or other platforms such as UNIX. As those that attended the demonstrations in our booth learned, this allows sites to adapt to new requirements without sacrificing investments in legacy systems, or evolve to new platforms without the expense of retooling or retraining. TAPESTRY has been designed to meet the information needs of today, as well as the ones you envision tomorrow.

TAPESTRY is composed of five highly integrated modules:

- **Online Public Access Catalog**

  A robust, menu-driven system for direct access and keyword searching of bibliographic records.

- Bibliographic/Authority Control

A cataloging system providing for the creation, eriting, and maintenance of bibliographic and authority records.

- Circulation

A sophisticated, table-driven system for controlling and reporting on the circulation of library materials.

- Serials Control

An online system for the management and reporting of serials information.

- Acquisitions

A system for the pre-order searching, creation, and updating of order records, fund accounting, invoice generation, and report generation.

P.S.S. TAPESTRY and CAUSE

P.S.S. TAPESTRY firmly believes in the ideas and work that CAUSE pursues. We believe TAPESTRY can play a major role in helping colleges and universities maximize their use of information technology and computing. We are commited to being an active member of CAUSE and advancing its goals.

We are excited by the enthusiastic response from so many attendees of CAUSE and the new relationships we formed. We look forward to continuing to support and enhance the information technology needs of CAUSE and its members for years to come.

P.S.S. TAPESTRY, Inc.
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Warrendale, PA 15086
(800) 835-7863

PINNACLE

PINNACLE SOFTWARE CORPORATION

CAUSE93 ANNUAL CONFERENCE
San Diego, California

Pinnacle Software Corporation specializes in the development and service of administrative and telecommunications software solutions for higher education. Pinnacle, located in Rochester, NY, is currently servicing over 60 higher education customers.

A representative sample list of Pinnacle customers includes:

* Tufts University,
* University of North Carolina at Chapel Hill,
* University of Colorado,
* Lehigh University,
* California Polytechnic State University, and
* several State University of New York (SUNY) campuses.

The services provided to these universities include software installation and support, product telephone consultation, defect resolution, consulting, enhancements, and federal regulation updates to the software.

The Pinnacle Booth

If you stopped by Pinnacle's Booth at this year's conference, you most likely had the opportunity to demonstrate your skills with the yo-yo, while Pinnacle demonstrated its AXIS Telecommunication Management System, PC70 Report Writer, and PC Financial Query. Below is a brief summary of each product.

AXIS Telemanagement System

Pinnacle's AXIS product enables universities to control telephone costs by efficiently managing their wire and cable plants. As a result of providing long distance service to students, universities are able to increase revenues and student services. This comprehensive system allows a university to turn their telecommunications department into a profit center.

AXIS is a GUI-designed, client/server product that utilizes the power and flexibility of SQL-based RDBMS networked to Windows and Macintosh clients. The telecommunications management system may be implemented in two separate modules. The first module is our Telephone Manager System which is comprised of toll rating, discounting, billing, accounts receivable, and traffic analysis. Our second module is our Facilities Manager System, which is a wire and cable-tracking system, that includes cable entry, cable availability inquiry and work order, and trouble ticket processing. They can be implemented separately or together. Together, the two systems integrate to provide you with complete access to all of your telecommunications information needs.

PC70 Report Writer

PC70 Report Writer, a Windows-based financial reporting product for SCT FAS/FRS Users, avoids mainframe constraints and allows for annotations customized to fit a user's unique needs.

PC Financial Query

Introduced at last year's SCT FAS/FRS Users Conference, PC Financial Query extracts financial data from the IA-Plus and IA-IDMS database allowing users to view it on their own PC. Adhoc reporting is easy and efficient!

Focus on CAUSE93

Quodata®

Quodata was pleased to participate in CAUSE93 in San Diego. CAUSE members stopped by to discuss Quodata's new Alpha server project, networking, PC Connection, and new Windows Look software.

□ The Company

Quodata was founded twenty-two years ago to provide the finest computer software and service to educational institutions. The company **focuses on smaller to medium-size members of the higher education community** with an array of administrative software systems which gives users greater flexibility.

Quodata joined with Digital Equipment Corporation in 1971 to provide administrators with the benefit of Quodata's expertise in software and service, plus Digital's leadership in technology. Quodata was Digital's first Systems Cooperative Marketing Program (SCMP) member for administrative systems in education.

□ The Software

Today Quodata can demonstrate an array of integrated **flexible, functional software** products running on a relational platform. This architecture includes not only a relational database, but also a structure in which extensive changes can be made to an application system without modifying the source programs. Quodata's software family of integrated products includes:

- admissions and recruitment
- billing and accounts receivable
- financial aid
- financial reporting
- institutional advancement
- payroll and personnel
- student information and degree audit

These products are all built with the same flexibility and integrated database structures. Changes to a wide variety of control files, collectively called libraries, make these systems extremely versatile. Users are free to change table values; add table elements, files, new logical views, or even entire databases; create or modify menus, video screens, reports, and command procedures; and even create new relationships between existing or new databases.

One very important benefit of this structure is that a new version of the software does not override changes to the existing version. Generally only a minor effort is necessary to add enhancements to the tailored libraries. No other software handles updates as easily as Quodata's new relational software architecture; **it is designed for change.**

Quodata's software architecture adheres to Digital's Networked Application Support (NAS) software standards, and will shortly be available on Alpha, which Digital exhibited at CAUSE93. Quodata believes that no one software company can fill all the administrative needs in higher education, and a standard platform simplifies access to other products and personal workstations. Quodata's software functions well within a distributed network, multi-platform environment.

□ The Services

Even the best software is of little value without the right support. **Providing excellent service is our highest priority**. Proof of its quality is the 96 percent software service contract renewal rate for Quodata clients over this past year. The most important commitment is to hiring capable, service-oriented people with experience in educational institutions.

Most clients move from an existing computer system to the Quodata system. Sometimes there are features users have or want which are not part of the standard system. The flexibility of Quodata software means that making these modifications is unusually easy, *without programming*. However, someone must analyze the situation, determine the best way to effect the change, and modify the parameters in question. Many clients have capable computer staffs, but not enough time. Quodata offers such users additional implementation options. Essentially, Quodata personnel will perform many of the tasks necessary to get the institution up and running.

□ The Users Group

A great deal can be learned by sharing information with peers at meetings like CAUSE93. Quodata actively supports and encourages its users groups. An annual conference is held each Fall. Sharing is further promoted regionally and through newsletters.

If you are interested in learning more about Quodata's products and services, please call our toll-free number, or write to:

Quodata Corporation
Marketing
One Union Place
Hartford, Connecticut 06013
Tel: (800) 654-4357
Fax: (203) 247-0249

Quodata®

Ross Systems Participation at CAUSE93

ROSS SYSTEMS
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(415) 593-2500
Fax (415) 592-9364

Ross Systems, Inc. is proud of our participation in CAUSE93, and we thank CAUSE for the opportunity to work with a dynamic organization which serves our higher education clients so well. In this spirit, we were happy to **sponsor a refreshment break** during the conference.

As a provider of financial and human resource software solutions to higher education, Ross Systems works extensively through partners who provide the computer hardware and complementary software solutions for student information systems. This strategy was key to our participation at CAUSE93 where we presented our technology and application solutions in three exhibits of our partners' exhibit booths.

We demonstrated our Gembase fourth-generation language and tool set as one of the solution stations in the **Digital Equipment exhibit.** Gembase allows rapid system prototyping and development of applications that can then be run on any hardware / operating system / relational database management system that is supported by Gembase. The product features an expanded active data dictionary coupled to a complete suite of developer utilities and end-user tools. This allows a consistent, sophisticated approach to application development.

The Gembase developer aids demonstrated include code generator / editor for WYSIWYG editing of application screens, an advanced debugging tool and metadata audit trails. Particularly interesting are both table editing and query-by-form utilities. These tools make learning the Gembase development process very quickly, producing high levels of developer productivity in a relatively short time frame.

We presented our newest financial applications in the **Hewlett Packard exhibit** area. Ross developed these systems, collectively called the Ross Renaissance C/S (Client/Server) Series, entirely with Gembase. This provides unprecedented flexibility and adaptability for the user organization. We are currently delivering full-featured fund accounting, general ledger, accounts payable, purchasing, inventory, fixed assets, and accounts receivable / billing with this technology. Ross also offers human resources and payroll solutions in a client/server environment which will be redeveloped in Gembase later.

Finally, we participated in the **Campus America exhibit**, where we discussed the Ross Financial and Human Resource solutions as part of a newly announced POISE Advantage Series which will be jointly marketed by Ross and Campus America. POISE Advantage Financials consist of the Ross Renaissance C/S Series coupled to the Campus America Student, Curriculum Development and Library offerings. Campus America has also begun redevelopment of their POISE Student Administration products using Gembase as the development environment. These new systems, which have not been formally announced, will provide even tighter integration between the POISE Student and Financial Administration systems.

For more information on Ross Systems, contact Tim Orwick, Strategic Accounts Manager, Ross Systems, Inc., at the address above, voice mail at 800-531-ROSS x2522 or via internet: TIMOR@spock.rossinc.com.

software interfaces

The theme for CAUSE93, **"Managing Information Technology as a Catalyst for Change,"** was especially relevant for Software Interfaces, as Software Interfaces provides tools that can help members of higher education implement their strategic visions today. Software Interfaces strives to provide the fastest, easiest, and most powerful campus-wide tools for relational database management systems (RDBMSs).

SQLASSIST

At CAUSE93, Software Interfaces featured its flagship product, SQLASSIST, in both its popular character-based version and in the Microsoft Windows graphical user interface (GUI). As an administrative tool, SQLASSIST is used to query databases, create management quality reports, and to convert data to other popular formats.

Querying

With SQLASSIST, queries can be run on an ad hoc basis or with predefined templates, which can include runtime variables. Queries can also be run in both interactive and batch mode for the most effective usage of IS resources.

In querying, SQLASSIST's drop down menus shield novice end-users from having to know the SQL query language as well as complex database design. For the expert database administrator, SQLASSIST still provides the full functionality of SQL. An advanced artificial intelligence rules facility, the Auto-Join, Auto-Path, and other facilities optimize queries, joins, and paths. A query advisor checks on the semantics and syntactics of SQL statements. These facilities help increase productivity and enhance system resource usage, for example, by protecting against run away queries.

Additionally, SQLASSIST runs directly against the database engine so that there is no system performance loss. There is also no need to set up or maintain separate data dictionaries. In addition to writing correct, efficient, and complex SQL queries, SQLASSIST can also read previously written SQL statements. These powerful features are helping save an enormous amount of time for system administrators.

Critical to campus-wide access are issues concerning data security. Although SQLASSIST provides powerful and easy data access, it is a read-only tool, so valuable data cannot be corrupted by users. Additionally, administrators can implement security on sensitive data with database, table, and column restrictions. Many other customization features are available, for example, the ability to create meaningful column and table names.

Report Writing

In its report writing mode, SQLASSIST offers columnar, matrix, and summary reporting. In a report, users can create new columns, use if-then-else statements, and place expressions anywhere in the report including page headers and footers. Allowing an unlimited number of breaks, SQLASSIST is great for census data reporting. At one demonstration, an administrator exclaimed, "In the last five minutes, you produced a report that I've been trying to build for a month. This is great!"

Other facilities include column text wrap or span options, support for numerous numeric formats, printing a query with a report, and sharing of reports. Transposing rows into columns is accomplished simply by choosing menu options. Postscript printing, charting, and graphing facilities are also provided.

Conversion

Research departments within educational institutions especially appreciate SQLASSIST's ability to convert query data, in a single bidirectional step, into statistical applications such as The SAS System and RS/1. Conversion is also available to Lotus 1-2-3, EXCEL, WordPerfect mail merge, Word, dBASE, delimited, and other formats. SQLASSIST also supports the widely-used Banner system.

Open Systems Design

Databases currently supported include DB2, INFORMIX, INGRES, ORACLE, SYBASE, and Rdb/VMS, as well as support for EDA/SQL and ODBC protocol. Platforms and operating systems supported include VAX/VMS, DEC/ULTRIX, HP, PC, RS6000, and SUN. SQLASSIST is designed for today's open systems; it is multiGUI, multiRDBMS, multiplatform/operating system, and multinetwork. This enables system administrators to leverage both their past and future technological investments.

Solutions for Higher Education

Software Interfaces works with universities to satisfy the diverse ad query and report writing requirements with integrated client-server solutions. Evidence of its success with higher education can be seen in the company's customer base, which includes most of the World 1000 companies. Of this customer base, ten percent are universities and research institutions.

Discounts are available for educational institutions. On-line demonstrations and 30-day customer satisfaction trials are available and encouraged. For more information, please contact:

Software Interfaces
1400 Broadfield, Suite 600
Houston, Texas 77084
Phone: 713-492-0707
Fax: 713-492-0725

CAUSE93:
Sterling Setting for SCT's 25th

There was real cause for celebration at CAUSE93, as SCT commemorated its 25th Anniversary in service to higher education. At the new SCT booth, prospects and clients were invited to view the Company's spectrum of information solutions for colleges and universities. Featured products included:

o The BANNER Series of administrative software; BANNERQuest™, the natural language query system which interfaces to BANNER; and BANNER 2, highlighting a new graphical user interface.

o The IA-Plus™ Series of administrative software for IBM or DEC VAX mainframes and for IBM users with the DB2 relational database, as well as Visage:IA™, its graphical user interface.

o EDI.Smart, a data interchange product for transcript management and delivery.

o The OnSite services computing management alternative.

The SCT booth also featured state-of-the-art,"touch-screen" kiosks from The George Washington University and from Alamo Community College -- interactive units which allow students to view "bulletin board" or other messages, as well as their transcript and financial aid data.

SCT's presence was further enhanced by SCT Chairman and CEO **Mike Emmi's** presentation, *Into the 21st Century: Journey on the Information Highway.* And, for the 12th consecutive year, SCT sponsored the CAUSE/EFFECT "Contributor of the Year" Award, presented to the author of the article judged to be the best of all papers published in *CAUSE/EFFECT* magazine during the prior year. In addition, the Company sponsored its second CAUSE ELITE Award, recognizing an outstanding individual from the higher education community for Exemplary Leadership and Information Technology Excellence.

SCT also assumed its annual role as sponsor of the CAUSE93 golf tournament. In the spirit of camaraderie, the Company thanked CAUSE and the higher education community for their business and fellowship by hosting a 25th Anniversary party featuring champagne, a six-foot anniversary cake, and assorted desserts. SCT presented special silver-dollar anniversary keychains to its clients and associates. A highlight of both the SCT exhibit and hospitality suite was Giovanni the Magician!

The Robinson Group Ltd.
Information Access is Our Business

The Robinson Group, Ltd. (TRG) was pleased to participate as a corporate member of CAUSE at the 1993 Conference. TRG's Southwestern booth was particularly busy with CAUSE members entering their business cards in the Kiosk Holiday Wrap-Up drawing. Considering that the prize was a 1994 IBM Touch Activity Center kiosk, we were not surprised to find so many conference attendees interested in participating. While we wished we could have given away a kiosk to every entrant, a member from the CAUSE board drew one lucky name -- Stu Warford, Executive Director of Information Resources from Pepperdine University. Congratulations Stu!

President John G. Robinson and other TRG representatives also welcomed many CAUSE members who were interested in learning additional information regarding TRG's products. John commented that many attendees expressed specific interest in *Intouch*, TRG's Campus Information System, and *Intone*: TRG's Voice Response Solutions. *Intouch* allows students and visitors to access information and conduct business transactions from networked touch-screen kiosks and PC's. *Intone* solutions, accessible from touchtone telephones, include voice registration, credit card payment, grade reporting, and financial aid status. *Intouch* and *Intone* can reside on the same powerful RISC System/6000 server.

TRG also participated in a Track Presentation. TRG's Dr. Judith W. Leslie, Senior Vice President joined Sinclair Community College's Dr. Kathryn Neff, Artificial Intelligence Specialist, to present *Providing Students and Visitors with Kiosk-based Campus Information Systems,*. The session illustrated how Sinclair Community College of Dayton, Ohio, expanded the level of service provided to students in a manner that also enabled its advisors and staff to increase productivity. Sinclair's project began in the summer of 1990, with research and development of an expert system, the "On-Line Advisor." The purpose of the system is to supplement counseling resources by providing students with a convenient alternative for obtaining answers to routine questions. In December 1992, Sinclair formed a partnership with TRG to merge Sinclair's expert systems with TRG's campus information system, *Intouch*. The presentation included a demonstration of Sinclair's system, a video featuring a test of students using the system, and a discussion of issues related to kiosk-based systems.

TRG representatives look forward to working with the CAUSE staff and its members in 1994. We look forward to CAUSE'94.

2929 N Central Avenue Phoenix, Arizona 85012 USA Fax: 1 602 217.2552 Telephone 1 602 217.2570

Summary of CAUSE93 Conference Evaluation

376 Evaluation Forms turned in

1. Rate the following CAUSE93 activities in terms of their value to you:

	Very Valuable	Somewhat Valuable	Not Valuable	No Opinion	Did Not Attend or Use
General Sessions	46	79	9	1	1
Welles	64	179	100	2	11
Young	69	155	81	6	36
Mescon	129	64	4	6	55
Current Issues Forum	103	108	16	6	56
Track Sessions	224	127	2	0	3
Current Issues Sessions	89	111	3	11	96
Constituent Groups	102	82	3	9	125
Special Interest Groups	53	78	6	24	124
Campus Perspectives	49	83	2	18	139
Special Sessions	73	109	2	15	95
Poster Sessions	105	147	22	5	60
Corporate hospitality	95	164	14	10	61
Corporate presentations	108	154	8	4	68
Corporate demonstrations	147	169	5	3	26

Other:

Peer contacts - 8 said Very Valuable
Pre-conference seminar - 2 said Very Valuable; 1 said Not Valuable
Breakfasts - 1 said Very Valuable
Business Meeting - 1 said Not Valuable

2. What made you decide to attend CAUSE93? Please indicate how important these factors were to you.

	Very Important	Somewhat Important	Not Important
Program content	279	63	0
Conference location	81	158	109
Peer recommendation	137	113	80
Identification with CAUSE	150	136	50
Networking with colleagues	273	79	5
Corporate demonstrations	89	195	54
Professional development	289	66	3

Other:

Session participation - 5
Committee or Board member - 3
Pre-conference seminars - 2
Previous conferences - 2
Management Institute - 2
Supervisor's recommendation
Keep abreast of technology
Recruiting
Reviewed it for a journal

3. Do you think anything you learned at CAUSE93 might have an effect on the way you do things at your institution? Yes - 281 No - 7 Not Sure - 1

If yes, please explain:

General:
New ideas - 15*
" perspectives and approaches - 11
" insights and trends - 7
" technologies - 7
Gained input from other institutions - 16
Discussion with peers - 14
Reinforced that we are on the right track - 10
Information on vendor products - 10
Inspiration, motivation - 9
Will better market IT to campus - 7
Interchange with vendors - 7

Specific:
Information on client/server environment - 38
Strategic planning - 19
TQM - 12
Networking - 10
Team building - 8
Reengineering - 6
Reorganizational efforts - 6
CWIS - 4
Distance learning - 4
Staff training - 4
Collaboration - 4
Library information - 4
Kiosk implementation - 4
BPR - 3
Data warehouse - 2
Downsizing/rightsizing - 2
Electronic forms processing - 2
Will pursue Gartner Group consulting - 2
Object technology
Multimedia networks
Increased efforts to coordinate academic & administrative efforts
reevaluating dorm connections
Info acquired very helpful for market research & market development (corporate member)
Metrics
Implementing SIS systems
Data Management
Internet tools
Demonstration at CREN
Tools to make it easier for data information "providers"
Degree audit
Emergence of standards in network infrastructure
Smart card
Implementing virtual university
Security

*indicates the number of times the comment was made

4. What topics/speakers would you like to hear at future conferences?

Topics:
Client/Server - 19
Networking - 10
TQM - 9
Distance Learning - 7
More case studies of successful and unsuccessful projects - 7
User Support - 6
Reengineering - 6
Voice, video, data transmission and use - 5
Dealing with change - 4
Management and leadership - 4
Additional library sessions - 4
Image processing/technology - 4
Software development - 4
Motivating staff - 3
Multimedia applications - 3
Planning - 3
Object oriented programming and architecture - 3
Partnerships between faculty and administration - 3
BPR - 3
Training issues - 3
More of the same - 2
Grant seeking skills - 2
More small college presentations - 2
More innovative use of technology - 2
Ethical issues - 2
Data warehouse - 2
Disaster recovery - 2
Customer service - 2
Communication skills - 2
Internet and Gopher resources and services - 2
Integration of technology into strategies to meet our missions
Partnerships with vendors
Intellectual models of institutional data needs
Cost recovery
Metrics
ICCD certification
EIS
Negotiation skill building
Understanding and identifying the culture of the institution
PC based administrative software solutions
How to effect change from middle management level
Classroom design for computing use
More effective use of IT in teaching
Merger of library and computer services
Integration of different technologies
Downsizing/right sizing
Data administration
Evaluation of IT
Strategies for "true" vendor compliance with standards

Speakers:
Futures oriented speakers - 11
Continue Gartner Group presentations - 3
Speakers similar to the present ones - 4
Management leaders - 2

Secretary of Education and key legislator
Speakers like Mescon
University presidents or other institutional leaders
More directors & sr analysts who do the work. Fewer VPs & executives who just plan the work.
General speakers who are on the cutting edge
Speakers who are developing prototype systems using newer technology
A non white, non middle-aged male as keynote speaker
Presidents who promote IT on their campuses and how they do it

Peter Drucker (for real) - 4	John Zachman	Kapot
Peter Senge - 2	Bill Smith	Reingold
Jennifer James - 2	Robert Fritz	Gates
Steven Covey	Welles	Jim Young
Tom West	Patricia Fripp	Perlman
Eddy Cheng	Brian Hawkins	CNI representative
Molly Broad	Kurzweil	Al Gore
Gideon Gartner	Bill Barry	Bob Heterick
Steve Jobs	Wozniak	Carole Barone

5. Are there any corporations that you would like to see participate in future conferences?

No - 8
Keep it as is - 3
Full text indexing software
Third party database tool vendors
Facilities centered product developers
Process modeling tools vendors
Vendors of PC databases
Departmental accounting software
A Malcolm Baldrige winner
Multimedia software vendors
Consulting groups do a "what to ask and not to ask a consultant to do for you"
More in overall plant operation and management
More from overseas
Communication providers

Microsoft - 16	Sybase - 9	Computer Assoc - 8	Sun Micro - 7
Word Perfect - 6	AT&T - 4	Lotus - 3	Uniface - 2
Novell - 2	Power Builder - 2	GUPTA - 2	Neuron Data - 2
CompuServe - 2	Hewlett Packard - 2	Image vendors - 2	Ingres - 2
SAS - 2	Storage Technology	Unix	Candle Corp
Apple	Powersoft	IBM	DEC
Merit	Datacard	Hitachi	NACUBO
Unisys	Datatel	Gateway	CBI
SPSS	UMI	OCLC	IAS
Keyfile	XVT	Shana Corp	Zenith
Cisco	Informed Decisions	Omnis	

6. Do you have any comments about the site of CAUSE93?

Excellent - 41	Great - 88	Nice - 20	Poor - 2

Crowding was a problem - 54
Towers were too far apart for meetings - 24
Overflow crowds handled very well - 6
Wonderful food - 6
Good shuttle service - 4
Accommodations not worth high prices - 4
A bit too isolated - 4
Too isolated - 3
Terrible food - 1

Go to convention center
How about a ski resort?
Parking fees annoying
Too near airport
Good to be near airport
Meeting rooms sometimes too cold or too hot
Pricey

7. How useful did you find the CAUSE93 daily newsletter?

Very useful - 128 Somewhat useful - 42 Not very useful - 22 Didn't read - 8
Excellent for program changes - 19 (please highlight program changes - 2)

Any suggestions?

Summaries of keynote speakers are expecially useful - 8
Liked the shorter size - 5
Less rehash or what happened yesterday; more previews - 4
Liked the larger ones (with more info) of past years - 2
Include more pieces on or interviews of attendees - 2
More summaries of sessions - 2
Add update of additional registrants
Deliver it to the hotel rooms each morning
Put it on seats in morning session
Viewed it as a Xerox promo, but looked at them
More news
Probably could be replaced by an electronic bulletin board
Excellent printing and formating
Surely there was more happening than the newsletter would indicate

8. How useful did you find the CAUSEnet e-mail messaging system?

Very useful - 45 OK - 1 Not very useful - 3 Didn't use - 8

How did you use it?
- To send e-mail to conferees - 216
- To communicate with my organization via the internet - 203
- To find conference information and updates - 63
- Other - 4
  - To register
  - To meet people I only knew by name
  - Read home email
  - Unsuccessfully attempted to locate unused meal tickets

What features would you like to see added?

More stations - 41
Internet clients: Eudora, Gopher, Mosaic - 6
Ability to delete messages read - 4
Great as is - 3
Less slow time on the Internet (telnet) - 2
"Help" was not easy to find - 2
Ability to mail something back home - 2
Printing facility (could be pay as you use) - 2
Ability to order paper from Proceedings at conference - 2
Ability to find conferees by first name as well as last - 2
Add an area for people who need more time (Internet access) - 2
Direct access to CAUSE ID services

Liked the photograph capability
Q & A Service
Electronic bulletin board
Would have been nice to have a few units in West Tower
Option to redo photo
Ability to send attachments (word documents)
Spell check
Mechanism to get unused meal tickets
Continue connections for powerbooks
Would like to tap it with my laptop to organize my conference schedule, etc.
Paper messages are much more accessible
Sign up for SIGs

9. What CHANGES would you like to see in future conferences?

Nothing - 11
Alleviate crowding - 15
Larger rooms - 8 Advance signup - 3 Limit conference size - 2
Better anticipation of room size - 2
Longer track sessions - 12
via more days - 6 via fewer general sessions - 3 via fewer track sessions - 1
Better keynote speakers - 6 (no vendors for keynoters - 2)
Too many parallel sessions - 6 (add another day - 3)
More opportunities and sessions for small colleges - 5
Vendor exhibit area should be open longer - 4
Too much food with too much sugar - 3
Institution/corporation name larger on name tags - 3
Change date - too close to EDUCOM and Thanksgiving
Send program out week before - 2
Online abstracts helpful but not organized by day/time and not all were available
Reschedule so staying over Saturday night more convenient
Another video screen needed in front so people in middle can see screen - 2
Evening socials are too noisy - 2
Greater emphasis on papers where people have actually delivered product or service - 2
More tracks - 2
Better audio-video - 2
Bulletin board to exchange unused meal tickets - 2
Make sure presentations match descriptions - 2
Go back to "tear out" schedule in program that fits in pockets - 2
Add some free time - 2
More poster sessions - 5 (Have poster sessions available both days - 1)
Markers or color coding on badges for first timers - 2 (one from a first timer)
Have papers available at conference time - 2
Don't let conference get much bigger - 2
Better presenters (topics are good, presenters are poor) - 2
Activities for spouses - 2
More large areas to sit and chat - 2
Make presentations 1/2 hour to leave 15 minutes for Q & A
Allow speakers to practice in room they will be speaking in
Repeat some sessions
Optional activities for early registrants
Should not atempt to cover everything for everyone
More corporate presentations (but no sales pitches)
Continue to provide reasonable housing
Tours of local institutions
Banquet speaker was all "insider" jokes
Maps of session rooms and vendor demos
Include K-12 education and administration

Totes should have outside pockets (a minor point!)
More sessions on technology training
Don't spend money on totes every year–they are silly with vendor logos
More intellectual content
Listening devices tied to amplification system for general sessions
More emphasis on overlap between academic and administrative computing
Meetings in one hotel
A good opening panel session that sets the tone of the conference
Speakers all talk about incremental change/where are the radicals and revolutionaries?
Apple kiosks might have provided conference and session evaluation forms
What about standards and use of such?
A bit more about technology: its relevance, its future
Less on client/server and downsizing
Some kind of liaison with NACUBO especially in area of Business Process Reengineering
More discussion of hot issues
Group thematic topics
A handful of large, spacious hospitality suites better than dozens of tiny rooms
Please find ways to keep the personal touch if we keep growing
Ask Xerox to print extras when handouts run out
Less social hours
Lunch presentations should be during meal (not after when people leave)
Final banquet should be a buffet
Buffet lunches
Box lunches

10. "I would like to say ..."

Excellent - 11 Great job- 24 Very well organized, good program - 27
Thanks - 38 Congratulations to CAUSE staff and all that made it happen - 14
General sessions not up to standards of previous conferences - 9
This year's track sessions were a disappointment - 7
Helpful for new ideas and specific information - 5
Audio needs improvement - 5
Good food - 4
Good shuttle service - 4
"Insider" humor at banquet was not good - 4
Poster sessions should be continued and promoted - 4
Breakfast for newcomers is a waste of time - 3
Not enough time to attend everything - 3
Publish standards for slides and overheads - 3
Serve bagels (something without sugar) as well as donuts at breakfasts - 3
Thanks for Mescon - 2
Institution name should be larger on nametags - 2
Great hotel - 2
Help newcomers more - 2
Networking opportunity invaluable - 2
I'll be back - 2
Helpful to have this in January
This date too close to Christmas
Too crowded
Excellent adjustment to increase in crowd
What are you going to do when attendance hits 2500? Look at EDUCOM!
Growth in attendance has really changed the atmosphere. I miss the old CAUSE.
Are we getting big enough for two conferences a year?
You treat 1700 people with care and respect.
Most presenters ran out of handouts.
Corporate exhibits should be open longer.
Have some spouse activity.

CAUSE continues to address a very important area in higher ed.
On site registration was first class.
Good keynote addresses
Closing panel session was outstanding (as usual).
Something other than coffee to drink at morning breaks
Pervasive attitude at CAUSE and EDUCOM is that teaching is something that machines can do as well or better than people.
I feel fortunate for having benefitted by activities of this organization.
I like the long breaks between sessions.
Vendor demos not as good as in the past
Your still photo of John Chaney in an Afro was not in good taste. Was insulted and will not attend future conferences.
More for small colleges
CAUSE continues to be the most useful and rewarding conference on my calendar.
Receptions do not have to be noisy and crowded.
Attendance at CAUSE is always a perspective stretching experience.
Why did same university win awards both days?
Most disappointing CAUSE in years, but I'll try again.
You're not getting older, you're getting better.

MANAGING INFORMATION TECHNOLOGY AS A CATALYST OF CHANGE

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- ☐ TAPE 14 TRACK V-WIRELESS COMMUNICATIONS—COME IN, DICK TRACY! - Frank H.P. Pearce
- ☐ TAPE 15 TRACK VI-ELECTRONIC PAPER FLOW: DEALING WITH THE REALITIES - Eloy Areu, Barbara Hope, Jeffrey K. Lemich, Jennifer McDermott & Timothy Munn
- ☐ TAPE 16 APPLE COMPUTER, INC. - Lani Spund
- ☐ TAPE 17 A PRACTICAL IMPLEMENTATION OF A FLEXIBLE INFRASTRUCTURE FOR INTEGRATING TECHNOLOGIES IN A CAMPUS ENVIRONMENT - SynOptics Communications, Inc.
- ☐ TAPE 18 EDUCOM'S TEACHING & LEARNING INITIATIVE - William Graves & Carol Twigg
- ☐ TAPE 19 TRACK II-USER-DRIVEN TRAINING—A STRATEGY FOR SUPPORT - Ken Pecka
- ☐ TAPE 20 TRACK III-IMPLEMENTING A NEW SYSTEM ON TIME IN BAD TIMES - Elaine David
- ☐ TAPE 21 TRACK IV-PROJECT SOLAR: HARVARD'S CLIENT/SERVER BASED FUNDRAISING MANAGEMENT SYSTEM - James Conway & Philip Gow
- ☐ TAPE 22 TRACK V-IMPLEMENTATION OF A VOICE, VIDEO & DATA BACKBONE NETWORK - Bruce Longo & Barbara Robinson
- ☐ TAPE 23 TRACK VI-NETWORKED DELIVERY OF MULTIMEDIA INFORMATION - Robert Brentrup
- ☐ TAPE 24 UNIX & NETWARE AS PARTNERS FOR RIGHTSIZING - Novell, Inc.
- ☐ TAPE 25 INTO THE 21ST CENTURY—JOURNEY ON THE INFORMATION HIGHWAY - Systems & Computer Technology (SCT)
- ☐ TAPE 26 CHIEF INFORMATION OFFICERS: THE SMALL COLLEGE PERSPECTIVE - Martin Ringle, Karen Leach, Les Lloyd & Thomas F. Moberg
- ☐ TAPE 27 HOW ONE ASSOCIATION IS COPING WITH CHANGE - James Cross & Patricia Searles
- ☐ TAPE 28 TRACK I-WHY UNIVERSITIES & COLLEGES DO NOT TAKE FULL ADVANTAGE OF THEIR INFORMATION SYSTEMS - Bethany M. Baxter
- ☐ TAPE 29 TRACK II-THE END-USER'S DESKTOP: "NEW CENTER OF THE COMPUTING UNIVERSE" - James H. Porter
- ☐ TAPE 30 TRACK III-QUALITY SOFTWARE ... BUT BY WHOSE DEFINITION? THE END-USER IS KING?! - Louise Marie Schulden
- ☐ TAPE 31 TRACK IV-TALKING TURKEY ABOUT "REAL" CHANGE - Carole Cotton
- ☐ TAPE 32 TRACK V-SOME COLLEGE/UNIVERSITY ROLES IN THE TRANSITION TO AN INFORMATION AGE SOCIETY - Charles R. Blunt
- ☐ TAPE 33 TRACK VI-LESSONS FROM THE BERKELEY MUSEUM INFORMATICS PROJECT - Barbara H. Morgan
- ☐ TAPE 34 AN ALTERNATIVE FOR CAMPUS-WIDE DOCUMENT DISTRIBUTION - Farallon Computing
- ☐ TAPE 36 THE CAUSE INSTITUTIONAL DATABASE (ID) SERVICE: THE SOURCE FOR INFORMATION - Michael Zastrocky
- ☐ TAPE 37 OUTSOURCING: A VIABLE BUSINESS ALTERNATIVE - A. Jerome York
- ☐ TAPE 38 REVOLUTIONARY THINKING - Jim Young
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