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ABSTRACT

This volume presents the proceedings of the Professional Association for the Management of Information Technology in Higher Education (CAUSE). Following an introduction and acknowledgements, a first section details the general session presentations which covered a gamut of issues from the future of information technology in the global village, to the history of economics and the transformation of higher education in the information age. The next section presents summaries of many of the professional sessions including "Ask the Expert" sessions, Current Issues discussion groups, Constituent Group meetings, Round Table meetings and Poster Sessions. The balance of the publication presents abstracts of presentations from the conference grouped in eight tracks which addressed the following topics: (1) "Strategic Planning and Management"; (2) "Managing and Leveraging the Technology Investment"; (3) "Organizing for Information Technology"; (4) "Managerial Support through Policies and Standards"; (5) "Integrating Telecommunications and Networking"; (6) "Managing Information Technology for Academics"; (7) "New Technologies and Applications Management"; and (8) "Management Challenges for Distributed Service." Also included are a listing of corporate participants and description of their activity as well as pictorial highlights and a conference evaluation summary. (JB)

CAUSE

Twenty Years of Managing Change: Visions of the Future

Proceedings of the 1991 CAUSE National Conference

December 3--6
The Disneyland Hotel
Anaheim, California

CAUSE twenty years 1971-1991 OF MANAGING CHANGE

Twenty Years of Managing Change:
Visions of the Future

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CAUSE

CAUSE, the Professional Association for the Management of 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 National Office opened in Boulder, Colorado, with a professional staff to serve the membership. Today the association serves more than 2,650 member representatives from over 900 campuses representing nearly 700 colleges and universities, and 49 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 systems descriptions 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 monograph and professional papers series;
- workshops, seminars, and institutes; and
- the CAUSE National 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.

Twenty Years of Managing Change: Visions of the Future

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INTRODUCTION

1991 marked the twentieth anniversary of CAUSE, the association for the management of information in higher education. Thus, *Twenty Years of Change: Visions of the Future*—the CAUSE91 theme—emphasized the significant role this professional organization has played in colleges and universities for the past two decades, and will continue to play as this decade unfolds into a new century. Accordingly, concurrent track presentations highlighted such subjects as change, transformation, organizational culture, quality, client/servers, TQM, measurement, values and ethics. imaging electronic forms, a paradigm shift, networked resources, and reorganization—all pertinent topics and issues of today and the future.

A record 146 concurrent track proposals were submitted this year, from which the 48 presentations were selected. Twenty corporate presentations were delivered at CAUSE91, along with corporate workshops, round table discussions, Ask the Expert sessions, and, for the first time, Poster Sessions.

We're grateful to a number of corporate sponsors for making possible some very high quality communications, entertainment, and educational components of CAUSE91. Communications Central, the daily conference newsletter, the conference messaging system, a new service providing long distance telephone calls, the golf tournament, a fun run, a special twentieth anniversary booklet, a *Best of* CAUSE/EFFECT publication, refreshment breaks, hospitality suites, and the demonstration area—all were made possible by corporate sponsors. The facilities of the Disneyland Hotel, the services of the hotel staff, and the support provided by Conferon's conference consultants were outstanding.

The CAUSE91 Program Committee, Current Issues Committee, and the National Office were joined this year by a 20-Year Anniversary Ad Hoc Committee in planning the conference and twenty-year anniversary celebration. Sixteen pre-conference seminars, including nine co-sponsored by EDUCOM, were offered on Tuesday. The Registration Reception sponsored by Digital Equipment Corporation was a "CAUSE 20th Anniversary Fair" with carnival booths and visits from Mickey, Minnie, and Goofy. "More Bells and Whistles," a complex data-driven computerized animation with an original music score greeted attendees on Wednesday morning. James S. Rosser, president of California State University/Los Angeles, provided the welcome to CAUSE91, followed by F.G. "Buck" Rodgers' opening keynote address, "Riding the Winds of Change." Brian L. Hawkins, vice president of computing and information services at Brown University received the second annual CAUSE *ELITE* Award, sponsored by Information Associates. Thursday morning, the first CAUSE Board President, Mike Roberts, presented a multimedia anniversary perspective, "CAUSE in 2011: Helping to Realize the Global Village." Grey Freeman, program director of IT management at the Gartner Group and Jerry York, associate vice president of information services and technology at the University of Medicine and Dentistry of New Jersey, received the 1991 *CAUSE/EFFECT* Contributor of the Year Award, sponsored by Systems and Computer Technology Corporation. IBM sponsored the Anniversary Banquet, "Yesterday and Today," which concluded with a lively concert by the rock group Three Dog Night. Dr. Gene Stanaland gave the Friday keynote address, "The Current Economy: How We Got Here, Where We are Going," which proved to be educational and very humorous. Higher education CEOs Stephen Mitchell, Robert C. Shirley, and Barbara S. Uehling participated in the Current Issues Forum, giving their perspectives on "Transforming Higher Education in the Information Age." The customary closing social provided a fitting conclusion to the conference and anniversary recognition.

These proceedings offer an opportunity for the 1,271 attendees and those who were unable to come to Anaheim to take an in-depth look at the excellent conference presentations. Also, note that recordings of the presentations are available on cassette tape (see order form on last page of the *Proceedings*). CAUSE91 and the 20th Anniversary Celebration were very special for me and, as the conference evaluations indicate, for many CAUSE members and guests. If you are not already a member, join us as we look to continued leadership, service, and truly excellent conferences from CAUSE in the exciting and challenging years ahead.

James Penrod
CAUSE91 Chair

ACKNOWLEDGMENTS

The success of the CAUSE National Conference is due to the contributions of many people and supporting organizations, several of whom deserve special attention:

▲ The CAUSE91 Program Committee

This committee, under the leadership of chair James I. Penrod and vice chair Corinne V. Fields, dedicated countless hours to produce an outstanding program at CAUSE91. CAUSE gratefully acknowledges their enthusiasm, time, and efforts, and the generous support of their institutions.

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James I. Penrod
California State/Los Angeles

Conference Vice Chair

Corinne V. Fields
Rice University

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▲ 1991 CAUSE Board of Directors

Left to right, front row: Vice Chair A. Jerome York, University of Medicine and Dentistry of New Jersey; Chair Carole Barone, University of California/Davis; Secretary/Treasurer Kenneth C. Blythe, Pennsylvania State University. Second row: Joanne R. Euster, Rutgers University; Arthur J. Krumrey, Loyola University of Chicago; Diane J. Kent, University of British Columbia. Third row: Leslie Maltz, Stevens Institute of Technology; ex officio past Chair, Robert C. Heterick, Jr., Virginia Tech; CAUSE President Jane N. Ryland; Ronald Bleed, Maricopa Community College. Fourth row: Lee R. Alley, Arizona State University.

The generous contributions of time, insight, and creative energy of the CAUSE Board of Directors are gratefully acknowledged and appreciated.

Retiring from the CAUSE Board during this conference were: past Board chair Robert C. Heterick of Virginia Tech, Arthur J. Krumrey of Loyola University of Chicago, and A. Jerome York of the University of Medicine and Dentistry of New Jersey. Carole Barone of the University of California at Davis, whose term ended in 1991, will remain on the Board for another year in an *ex officio* capacity as immediate past chair.

1991 Board Chair Carole Barone presents out-going past chair Robert Heterick with a Mickey Mouse "wizard" to recognize the unique quality of his leadership of CAUSE.

1992 Board Chair Ron Bleed presents 1991 Chair Carole Barone with a monogrammed briefcase as he assumes office during the CAUSE Annual Business Meeting.

▲ CAUSE Member Committees

Neither the conference nor the other association activities could continue without the contributions of the seven creative and active CAUSE Member Committees. In 1991 two *ad hoc* committees developed activities to mark the 20th anniversary of the association. CAUSE appreciates the time and energy contributed by the volunteers who carry out the duties of these committees.

The many people who supported the association in 1991 through participation on association committees were acknowledged during various occassions throughout CAUSE91. Plaques containing certificates of appreciation were given to the following retiring committee members:

'Best of *CAUSE/EFFECT*' Ad Hoc Committee

Robert R. Blackmun, University of North Carolina/Charlotte
Sandra Dennhardt, Northwestern University
Patricia S. Ernest, University of Montevallo
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William Mack Usher, Oklahoma State University

▲ Corporate Contributions

CAUSE thanks all those corporations who set up exhibits, gave corporate presentations, and provided evenings of hospitality. Their contributions add an enormously valuable dimension to the conference experience. Special thanks go to

Apple Computer, Inc. for co-sponsorship of the daily conference newspaper, *Currents*, sponsorship of the conference information and messaging system, speaker support, providing hardware which makes these projects and on-site conference nametag production possible, and for contributions to CAUSE Communications Central.

California State University System for support of CAUSENet links to e-mail and the Internet, assistance with the video magnification of general sessions, and the videotaping of Mike Roberts' general session presentation.

Digital Equipment Corporation for sponsorship of the CAUSE91 Fun Run and for sponsorship of the registration reception, "CAUSE 20th Anniversary Fair."

Education Communications Consortia, Inc. (ECCI) for providing conferees with telephones with free long-distance access.

Hewlett-Packard Company for contributions to CAUSE Communications Central.

Hitachi Data Systems for providing pencils for registration packets.

IBM Corporation for sponsorship of the CAUSE91 anniversary banquet, "Yesterday and Today," for production and publication of the CAUSE 20th anniversary commemorative booklet, development of a CAUSE 20th anniversary video, multimedia support for Mike Roberts' general session presentation, speaker support, and for contributions to CAUSE Communications Central.

Information Associates for sponsorship of the CAUSE Exemplary Leadership and Information Technology Excellence *(ELITE)* Award.

Pacific Bell for co-sponsorship of CAUSENet T1 line.

Periphonics for providing tablets for registration packets.

Spalding Corporation for providing a sleeve of golf balls for each participant in the golf tournament.

Systems and Computer Technology Corporation for sponsorship of the CAUSE91 golf tournament, sponsorship of the *CAUSE/EFFECT* Contributor of the Year Award program, and sponsorship of the publication of *The Best of CAUSE/EFFECT*.

Xerox Corporation for co-sponsorship of the daily conference newspaper, *Currents*, and for contributions to CAUSE Communications Central.

GENERAL SESSIONS

CAUSE91 general session presentations covered a gamut of issues, from the future of information technology to the history of economics.

On Wednesday morning, former IBM Vice President F. G. "Buck" Rodgers offered conferees management ideas for keeping up with the inevitable changes the 90s will bring.

On Thursday, EDUCOM vice president Mike Roberts presented his vision of possibilities for the future of information technology in a networked "global village."

Economist Gene Stanaland on Friday gave humorous and trenchant overviews of U.S. economic theory and suggested some approaches higher education may have to adopt to survive and thrive.

Friday's closing session, the Current Issues Forum, brought together three campus CEOs who discussed "Transforming Higher Education in the Information Age." Stephen Mitchell, president of St. Philip's College, Robert Shirley, president of the University of Southern Colorado, and Barbara Uehling, chancellor of the University of California/Santa Barbara participated.

Other sessions included a luncheon presentation of the *ELITE* Award on Wednesday, the *CAUSE/EFFECT* Contributor of the Year award ceremony at Thursday's luncheon, and the annual business meeting on Friday morning.

WEDNESDAY MORNING KEYNOTE ADDRESS

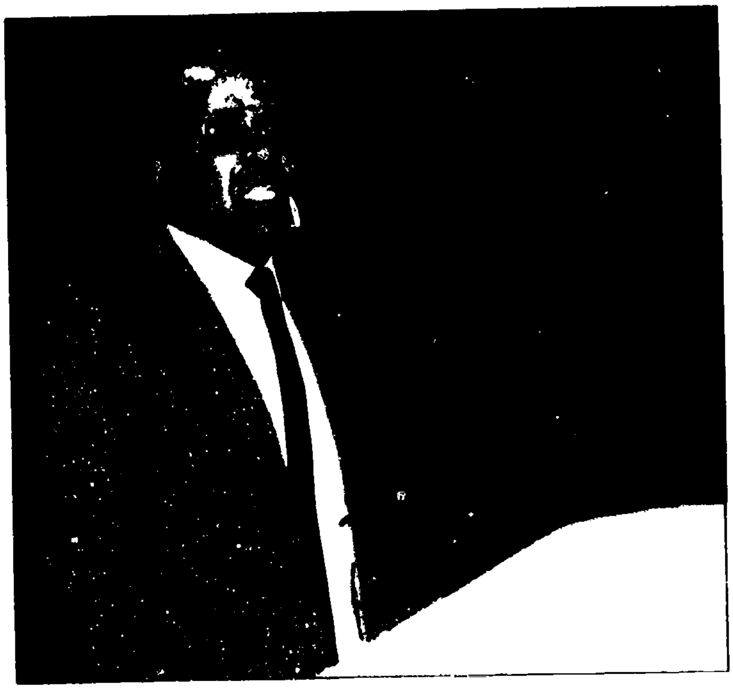
"Riding the Wind of Change"

F. G. Rodgers

Author, Lecturer, Retired IBM Vice President

In his Wednesday morning general session address, F. G. "Buck" Rodgers shot dozens of one-line management tips at his audience of 1,000 conferees. The popular writer/lecturer, who spent his last ten years at IBM as vice president of worldwide marketing, focused on the importance of managers keeping up with an ever-evolving field in a talk entitled "Riding the Winds of Change."

Referring to the conference theme, "Twenty Years of Managing Change: Visions of the Future," Rodgers suggested that in formulating our visions, we must consider change, which is the only constant in today's changing world. He described some of the changes he sees coming in the 90s and the ways they will affect us, such as the increasing importance of quality of life over jobs that promise only high pay. Some of his management shots included "Keep a positive attitude: it's contagious," "There is no substitute for good human relations," and "Never change your guiding principles."



California State University/Los Angeles President James Rosser welcomed conferees to California and CAUSE91 during the opening activities of the general session.

ELITE AWARD LUNCHEON

Brian Hawkins, vice president of computing and information services at Brown University was awarded the second annual CAUSE *ELITE* Award for Exemplary Leadership and Information Technology Excellence at a Wednesday luncheon.

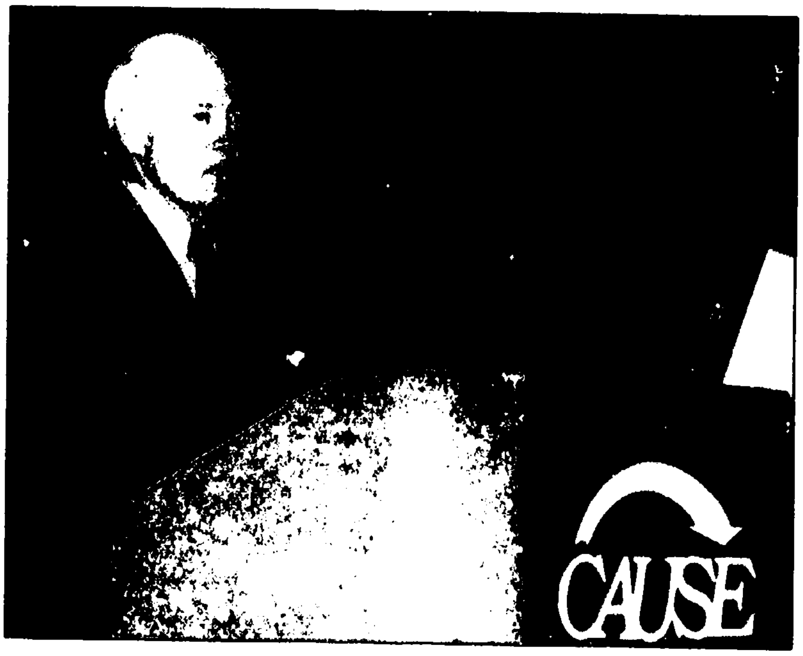
The ceremony included a video presentation that featured an overview of the profession, the concept behind the award, and comments from Hawkins' colleagues. In his acceptance remarks, Hawkins demonstrated the wide-ranging scope of his interests and his committment to a cooperative spirit within the IT field and between IT and other areas of higher education and society.

Pictured are 1991 CAUSE Board Chair Carole Barone, Elliott Haugen, Brian Hawkins, and John Geraci, president of award sponsor Information Associates.

THURSDAY GENERAL SESSION

"CAUSE in 2011: Helping to Realize the Global Village"

Michael M. Roberts
Vice President
EDUCOM
First CAUSE President



In Thursday morning's general session, Mike Roberts—EDUCOM's vice president the first president of CAUSE—offered conferees a compelling vision of possibilities for the future of information technology in a networked "global village." His presentation interwove his observations from years of involvement with higher education, government, and network issues with dramatic multimedia illustrations of the potential of technology.

He depicted education as part of a true partnership with government and business. The overwhelming success of NSFNet was the first fruit of such a coalition, he said, and recent passage of legislation authorizing development of a National Research and Education Network (NREN) was in large part the result of the effectiveness of the alliance.

A historical video which preceded Roberts' presentation was developed in honor of the CAUSE 20th anniversary celebration. The video—a collage of comments of current and past CAUSE leaders and film clips of technology through the years—gave the audience graphic evidence of how far this profession has moved in 20 years.

THURSDAY LUNCHEON

The winners of the 1991 *CAUSE/EFFECT* Contributor of the Year Award—Jerry York and Grey Freeman—were introduced at a Thursday luncheon. In addition, a special anniversary booklet, *The Best of* CAUSE/EFFECT, was distributed to conferees at the luncheon. The 50-page publication includes reviews and excerpts from over 150 of the more than 450 articles that have appeared in the magazine since its inception in 1978. Mark Olsen, co-chair of the ad hoc Best of *CAUSE/EFFECT* Committee, made a surprise presentation from committee members to Julia Rudy, editor of *CAUSE/EFFECT*, for being "truly the best of *CAUSE/EFFECT*."

CAUSE/EFFECT Contributor of the Year

Jerry York, associate vice president of information services and technology at the University of Medicine and Dentistry of New Jersey, and Grey Freeman, program director of information technology management at the Gartner Group, penned the winning *CAUSE/EFFECT* article for 1991, "Client/Server Architecture Promises Radical Changes." It focuses on the latest approach to delivering computer applications. Client/server architecture has emerged in response to the proliferation of microcomputers and LANs, and will have far-reaching implications throughout higher education and the private sector. The article appeared in the Spring 1991 issue of *CAUSE/EFFECT* magazine. The Contributor of the Year Award has been sponsored since 1982 by Systems and Computer Technology Corporation.

THURSDAY LUNCHEON
INTRODUCTION OF 1992 CAUSE BOARD

Front row, left to right: Vice Chair Kenneth C. Blythe, Pennsylvania State University; Secretary/Treasurer Diane Kent, University of British Columbia; Chair Ron Bleed, Maricopa Community College. Second row: Joanne Euster, Rutgers University Central Office; Carole Barone, University of California/Davis. Third row: Thomas F. Moberg, Kenyon College; Geraldine MacDonald, SUNY at Binghamton; Gene T. Sherron, Florida State University. Back row: Leslie Maltz, Stevens Institute of Technology; Jane N. Ryland, CAUSE President; Lee R. Alley, Arizona State University; James I. Penrod, California State University/Los Angeles.

FRIDAY MORNING GENERAL SESSION

"THE CURRENT ECONOMY: HOW WE GOT HERE—WHERE WE ARE GOING"

Gene Stanaland
President
GSE, Inc.

In the Friday morning general session Gene Stanaland, "the Will Rogers of Economics," sketched the economic theories used by political leadership in Washington and discussed how the interplay of such theories affect fiscal policy, and, therefore, the economic climate of coming years. In coming years higher education will have to respond to major social and economic changes, Stanaland said, and it will have to market itself to new constituencies: immigrants, displaced workers needing retraining, retired people wanting new, marketable skills or intellectual stimulation. Such changes will likely require a change in business orientation for most colleges and universities.

CURRENT ISSUES FORUM

"TRANSFORMING HIGHER EDUCATION IN THE INFORMATION AGE"

Stephen Mitchell
President
St. Philip's College

Robert Shirley
President
University of Southern Colorado

Barbara S. Uehling
Chancellor
University of California
Santa Barbara

The Current Issues Forum, the closing forum of CAUSE91, brought together three campus CEOs. Stephen Mitchell, Robert Shirley, and Barbara Uehling discussed the changes that are necessary in higher education to respond to new social and workforce demographics and highly competitive markets for higher education institutions, including the role of information technology in these changes.

Mitchell, as president of two-year St. Philip's College, said information technology is so pervasive in our society and in all processes of college and university life that even the most resolute and reactionary institution cannot avoid some accommodation to it.

Shirley, president of the University of Southern Colorado, based his remarks on his experiences with an alliance between the University of Southern Colorado and the local public school district.

Uehling, chancellor of the University of California/Santa Barbara, focused on the importance of information to the effective management of institutions, and of technology as it makes information more available.

The forum was moderated by 1991 CAUSE Board Chair Carole Barone of the University of California/Davis and coordinated by 1991 Current Issues Committee Chair Fred H. Harris of the University of Tennessee/Knoxville.

PROFESSIONAL PROGRAM

CAUSE91 brought together over 1,200 conferees from around the world for nearly 50 professional presentations in eight tracks at the Disneyland Hotel in Anaheim, California. Aside from these track presentations, conferees could choose from Ask the Experts sessions, Current Issues discussion groups, Constituent Group meetings, Round Table meetings, and a new conference offering, Poster Sessions.

This section includes summaries of many of these sessions, followed by the text of papers presented, organized by track.

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 standby paper which was not presented at CAUSE91 is included here.

Current Issues Sessions

Eight 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 which have been of interest to the profession in the past year.

Holistic Networking: Building Infrastructures in the '90s
Discussion Leader: Gene Sherron, Florida State University

Computers and Health
Discussion Leader: Daniel A. Updegrove, University of Pennsylvania

Client/Server Architecture and Distributed Computing
Discussion Leader: Robert Little, Lock Haven State University

Campus Computing: Organizing for Service
Discussion Leader: Betty Le Compagnon, University of New Hampshire

Consolidating, Outsourcing, and Downsizing
Discussion Leader: Richard Mann, University of Kansas

Image Processing Applications
Discussion Leaders: Roger Printup, University of Virginia
Deborah Mills, University of Virginia

Disaster Recovery
Discussion Leaders: Roy Gruver, Lehigh University
Peter Rittner, University of Miami

The Virtual Library
Discussion Leaders: Maurice Mitchell, University of Nevada, Las Vegas
Laverna Saunders, University of Nevada, Las Vegas

Holistic Networking: Building Infrastructures in the '90s

Discussion Leader:
Gene Sherron, Florida State University

For a late afternoon session, this one seemed to be fairly well attended with about 25 institutions represented and 30 people present. After a brief introduction, a dozen or so spoke up to give campus answers to tough networking issues. The following notes highlight the discussions and offer institutional identity, in the event follow-up is desired.

What does a network have to look like to allow everybody to talk to anybody, over whatever technology?

Even though there are many network architectures available, it was generally conceded that its hard to go wrong with accepting Ethernet and Token Ring as campus standards. If other architectures are present on campus, gateway them into the mainstream. In short, don't fight diversity, "buy" them into the campus "backbone."

On the subject of LAN protocols, again the campus should support a "standard" such as Novell (80 percent of the market) and bridge in the "others."

An interesting security idea was offered by Penn State's Hershey Medical Center as a means of placing responsibility on the user's shoulders. The concept calls for each department to be connected to the backbone through a port on a router. In a reasonably configured router, the cost per port is about $3K. Each department is then in compliance with security procedures and connected to the backbone. The importance of each department being connected is to ensure that local networks are in compliance and security risks are isolated. LANs in violation of security procedures are temporarily disconnected until the problems are corrected. It takes the network manager out of the policing business and reduces vague finger pointing.

All networks are facing the directory issue differently. Northwestern's Internet directory software is freeware and regarded by many as a very effective directory system that responds to internal and external needs. Case Western has taken this another step by integrating all faculty, staff, and students into an electronic telephone directory and E-mail directory. The University of Maryland at College Park also has an electronic directory for faculty and staff.

How to get everybody connected to the network led to a discussion about minimum connectivity to each office. BYU uses a cost sharing approach of 80 percent/20 percent with the departments coming up with a $50 one time, "capital" charge to the unit for an Internet connection and a $50/year maintenance charge. Along this train of thought, the networkers suggested that users should make their own case for technology enhancements/upgrades with the networker going along for moral and technical support.

Then there was the issue of organizing for networking. Clearly, there were as many approaches as institutions present. Yet, there is a discernible movement toward an identifiable networking unit. In some cases, there are separate units under a CIO; in others the home was within Telecom.

In closing, we recognized that "we had come a long ways, baby!" But, the goal of a consistent user-interface for all of us to a multi-vendor network so that all could "talk" to any was still a few years away.

Computers and Health

Discussion leader:
Daniel A. Updegrove, University of Pennsylvania

Computing professionals have been at the forefront of campaigns to make colleges and universities into computer-intensive environments. Computers can now be found in faculty offices and homes, student residence halls and apartments, staff offices and homes, computer labs, libraries, and student unions. And, as more scholarly and administrative data are made available in on-line databases, and as more word processing, spreadsheet, electronic mail, and calendaring programs proliferate, we find people spending more and more time sitting at computers.

Unfortunately, our investment in computers and networks has not been matched by investment in either appropriate furnishings or research into the health effects of long-term, intensive computer use. Renewed concerns about radiation, combined with reports of newly-recognized "repetitive stress injuries" such as carpal tunnel syndrome, have led some to call for regulation in the workplace and others to rearrange their offices and computer labs. If, as is widely suspected, health effects are cumulative, then many of us are at risk. Unfortunately, many years will be required before epidemiological studies can provide definitive guidelines for computer users, managers, furniture suppliers, and office designers. In the interim, computer users and institutional decision makers must educate themselves about these issues and appropriate remedies.

Those interested in more information on this topic are referred to: "Computers and Health: Individual and Institutional Protective Measures," by Daniel A. Updegrove and Kimberly H. Updegrove, CAUSE/EFFECT 14, Fall 1991 (reprints are available from the address above); and the listserv-discussion group, C+HEALTH, which is open for subscription to anyone with access to BITNET or Internet. To subscribe, send electronic mail to LISTSERV@IUBVM.BITNET or LISTSERV@IUBVM.UCS.INDIANA.EDU with any subject and this text in the first line: subscribe c+health firstname lastname.

Client/Server Architecture and Distributed Computing

Discussion Leader:
Robert Little, Lock Haven State University

There were 26 persons who signed the attendance sheet for this session. Even though the session was held late in the day, enthusiasm for this topic was keen. The moderator opened the discussion with an overview of the three compelling forces driving us towards the client/server model: technology, economics, and organization. A brief overview of the client/server implementation at Lock Haven University followed.

Subsequently, representatives from the University of Quebec, the University of Miami, Baylor University, West Chester University and American Management Systems each commented on their widely divergent experiences in implementing the client/server model. In the flow of the discussions, several major contemporary issues were identified:

Distributed inquiries are fine, but how do you do updates? We have SQL as an enabling tool for merging data from different servers at the client. But the current tools leave us without a means of controlling distributed updates.

Data dictio.'ary for distributed database. How do we know what data is used where? How do we know where data is stored?

Software version control. Faulty version control for client or server software can produce catastrophic failure for the application.

Standards for the client interface. Even though the same tools may be used to construct client interfaces, differe. ystems designers often create a completely different "look and feel."

Performance problems with database I/O. When an application, such as a financial transaction, must complete numerous database I/Os, the performance of the network (and the transaction) can be degraded severely. This, of course, depends on the distributed application design and the location of the client and server on the network.

Database synchronization. All standard concerns regarding data integrity, rollback and recovery take on new meaning in a distributed database implementation.

Finding, training and retaining qualified staff. The new technology requires new skills, which are at a premium in the marketplace.

Network bandwidth limitations. The capacity of the network to handle data, can be a severe constraint, and is an important design consideration. A term, Network, I/Os Per Second (NIPS), was introduced to define this constraint.

Many of these issues directly relate to the relative immaturity of distributed database technology. Other concerns, such as capacity monitoring and personnel retention are perennial management issues, but assume an important new perspective. It is clear that on the client/server frontier, there are few current standards, so we must forge these standards now to avoid chaos and rework.

Campus Computing: Organizing for Service

Discussion Leader:
Betty Le Compagnon, University of New Hampshire

Institutional computing is becoming increasingly decentralized, yet, with the expansion of campus networks, incereasingly interdependent. Faculty, staff, and students with the access to specialized hardware, software, and data bases are asking for help with installation of software, connections to the campus network, backups, maintenance, and trouble-shooting. As users change, so too must the support services provided by campus computing organizations.

This session began with a review of those factors which must be taken into account by information technology (IT) managers as they organize user support: 1) Severely limited budgets are restricting the flexibility of IT managers to provide adequate support, often forcing a consolidation of support functions and a reduction in staff; 2) A broadening range of hardware and software has made it increasingly difficult for IT support staff to remain "experts" in their field; 3) Distributed computing and local area networks have created isolated pockets of users with unique support needs; 4) The need for connectivity and integration to support executive decision-making has created a computing environment that is, at the same time, centralized and decentralized; 5) The lines between academic and administrative computing are becoming blurred as the use of technology expands into all aspects of campus life (i.e., electronic mail and conferences, campus-wide information systems, online transfer of documents, etc.).

It was generally agreed that there is no single, "best" way to provide user support, but that the key to successful support services is to find a way to combine the benefits of both central and distributed support. Most institutions represented had a central user support staff; however, they felt they were no longer able to provide adequate user support through these centralized services alone. For this reason, most institutions either had, or were considering, some sort of department "liaison" function. In some institutions, this person was part of the computer services organization, while in others the person was a member of the user department itself. In either case, the role of the liaison was to provide local computer expertise and support, to coordinate the communication between users and the computer services department, and to report and track user problems requiring technical assistance from the central computer services organization. In those institutions that had department liaisons, the computer services organization generally held monthly meetings for liaisons to discuss common user problems and solutions, distribute information, and provide training on new hardware and software.

Participants agreed that the department liaison function worked well since users liked having a single point of contact for computer support. Generally, however, computer services departments in smaller institutions found that the economics of scale made it impossible to place support staff in user departments. They also found it impossible for staff members to become experts or specialists in a wide variety of hardware or software and were sometimes called upon by the computer services department to provide support to other users or to teach seminars or short courses in their areas of expertise.

A number of institutions maintained central "help desks" where "one call does it all." In some cases, these help desks were staffed by students, with a computer services staff member serving as coordinator of the group. Some institutions indicated, however, that it was difficult to coordinate student coverage of the help desk given the changing nature of student schedules.

Participants generally agreed that limiting the number of products supported by the computer services organization would improve their ability to provide support. Some institutions had compiled a "supported products" list and were encouraging users to buy only from that list. Others indicated that, although it might be desirable to limit the number of products supported, it was impossible to enforce standards on users, especially faculty. It was also generally agreed that it was difficult to refuse support to users regardless of the product they were using.

In conclusion, it was agreed that providing satisfactory user support is an increasingly challenging task for computer services departments and that the model that works best in one institution will not necessarily work in another. The key to providing successful user support is to work closely with users to identify needs and to encourage communication and cooperation between users and the central computer services support staff.

Consolidation, Outsourcing, and Downsizing

Discussion Leader:
Richard L. Mann, University of Kansas

Thirty people attended this session and there was vigorous discussion. There appeared to be agreement that some action—selective consolidation, outsourcing, downsizing—will need to be taken by many institutions to address the continued tightening of budgets in computing facilities.

It was determined, however, that outsourcing means different things to different people. Many institutions today are outsourcing some aspects of their operation, such as application development, by buying a software package; or project management in the form of consulting services. What is new is the availability of hardware and software services from remote sites such as that being offered by IBM and other companies in the private sector. Higher education is one of the last industries to see a vigorous effort by commercial outsourcing providers. It is unclear how successful this effort will be.

A major concern that a commercial provider would have, cited during the discussion, is whether there are sufficient margins in university budgets to allow a commercial outsourcing provider to make a profit. Many institutional computing budgets are already tight and it would take the aggregation of many institutions' computing loads to yield a viable profit for a commercial outsource company. An alternative to this would be a consolidated computing facility operated on a non-profit basis by a group of institutions.

There was agreement that a regular session on this topic should be included in the 1992 CAUSE conference. It would be interesting to hear from vendors as to their success to date, as well as those universities which are evaluating or committing to consolidations projects or outsourcing services.

Image Processing Applications

Discussion Leaders:
Roger O. Printup and Deborah Mills, University of Virginia

The University of Virginia is a beta-test site for IBM's OS/2 version of Image Plus image processing system. The system has been installed in the Graduate Arts and Sciences Admissions Office. Approximately 5,000 applications are received annually. Initially, only the applications for the English Department (approximately 1,000 applications) will be scanned into the system. The original documents will be sent to the department and the Graduate Admissions Office will rely solely on the scanned image. The next phase of the project will be to scan all applications for admissions with the originals going to the departments. When fully implemented, the departments will also have workstations connected to the image processing hardware, and they will be able to access the applications directly.

As an emerging technology, image processing offers a number of potential benefits to offices which handle large volumes of paper. Among those benefits are: immediate access to documents without having to move away from a work location; faster retrieval of documents than conventional filing methods; access to the same document by multiple users at the same time; dramatic reductions in storage space and costs.

As with any new technology, however, the cost at this early stage of release is quite high. A price tag of $10,000 per workstation is not unusual. Substantial savings need to be demonstrated in order to cost-justify image processing at the current price levels.

Through the pilot project, we've learned that scanning and indexing need to be well developed procedures. The documents being scanned need to be reviewed prior to system implementation. Things to look for on the documents are the quantity of data per document and the placement of key information used for indexing on the document. With image, as with any new technology, there is a learning curve for the technical people who set up the equipment, the managers of the offices using the equipment, and the operators of the equipment who use it on a day-to-day basis.

Areas of the university which have a high number of documents which need to be accessed frequently are the most logical applications for image processing. Functions such as admissions, financial aid, purchasing, accounting operations, and personnel, were mentioned frequently by persons who attended the session as those under consideration by their institutions. Functions which have large quantities of paper which are not accessed frequently are better suited to more traditional types of storage such as microfilm or microfiche.

Disaster Recovery

Discussion Leaders:
Roy Gruver, Lehigh University, and Peter Rittner, University of Miami

The discussion leaders began by contrasting disaster recovery planning at their respective institutions. Lehigh University is in the process of developing a business continuity plan intended to do only what is necessary to ensure survival of the institution. Two objectives have been established: (1) to provide essential services to customers and (2) to maintain cash flow. The University of Miami has developed separate disaster recovery plans for computer and network services. They address those central computer and network resources and services critical to the support of essential business functions. Continuation of operations dependent upon central computer and associated network services while disaster recovery planning is being implemented is the responsibility of individual business units.

Several themes emerged in the discussion which followed:

- While the need for disaster recovery planning is generally conceded, its real value in cost/benefit terms is often questioned. Therefore, the impetus for disaster recovery planning is frequently external, such as pressure from auditors or an actual occurrence of a disastrous event.

- Risk analysis is a likely and usually fruitful starting point in disaster recovery planning. Whether absolute costs or weighted values are assigned as part of the risk analysis, the relative priority of critical business functions usually emerges in the process of identifying exposures and their potential impact.

- The criticality of some business functions, such as registration, is time dependent. Their inclusion in disaster recovery planning should be qualified by that time dependence.

- Two measures of time are fundamental to disaster recovery planning.
  What estimated period of outage initiates implementation of the disaster recovery plan? Once the plan is initiated, for how long will business be conducted in post-disaster mode?

- Consultants can be of value in disaster recovery planning if their task is well defined and closely controlled. Representatives of the institution must assume leadership roles and actively participate in plan development because they will "own" the plan and be responsible for it. Those who will implement the plan must subscribe to it and feel they have a vested interest in its success.

- Once developed, a disaster recovery plan must not be treated as a static document if it is to retain value. Environments, personnel and other pertinent circumstances change, sometimes constantly and/or dramatically. The plan, therefore, should be reviewed, revised and tested regularly and fairly frequently. The medium in which the plan is maintained and the way it is distributed can have a significant impact on the effort required.

The Virtual Library

Discussion Leaders:
Maurice Mitchell and Laverna Saunders, University of Nevada

During this current issues session, library and computer center administrators met to discuss virtual library issues. Participants voiced numerous questions, but in the time allowed arrived at few answers. The questions indicated, however, that librarians and their computer center counterparts share a common vision and are partners in working through the following issues.

For the purpose of discussion, the virtual library was defined as a system by which a user may connect transparently to remote libraries and databases using the local library's online catalog or a university or network computer as a gateway. Eventually the necessary information that a user might need—bibliographic, journal citation, or full text—will be stored in a computer somewhere in digital format. Assuming an increasing reliance on technology for access, how do we budget for ongoing upgrades for computer hardware and new releases of software? How do we budget for collections? At what rate will collections grow? What mixture of paper and electronic sources is appropriate? What should we purchase and retain on site, and what should we purchase access to? What criteria should be developed and used for evaluating collections and access? How do we ensure that information stored electronically will be preserved?

Two critical keys to providing access to sources not owned will be cooperative collection development and networking. If remote users can view bibliographic records and journal citations, they will want to obtain the physical item. Until the evolution to full-text retrieval is complete, some version of interlibrary loan seems necessary. How will libraries bear the cost of increased interlibrary loan and document delivery? Who gets priority access—local or remote users? Who really owns materials and information? Do they belong to the library or institution that made the original purchase or do they belong to the network if cooperative collection development governed selection? How can we live within or overcome the provinciality of state and local funding agencies? What new relationships should be created between libraries within a community (academic, public, special, K-12) to best use resources? What security is appropriate for copyrighted databases and locally created data files?

Library organizations will change as the virtual library evolves. The diversity of user needs and skills will continue to challenge public services. Training naive users to become competent in accessing and understanding various types of electronic services will become another facet of library instruction. Likewise helping users develop critical thinking or filtering skills to cope with the abundance of information will be part of our mission. Computing center staff have an overlapping concern with user training and can be partners in the process. The relationships of libraries and computer centers to each other will change in subtle and dynamic ways as libraries depend more on computer access. Library staffs will need more technical skills and ongoing training. Technical services will be challenged to evaluate the functionality of MARC records in relation to a greater need for contents and full-text indexing. Electronic transmission of orders and financial data is already happening as vendors work out networking standards and protocols.

The answers to the above questions will influence the design of library facilities. What amount and forms of storage space will be needed? What functions should the physical library offer? To what extent can we plan flexible facilities which can be modifies as technologies change? How should facilities promote human needs to gather together and to work in ergonomically designed comfort?

Obviously, librarians and computer center administrators will be challenged to work through these issues together as the virtual library evolves.

Round Table Discussions

These working round tables are small interactive "brainstorming" meetings to allow colleagues to share experiences and ideas. Participation is limited to 25 people, on a first-come basis.

Managing with Budget Cuts and Shrinking Resources
Discussion leader:
Tom Warger, Bryn Mawr College

External Partnerships
Discussion leader:
Roger V. Bruszewski, Frostburg State College

Managing with Budget Cuts and Shrinking Resources

Discussion Leader:
Tom Warger, Bryn Mawr College

There was general agreement that we are now facing a very different situation in funding. Reductions have been made at many institutions, and prospects are that more are in the offing. But expectations for computing capabilities and support services are not declining. Speakers at the round table agreed on the general problem but reported differing responses on their campuses.

The focus in computing at Arizona State University, which is facing across-the-board cuts of approximately five percent, is to reduce the heavy cost obligations in mainframe computers. Planned acquisitions may be frozen. Options to buy used equipment or to reduce replacement cycles in the future are being weighed. Cuts in support of research computing are also under consideration.

Larger concerns loom for the years ahead. How can agreement be obtained to make the cuts? Who will decide? Technological solutions, such as downsizing computing platforms, require lead-time and substantial investment before they can bring cost reductions.

Catholic University has seen flat budgets for several years now. In computing, reductions were made in operating costs: backup operations have been automated; central computing hardware maintenance costs have been reduced through replacement of older equipment by newer. The University hopes to raise funds for continued development of campus networking through construction bonds. Training in computer literacy has been consolidated and reduced. Campus site licenses for software will also help to lower costs.

The University of Michigan Consulting and Support Services office believe they can continue to make efficiency improvements that will reduce costs. Cuts in staff travel funding and in outside training services will be made. An effort to deliver more assistance in the form of printed information is in progress. The general strategy is to give the same functionality as before, but in other forms. There will be less hands-on training in favor of a tutorial approach. Software will no longer be upgraded automatically. Limits on products supported will be articulated.

An important challenge will be to re-define user services through discussion involving the users themselves. Central services and local departments will need to cooperate in new ways.

The University of California faces a prolonged downturn in available funding. There is concern for the eventual impact of decisions being faced now; more budget cuts are virtually certain for the future, given the condition of the state's economy. Is there adequate time now to plan a better long-range strategy for computing with reduced resources? While the trend in cost/performance ratios is favorable, are there enough time and resources available now to implement them?

The imperative to raise outside revenues is posing politically difficult issues for computing support organizations in the California university system. Training, network support, and system management are under consideration as services to be offered for chargeback. Subsidy of central staff through assessments against the budgets of departments served is proposed. Yet this approach accentuates the differences in treatment extended to departments with varying abilities to pay for service. Wider questions can be asked about the fate of expectations that have been raised in recent years by the impressive advances in technology.

Bryn Mawr College proceeded with development of its computing capacity in recent years within the context of a campus plan to maintain financial equilibrium. The pace and priority of projects are subject to the year to year availability of funding. All capital projects in computing are scrutinized for their value relative to current institutional priorities. The prospect of even tighter constraints on funding for computing places a premium on the partnerships developed between the central computing services organizations and their departmental clients, as strong support from constituencies may be essential to success in obtaining funding.

Increased self-sufficiency in computing support is College policy for administrative departments (who are encouraged to build computing expertise into their own job descriptions) and academic departments—where gran. funding is essential for the expansion of facilities and the base of equipment. The contention for funding between network extension projects and equipment replacement needs are a source of concern.

Participants in the round table agreed that there are sobering precedents in the deferral of replacement costs in physical plant that was common among higher education institutions in the past two decades. The pace of advancement in technology compounds the difficulties of tight financing: obsolescence and increased cost of operation for older equipment relative to new argue for shorter replacement cycles but sometimes cannot achieved without other increased capital outlays.

External Partnerships

Coordinator:
Roger V. Bruszewski, Frostburg State College

Due to low participant turnout, the internal and external partnerships roundtables were merged into one roundtable on partnerships. The major focus of the roundtable was to discuss the various benefits generated from building both internal and external partnerships.

The external facilitators shared their experiences and interests in establishing partnerships. The emphasis was placed upon building a relationship between the university and the external entity. Discussions centered around how to get started, different kinds of partnerships, and the various advantages and disadvantages of such agreements. Some participants were concerned about the balancing of resources between internal demands and external relationships.

Next, the roundtable discussion turned towards internal partnerships and each facilitator defined the various strengths and weaknesses of their experiences. A good deal of dialogue developed on how to sell these internal partnerships to the administration of the institutions, and the various areas where internal partnerships can be developed were explored.

Everyone seemed concerned with how to maximize these relationships at a time when resources are declining. The facilitators pointed out that these partnerships can bring new resources to the table.

Ask the Experts Sessions

Experts from education and industry this year shared information on a specific topic, and answered questions from conferees.

Technophobia, It *Does* Affect Everyone, from Students to College Presidents

Moderator:
Michael Dolence, California State University/Los Angeles

Experts:
Larry D. Rosen, Chair and Professor of Psychology, California State University/Dominguez Hills
Michelle M. Well, Psychologist and Adjunct Professor, Chapman University

Electronic Publishing

Moderator:
David Koehler, Cornell University

Expert:
Robert Benjamin, Robert Benjamin Consultants

Total Quality Management: A Campus/Corporate Experience

Moderator:
Constance Towler, Harvard University

Experts:
Stephen Hall, Harvard University;
Frank Steenburgh, Xerox Corporation

Electronic Publishing

Moderator: David Koehler, Cornell University
Expert: Robert Benjamin, Robert Benjamin Consultants

The session on Electronic Publishing was enhanced by the presence of Robert Benjamin, President of Robert Benjamin Consultants. Robert has a consulting practice in strategic management of information technology. He is a Visiting Scientist at the MIT Sloan School of Management, and is engaged in research activities at MIT's Center for Information Systems Research, and Management in the 90's Program. Mr. Benjamin previously worked for Xerox for seventeen years and was manager of Strategic Planning for Information Systems before his retirement.

Mr. Benjamin's presentation focused on the opportunities now upon us in electronic publishing. He made a distinction between the management of image transactions (like we have all heard about with American Express), and the management of "Distributed Print" documents. An example would be the creation, storage, and distributed printing of class notes.

He spoke about the types of equipment available today (e.g. Xerox Docutech and Kodak Lionheart) and tried to forecast what would soon be available. For example, the ranges of available options in distributed digital print are in quality (300 dpi to 600 dpi), speed (6 ppm to 135 ppm), and in networking availability.

The key values that promote the use of distributed digital printing capabilities are:

> Access, Capture, and Reproduction - in many campuses we have built multi-million dollar networking infrastructures and now have the ability to really use them to change the way we do business. For example, class notes, research reports, and access to library materials.
>
> Just in Time - to allow on demand printing at remote sites thus eliminating waste and inventory carrying costs.
>
> Quality - comparable to offset presses with commensurate cost savings.
>
> Finishing - with a wide range of options available today.

During the discussion with the attendees, some of whom had already embraced digital print technology, three main recommendations came forth:

> The technology is available now and the institution's IT management should be aware and be proactive in investigating its uses.
>
> The main selling points today are quality and service. These are further described as print quality, finishing, and turnaround time.
>
> There will be an inevitable merger between campus print shops and IT organizations. It has already happened on some campuses using this new technology.

Technophobia: It *Does* Affect Everyone, from Students to College Presidents

Moderator:
Michael Dolence, California State University/Los Angeles

Experts:
Larry D. Rosen, Chair and Professor of Psychology, California State University/Dominguez Hills
Michelle M. Weil, Psychologist and Adjunct Professor, Chapman University

This Ask the Experts talk began with a twenty-minute summary of the pioneering research done by Dr. Rosen and Dr. Weil and was followed by a lively discussion. Technophobia is a serious problem that afflicts 30 to 40 percent of all students, faculty, staff, housewives, corporate managers, school teachers and even school children. Technophobia has been shown to be a multidimensional combination of one or more of the following: a) anxiety about present or future computer or technology experiences, b) negative global attitudes about computers, computer-related technology or their societal impact and c) negative cognitions of self-critical internal dialogues during computer interaction or when contemplating future computer interaction. The "technophobic" can exhibit characteristics that range from mild distress in any of these areas to severe discomfort in one or more areas.

Over the past ten years, Drs. Weil and Rosen have studied nearly 10,000 students in 23 countries, a thousand elementary and secondary school teachers and hundreds of elementary and secondary school students. The results of these studies have shown that there is no "technophobic" profile. Technophobics are equally likely to be men or women, older or younger and from any ethnic background. Further, there is no strong support for the belief that technophobics are simply more anxious in general or are more anxious about mathematics.

Under a grant from the U.S. Department of Education, Drs. Weil and Rosen developed and tested the Model Computerphobia Re-education Program. This three-year grant demonstrated that technophobia was eliminated in nearly 200 students, faculty, and staff (a 92 percent success rate) in *only five hours!* A massive study of nearly 2,000 students showed that the program also increased retention and improved course performance. Long-term follow-up studies indicated that even six months after this brief psychologically-based intervention program, all participants maintained their comfort level, gained computer competency and showed strong interest in future computer interactions.

Through their eighteen studies, Drs. Rosen and Weil have proposed a model for what makes someone technophobic and what maintains that technophobia. The model stresses the importance of the "introducers" of technology (most often teachers or parents) and their comfort level with technology. The model also suggests that technophobia is maintained by providing computer/technology experiences in high-intensity environments that allow limited "free play" with the technology and are evaluative in nature.

Ensuing discussions focused on the application of this research paradigm to the university computing environment. Dr. Weil and Dr. Rosen indicated that they have a series of measurement instruments that have been shown to be valid, reliable and have strong clinical applications.

Total Quality Management: A Campus/Corporate Experience

Moderator: Constance Towler, Harvard University
Experts: Stephen Hall, Harvard University; Frank Steenburgh, Xerox Corporation

Frank Steenburgh described how Xerox has applied quality improvement principles in their Leadership Through Quality Program over the past dozen years, and how Xerox is modifying these techniques for the future.

Steve Hall talked about the Harvard Quality Process, which has been developed over the past two years at Harvard, and described plans for distributing this process to other parts of the university.

The experts spent one half hour each on their presentations, which left one half hour for questions. The session was attended by over 40 individuals and the question period was lively. The questions ranged from: "what is included in your training program" to "how do I convince my management, and particularly the faculty, that this is a good idea." Gaining commitment from the top of the organization was an important question for many participants. The point was made that the principles of Total Quality Management must be applied to an organization depending on the needs and desires of that organization, and therefore, there is no textbook answer to this question. Since this is the case, participants wanted to hear about applications success stories from the experts, and wanted to share some of their experiences. Unfortunately, there was minimal time for this activity. The one and one half hours went by very quickly and it is my impression that everyone felt rushed. Many participants stayed on to ask additional questions after the formal close of the session.

Some material was distributed and the experts took business cards to send additional information following the conference.

Constituent Group Meetings

A number of subgroups of CAUSE members and conferees met at CAUSE91 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 National Conference, and occasionally at other times during the year. The number and focus of the groups change according to members' needs.

Administrative Systems Management
Coordinator: A. Wayne Donald, Virginia Tech

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: Richard D. Sheeder, Pennsylvania State University

Executive Information Systems in Higher Education
Coordinator: Robert H. Glover, University of Hartford

Four-Year Colleges and Universities
Coordinator: John W. Eoff, New Mexico State University

IBM Higher Education Software Consortium
Coordinator: Douglas E. Hurley, University of Kentucky

Institutional Researchers and Planners
Coordinator: Richard Howard, University of Arizona

Internet
Coordinator: Mike Staman, CICNet, Inc.

Medical/Health Science Schools
Coordinator: Carla T. Garnham, Medical College of Wisconsin

Multicampus/State Systems
Coordinator: Robert R. Blackmun, University of North Carolina

Small Institutions
Coordinator: Clyde R. Wolford, Le Moyne College

User Services
Coordinator: Claire Gorman, Tufts University

Administrative Systems Management

Coordinator: A. Wayne Donald

The Administrative Systems Management constituent group (CAUSEASM) met at CAUSE91 on December 4, 1991, at 4:30 pm in the Santa Rosa Room (Bonita Center) at the Disneyland Hotel. The second annual meeting for CAUSEASM had 49 conference attendees sign the attendance sheet. Wayne Donald, Manager of Administrative Systems Planning at Virginia Tech, opened the meeting with a report on activities during 1991.

Progress report: Interest in the Administrative Systems Managemer· constituent group continues to grow. A list server was set up after the 1990 meeting with approximately 40 initial subscribers. As of November, 1991, the list server had over 150 subscribers, a substantial growth for 1991. Activity on the list server has been above average for a new server, and it appears quality information exchanges have been the norm. Subscribers were encouraged to continue using the list server for information exchanges and general discussions relating to management issues for administrative systems. Wayne Donald announced that Jerry Hoover, Franklin and Marshall College, will assist with constituent group activities during 1992, and that David McGuire, University of New Mexico, agreed to keep notes during the 1991 meeting.

Main Discussion: Mark Olson, Columbia University, led a discussion on distributed computing—a topic that was frequently discussed on the list server during 1991. Mark described the environment at Columbia — one where the end users responsible for a function is responsible for all tools/resources supporting that function, including computing. Concerns were expressed about the Columbia model: it's expensive to hire and/or develop people with such a broad skill set; and, large projects still require central resources. To summarize other comments: without central coordination distributed computing can lead to "disintegrated systems"; small schools cannot follow the Columbia model but can cultivate "expert users" or computer coordinators in key departments; people with special skill sets will be required and that may be a problem for many institutions; and finally, building partnerships (working as a team) is critical to the success of distributed computing. It soon became obvious the discussion could go on beyond the allocated time. Mark indicated he will review the information and hopes to incorporate it with other information to write a paper that can be shared with the constituent group.

Open discussion: An open discussion revealed interest in some other areas relating to the management of administrative systems. These areas may certainly be candidates for future discussion on the list server.

- Academic demands for service
- Reporting structure for merger Information Systems structure
- Planning for client/server architecture
- Extract files: how to coordinate file refresh/insuring reporting integrity
- Liability for external systems

There was not much time for discussion on these issues but more information will be distributed to CAUSEASM subscriber in early 1992.

Adjournment: Prior to adjournment, Wayne Donald suggested the constituent group attempt to have a "Topic of the Month" on the list server as a new activity for 1992. This can stimulate some discussions and provide subscribers with an open forum for each month. Anyone willing to "administer" a specific topic can summarize the comments and publish a short conclusion for distribution on the list server. Everyone was encouraged to send potential topics to Wayne Donald (AWDCMS@VTVM1.BITNET), and agree to serve as a administrator for one month. The first topic will be scheduled for February, 1992.

Some attendees expressed an interest in moving the CAUSEASM meeting in 1992 so it will not conflict with the Data Administration group. Wayne Donald agreed to pass this information on the Debbie Smith at CAUSE. The meeting was adjourned at approximately 6:00 pm.

Chief Information Officers

Coordinator:
Ken Pollock, Wright State University

Approximately 40 people met at CAUSE91 in Anaheim to discuss issues related to the role of Chief Information Officers (CIOs) in higher education. The major agenda for the meeting this year was to:

identify critical issues that merit further discussion by this group and identify which of those issues should be considered and/or supported by CAUSE;

discuss future plans for the CIO constituent group; and

discuss the possibility and logistics of holding the next constituent group meeting in April of 1992

The meeting began with two presentations designed to stimulate discussion and assist with the task of issue identification. The presentation was by Mike Zastrocky and Lew Temares who discussed results of the recent CAUSE postcard survey. The survey asked CAUSE members to rank information technology issues in order of importance for the 1990s. The results will be published at a later date. The second presentation was given by Chuck Thomas who surveyed campuses across the country to compare the characteristics and profiles of CIOs today versus five years ago. There were no major surprises in Thomas' data except that the number of "CIO positions" has increased significantly in the past five years.

The group had a difficult time distilling the variety of issues facing CIOs into a concise list which should be considered by CAUSE as a part of the strategic planning effort. However, a few of the most important issues that were agreed to are:

educating presidents/boards/senior administration on the value of information technology;

establishing measurement techniques (which includes an assessment of productivity and quality) to assess the effectiveness of information technology;

calculating the value of information technology as a return on investment rather than a cost;

re-engineering and/or changing the culture of the university in general;

changing the reward structures to encourage the use and development of information technology;

changing the reward structures to encourage the use and development of information technology.

Other issues were also identified for further discussion by the CIOs at their next meeting. That list and the list which developed at the CAUSE90 meeting are available from CAUSE or Ken Pollock at Wright State University.

The group agreed that the best time to hold the next CIO meeting would be the last week in April. Several locations were discussed with the most probable being either Chicago or Atlanta because of the strategic location with respect to airlines. The suggestion was made that the meeting be held for approximately one and one-half to two days at a hotel located close to the airport. Ken Pollock will set up the logistics for the next meeting and solicit topics for the agenda in February 1992.

Individuals interested in participating in a meeting tentatively set for April 27-28 can contact Ken Pollock via e-mail (kpollock@desire.wright.edu) with suggestions for topics.

Coalition for Networked Information

Coordinator:
Leslie Maltz, Stevens Institute of Technology

"The mission of the Coalition for Networked Information is to promote the creation of and access to information resources in networked environments in order to enrich scholarship and to enhance intellectual productivity.

The Coalition pursues its mission by seeking to realize the information distribution and access potential of existing and proposed high performance computers and networks that support the research and education activities of a wide variety of institutions and organizations.

The Coalition accomplishes this realization by undertaking activities, on its own and in partnership with others, that formulate, promulgate, evaluate, and promote policies and protocols that enable powerful, flexible, and universal access to networked information resources.

The Coalition directs the combined intellectual, technological, professional, and financial resources of its members according to the shared vision of how the nature of information management is changing and will continue to change through the end of the 20th Century and into the beginning of the 21st."

The mission and goals of CNI were briefly described along with the fact that participation ir projects is open to everyone. Participation is not limited to the institutions who have generously decided to provide financial support for CNI through their membership. Individuals and institutions who wish to participate in projects sponsored by CNI are strongly encouraged.

Three specific projects were described. In each case, individuals with an interest in participating as well as relevant experience were encouraged to contact the CNI staff. Each project was described in a "Call for Statement of Interest and Experience' publication which contained the project description, requirements, and the CNI staff contact.

The projects were:

"Development of a packet of information for use in formulating and addressing institutional and organizational issues arising from the emergence of a national networked information infrastructure and environment." This will include summary documents on topics of institutional importance that will be needed in a nationally networked environment.

"The TopNode for Networked Information Resources, Services, and Tools." This could be considered a directory of directories with navigational aids.

"The Rights of Electronic Access to and Delivery of Information (READI) Program." The READI Program is investigating and documenting issues related to licenses, agreements, copyright law, and contract law in networked environments with emphasis on managing relationships and managing intellectual property.

Community and Two-year Colleges

Coordinator:
Gordon Mathezer, Mount Royal College

Approximately 25 people met for two hours to exchange information on significant current projects, issues and challenges. The discussion was lively, and as usual, most people picked up contacts and ideas that will be useful to them in the future.

The one common theme that emerged was that of severe financial constraints. Much of the discussion had to do with different responses to this problem. Some of the more significant issues considered were:

Downsizing/Client/Server/Open Systems:
Several institutions reported that they were looking at these approaches in an attempt to "do more with less." Although the direction was deemed very promising, the consensus was that the movement would be very slow and gradual. People were concerned about the technical expertise needed, the training required and the significant front-end investment that was likely in moving critical applications to such a distributed architecture.

Nevertheless, all expressed a desire to move in this direction and several reported having taken concrete steps, such as moving to Unix.

Networking:
A logical consequence of the above and of the current industry trends is that most institutions are working hard to put together the network management expertise that is required to operate successfully in the distributed environments that are emerging. Sharing of ideas and experience in this area was considered very important.

Integrated Systems:
Many institutions reported an increasing demand for "good information" as opposed to lots of data. Given that most have a patchwork of difficult-to-relate systems, ways and means of linking or integrating (while renewing) these systems received a lot of attention. Some institutions responded to the challenge by acquiring all their administrative systems from a single vendor. This had the obvious advantages and disadvantages.

Other items reported included the installation of Touch Tone Registration Systems by several, the increasing use of campus-wide student information dissemination and work towards a policy to recycle used PCs consistent with changing institutional needs.

The group also considered how members could keep in touch between conferences and how the CAUSE office could assist this group of institutions. The consensus was that the CAUSE office should set up a "reflector list" for participants. Denny Farnsworth undertook to arrange this and will inform attendees once the service is available.

The first suggested use for the reflector list was to refine the mission statement characterized by a heavier emphasis on teaching and advising. They were felt to be more "student centered."

The effectiveness of communication and sharing ideas via the reflector list will be assessed at CAUSE92.

Data Administration

Coordinator:
Richard D. Sheeder, Pennsylvania State University

Fifty-two people attended the meeting of the Constituent Group, and the discussion was excellent. The following five items were discussed:

1. Membership and use of DASIG. DASIG is the electronic mail distribution list resident on the Syracuse SUVM node to which higher education professionals interested in data administration subscribe. There are 143 institutions represented on DASIG, and 239 members from those institutions. Members are from the United States (216), Canada (16), Germany (2), Puerto Rico (1), Saudi Arabia (2), Singapore (1) and Taiwan (1). Those attending the meeting encouraged the expanded use of the list by everyone. A suggestion was made that a "current, meaningful question a month" be entered onto the list, and answers summarized to send back to the list, as a way of maintaining interest in furthering its use.

2. Review of the Standards Manual from the Data Administration Management Association. The table of contents was reviewed, as were the definitions of data administrator, and data administration and database administration. The Manual is in draft form, and comments from reviewers are being solicited. It was suggested that comments be sent to Leonard M. Brush, Director of Administrative Systems at Carnegie-Mellon University. Copies were offered to attendees.

3. The methodology for defining a strategic data architecture for the entire institution. A DASIG subscriber had offered the following six-phase approach: planning initiation, business modeling, current systems and technology, data architecture, applications architecture, and migration plans. Attendees at the Constituent Group meeting agreed in principle that the approach was sound but, with one exception, indicated that the time and resources to take this approach were generally not available (there was much agreement about the ultimate objective of "draining the swamp," but also a realization of the number of "alligators" complicating the task). Most institutions take a "chunking" approach, where a major function or functions of the University were defined in this manner, and then carried through to implementation. By taking the chunking approach it was understood that the resulting database design could be suboptimal.

4. CAUSE Strategic Planning suggestions. The group was asked for suggestions regarding issues for the CAUSE Strategic Plan, and several were offered which were passed on to CAUSE Staff.

5. A question and answer/discussion period completed the meeting.

At the end of the meeting Richard Sheeder, the convener, stated that he was changing positions within Penn State University and asked if there were any volunteers to assume the responsibilities of overseeing the group. Dan Updegrove from the University of Pennsylvania agreed to do so. Ron Spangler from the University of Kansas Medical Center agreed to assist Dan by working with the Special Interest Group on Data Administration that meets at the Association for Institutional Research Forum each year. Sue Borel at Syracuse University will continue to oversee the DASIG which is resident on the Syracuse VM computer.

Executive Information Systems in Higher Education

Coordinator:
Robert H. Glover, University of Hartford

About twenty-five participants attended the EIS Special Interest Group at CAUSE91. Executive Information Systems (EIS) and Decision Support Systems (DSS) were defined to establish a common frame of reference for discussion.

EIS is a presentation system designed to provide decision makers with convenient and timely access to shared summary information on demand in the form of text, tables, and graphs through user-friendly menus and screens and a desktop computer or terminal.

DSS is an analytical system used by analysts or end-users which applies relational database and statistical analysis software on management databases to convert data into summary information using user-friendly menus and screens or a query command language to control the processing.

Interest in development of EIS/DSS applications is high based on a recent CAUSE survey of chief information officers, and decision makers recognize that in this current era of resource constraints and increased competition in higher education that strategic planning, effective management, and better information are more critical than ever.

Each year advancing technology creates new tools for building more flexible and responsible EIS/DSS applications in a more cost-effective way. If the need for EIS/DSS applications is recognized, and cost-effective tools are now widely available to developers, why do so few colleges and universities have EIS/DSS systems in place to inform strategic decisions and to monitor institutional performance?

Much of the discussion of the group focused on barriers and incentives to EIS/DSS development and implementation strategies designed to increase chances of success.

Executives in higher education are not getting the message about the potential value of EIS/DSS and what support is required to provide more timely access to quality information for strategic management.

Many colleges lack the organization and infrastructure necessary to build an integrated management database from operational databases and external data files. The microcomputing revolution has created user-friendly tools for information processing, but largely for stand-alone environments that encourage shadow record-keeping rather than information sharing. With more and more campuses investing heavily in campus-wide and local-area networks and high powered database/file servers and work-stations with graphical user interfaces, the necessary infrastructure for EIS/DSS implementation and information sharing will become more widely accessible on college campuses in the near future.

Mainframe vendors of EIS/DSS turnkey software are still high priced; and few administrative computing software vendors in higher education have expressed any interest in EIS/DSS development.

EIS/DSS development requires leadership and resource support from an executive sponsor, clearly defined responsibilities for EIS/DSS support staff (e.g., institutional researcher, database administrator, computer staff, end user), and professional development conferences and hands-on training for both users and developers.

Presentations of EIS/DSS applications at CAUSE and interests of participants in the session were discussed including: the U of Hartford demonstrations, the IBM/Missouri project, the IBM/Cal State Los Angeles project, the Georgia Tech presentation, the TRG/Maricopa Community College exhibit, and alternative vendor approaches to database access through SQL front-end products.

Access to the EISSIG bulletin board is obtained through ASUACAD SUBSCRIBE LIST EISSIG; contact Hans Ladanyi (ladanyi@maine) for further information information on access and information submission.

Four-year Colleges and Universities

Coordinator:
John W. Eoff, New Mexico State University

The Four-year College and University constituent group was very lively and informative. The purpose of this group is to share experiences in the three functional areas of student, human resources, and financial accounting and in fourth generation software languages and database systems. Of special interest were comments from John Walsh, Indiana University, about their using a fourth generation language.

In response to CAUSE's request for recommendations concerning future directions that CAUSE should consider, the group suggested that CAUSE sponsor resource sharing groups via electronic mail facilities. Most vendors have "user groups" which meet annually; these groups could share more information through out the entire year if an "information system" was available. CUMREC offers the service on a university-wide basis. It was suggested that the service be categorized on a system/vendor basis.

IBM Higher Education Software Consortium

Coordinator:
Douglas E. Hurley, University of Kentucky

For the past several years, there has been a Higher Education Software Consortium (HESC) Constituent Group at the annual CAUSE conference. This year's constituent group meeting was again a useful opportunity for participants to learn more about the HESC and to dialogue directly with IBM ACIS regarding this program. This year's meeting was well attended with over 20 participants along with several IBM representatives.

The session focused on IBM product announcements in 1991, in particular the Fall announcements. Several questions were raised regarding product availability, and timing. Fred Dwyer, IBM ACIS, discussed HESC product and pricing strategies, in particular alternate pricing strategies being considered for the future. A potential MVS software group was discussed, along with pricing and usage restrictions.

Doug Hurley and Ron Wills (Chair, HESC Steering Committee) discussed the role of the steering committee. A general discussion followed on products that attendees would like to have added to the HESC.

The meeting concluded with a reminder to all HESC institutions to discontinue any HESC software not actually installed and utilized.

This CG continues to be a useful forum for providing information about HESC offerings and future directions, and provides an opportunity for CAUSE conferees who are also HESC members to voice concerns and needs directly with IBM-ACIS personnel.

Institutional Researchers and Planners

Coordinator:
Richard Howard, University of Arizona

The Institutional Research Constituent Group met on Tuesday afternoon and and discussed Data Administration for the entire time period. It seemed that organizational location of the function is institutional specific, and may in fact be as much a function of institutional personalities and history than logic. It was obvious however that data administration and institutional research functions work closely at most institutions to provide the infrastructure necessary for effective decentralized data access and use.

Internet

Coordinator:
E. Michael Staman, CICNet, Inc.

The purpose of this SIG is to provide senior administrative computing executives with both an electronic forum and a specific time during CAUSE meetings devoted to learning about and discussing Internet related activities.

During the first meeting there was a discussion of the kinds of questions and issues which might be addressed by an Internet SIG. Below is a partial list of the results:

Acceptable use policies
Examples of research and education applications
Establishing end-end connectivity
Description of Network Information Center Services
K-12, rural health, outreach applications
Bitnet, file transfer and electronic mail questions
Getting software updates from vendors
Converting from Bitnet to the Internet
Obtaining funding for Internet access
Applications involving the use of full text
Security issues
Transit traffic measurements
Access to large archives, such as at Washington University
Library applications
Contracts with information providers
Maintenance of directories, lists, etc.
Use of information and network navigation tools
Commercialization for the Internet
Developing cost and charging algorithms
Campus-wide information systems (CWIS)
Access to federal information repositories
Municipal and state government agency connections
Reaching colleges and secondary schools abroad
Foreign technology-transfer (USSR e-mail)
Internet study locations—managing budgets, currency transfers, etc.
Video applications
Sharing of institutional research databases
Cross-references to other relevant list-servers or netnews groups
Document exchange (transcripts)

A mail reflector has been established and interested individuals, whether they be CAUSE members or not, are invited to join the discussion. About thirty individuals attended the initial meeting and are now members of the discussion group. To join the discussion group, send mail to cause-interest-info-request@cic.net and ask to be added.

The SIG has also established an archive to hold a complete history of correspondence on the reflector and a directory for documents that the members might want to produce or share. Both of these services are available via anonymous FTP. To add documents to the directory send the material to staman@cic.net.

Medical/Health Science Schools

Coordinator:
Carla T. Garnham, Medical College of Wisconsin

Sixteen conferees from eleven states and South Africa held a lively discussion at the CAUSE '91 Medical and Health Science Schools Constituent Group meeting. To encourage continued discussion, Dr. Alton Brantley of Pennsylvania State's Hershey Medical Center established a new listserv called CAUSEMED. To subscribe, send a bitnet or internet message to listserv@psuhmc.bitnet or listserv@psuhmc.hmc.psu.edu with the one line message:

Subscribe CAUSEMED Your Name

Several themes emerged from the group's discussion. Recurrent questions asked "Why is there so little organized and effective academic computing services within medical schools?" and "Why is information technology, especially networking, so neglected within hospitals?" We focused on how to stimulate information technology transfers between medical centers and hospitals. Hospitals rely too much on vendors to provide technology solutions. They are largely uninformed about applicable and less costly developments in university computing. We discussed ways to bring CAUSE's resources to medical schools, e.g., by elevating AAMC's (Association of American Medical Colleges) awareness of information technology. A second theme concerned access to databases and information exchanges. High quality health care requires access to timely data, and medical centers will be legally accountable if they fail to provide an adequate level of care.

Standards was the third theme. We need a forum to evolve standards for storing patient information. We agreed that an essential first step was to connect major medical schools and health sciences universities through the internet to dialogue on key topics such as the federal Health Care Financing Administration (HCFA) regulations and the National Library of Medicine (NLM) initiatives.

Multicampus/State Systems

Convenor: Robert R. Blackmun, University of North Carolina at Charlotte

The Constituent Group met at 4 p.m. on Tuesday, December 3, 1991. Approximately twenty representatives from nine states participated in the meeting.

The meeting opened with Jane Ryland, CAUSE President, describing the strategic planning efforts of the CAUSE board and their desire for input from a broad range of CAUSE members, including both individuals and institutions. A lively and productive discussion of a variety of issues on which CAUSE can help followed. Among the issues discussed were:

- The need for a central repository of job descriptions for information technology positions in higher education; a particular need for job descriptions for people who provide multi-campus and state-wide service and support was noted.
- The desirabilility of sharing information on state-wide contracts for software, equipment and services, including contract terms and vendor evaluations.
- The need for information on state-wide standards, particularly as they may related to interest in decentralizing and downsizing and/or consolidating services.
- The desire for information on telecommunications services, particularly in the emerging partnership between higher education and K-12 education.
- The need for comparable cost information so that relevant measurement and decisions can be accomplished.

The group also discussed trends and directions in centralization vs. decentralization that are continuing as a result of budgetary and political pressures in several states.

Small Institutions

Coordinator:
Clyde R. Wolford, Le Moyne College

This year's Small Institutions Constituent Group meeting was well attended as in past conferences. As a change of pace, attendees were encouraged to share successes they had experienced in their endeavors during the past year. This led, as expected, to some rather lively discussion and exchange of ideas.

With the group now involved in considering how they might be able to help each other, attention turned to a discussion of current issues among small institutions and how CAUSE as an organization might assist members in addressing them. Issues most strongly identified included those pertaining to local and wide area networking, distributed (multi-platform) processing, and training for both IT personnel and end users. It became clear that these issues were not unique to small institutions but the resources required to pursue them may be more difficult to obtain.

In discussing ways in which CAUSE might help small institutions, several key suggestions surfaced. First, and foremost, was the suggestion that CAUSE provide assistance with the advocacy of technology demands on local campuses. Second, making materials available which provide information on opportunities for obtaining resources (such as grant programs) was seen as a key service. Finally, and probably most unique to small institutions, was the suggestion that CAUSE provide materials or other resources which would describe specific "how to" information on understanding and implementing these technologies. For example, many small institutions would benefit from CAUSE working with larger institutions, having proven expertise, in a program which made that expertise available to nearby smaller institutions, assisting them in getting started in these and other areas.

The session ended well beyond the scheduled time with many attendees continuing their discussion. It was clear a beneficial exchange of information occurred while many new friends were made.

User Services

Coordinator:
Claire Gorman, Tufts University

The topics proposed for discussion and some of the items covered were:

- **training**
  - internal:
    - dedicated person
    - how to evaluate the effectiveness of the training (follow up with the trainees' supervisor?)
  - coordinator
    - make training available, not necessarily in-house
- **help desk**
  - focal point for support
- **communicating sources of support to make users aware that they exist**
  - information, documentation, quick notes
- **planning**
- **standards**
  - setting
  - enforcing
- **user groups**
  - formal
  - informal
- **software**
  - sharing code
  - support
- **hardware**
- **consulting** (highest level of user support)
  - focus on functions
  - playscript documentation technique
- **site licenses**
  - administration

In what appeared to be a natural migration, the discussion that followed centered more on user support in a distributed processing environment rather than PC hardware and software support (as in prior years). Concerns were expressed about:

- allowing users to update the database
- when users access the database...
  - are they getting the information they think they are?
  - do they understand the data well enough to ask for what they really want?
  - how do you teach people data instead of tool sets?
  - should users be provided with menus to control access?
- data security in a distributed environment

"Writing for *CAUSE/EFFECT*"

Jan Baltzer, 1991 Editorial Committee chair; Julia Rudy, CAUSE director of publications and *CAUSE/EFFECT* editor; and members of the 1991 CAUSE Editorial Committee hosted a round-table workshop for conferees interested in learning more about writing for *CAUSE/EFFECT* magazine. Participants informally discussed ideas for publication with committee members, who shared their experiences and answered questions about what they are looking for when they review articles submitted for publication.

Track I

Strategic Planning and Management

Coordinator: John Wasileski

Technology has changed our world of today in ways never envisioned twenty years ago. Trends indicate that these changes will continue at an accelerated pace and, perhaps, in ways just as unpredictable as those of the past. If we are to prepare students for the society of tomorrow and position our institutions to take advantage of future opportunities, then we must begin today to plan and develop strategies which will embed technology within the curriculum as well as in offices, and adopt a policy of strategic management in addition to building the technological infrastructure. Papers in this track address these issues.

Improving Productivity in Higher Education: The Need for a Paradigm Shift

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ABSTRACT

In 1984, IBM discovered that it was spending $900 million a year on employee education without an overall management system. Costs were going up, and quality was going unmeasured. That discovery led to a major restructuring that streamlined delivery using advanced technology. IBM developed a new paradigm for lowering costs and improving quality in its educational program.

In *Discovering the Future: The Business of Paradigms*, Joel Arthur Baker says that the key component of strategic planning is the ability to understand how one's perceptions are influenced. From the Greek word "paradeigma" meaning model or pattern, a paradigm is a shared set of assumptions. When a paradigm shifts, the rules for success change. Those who have been using the existing set of rules may be resistant to change and less likely to look for creative, innovation solutions to problems.

Is American higher education undergoing a paradigm shift? To what extent do our perceptions of how colleges and universities "work" prevent us from finding new solutions to the problems that confront us? Using analogies from the business world, this paper discusses how the predominant paradigm in higher education creates obstacles to the effective application of new technologies.

INTRODUCTION

There is universal agreement among all sectors of American society that improving education and training is essential if the United States is to remain competitive in the 1990s and beyond. Yet, as William C. Norris, founder of Control Data Corporation, has recently said, "There is little doubt that progress toward that national objective is discouragingly slow."

There is also general agreement that one of the most serious problems facing the U.S. is the seemingly inexorable rise in the cost of education with no apparent increase in education's benefits--i.e., students are paying more for less. As James Wetherbe, speaking at CAUSE90, observed, "There is a feeling that American higher education costs too much and does not deliver," and that, as Norris says, "Increased spending has not been matched by productivity improvements."

A May 1991 article in *Forbes* magazine, "College Education Without the Frills," sums up the public's attitude: "Can nothing stop this relentless inflation in college costs?" Forbes' answer: "Nothing but innovative thinking and a serious restructuring in the universities." Or, in words familiar to those of us in the information technology profession, nothing but a paradigm shift.

While there is a general sense among us that the application of information technology to higher education can somehow solve these problems--can, in fact, contribute to increased productivity--there is little consensus about how this can be done. Many in higher education, like Milton Glick, argue that "increased productivity in higher education is hard to define, let alone quantify or measure." Despite the frequent and urgent calls for restructuring education, equal numbers of articles appear bemoaning "the failed revolution," the numerous failures of technology to transform training and education and training. As Brian Hawkins expresses it: "Computing has not lived up to its promise of bringing truly revolutionary improvement in the quality of our core education programs. In retrospect, we were naive in expecting dramatic change, given the numerous structural problems affecting higher education, which technology itself cannot address."

The premise of my presentation is that as long as technology is applied to the current model, or paradigm, of higher education, the result will be merely added costs rather than increased productivity. What does it mean to increase productivity in higher education? Simply defined, it means either increasing output at same cost and/or reducing costs while producing the same output. Currently, higher education places its emphasis on increasing inputs in order to produce the same or lesser outputs. We need to develop meaningful, sophisticated measures of what students need to know and be able to do as a touchstone for more productive education policies. Our goal should be a vast increase in productivity: more learning for more people at less cost.

Why is a paradigm shift necessary in order to increase productivity in higher education? As James Wetherbe puts it, "The biggest obstacle to innovation is thinking it can be done the old way." Familiar examples of how, in Wetherbe's words, "technique lags behind technology" come to mind:

o During the American Revolutionary War, the British soldiers, dressed in bright red uniforms, clustered together in a style that had made sense doing battle with swords and shields but made them vulnerable to the Americans' new style of fighting. Feelings of superiority prevented them from seeing why they were losing the war.

o The first ATM was located inside a bank and was available only during banking hours. Real innovation occurred when it was placed outside the bank, available 24 hours a day.

o Faced with the invention of the telegraph, the first reaction of the Pony Express was to buy faster horses. When that failed, they tried to hire better riders. They did not realize that the world had changed, and they went out of business.

As Lewis J. Perlman points out in a recent *Business Week* article: "Without critical, structural changes in the system, placing more computers, videodiscs, and other gadgets into conventional classrooms will do nothing to reverse the failure of the education economy; it may actually make things worse. For one thing, we know from the extensive experience of office and factory automation that roughly 80% of the productivity gains from technology innovation come not from new hardware or software but from fundamental changes in management, organization, and human resources."

Much of the discussion of applying information technology to education treats it as an input, or an add-on. As Kenneth M. King, President of EDUCOM has noted, "The corporate sector has used information technology to reduce unit costs while information technology is widely regarded as an add-on cost for higher education." Yet when thinking about its application to higher education, the most King can suggest as an example of re-thinking instructional delivery systems is to use projectors and computers in the classroom. When King talks about "wiring the classroom" or Ball State's Ray Steele talks about "wiring the campus," I believe exemplify the principle of "technique lags behind technology." They advocate automating the existing process. And the result is ineffectiveness.

Bob Heterick has eloquently written that "microprocessor technology has clearly demonstrated that it is the idea, not the physical embodiment in artifact, that has enduring economic value. The surrogate of the library as a physical place, the computing center as a collection of machines, and the network as an assemblage of wires are weak concepts in the age of the microcosm." If Heterick is right, if the image or paradigm of networking technology is "anyplace, anytime, anyway," why would we want to confine its application to the classroom or the campus?

THE PARADIGM EFFECT

The word "paradigm" comes from the Greek word "paradeigma," meaning model or pattern. A paradigm represents a way of looking at the world, a shared set of assumptions which enables one to understand or predict behavior.

In his book *Discovering the Future: The Business of Paradigms*, Joel Arthur Baker describes what he calls the "paradigm effect." Paradigms have a powerful impact on individuals and on society because one's view of the world is determined by his or her set of assumptions. To put it another way, a person's vision is often affected by what he or she believes about the world; one's beliefs often determine the information one "sees."

To apply this concept to the application of technology, the paradigm effect may cause people to be "blind" to what is happening around them such that they may fail to "see" the potential in a new application of technology. A familiar example is that of the quartz watch revolution. The Swiss Watch Federation Research Center at Neuchatel created the first prototype of the quartz watch in 1967, but the watch manufacturers' rules about mechanical watches blinded them to the potential of the new technology. Market share dropped from the 1970 level of 60 percent to 10 percent during the 1980's.

A more recent example of the paradigm effect is described in *Fumbling the Future: How Xerox Invented, and Ignored, the First Personal Computer*. The authors recount how Xerox executives refused to market the Alto, the first personal computer which was developed at the Xerox Palo Alto Research Center, because they never fully realized the implications of personal computing. They were victims of the paradigm effect.

If a belief in an existing paradigm is unrelenting, it can lead to what Barker calls "paradigm paralysis," a terminal disease of certainty. Leaders of the old paradigm community, who have a tremendous amount of time and energy invested in using the old rules, are often resistant to change and less likely to look for creative, innovative solutions to problems. In much the same way as Thomas Kuhn, who first called our attention to the idea of paradigm shifts, observed scientists trying to "save the theory," so too do victims of paradigm paralysis focus their efforts in defending old solutions to new problems.

All paradigms give practitioners a view of the world that enables them to solve specific problems. The problem arises when the old paradigm cannot solve new problems. When change is slow, dogmatic beliefs are not as damaging. However, in periods when the ability to react and change quickly is crucial, unswerving commitment to the old paradigm can be fatal, as the British Army discovered in the American Revolution.

According to Barker, a paradigm provides both boundaries for behavior, or guides to action, and direction for success within those boundaries. When a paradigm shifts, the rules for success change. A crucial managerial tool during times of dramatic change is the skill of anticipation, the ability to foresee, to realize beforehand, the consequences of changes that are occurring in society. By anticipating major changes, rather than reacting to those changes, managers can leverage their competitive advantage during times of turbulence. Bob Heterick puts it another way: "Struggling against inevitable change leaves us the object rather than the agent of change."

Barker's view is that most of the turbulence in society today is caused by two contrasting situations: 1) the failures of existing paradigms and an unwillingness to change the current rules, and 2) the creation and development of new rules in times of crisis. Those who create the new rules, the "paradigm shifters," are almost always outsiders to the paradigm community. Since they lack investment in the prevailing paradigm, they can look for innovative ways to solve new problems.

Finally, Barker emphasizes that the key component in what he calls strategic exploration is "the ability to understand how your perceptions are influenced." Without this understanding, all else is rendered ineffective.

MAJOR CHANGES AFFECTING HIGHER EDUCATION

If Barker is correct in saying that the ability to foresee the consequences of changes that are occurring in society is a crucial managerial tool, it is incumbent upon us to begin our discussion of a paradigm shift by considering the changes that are affecting American higher education.

The 1980's were supposed to be a time of decline in postsecondary enrollments. Instead we leave the 80s with record numbers of applicants and stable to increased enrollments. What happened? While the traditional sources of college students, 17 to 19 year-old high school graduates, declined, new sources of students have emerged that have "masked" the effects of the decline.

According to the Pew Higher Education Research Program, by the middle of the 1990's, traditional college students--those who proceed directly from high school to enroll full-time in an undergraduate program--will be a clear minority of all students in collegiate programs. Non-traditional students will constitute what is being called "the New Majority" in American higher education. In 1976, traditional students comprised 60 percent of students; in 1986, 52 percent; and by 1999, traditional students will constitute only 40 percent. The Pew Trust calls this "a fundamental transformation of the student market for higher education."

What characterizes the students of New Majority? First, they are primarily working adults who come "in and out" of higher education. Second, they are placebound. Due to work and/or family obligations, these students are almost entirely placebound in their communities. It is no wonder that, in a 1986 College Board study of adult learners, location was listed as their number one consideration when choosing a college or university. Third, college students are increasingly part-time. According to a 1989 report of the National Center for Education Statistics, part-time students represent the fastest growing population in higher education. Between 1965 and 1989, part-time enrollment increased by 109 percent compared to a 32 percent increase for full-time enrollment. Nearly half of all students enrolled at all levels of higher education attend part-time. During 1989, there were 13.5 million students enrolled in higher education; 5.8 million--or more than 43 percent-were part-time.

Even now, the paradigm of the residential four-year university does not fit the majority of higher education's students. 37 percent of the nation's students are enrolled in public two-year institutions. While 57 percent of students currently enrolled are full-time, only 44 percent, a minority of all student enrollments, are enrolled full-time at a four-year institution. In my own university system, the State University of New York with some 64 member institutions, only 20 to 25 percent of its more than 200,000 students are residential.

Another significant societal trend affecting higher education is the growing importance of lifelong learning. Education no longer ends at graduation; retraining the work force is the next big task for education and training. According to the College Board's Office of Adult Learning Services, Americans work at ten different jobs during their lifetimes, each possibly requiring new skills, new knowledge, new attitudes and values. Adults will enter and re-enter higher education continuously throughout their lives to acquire these needed competencies.

A 1987 report of the National Governors' Association, "Making America Work," points out that three-fourths of the citizens who will be working in the year 2,000 are already in the labor force. Others estimate that the number is closer to 90 percent. Thus, the education and training of the *current* labor force is the key to increasing productivity over the next two decades. The American Society for Training and Development estimates that, by the year 2000, more than 75 percent of the nation's workforce will need re-training.

THE HIGHER EDUCATION PARADIGM

Despite these dramatic changes occurring in society, most discussions of the application of technology to higher education take place within what I will call the Higher Education Paradigm. What characterizes the Higher Education Paradigm?

o **It is a university.** Allan Hershfield: "There is a single more or less pervasive model of excellence in higher education--the prestigious research university."

o **Specifically, it is a residential university.** Milton D. Glick refers to Iowa State, the University of Missouri-Columbia and Wayne State University, as the "great heartland universities . . . where most college students in this country are educated."

o **Fully elaborated, it is a "complete lifestyle bundle."** Milton Friedman: "The current American idea of higher education encompasses a complete lifestyle bundle, including fancy buildings, research teams and athletic opportunities."

o **Its students are young people.** They are 18 to 22 years of age, recently graduated from high school; they attend full-time and live on campus.

o **It is sequential.** Degrees are pursued during a four-year time period via courses that meet three times a week, four or five courses per semester, sixteen weeks per semester, two semesters per year.

o **Its instruction takes place in the classroom, face to face, primarily via lectures.** Bob Heterick: "The classroom lecture has been the primary means through which institutional faculty deliver instruction since the time of the founding of Harvard in 1636. In the late 1800s, the laboratory was added as a supplement to the lecture." Since the 1950's, radio, television, film and computing have been used as marginal aids to the instructional process. "Yet, none of these techniques has radically altered the paradigm of the faculty member standing in front of a group of students, transmitting information by way of a lecture."

The problem with this paradigm is not that such institutions do not exist but rather that discussions about applications of technology take place within this rather specific context, leading to the "paradigm effect." For example, Allan Hershfield notes that television was used by 71 percent of all American colleges and universities in 1978-79, but continues, "Only a few universities and colleges have television as part of a carefully planned package of instructional materials used in their regular academic programs, and those institutions using television in this way tend not to have on-campus students." The implication: Real students live on campus.

The Joe Wyatt Challenge, an effort to identify success stories of technology application in higher education, included a selection committee made up of 29 members. Of the 25 members from higher education, 21 were from large universities; two were from four-year colleges and two were from community colleges. It is not surprising that of the 101 projects cited, the majority were from large universities. The implication: Success is defined within a university context.

Milton Glick says that the impact of computers on the educational process is "marginal at best." Commenting on the situation at Iowa State and other like institutions, Glick concludes, "I am a serious skeptic about our ability to integrate computing into most of our curriculum in the near future in a substantive way. This is not due to any lack of technological capacity. Even on star wars campuses, the culture changes slowly." The implication: Real change occurs at the "heartland universities."

I suggest that these conclusions are examples of Barker's paradigm effect. The assumptions of traditional academics blind them to the changes occurring around them and to finding creative solutions to the problems that confront them. The Higher Education Paradigm is time and place specific. In this context, it is little wonder that discussions of applications of technology consist largely of wiring the classroom or wiring the campus. Contrast these ideas to the paradigm of the "ubiquitous digital network." Something is amiss here.

WE NEED A PARADIGM SHIFT, BUT WHAT KIND?

It is not sufficient to call for a paradigm shift in higher education as so many are fond of doing; instead, we need to analyze more deeply the assumptions that dominate the Higher Education Paradigm. I have shown how changes in society are forcing a shift in the paradigm in regard to the make-up of the student body and the predominance of the residential university. Let us now turn our attention to another piece of the paradigm: instructional delivery. I believe that we will be unable to realize gains in productivity through the application of technology to higher education as long as the labor-intensive, classroom-based instructional model dominates our thinking.

The Paradigm of Quality

Higher education has created its own paradigm of quality that stands in the way of increased productivity. The conventional wisdom says that high priced, well endowed, prestigious universities can provide a better education than colleges of more moderate means and lower admissions standards. This is a variation of the old saw, "You get what you pay for." But is "quality" a by-product of cost? Increasingly, the evidence says no. See, for example, *How College Affects Students*, by Patrick J. Terenzini and Ernest Pascarella, which synthesizes 2600 studies in which researchers examined colleges' impact on students. The conclusion: Students can get just as good an education at state colleges as at the nation's more elite, private universities.

Quality in higher education is primarily defined as the amount of "inputs"--the number of Ph.D.s or the number of recognized scholars on the faculty, the number of books in the library, the number of students in a class, the amount of contact between students and faculty, both in and out of class. A low student/faculty ratio is good; a high student/faculty ratio is bad. The more time faculty spend face-to-face with students, the better the educational process. Ideas about increased time on task as a measure of quality, I believe, grow out of the paradigm of the residential campus.

Increased Quality Equals Increased Inputs

The consequence of this definition of quality is that it forms the context for the national discussion of the need to increase productivity, a discussion initiated largely by higher education's critics. Calls to increase input measures such as how many students and how many hours the faculty teach predominate. Higher education is, in a sense, being "hoisted on its own petard."

The business world has seized the theme of increased inputs. *Forbes* magazine cites the following as examples of declining productivity: "Since the 1920s, time spent in the classroom has shrunk in universities by as much as two-thirds. Since 1970 U.S. colleges have reduced each semester by an average of two to three weeks . . . . Between 1977 and 1987 arts and science faculties grew by 16.3% while student enrollment in arts and sciences decreased by 14.2%." *Forbes* goes on to compare two liberal arts colleges, one with tuition, room and board charges of about $20,000 per year, the other with charges of $7,000. At the latter institution, the student/faculty ratio is 21:1, and full-time faculty spend 12 hours a week in the classroom. The former has a student/faculty ratio of 9.5-to-1, and, *Forbes* concludes, "the resulting productivity problem is visible."

Politicians and auditors have jumped on this bandwagon. The August 7, 1991 issue of *The Chronicle of Higher Education* reports that the states of Mississippi, New York, Virginia, Arizona, and North Carolina are engaged in studying faculty workload. Workload is defined as how much time faculty spend working with undergraduate students. A recent New York State audit criticized the faculty at the State University of New York at Albany by noting that 51 percent spent fewer than nine hours a week in the classroom. The stated goal of Virginia's workload study, like those of other states, is "to develop incentives to encourage faculty members to focus on teaching and advising." Because the accepted definition of educational quality revolves around time on task, the demand for increased productivity--from higher education's critics--leads to a call for greater labor intensity. Yet, is there any evidence that an increase in contact hours will improve the quality of education? Is there any evidence that time spent in the classroom is a true measure of productivity and quality? And, how do we apply information technology to increase productivity in this context?

A Plethora of Confusion

If we accept the premise that more time in the classroom is good and fewer student/faculty contact hours is bad, the discussion becomes even more convoluted when we attempt to apply technology and, I believe, produces the widely varying, and contradictory, approaches to what is needed. Some say we should use technology to increase student/faculty contact. For example, a 1988 report produced by the National Institute of Education, *Involvement in Learning: Realizing the Potential of American Higher Education*, says, "Learning technologies should be designed to increase and not reduce the amount of personal contact between faculty and students on intellectual issues." The report condemns the current uses of educational technology which "isolate the learner from the teacher and the teacher from the assessment process."

Others advance the idea of the "whole course concept," what I call the all or nothing argument. Glick says, "If you have a complete course for me, great, but it has to be all or nothing, or I don't want it." After setting up the straw man of the "whole course replacement," he then goes on to tell us why it won't work due to the enormous investment of time and effort required to produce a very small piece of courseware. (Glick cites the popular, though somewhat inexact, figures of "100 to 1,000 hours to develop 1 hour of courseware.") Similarly, Hershfield calculates that the cost of developing and deliverying whole courses is "five times that of instruction in the traditional mode" and that "the full scale use of technology cannot result in the more efficient delivery of educational services unless technology is used to displace faculty members."

A third approach is to leave the decision to use a particular method of instructional technology to each individual faculty member in each individual course at each individual institution. As Hershfield says, "Getting a new method of instruction adopted widely requires thousand of faculty members to make *individual* decisions to use the new method." Michael Stamen, asking why after several years of significant investments in technology, so little has changed in the classroom, points to the same phenomenon. This idea also leads to predictions of failure since, as Stamen observes, the momentum of using technology in this way is "excruciatingly slow."

Another outcome of leaving the decision to individual faculty members is the the creation of "precious jewels" of experimentation. Two examples from a NeXT brochure citing examples of effective classroom technology applications will suffice to make the point. One professor created a multi-media module to be used in his class: "I specialize in African aesthetic traditions, and I've studied brass casting technologies and the contexts in which brass is used in Africa. . . . The finished module will present the different contexts in which brass functions in West Africa." A second project, called "Bringing a Dead Language Back to Life," helped the professor overcome one of his greatest instructional challenges: teaching students how to handwrite in Classical Greek and to master the language's "odd sounds which one will tend to ignore later on, because, after all, it's a dead language." While these experiments may have some value, they are hardly designed to lead to an improvement in productivity.

Only by breaking free of the paradigm of classroom instruction and the tyranny of labor intensive student/faculty contact can we begin to improve productivity through the application of technology to higher education. To do this, we need to develop new definitions of quality based on measuring outputs like student learning. Can we measure faculty productivity, or faculty achievement, by measuring student learning achievement? After all, it is not what teacher does but what he or she gets the student to do that results in learning. Why should we care if students and faculty are never in the classroom or always in the classroom if student learning results? Why should we care if faculty meet students face-to-face or never meet students face-to-face if the learning results are the same?

For those of you suffering from "paradigm paralysis"--i.e., you are convinced that higher education cannot or will not change its classroom mode--I'd like to turn to business and industry to see if we can discover models that suggest an alternate vision of the future organization of higher education.

A CASE STUDY: IBM SHIFTS THE PARADIGM

In a January 1989 article in ASTD's *Training and Development Journal*, Patricia A. Galagan describes how IBM restructured its entire education function and streamlined delivery by heading "rapidly out of the classroom into the world of advanced technology." Many of the problems faced by IBM when it began this process will sound familiar to observers of American higher education.

In 1984 IBM discovered it was spending $900 million a year, or 4 percent of its total operating budget, on employee education with no central planning or management system. Jack Bowsher, a 32-year veteran of IBM who came to education via accounting, marketing and personnel, spent the next two years examining IBM education. He discovered the following:

o **No central direction, no central focus, no plan.** "People were trying out every kind of delivery system and measurement system. The result was lots of duplication and yet also voids."

o **A cafeteria curriculum of thousands of courses.** "We put a rich smorgasbord on the table and left the choice of courses up to managers and their workers, who were often overwhelmed."

o **High costs.** "Costs were going up without control and quality was going unmeasured."

At the completion of the study, Bowsher assembled a group to re-design employee education and to create a new delivery system.

The first step was a re-definition of the purposes of education at IBM to relate it more clearly to the company's business requirements. Curricula would exist only to train people for jobs they have today or to train people for jobs of greater responsibility. That meant no more "nice-to-have" courses.

The next step was a re-design of course content with a heavy reliance on instructional design. "Instructional designers can build high-quality, efficient, motivating courses; they can reduce the length of a course by about 25 percent." The re-design put more measurement of outcomes into training by systematically testing how much knowledge and skill passes to the student in each course and measuring the course in terms of business results--i.e., how the course content applies to the job.

Finally, IBM incorporated technology into the delivery of education, reducing costs and improving quality in the process after its cost study revealed the following:

o **A central classroom.** It costs an average of $350 a day to train each student.

o **On site classrooms.** Training at IBM plant sites around the world costs an average of $150 a day.

o **Satellite delivery.** Courses carried by satellite from a central classroom to distant sites cost $125 a day.

o **Self study.** Whether by computer, video or print-based, independent study costs $75 per day.

Since the 1970's, education at IBM has been moving steadily out of the classroom into the circuits and airwaves of increasingly sophisticated delivery systems. In the early 1980s, no more than 5 percent of the company's education was delivered using technology; today that figure stands at about 30 percent. In 1989, about half its courses were classroom-based and half were self-paced, but Bowsher predicts that by the end of 1990's, only 25 percent will take place in the classroom. "That's a revolution," he says.

And I say, that's a paradigm shift.

Other Examples from the World of Training

In a *Training* magazine article titled, "Good Bye Classrooms (Redux)," Beverly Geber points to other corporate leaders who expect that significant portions of their training will be delivered outside the classroom by the turn of the century. Ford Motor Company estimates that by the end of the 1990's as much as 50 percent of its training will be out of the classroom. For example, Ford Motor Credit Company, the second largest finance company in the world, has replaced most of its classroom training with an interactive video system. Ford currently delivers all training to mechanics at its 1,500 dealerships through interactive video. Motorola estimates that between 25 and 50% of the training it will design in the next two years will be delivered via technological systems. Other companies, in an effort to reduce classroom time as much as possible, are requiring trainees to complete work on their own in conjunction with classroom work. Aetna's management training courses typically include a self-study portion that is usually delivered by computer.

Why this accelerated move out of the classroom to technology-based delivery systems? Geber cites the convergence of several factors:

o **Competition and time.** In these days of shortened product development cycles, training must become more efficient and effective just to keep up. Corporate trainers are asking, how long would it take to train everybody in a classroom? And who has time to sit in class, anyway?

o **Greater demand for training.** According to many training directors, the skills of entry level employees are horrendous; technology offers an efficient means of imparting basic information. Technology is also a cost-effective way to distribute information to current employees in a fast-changing workplace.

o **Evidence of cost-effectiveness.** Overwhelming evidence shows that these forms of delivery are considerably more cost effective than classroom training and produce learning at least equal to what can be achieved in a classroom.

o **Better technology.** The increasing power of personal computers, innovations such as hypermedia and CD-ROM, the pervasiveness of electronic communications systems have combined to produce a conceptual shift in training philosophy from a model with the teacher at the center to one that has the learner at the center.

Gloria Gery, a longtime expert in computer-based training, believes that these nascent developments will usher in a fundamental change--a new paradigm--in the way training will be delivered by the end of the decade. "We worked hard to automate the old model, says Gery. "We made it prettier, more interactive and faster. We automated it. But, fundamentally, the model was wrong." What was needed, Gery concludes, was a paradigm shift: the ability to stop seeing training as an classroom "event" and begin to see it as a workplace tool that can be delivered in a variety of ways.

CONCLUSION

When we return our attention to higher education, it is not surprising to find that new models of educational delivery are emerging from those institutions who are responding to the New Majority. Examples at all levels of collegiate instruction include the Community College of Maine, the Extended Learning Institute at Northern Virginia Community College, SUNY Empire State College in New York, Thomas Edison College in New Jersey, and the National Technological University. These institutions are Barker's "paradigm shifters," outsiders to the traditional paradigm community who are finding innovative ways to meet new challenges. These institutions see information technology as essential to their efforts, and they are all, in one way or another, developing alternatives to the Higher Education Paradigm.

Greg Kearsley, a well-known writer and speaker on the topic of information technology, is conducting a study for the federal Office of Technology Assessment on the current status and future direction of training technology in the workplace. In the future, Kearsley suggests, trainers will have to justify a decision to hold a class rather than delivering the information through some technological means. As higher education increasingly experiences the same factors affecting training's move out of the classroom, will we too someday have to justify a decision to hold a class?

Some say that day has arrived.

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Managing Strategic Information Needs in a Changing Environment

The strategic information needs of many colleges and universities are growing due to demographic changes and factors such as state mandates for assessment and strategic planning. Meeting these needs in a changing information systems environment is a challenging task requiring access to data maintained throughout multiple offices and computer systems across campus. This presentation describes a procedural routine established to create and deliver strategic information to key administrators. Past methods required manual input from various printed reports into a spreadsheet. This paper describes the consolidation of existing non-integrated administrative data into a single relational data base. This relational data base then serves as the source for Structured Query Language (SQL) queries and provides input to spreadsheet programs for reporting executive information systems (EIS) "benchmark data". This strategy allows an effective transition to a future integrated administrative and EIS system which is in ongoing development at Georgia Tech.

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Managing Strategic Information Needs in a Changing Environment

Georgia Tech, an institution known for its achievements in engineering and applied technology, relied until recently upon some information systems that were less primitive than smoke signals, but were nonetheless primitive by the standards expected of a technologically-oriented institution. This paper will present the evolution of an Executive Information System (EIS) at Georgia Tech requested by the Institute's president. It is an example of how the Institute is managing the transition to the more sophisticated information systems required to become the premier technological university of the 21st century, a stated goal of the president.

The president's initial request was for a set of "Benchmark Data" which would provide summary information on the Institute's four colleges and their constituent schools.[1] Individual school data are summed to the college level, and the colleges in turn are summed to a set of Institute-level benchmarks.

The intent was to provide Institute management with information on which to base resource allocations and to provide information of a strategic nature which could be used in determining the future direction of the Institute. Presently, the benchmark data are published annually as a paper report and are distributed to the president, vice presidents, deans, school directors, and the director of budgets. Wider distribution of the data is under consideration.

The data set was developed from the President's initial request, and refined by the Office of Institutional Research and Planning to include the following information:

[1] Georgia Tech underwent an academic and administrative restructuring in 1990 which resulted in academic programs being offered in five colleges: Architecture, Computing, Engineering, Sciences and the Ivan Allen College of Management, Policy and International Affairs. Prior to this time the four colleges were Architecture, Engineering, Sciences and Liberal Studies and the Ivan Allen College of Management.

Student Information

•Enrollment by level - headcount and equivalent full-time (EFT)

•Number of credit hours generated

•Number of degrees awarded

Personnel Information

•Academic and Non-Academic EFT personnel counts for staff and faculty

Financial information

•Information on various categories of expenditures, divided into general operations and sponsored operations

These data were then used to derive "benchmark ratios" , or productivity measures for the academic units. These ratios are used to evaluate the relative contributions of programs to the Institute's mission. The data definitions must be and are consistent across units and over time so that the data will have value for comparative analysis and decision-making. The profile of each element , e.g. , school or college, is primarily intended for use in comparing the element to itself over time. However, cross-comparisons are inevitable. One school has successfully used the information in the benchmark EIS to support its case for additional resources. Color graphics tracing the benchmark ratios over time are also included. See attachment for an example of the benchmark data.

Additionally, the onset of a funding crisis in the state University System has necessitated deep cuts in the Institute's budget. The benchmark data have proven useful in making the painful decisions on the allocation or reallocation of scarce resources. Intelligent choices based on sound information are more important than ever in an environment of reduced funding if the Institute is to be able to achieve its goals. As better information becomes available more quickly we expect management to be more proactive, as well as make better decisions, or at least make the same decisions more quickly.

The improvements in strategic and operational planning which could result from the benchmark EIS are numerous. There will be a common data set upon which strategic and operational planning will be based that will be available to planners, administrators and the staff who will ultimately put plans into practice. Insofar as these plans are implemented, the EIS data will be available as justification for decisions to take particular actions. Thus, enhanced communication, elimination of time spent in resolving differences in contradictory data, and the resultant improved quality of discussion between decision-makers who are better informed are benefits of the EIS.

In its first incarnation, the five years of benchmark data had to be manually input from various printed reports into a spreadsheet, from which the benchmark ratios and various levels of summary could be calculated. This method was slow, tedious and, because of the potential for data-entry error, necessitated extensive proofreading, which consumed even more time and effort that could have been better spent on analysis.

A second set of the benchmark data, delivered in September 1991, included seven years of data and reflected the restructuring of the Institute's academic programs completed during the preceding year. The addition of new academic programs and two more years of data made the old method even less practical. Thus, a new procedure developed over the year was implemented, in which the computer source files for the printed reports used to assemble the data were accessed directly by programmers and new files generated which were in turn downloaded to the Office of Institutional Research and Planning for incorporation into the spreadsheet format, where again summaries to the college and institute level were calculated and color graphics generated.

This procedure is still difficult and complicated due to the residence of the source files on different computer systems maintained by different offices throughout the campus, however. While the need for extensive proofreading has been diminished and the time required to input the data cut dramatically, there is still considerable delay in coordinating the acquisition of the data from various source files, and the reliance of the Office of Institutional Research and Planning on outside offices for technical assistance.

Management will be relieved of some duplication of effort in reproducing reports which answer substantially similar information requests on an *ad hoc* basis due to the accessibility of information through this system, that is, the information will be available on demand. Routine paper reporting could eventually be eliminated (though in practice, is unlikely to be), and replaced with on-line information updated on a more frequent basis.

Relational data base technology can easily provide access to more information and greater flexibility in reporting. But, the quantity of information which can be made directly available to executives is likely to exceed their time to digest it, and will therefore probably be made available to them primarily in summary form. Theoretically, a user may be able to access the entire universe of information in the data base, but more likely will work through "views" which provide a constrained menu of information pertinent to his or her needs.

The relational data base portion of the EIS is to be normalized to eliminate storage redundancy of data in the EIS from the raw data file from which it is drawn. This will also eliminate anomalies in data resulting from failure to update information in all places in which it resides and will ensure data integrity. The use of non-proprietary protocols and the distributed nature of the system will ensure system accessibility to end-users with a wide variety of computing platforms and operating systems. These improvements could have been realized without them being incorporated into the EIS, but are more valuable for their inclusion. Furthermore, they are consistent with the President's four directives for data base integration:

•Must be relational (A relational data base performs the operations necessary to retrieve data at the time the request is made, making it more more flexible than other data base systems in which data is available only in predetermined formats)

- Must have an standard query language (SQL) interface, which is a non-proprietary data base access language and is standard across industry
- Must be distributed, that is client-server not tied to a single machine or host for hardware or software
- Must be based on non-proprietary protocols

Technical Implementation of the Transition

The Source Data

The following sections describe the technical details of implementing a relational database to store executive information data which has been derived from multiple, different sources. The goals are as follows: to automate the process of collecting data, with varying record structures, from different source programs; to maintain an archive of successive years of data; and to simplify access to the data by EIS end users.

The required data have been generated by four separate report programs which were part of the COBOL-based registration and budget application systems, which were running on a CDC 990 mainframe under NOS. These applications were developed over a 13- year period, and while each has been adequate for its original intent, the data were not readily available for EIS reporting. In particular, it was difficult to respond quickly to *ad hoc* report requirements. Rather, the process was a relatively arduous one of manually scanning the four printed reports for bits of data, then inputting these data into a spreadsheet. Not only was the process laborious, but also it required building up a single record of data from files with different record structures, different reporting periods, and different summaries and breaks.

A key part of the process was to automate the collection and coordination of the data and to devise a means of providing this data with a high degree of transparency to the EIS end user. The EIS users want to use and analyze information, not to have responsibility for finding and collating data from varying sources. Using a relational database allowed the data to be stored separately - as entities from separate originating programs - and then SQL was used to relate the entities in a correct and logical manner required for EIS reporting. The relational database provided the common, dynamic SQL interface that was missing when the data was stored in separate COBOL-generated flat files.

Four separate data files were the sources of the data. A budget file provided master details for Georgia Tech's budget, including salary and fringe benefits data for faculty, staff and miscellaneous personnel, budgets for materials and supplies, travel, equipment, and other categories. Three files provided data related to credit hours, degrees awarded, and enrollment. These data were identified by college, school, and major. Student enrollment and degrees data are reported by level (undergraduate lower and upper divisions, master's and doctoral), gender and ethnic group.

These files provided detail data for specific needs, but logically provided a means for answering many information requests beyond the original intent. Additionally, when the data for past years were stored with data elements coded for year and quarter, the information was not only a resource for reporting current activity, but also provided historical comparisons for trend analysis.

The four existing programs were used as templates to create new programs which would output an ASCII file of the relevant data. The programs wrote the data to four flat files, including some formatting processing such as edit masks and writing fixed length fields so that Oracle's SQL*Loader product could load the data into a database. Finally, procedure files were created which automated the job steps required to accomplish the conversion of the data files to the ASCII output format. These procedure files will be set up so that they are automatically invoked by the original administrative programs during the normal business operations - such as budget closeout cycle or the quarter end credit hours reporting.

The Data Base Server

An IBM RISC 6000/320 was identified as a data base server on which Oracle's Relational Database was to be installed. The machine was connected to the Georgia Tech network using EtherNet running Transmission Control Protocol/InterNet Protocol (TCP/IP) The TCP/IP protocol provides a non-proprietary connectivity standard which allows for communications and also file transfer between computers. The ASCII data files generated on the CYBER 990 were transferred across the network to the IBM 6000/320 using File Transfer Protocol (ftp). The ftp process was manually initiated, but is planned to be automated as the last step in writing out the flat files of data on the CYBER 990. Ideally, the process of sending the files to the database server for loading will be accompanied with an e-mail notification to appropriate operational personnel to load the data to the database.

In setting up the Oracle data base which would store the data, a single user account was defined which would "own" all the data which had been derived from multiple application "owners" on the CYBER 990. A set of entities and their relations was designed which provided for normalized data, with redundancy reduced, appropriate primary and foreign keys defined to correlate the data, and with data stored at a detail level. The goal was to achieve an integrated set of data which could easily use common criteria in reporting summary data across Institute units.

Having defined an owner account, designed the tables, their relationships, and needed indexes, scripts were developed to create and load the Oracle data base objects from the ASCII data files. While the original source programs on the CYBER presented data for a quarter or fiscal year, with prior years archived, the Oracle data base was loaded with the last six years of budget data and the last three years of registration data, all available to the users through SQL.

It is intended that the data base will become a repository of historical data, enabling comparison to and analysis of prior years data. In setting up the tables, a year column and a quarter column were stored (except for budget data which was fiscal year-based). This allowed the data to be maintained at a detail level even though the immediate need was for summary data. The summary roll-ups were provided through coding SQL scripts, but the data remained at a detail level that can easily be aggregated for *ad hoc* reports and unanticipated needs.

The Data Base Access

Having created and loaded the data base with detail level data, several SQL scripts were defined which were executed by the end user to create appropriate data sets. These data sets were then transferred to the user's Macintosh and loaded to a WINGZ spreadsheet for further analysis. These scripts were designed to output the data in summary form, and sorted so that the spreadsheet could directly reference the resulting cells for generating graphs, and reports which had been in use in prior years. The script was parameter-driven so that the user could run the report for selected periods.

SQL provided access to and reporting of the data and was used to address a specific need, i.e., that of updating a spreadsheet from data derived from four separate source files. However, the relational data base implementation using Oracle and structured query language provides access beyond that initially required.

SQL is the ANSI standard for database access and it allows the "owner" of the data to permit levels of select, write and update access to users. Views can be defined which limit the data access to certain columns and/or rows, and which can even provide for automatic summing of data presented in the view. Such views can be used to give appropriate levels of access to various groups. Because the data base server is connected to the network, it is readily available to users with workstation access. The data must be stored centrally only once and are available to multiple, concurrent users.

Another option that might be utilized is Oracle's SQL*Net product. SQL*Net allows Oracle to run as client/server architecture, so that the application resides on a workstation, with the data base on a server node. Running client/server architecture allows the processing load to be shared between the workstation and the data base server, and the client workstation to be dedicated to processing the users application with the server handling the data base access.

SQL*Net allows other advantages beyond the scope of this paper, but one is noteworthy for this application. Oracle can utilize the SQL*Net implementation to allow a user's spreadsheet application to directly access data in a remote Oracle data base, e.g., Lotus 123 has such an option. The user then is insulated from the details of running a script to output data, transferring the data to the workstation, and loading the spreadsheet: this step is handled through the SQL*Net connection with the application always referencing the current data base. The user's access is transparent.

There is improvement in the quality of the information to the extent that users will be motivated to ensure that the definitions for the authoritative "benchmark data" are sensible, and because the existence of a commonly accessible data set can help to eliminate the use of data that are not current or are defined irregularly. Circulation of analyses based on data that are unusually defined or not current can be compounded as readers in turn draw conclusions and base decisions on secondhand information.

There will be new information sources in the sense that many users will have expanded access to data, and in that relational data base technology has greater flexibility for using data in new ways.

No immediate changes in the structure of the organization are anticipated as a consequence of this EIS system. With the ease of use of the system, some executives may elect not to delegate some of their requests for information which they had in the past. The responsibilities of staff who provide information may grow to include more analysis.

Presently, the office is developing plans which will decrease the time required to publish the benchmark data further, as well as ease access to the data. The primary goal for achievement of this is the consolidation of all source files into a single relational data base. All administrative computing at the Institute will eventually be based on relational data base technology residing on UNIX systems and utilizing TCP/IP protocols, which will give the Institute a single information standard compatible with the widest range of institutions outside the campus.

This data base will integrate the distributed files and be directly available to Institutional Research and Planning through SQL queries for the generation of routine reports such as the benchmark data, as well as for *ad hoc* queries with a much shorter turnaround time. In addition, the use of the spreadsheet to sum data and provide graphical displays could be eliminated altogether with the full use of SQL* Reports and relational data base graphics packages. Publication of the data in electronic format may also be done, as a supplement rather than a substitute for the paper report, however.

The establishment of an EIS system which delivers accurate, timely and useful information can be a difficult process. A fully integrated EIS system in which all data reside in a single relational data base accessible through SQL and capable of producing standard and *ad hoc* reports and summaries, as well as generating graphical displays is the ultimate goal for the benchmark data EIS at Georgia Tech.

Over a longer term, an automatic tie to the Administrative Information Management System (AIMS) project which is currently under way at Georgia Tech will be developed. The AIMS project will encompass financial transaction processing as well as student accounting for the campus and integrate them using relational data base technology.

A final goal is to use the new, flexible system to anticipate needs and establish proactive responses to a changing environment. Information technology continues to advance at a rapid pace, and with it the demands and sophistication of users. The lessons learned in moving from the "smoke signal" information system of old to the integrated relational data base will enable EIS designers to fulfill end users' information needs while the information is still useful.

SUMMARY: [redacted]
(Includes [redacted] Fiscal Years 1985 - 1991

Section A.

STUDENTS	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991
Fall Quarter Headcount Enrollment							
Lower Division	225	246	277	262	321	362	369
Upper Division	202	211	216	260	261	280	300
Total Undergraduate	427	457	493	542	582	642	669
Master's	225	218	221	217	208	211	195
Ph.D.	8	10	13	17	20	17	26
Total Graduate	233	228	234	234	228	228	221
Total Fall Quarter Headcount Enrollment	666	665	727	776	816	870	898
Fall Quarter EFT Enrollment							
Lower Division	193	202	225	226	222	279	283
Upper Division	202	214	249	265	331	287	337
Graduate	156	187	197	213	177	183	191
Total Fall Quarter EFT Enrollment	556	603	671	785	749	749	811
Credit Hours							
Lower Division	7,180	7,907	8,830	9,498	9,363	13,078	13,340
Upper Division	9,063	9,322	10,261	11,406	13,515	12,646	14,349
Grad-1	0	0	0	0	0	0	0
Grad-2	0	0	0	0	0	0	0
Graduate	7,047	8,207	8,925	9,020	7,575	7,983	6,280
Total Credit Hours	23,294	25,435	38,635	29,923	36,453	33,766	35,968
Degrees Awarded							
Bachelor's	76	79	69	78	98	104	103
Master's	52	70	68	65	76	64	68
Doctorate	0	0	0	1	3	2	2
Total Degrees Awarded	128	149	137	144	177	176	173

Section B.

PERSONNEL	FISCAL YEAR 1985 GEN OPNS	FISCAL YEAR 1985 SPONSORED	FISCAL YEAR 1986 GEN OPNS	FISCAL YEAR 1986 SPONSORED	FISCAL YEAR 1987 GEN OPNS	FISCAL YEAR 1987 SPONSORED
Regular Faculty	37.32	7.63	39.22	4.10	33.46	3.82
Instruction	31.80	0.47	32.95	1.34	27.61	1.47
Research	3.03	7.14	5.74	2.32	5.29	2.35
Indirect Research	0.39	0.00	0.53	0.00	0.50	0.00
Georgia Tech Foundation	0.00	0.00	0.00	0.00	0.00	0.00
Other Sponsored	0.00	0.02	0.00	0.42	0.00	0.00
Part-Time Faculty	1.70	0.00	1.90	0.00	7.14	0.00
Summer Faculty	0.53	1.33	0.63	0.84	0.73	0.70
Graduate Assistants	8.80	2.66	4.33	4.60	3.95	4.18
Misc Professional	0.00	0.65	0.00	0.00	1.51	0.26
Administrative	7.10	1.02	6.64	0.26	6.58	0.50
TOTAL ACADEMIC EFT	55.35	13.91	52.72	9.88	53.31	9.46
Staff	10.[illegible]	2.87	11.42	2.61	10.13	0.00
Student Assistants	1.32	0.34	1.34	0.21	1.56	0.00
Misc Non-Prof's	0.24	2.77	1.31	1.94	1.45	0.61
TOTAL NON-ACADEMIC EFT (Ex. OT)	11.68	5.96	14.09	4.76	13.16	6.61

PERSONNEL	FISCAL YEAR 1988 GEN OPNS	FISCAL YEAR 1988 SPONSORED	FISCAL YEAR 1989 GEN OPNS	FISCAL YEAR 1989 SPONSORED	FISCAL YEAR 1990 GEN OPNS	FISCAL YEAR 1990 SPONSORED	FISCAL YEAR 1991 GEN OPNS	FISCAL YEAR 1991 SPONSORED
Regular Faculty	36.38	3.62	34.65	3.65	37.63	3.42	38.35	3.61
Instruction	27.50	1.91	30.73	0.19	33.84	0.98	34.96	0.13
Research	2.97	1.30	3.67	2.66	3.40	2.06	2.99	3.33
Indirect Research	0.11	0.00	0.25	0.00	0.37	0.00	0.40	0.00
Georgia Tech Foundation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Sponsored	0.00	0.41	0.00	0.80	0.00	0.38	0.00	0.15
Part-Time Faculty	5.80	0.02	8.68	0.83	3.74	0.23	2.98	0.42
Summer Faculty	1.14	0.52	1.43	1.03	1.81	1.07	1.53	1.44
Graduate Assistants	5.13	4.14	3.25	3.10	8.23	1.51	9.34	3.30
Misc Professional	0.01	0.93	0.14	0.41	0.15	0.34	0.00	2.33
Administrative	7.78	0.85	7.76	1.47	8.04	1.12	9.60	0.93
TOTAL ACADEMIC EFT	56.44	10.08	57.91	10.49	59.66	7.69	61.88	13.83
Staff	9.00	0.29	10.61	1.21	11.67	1.47	9.36	0.29
Student Assistants	1.93	0.15	2.52	0.29	2.36	0.12	2.13	0.18
Misc Non-Prof's	1.78	0.42	1.24	0.49	0.20	1.14	1.07	4.44
TOTAL NON-ACADEMIC EFT (Ex. OT)	12.71	0.86	16.37	1.99	14.23	2.73	12.76	4.91

SUMMARY: [redacted]
(Includes [redacted]
Fiscal Years 1985 - 1991

FINANCIAL INFORMATION	FISCAL YEAR 1985 GEN OPNS	FISCAL YEAR 1985 SPONSORED	FISCAL YEAR 1986 GEN OPNS	FISCAL YEAR 1986 SPONSORED	FISCAL YEAR 1987 GEN OPNS	FISCAL YEAR 1987 SPONSORED	FISCAL YEAR 1988 GEN OPNS	FISCAL YEAR 1988 SPONSORED
Instruction	$1,893,313	$22,521	$2,528,019	$126,545	$2,910,641	$117,414	$3,082,963	$161,471
Research	$335,959	$837,663	$381,978	$412,540	$402,545	$415,675	$314,955	$440,368
Indirect Research	$113,037	$0	$202,022	$0	$68,882	$0	$94,243	$0
Georgia Tech Foundation	$0	$0	$0	$0	$0	$0	$0	$122,505
Callaway	$0	$0	$0	$0	$0	$0	$0	$0
Other Sponsored	$0	$4,877	$0	$53,483	$0	$3,153	$0	$92,184
Personal Services								
FTE	67.03	19.89	66.81	14.56	66.47	10.07	63.15	10.94
Amount (Includes Staff Benefits)	$2,086,604	$607,784	$2,764,395	$475,122	$2,981,269	$402,594	$3,004,678	$648,519
Non-Personal Services								
Travel	$30,973	$18,791	$14,664	$21,234	$29,335	$962	$56,804	$13,926
Operating Supplies & Expense	$223,581	$177,639	$263,141	$78,179	$289,960	$90,945	$372,397	$127,914
Equipment	$21,151	$60,847	$69,819	$18,033	$81,504	$41,741	$56,282	$26,169
Total Non-Personal Services	$275,705	$257,277	$347,624	$117,446	$400,799	$133,648	$487,483	$168,009

FINANCIAL INFORMATION	FISCAL YEAR 1989 GEN OPNS	FISCAL YEAR 1989 SPONSORED	FISCAL YEAR 1990 GEN OPNS	FISCAL YEAR 1990 SPONSORED	FISCAL YEAR 1991 GEN OPNS	FISCAL YEAR 1991 SPONSORED
Instruction	$3,829,305	$46,532	$4,025,617	$162,994	$4,092,364	$83,849
Research	$333,505	$464,237	$392,788	$338,323	$379,600	$613,383
Indirect Research	$81,203	$0	$87,973	$0	$96,316	$0
Georgia Tech Foundation	$0	$127,326	$0	$0	$0	$0
Callaway	$0	$0	$0	$0	$0	$0
Other Sponsored	$0	$146,760	$0	$104,901	$0	$72,903
Personal Services						
FTE	72.28	12.48	73.83	10.42	74.56	16.94
Amount (Includes Staff Benefits)	$3,641,052	$698,203	$4,035,850	$497,696	$4,098,970	$626,134
Non-Personal Services						
Travel	$47,479	$29,749	$49,171	$22,753	$51,946	$41,000
Operating Supplies & Expense	$449,906	$56,903	$395,847	$83,535	$366,635	$85,000
Equipment	$105,576	$0	$25,310	$2,234	$50,629	$18,000
Total Non-Personal Services	$602,961	$86,652	$470,328	$108,522	$469,210	$144,000

Section C.

	FY 1985	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991
Total Gen Oper Expenditures	$2,342,309	$3,112,019	$3,382,068	$3,492,161	$4,244,013	$4,506,378	$4,568,180
Special Initiative							
Sponsored Operations	$865,061	$592,568	$536,242	$816,528	$784,855	$606,218	$770,134
Departmental Sales & Services	$12,062	$0	$0	$0	$0	$0	$0
GRAND TOTAL	$3,219,432	$3,704,587	$3,918,310	$4,308,689	$5,028,868	$5,112,596	$5,338,314
RATIOS							
Hdct Enrollment & Gen Res Fac (Gen Opns)	16	18	22	25	24	23	23
Credit Hrs/Reg Faculty (Gen Opns Instruction & Resea	602	657	852	982	885	905	948
Regular Faculty/Staff (Gen Opns)	3.68	3.43	3.29	3.40	3.27	3.22	4.01
Sponsored Opns/Reg Faculty (Gen+Spons)	$19,388	$13,079	$14,407	$23,875	$20,492	$14,768	$18,354
General Opns Instruction & Research/Credit Hr	$96	$114	$118	$114	$137	$131	$124
Sponsored Opns,% of Grand Total	26.70%	16.00%	13.69%	18.95%	15.61%	11.86%	14.43%

NOTE: "Course type" (lecture, laboratory or studio) is an important consideration not factored in the above data. The predominant course type in the College of [redacted] employs the laboratory (studio) mode of teaching without associated lecture activities, requiring courses to be appropriately limited in size. The ratios resulting from using data which do not consider course type tend to be [redacted] when compared to other units with predominantly lecture courses.
SOURCES: Headcount enrollment: Student History File; Credit Hours: Office of the Registrar, (RMSR01); Financial: Analysis of Operating Expenditures (BUD903)

Changing the Culture
Implementing TQM in an Information Technology Organization

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Total Quality Management (TQM) is a structural system for creating organization-wide participation in planning and implementing a continuous improvement process for more effectively meeting the needs of the customer. It is increasingly being used in the industrial sector to improve product quality and is beginning to be used in the service enterprises. Several institutions of higher education are now beginning to implement TQM programs. At the University of Michigan, the Information Technology Division (ITD) has taken the lead in pursuing TQM. This paper will describe some of the basic premises of TQM, how TQM is being implemented within ITD, and what has been achieved to date.

I. Introduction

- W. Edwards Deming
- Why TQM?

II. What Is Total Quality Management?

- Definition
- What Skills are Needed
- How Quality Saves Resources

III. How Did We Go About It?

- Management Structure
- Training
- Quality Improvement Teams
- Getting Started

IV. What Is the Progress to Date?

- Process Improvements
- Cultural Change
- Staff Reactions

V. What Is the Expected Result?

- Paradigm Shift
- Cultural Change
- New Way of Doing Business

VI. What Has Been the Most Difficult Aspect of TQM?

Changing the Culture

Implementing TQM in an Information Technology Organization

Introduction

Within the last year, a great deal of interest has been generated within the higher education community in Total Quality Management or TQM. Several Colleges and Universities are now putting TQM programs in place. NACUBO, CAUSE, and EDUCOM are offering seminars in TQM. This focus on quality is borrowed from the industrial sector, where product quality is mandatory if companies are going to meet the challenges of increasing competition. As we all know, TQM concepts have been one of the factors that has led to the success of the Japanese in establishing a lead role in the international economy. These TQM concepts were brought to the Japanese by W. Edwards Deming, who at the age of 91, continues to carry his message to managers both in the U.S. and abroad.

A TQM program was first instituted at the University of Michigan by the University Hospitals about three years ago. Hospitals have been faced with increasing costs, rising at about 6% per year, while revenues have been increasing only about 3% per year. This, coupled with increasingly restrictive reimbursement regulations and greater competition meant that costs had to be driven out of the system. Whereas it is not easy to motivate staff to cut costs and increase productivity, it is relatively easy to motivate them to a positive vision of increased quality. Early results were encouraging. Using a quality improvement process developed by Qualtec, a subsidiary of Florida Power and Light, real improvements and savings were made. The time to admit patients was reduced from 120 minutes to 20 minutes with a resultant savings of $250,000 annually. The number of care givers in ICU's were increased and the cost was reduced by $150,000 per year. Operating Room throughput was increased by 33%. Delays until discharge after patients were medically ready to leave the Hospital were reduced by 0.7 days. As the program continued, there were more equally impressive results. Currently the Hospital can demonstrate $14 million in savings resulting from TQM efforts.

The Information Technology Division (ITD) at the University of Michigan wanted to improve its ability to meet user needs, to free up resources for new initiatives, and to be viewed more positively by the University community. Early in 1990, University Information Systems (UIS), a component of ITD, began looking at TQM as a way to improve its service to its client base. This approach caught the interest of the rest of ITD and in the Fall of 1990 a formal planning effort began. A great deal of assistance in understanding how TQM could be implemented was received from the University Hospitals. We were also fortunate in having available to us Dr. Ed Rothman, Professor of

Statistics and co-presenter with Dr. Deming at many TQM seminars. With help from these two sources, a plan was prepared and TQM activities began in earnest late in 1990. We are now one year into our TQM program.

What is Total Quality Management?

Total Quality Management is based on systems thinking. A system is a group of components within an organization that work together for the aim of the organization. For an organization to achieve its aim it must be managed. Management's responsibility is to strive to optimize a system and to keep it optimized. A key element of optimization is to assure that the output of the system meets the requirements of the customer. Quality, then, is defined as meeting valid customer requirements. A system must have an aim and everyone involved with the system must understand and share this common aim. Every process within an organization must be optimized to achieve the aim of the system and to satisfy valid customer requirements. Thus, Total Quality Management is an all-encompassing approach of managing an organization in an optimal way so that the goods or services it produces meet the needs of the organization's customers. These are all elements of the Deming approach to TQM and it is upon these concepts that ITD's TQM program is based.

What Skills Are Needed in the Quality Improvement Process?

The focus of the quality improvement process is external---upon the customer. As the people within an organization try to continually improve their service to the customer, it will need to employ people skills and analytical skills. People skills include team-building techniques, brainstorming, nominal group technique, focus groups, coaching, and mentoring. Analytical skills include flowcharting, checklists, histograms, pareto analyses, fishbone diagrams, run charts, scatter diagrams, and so forth. The process of migrating from the current management culture to the new management culture will rest upon these tools.

How Does Quality Save Resources?

TQM tries to take work out of the system by eliminating complexity, rework, duplication and waste. TQM does not rely upon inspection after the fact but tries to "move quality upstream". If defects can be found early in a process, then rework or waste can be avoided. If the plan or design can be improved, then duplication of effort can be avoided. If there are steps in a process for which there are no customers, then these steps can be eliminated. Resources released by process improvement can be reinvested in new activities and innovation. While this is an important outcome of TQM programs, it is not the primary reason that ITD began its TQM program. The single most important aim was to better serve our customers and the institution. Customer focus has become a key ITD value.

How Did We Go About It?

ITD is made up of six line units reporting to the Vice Provost for Information Technology. The Directors of each of the six units, plus the Vice Provost and Deputy Vice Provost, comprise the Senior Management of ITD. ITD Senior Management appointed a planning committee to recommend how ITD should approach TQM. The planning committee, consisting of one member from each line organization within ITD plus Dr. Rothman, recommended the formation of an ITD TQM Council to oversee the process, a Steering Committee to support the Council, an educational program, and a structure for organizing Quality Improvement Teams (QIT's) and Task Forces. The planning committee became the steering committee; the steering committee and senior management together form the TQM Council.

The Council meets one hour each week. Its purpose is:

To set the direction and demonstrate the commitment to TQM.
To appoint the steering committee.
To pick QIT pilot projects and receive recommendations from them.
To agree to support time lines.
To sanction, attend, and support training sessions.
To define target customers.
To refine the operational definitions of TQM within ITD.
To manage the overall scope of the TQM activities.
To tie TQM to ITD's strategic plan.

The steering committee meets each week for two hours and provides staff support for the Council, prepares Council agendas, monitors progress, makes recommendations to the Council for Council action, and generally facilitates the work of the Council.

Task Forces are groups charged with investigating and recommending improvements in organization-wide policies and/or processes. Task Forces are appointed by the Council for specific purposes and disband when the purpose has been achieved. So far, three task forces have been appointed:

Purpose and Values - To develop a statement of values to be used in guiding all ITD activities. Subsequently, to develop a statement of purpose of ITD that will define a common direction.

Management Expectations - To Provide ITD with a description of what is expected from managers.

Personal Work Planning - To develop an approach to employee performance planning and to specify ways that employees may expect to increase their compensation.

Quality Improvement Teams (QITs) are formed to bring about improvement in a process that the team has identified as needing improvement. A specific seven step process, developed by Qualtec, is followed to select a theme, determine causes, select and implement countermeasures, measure performance improvement, and operationalize the changes. Six QITs are now in place within ITD.

All Task Forces and QITs are led by a trained team leader assisted by a trained facilitator.

How Did We Begin?

A one day introduction to TQM concepts, called TQM 101, was put together by the Steering Committee. The curriculum for this course consisted of the following:

Welcome and Introduction by an ITD Senior Manager
What Does Quality Mean to You - Group Exercise
Why Change? Why Quality? - presented by an ITD Senior Manager
What is Total Quality? - presented by Dr. Rothman
Red Bead Experiment - conducted by Dr. Rothman
Deming's System of Profound Knowledge - presented by Dr. Rothman
Customer/Supplier Group Exercise
Introduction to Deming's 14 Points - presented by Dr. Rothman
Implementation of the Total Quality Improvement Process (TQIP) within ITD - presented by an ITD Senior Manager
Summary Exercise
Questions and Answers - All presenters

Up to 100 persons could attend a TQM 101 session. It was presented first to ITD top management, then to middle management, and finally to the rest of the staff. The reason for rolling it out in this fashion is so the manager would be informed of the TQM program before his or her subordinates did and would be in a better position to answer questions. Not only ITD staff, but many persons outside of ITD attended one of the 13 sessions given.

A second one-day course, TQM 102, providing elaboration of TQM concepts was given for about half of the ITD staff. The curriculum for this course consisted of the following:

Welcome and Introduction by an ITD Senior Manager
Learning Cycle - presented by Dr. Rothman
Sense Deception - presented by Dr. Rothman
Plan-Do Check-Act (PDCA) Experiment
Tampering - presented by Dr. Rothman

Measurement - presented by Dr. Rothman
Systems Thinking - presented by Dr. Rothman
Quality Improvement Process - ITD facilitator
Questions and Answers - All presenters

A five day team leader training course was designed based on Qualtec materials. This has been presented twice, so far, with a group of 20 in each session. An additional training course for team facilitators is being designed. An ITD staff member attended the Qualtec Team Leader and Facilitator Training for Trainers and each Task Force and QIT is led by a trained team leader assisted by a trained facilitator.

What is the Expected Result?

TQM is not a short term project that will end at some given date in the future. TQM is a will engender a complete change in the management style and culture of the organization. We expect that ITD's way of doing business will change; there will be a management paradigm shift:

- From Managing to Leading. Instead of supervising every aspect of an operation, we must lead the organization by setting the aims, allocating resources, and defining the expectations of each component of the system.

- From Control to Coaching. Instead of retaining total control of the operation of a system in management, we must coach our staff in operating the system to best achieve the aim of the system.

- From Quantity to Quality. Instead of focusing on the quantity of output, we must focus on the extent to which the output meets the needs of the customer.

- From Opinion to Data. Instead of making system changes on the basis of opinion or anecdote, we must make changes based on facts that demonstrate change is needed.

- From Resistance to Change to Open to Change. Instead of imposing change upon the staff, we must allow them to participate in the process by which change is instituted.

- From People as Commodities to People as Resources. Instead of treating people as unknowledgeable interchangeable components, recognize that they comprise the knowledge base necessary to operate the system.

- From Suspicion to Trust. Instead of being suspicious of each other, we must learn to trust each other as cooperating members of a team.

- From Compliance to Commitment. Instead of behaving in a certain way because we're required to, we must move to behavior resulting from an internal commitment to the team.

- From Internal Focus to Customer Focus. Instead of making the aim of the system internal convenience, the aim of the system must be on meeting the needs of the customer.

- From Individual to Team. Instead of individuals competing with each other for extrinsic rewards, we must function together as a team for a common purpose.

- From Detection to Prevention. Instead of after the fact inspection of the output of a system, we mu· build quality into the system so that errors are prevented from occurring.

What is the Progress to Date?

Although none of our QIT's have completed their work, nevertheless change is evident. The term "customer" is now heard regularly. Customers, both internal and external, are involved in the decision making processes; customer needs and quality indicators are common concepts. Meetings are conducted in accordance with TQM concepts, that PAL (Purpose, Agenda, Limits). Customers are beginning to comment on instances where service levels exceeded expectations. ITD TQM training has served as a model for the campus wide training program, just now beginning.

Whereas the bulk of the activity to date has been part of the "roll-out" of TQM, ITD is now beginning the effort to employ TQM concepts in its everyday activities. Each unit within ITD is identifying key processes, identifying the customers of those processes, determining the valid customer needs and quality indicators, and establishing run charts. These run charts can be used to track the customer reception to ITD activities and to measure the success or efforts to improve the quality of service.

The ITD staff have reacted very positively to the TQM effort. Evaluations from TQM 101 and 102 have been very favorable. Many persons who were originally critical have become supporters. And while we still have critics, they are not impeding our efforts. The negative comment that we have received most often is a skepticism that the top management of ITD is serious and will follow through. There are many who wonder if TQM isn't just another fad that will pass and be forgotten.

What has been the most difficult aspect of the TQM effort?

As mentioned above, TQM is based on systems theory. Every system must have an aim and all functions within that system must be focused on achieving that aim. This means, for example, that the staff must be focused on valid customer needs. This throws into question many of t ~ current management practices such as performance reviews, merit pay, and manageme .. by objectives. These practices create competition among the staff rather than cooperation. Staff members compete with each other for the better performance review and for the better pay increase. The focus becomes how to please the boss, with all the positive and negative connotations that implies.

As Dr. Joseph Juran pointed out years ago, the problems with achieving customer satisfaction lie with the process itself and not with the workers. There is a rule of thumb that 85% of problems are with the system and only 15% with the people. Individual performance is impossible to evaluate objectively because performance is so much controlled by the system. Yet we continue to do employee evaluations and base pay increases upon them. We do this despite the fact that almost no one is happy with this way of compensating people. University staff find that reconciling new TQM based ideas with long held managerial concepts to be very difficult. In facing these issues, one finally begins to understand the profound effect TQM concepts will have on the way we do business.

DO YOU HAVE YOUR BACK TO THE FUTURE!

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California

Administrators and managers of information systems, or directors of computer operations and data processing centers -- what is our role in the structure of campus administration?

Technology, and the knowledge to use it, has spread to every desktop. Job descriptions and roles are changing. Directors and other office managers are needing to adapt to these changes. The role of the computing center director is evolving from one of data processing to one of providing information services.

The success, not only of the director of computing, but also of the institution itself, can be measured by the ability to become an agent of change. This paper examines the factors and skills needed to facilitate the process.

CHANGE

Information technology is all about change, and the director of technology becomes an agent for change-- change concepts and approaches that are no longer optimal. Most of us don't get the chance to start with a clean slate.

Change of any kind causes discomfort because it disrupts people's assumptions about the world they inhabit. It becomes acceptable only if it's less troublesome than the Status Quo. So we have to figure out how to take the **Status** out of **Status Quo**. In fact, I think God was able to create the world in only six days because there was nothing to change.

The most important quality needed to expedite change is to be able to shake off the fear of doing something different, because to make it all work, gigantic changes need to happen.

Campus executives are looking at the changes in technology, but they don't realize they need to change the organizations and processes that go along with it. See Figure 1.

Let's look at where we've come from - the system and the people involved - and see where we're going.

In the computing center, there was a zoology professor or an accounting professor, someone who was really great with spreadsheets. Whoever the source, it was more than likely an introspective individual with a solitary nature. The staff was writing code that provided entry, processing and output for the operator. Stacks of data arrived regularly, reams of greenbar were delivered to the office on somewhat of a regular basis in the form of lists.

Office staff personnel were treated like customers, they were not users at the time. They were told what they could have and when. In the computing center, we did things FOR and TO them. Even when data entry had begun to spread to the offices, the control was still maintained in the computing center.

The office director was in control of her staff. Each one had a role to fill. For example in the Admissions office, letters of inquiry were opened, sorted and entered by entry clerks with some sort of title. Letters were generated by another person or persons. High School recuruiting and fairs were accomplished by someone else. The director had control over who did what and when. The data in the computer was controlled by those with that role. No one else had access. Certain data arrived on their desks in a designated form.

Each office had to be directed and administered similarly, since the information, being on paper or in the computer was not easily accessible. Even when they decided to bring in some PC's, there was still a feeling of control. Everyone had her own pocket of technology and could provide herself data when and how she needed it.

One day, it was decided that the data needed to be easier to be access by more people. See Figure 2.
This is the first major development since the invention of the printing press. The printing press was developed so that everyone could have a copy. Now all we need is access to the screen copy.

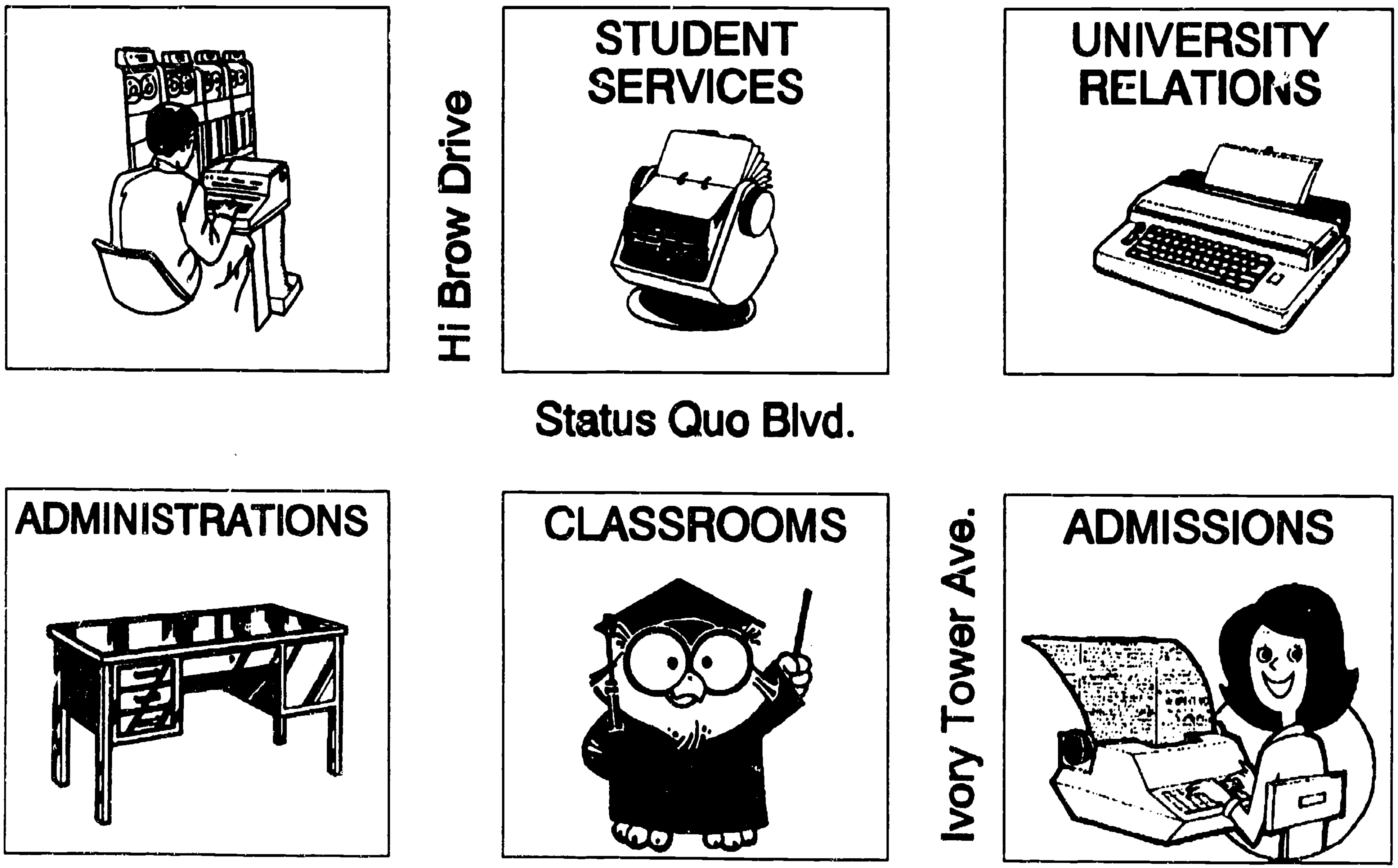
STUDENT SERVICES
UNIVERSITY RELATIONS
Hi Brow Drive
Status Quo Blvd.
ADMINISTRATIONS
CLASSROOMS
Ivory Tower Ave.
ADMISSIONS

Figure 1

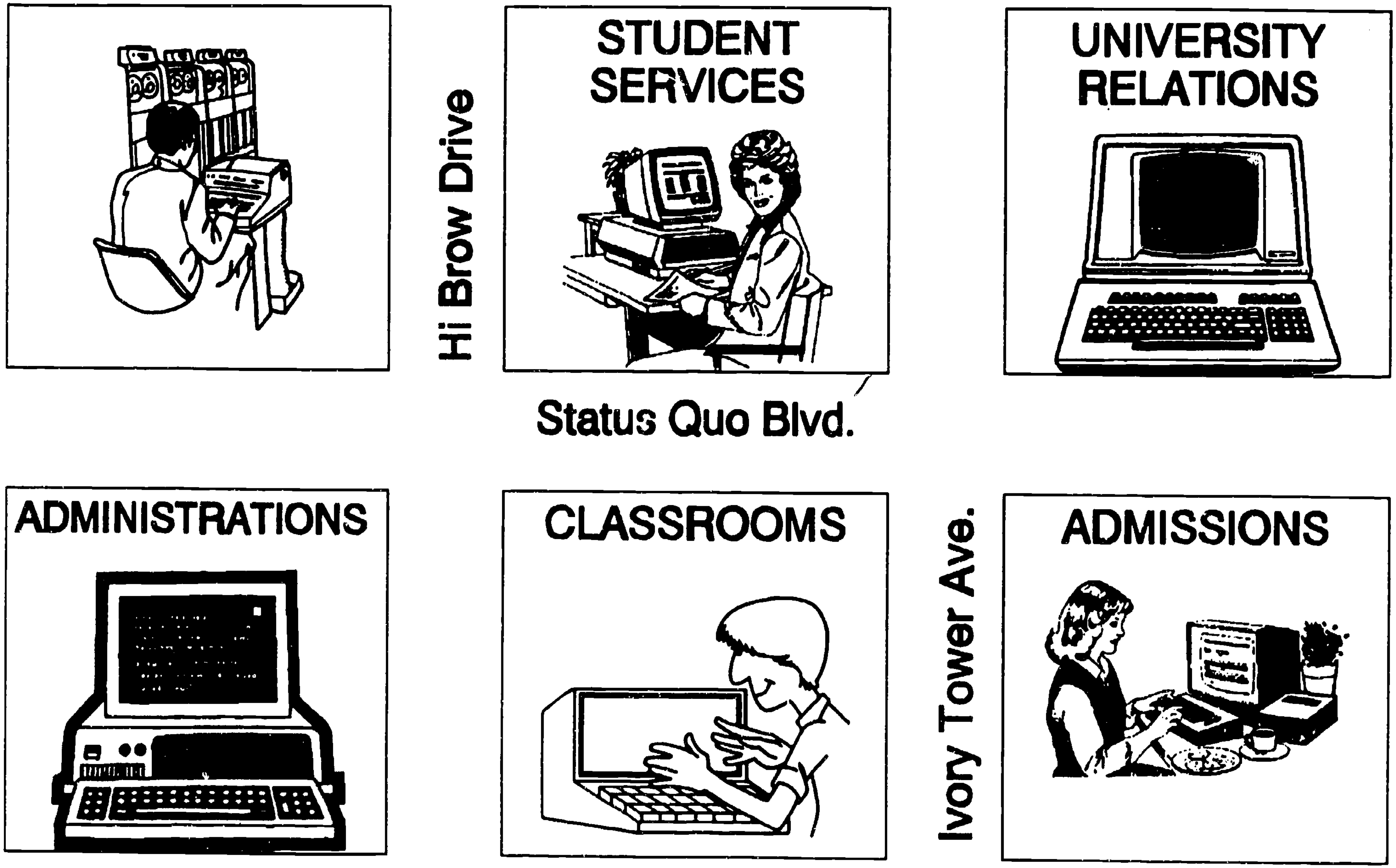
STUDENT SERVICES
UNIVERSITY RELATIONS
Hi Brow Drive
Status Quo Blvd.
ADMINISTRATIONS
CLASSROOMS
Ivory Tower Ave.
ADMISSIONS

Figure 2

DISTRIBUTED PROCESSING

With data access on every desk, things can change fast. When twenty five checks arive in the mail from major donors, or twenty letters of application, several can input the data, manipulate it and get results. Inquiry can occur on every desk. No one is waiting for lists from the computing center when each one has a screen copy.

With information created in the office environment instead of the computer center, what are the job roles of office personnel? What is the role of the director? She no longer has control of who does what or sees what data. How do people decide what their roles are.

It now appears that skills become more important than roles and not only professional skills - but also problem solving skills and leadership skills. Ability to lead, to initiate new procedures, to share knowledge; these are the skills that will take people to new leadership roles. Staff learn that it's not so important to move up as it is to do a good job where they are and get paid in accordance with how well they perform in the new environment. See Figure 3.

Information, now readily available, begins to flow where it's needed. This flow dictates responsibility and eventually becomes the design for a new decentralized system. The system, the way they do their job, changes. WHO they are changes to WHAT needs to be done.

Requests for information begin to proliferate. Not only from the office responsible for the data but from other related, and sometimes, non-related offices. How does the information get from one office to another, who's responsible for its reliability and security? Barriers between directors and staff break down or are built up as the case may be.

Teams begin to develop between offices as the 'job' of getting a good student bill in the mail continues to grow. When is the housing office going to enter the dorm data, how come the meal plan has not been entered? Nobody told me not to charge tuition, when did he drop out.

Teams of players across many offices begin to work together. Jobs need to be done that never needed to be done before. Will the director give me time to enter the data before the first of the month. The director begins to wonder "who is telling whom what to do anyway".

There is now a distinctive loss of control. The computing center is completely lost. What is it's role in all of this? Titles of programmer and programmer/analyst become obsolete. The code that's already written is probably causing job rigidity instead of creating opportunities for users.

Office personnel are no longer customers, we're having to work WITH them; sometimes it seems they're even doing things for themselves without our input. Whose computer is it anyway! Are we like Gandhi who once said "There go my people, I am their leader, I must follow them"
See Figure 4.

Figure 3

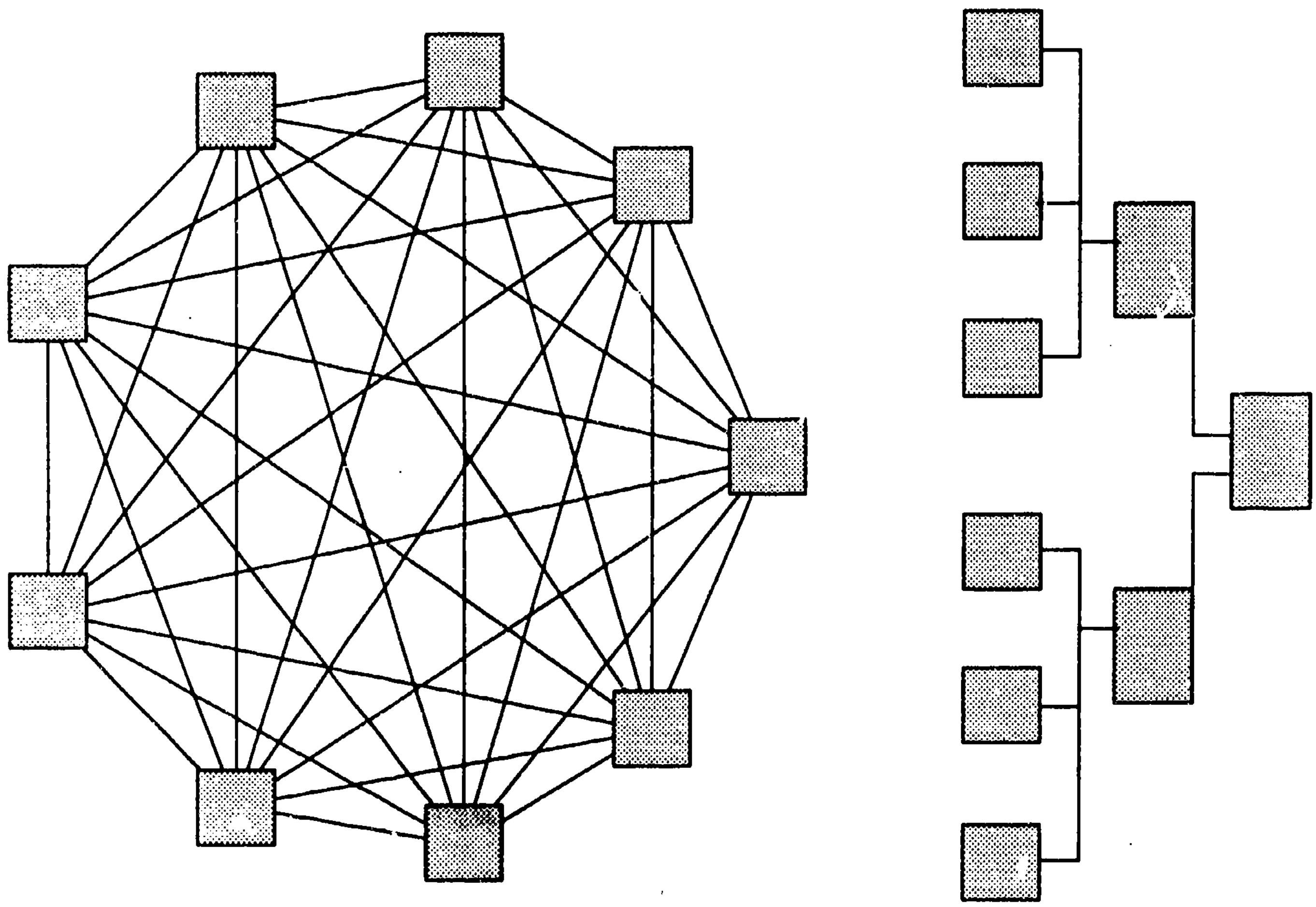

Figure 4

CHALLENGES AND OBSTACLES TO CHANGE

- There is a general resistence to change
- So we keep changes to a minimum
- Because of inadequate people skills
- There is a failure to train people properly
- All must learn that technology doesn't solve problems, people solve problems.
- Success rests with OUR ability to be effective, as much as with the hardware and software.
- Programmers need to learn the users language, the language of business.
- Develop mutual respect with office personnel

EVERYONE NEEDS TO REALIZE THAT OFFICE AUTOMATION REDESIGNS BUSINESS PROCESSES

Figure 5

WE MUST CONVINCE OFFICE DIRECTORS THAT

- The integrity of their data is assured
- Data is secure from all intruders
- The purpose of jobs won't change, only how they are done.
- There is prompt availablility of information
- Users are integrated
- Data is portable

FOR THAT TO HAPPEN SHE MUST

- Be willing to take risks knowing she will get what she needs.
- Learn how to diagnose and resolve problems
- Think about problems from the computer perspective
- Be willing to develop local expertise
- Read manuals

CHANGE TO WHAT

As you can see, Information Technology doesn't just automate clerical processes, but is beginning to change the way people think about their work. It becomes more integrated with the entire processes of the institution.

Providing an accurate bill becomes the responsibility of many people in various offices. It becomes an ACTIVITY or function of the college. Technology is sed to help people co-ordinate these activities. It looks at:

how important is that activity
how important is the system that supports that activity
how effective is the system that supports it.

In other words the computing system must meet the goals of the institution. It is designed to help people achieve their jobs, and should be defined in terms of **WHAT** it does not in terms of **WHO** uses it.

Systems will be created with centralized architecture, but the access to the information wil be decentralized. LAN's will replace the one-vendor, one-operating system approach. Network management will be the crucial operational role of the 90's.

If a link can be created between the Arctic and the Anarctica, we certainly should be able to connect effectively between two offices on our campus. Maybe we need to move one to the north pole.

In order to keep the system in line with the institutional goals, we need to look at how to design it. For it to be successful, we need to get involved in its design from the beginning. We can't let it become a truckload of garbage.

Islands of technology or data are the greatest challenge to good design. MY data, YOUR data, and MY printer need to become outdated concepts. Data should be available to everyone who needs it and, of course, ONLY to those who need it. Access is defined by need, not by title.

Networks used to be designed in order to share computer resources, now they're needed to share the results. They need to be designed with flexibility since needs change. Ken Olson, president of Digital Equipment says that computers are peripherals. You start with the network and hang the computers on later.

LANs are designed like sidewalks, they are placed so as to integrate what needs to be integrated. However, it must be done carefully. If one is not careful when installing plumbing, not only the hot and cold water can mix; the sewer can be combined too.

THE PEOPLE WHO MANAGE

Failure or success of the system rests with the people who are asked to change - to change attitudes and work habits. Throwing a piece of hardware at a mess doesn't solve it, it only creates an automated mess.

Computers no longer just perform basic administrative operations, but have become systems that can improve management decisions and techniques creating a competitive edge in the field of education. The old infrastructures will not hold up to the pressure of expanding information. The institution must view its current structures and use personnel in new ways. Policies must be changed.

Top executives, howev ḷidn't include in their resumes their knowledge of information technology, so it becomes our responsibility to be the thought leader. But they can not be spectators. They need to work with us to promote responsible end-user computing. We neea to help guide the institution efficiently and intelligently through the transition from the machine-centered age into the user-centered desk-top environment. See Figure 5.

Without trust and teamwork, there can be no joint planning to find out what it is they need to do their jobs and how to design the system to achieve that goal.

This type of design demands an inter-dependent infrastructure. The teams will often be inter-departmental, flattening the organization, as strategic systems of institutionalized information develop. There will be less hierarchy and less paper. There will be no directors or secretaries, no white or pick collar workers -- only knowledge workers. American industry is calling it Participatory Management.

Those selected for the team will be those who have the most adaptability and problem-solving ability, not those who hold titles or who have technical skills. The wisest decision maker will become the leader. See Figure 6.

INFORMATION SYSTEMS PERSONNEL

A poll taken in June 1989 stated that IS positions are being filled with people who have knowledge of the industry. For us that means knowledge of higher education. It also stated that the skills most important to success in the position are

1. management skills
2. inter-personal skills

Technical skills were far down the list. There is an obvious need for technicians and for the director to have technical skills but without the other two, failure is certain. Desktop computing requires management of technology, people and processes. See Figure 7.

Technology has always stayed somewhat ahead of our ability to manage it. The majority of the tasks completed by a director of information are no longer technical in nature. Our academic backgrounds in mathematics and computing science and programming don't play the key role they once did. There is a much greater emphasis on business and interpersonal skills. Management skills that are necessary are

planning
budgeting
supervisory

Flexibility, an inquisitive nature and creative problem solving can not be measured but are necessary personality traits. The ability to prevent situations from developing into problems is all-important.

Figure 6

WE ARE THE THOUGHT LEADERS BECAUSE WE

- Keep abreast of new technology developments
- Have the responsibility to encourage its use
- Understand the flow of information through the organization

THERE ARE OBSTACLES TO OUR SUCCESS AS THAT LEADER IF WE

- Refuse to admit the power and capacity of end-users
- Can't talk their language
- Are unwilling to give up our power
- Have inadequate people skills

WE WILL FAIL IF WE

- Resist change and do not prepare for it
- Don't adapt - just wait it out
- Continue to function on outdated objectives as the institution changes.

Figure 7

STANDARDS FOR MEASURING SUCCESS:

THE SYSTEM MUST

- Be cost efficient
- Conform to institutional need
- Provide services
- Give value to information.

Technology has always stayed ahead of our ability to manage it. Do the following duties we perform lead to a successful system.

- Developing proposals and analyzing bids
- Planning technological growth and educating users
- Justifying upgrades and defending response time
- Co-ordinating the work of others
- Managing contracts and other vendor relationships
- Training, documenting, consulting, selecting software
- Hardware operations and software maintenance
- Insuring integrity and security of data

Success is not a function of technology, but a function of vision, using the information network to array the world and define its possibilities. "It's not the machine, but the curiosity and the courage that counts," says Paul Soldener, world renown ceramist. That holds true in computing as well.

We must be able to project technological developments, with a need to be visionary, keeping in synch wih developments on campus and the direction they take.

We need to have skin as thick as a tank so that we can deal with high-strung egotistical tech staff. We need to be able to communicate with people who know nothing about computing and those who are proficient users, and some users who think they know everything. We must deal with directors who don't like what they are using and have been to a conference where they've seen a system with bells and whistles and will do everything they ever wanted and more; except of course to integrate with the rest of the office.

We need to influence users without making their decisions for them. We need to have patience and be prepared for lots of disappointments. We need to have a certain presence, exuding confidence but without arrogance. We need to be flexible yet make good decisions.

Last of all, we need to be able to solve problems we know nothing at all about. And come up with a solution that will make everyone happy.

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Strategic Planning:
Guiding the Computing Organization Toward the Future

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Abstract

What is the role of strategic planning in guiding a university computing organization through the next decade? An environmental scan can provide a general description of the computing organization of today -- its organization, the environment in which it operates, and the services it provides. Similarly, a review of the literature can provide a picture of the computing organization of tomorrow. From this environmental scan some trends and issues emerge -- decentralization, autonomy vs. standards, technology-based planning vs. application-based planning, the rapidly expanding user base for traditional information systems and services, and the re-emphasis of the academic mission. How does a computing organization -- one in an institution having a relatively mature set of information systems and a sophisticated set of traditional information system users -- orient itself toward meeting the challenges of the future? Strategic planning -- building on the foundation of the university's academic mission, drawing on strong user input, clearly focused on a manageable set of future-directed goals, and translated into specific and measurable objectives and initiatives -- provides the structure to move a computing organization forward. This paper describes a strategic planning process developed in this context of future-oriented trends and issues, presents the specific goals developed in this strategic planning process, and discusses some of the activities and initiatives which have been generated from this planning process.

Presented at

CAUSE 91
Anaheim, California
December 5, 1991

Strategic Planning
Guiding the Computing Organization Toward the Future

Indiana University's University Computing Services is using a process for strategic planning which has served the organization extremely well. A discussion of computing at IU today, as well as trends and issues shaping the computing environment of tomorrow will help to present the planning process and its resultant strategic plan in proper context.

The Computing Organization Today

The senior management of University Computing Services reports to the Associate Vice President for Information Resources. The Associate Vice President for Information Resources is the chief information officer for the University and reports jointly to the Vice President for Bloomington (who chairs the university's academic cabinet) and the Vice President for Indianapolis (who chairs the university's operations cabinet). The Office of Information Resources provides leadership on issues relating to information technology and resources for the university. The Office has operational responsibility for University Computing Services, University Printing Services and University Telecommunications and also has coordination responsibilities through plans, standards and polices for campus level computing, video, voice technologies, networks, learning technologies and other information resource functions.

Since January of 1989, University Computing Services (UCS) has encompassed both academic and administrative computing. The merger of these two groups has resulted in an organization that can function well under the common mission of providing an excellent computing and electronic information environment for scholarship and the service functions that support it. There are six operational divisions; Computing Services, Information Systems, Network Systems, Support Systems, Workstation Systems, and Management and Administration reporting to the Associate VP of Information Resources. The model for the UCS Organization is a matrix consisting of technology and services axes. Computing Systems, Information Systems, Network Systems and Workstation Systems are the four technology units. Each of these technology units has a technology, standards and planning; an applications; and a service delivery component. The Support Systems organization acts as a front door to and involves the entire organization. Management and Administration serves the organization in its business, publications and training functions. There are also individual centers or programs within the organization, providing focused effort in the areas of distributed computing, math/stats and innovative computing applications. Cross-divisional coordination is vital within such a structure.

The Computing Environment Today

Our hardware systems at IU consists of central mainframes, departmental systems, local area networks and workstations. A 3090 IBM system houses mostly administrative systems and its corresponding institutional data. A multi-node VAX Cluster is the main resource for research, student and instructional computing on the Bloomington campus. LANs and PCs, Macintoshes and UNIX workstations are found in the public facility clusters as well as campus departmental offices. TCP/IP is the standard for the high-speed university-wide network and is being installed globally on the Bloomington campus and to the doorsteps of all other campuses. Current plans are to facilitate network connections to faculty and staff on all campuses by July of 1993.

University Computing Services looks carefully at the types of services offered to insure that they are in keeping with user needs. Information Systems (IS) offers systems development services, either in turnkey mode or in partnership with end users doing any or all of the traditional systems development tasks. IS also offers information access, data administration, and database administration services. In addition, IS offers technical consultation on technology infrastructure standards and recommendations. Support Services includes documentation, publications, general consulting, departmental planning, contract and specialized consulting, workstation installs and maintenance, education and training.

Student computing is serviced by public cluster facilities and the VAX Cluster mainframes which house a user-friendly Academic Information Environment.

Faculty and research computing is serviced by UNIX and VMS mainframe resources as well as departmental systems. A goal of UCS to have a networked workstation on the desk of every faculty member has been largely realized. The math/stats lab, the scientific visualization and graphics facility, textual databases, and instructional aids are all part of faculty and research computing.

Network Services consists of the installation of TCP/IP at the Bloomington campus and inter-campuses, network management, maintenance and consulting, LAN installation, management and consultation.

The Computing Organization Tomorrow

What's changing about the computing organization?

The organization itself is becoming more networked, building on the current matrix structure. We are seeing an increasing number of dynamic work groups and teams springing up as needed to address specific projects. Peer to peer relationships are becoming more important than hierarchical ones. Each individual's experience and knowledge are valued and all levels are becoming empowered to make decisions. The organization is not growing, but existing staff are being reallocated to address the most important strategic goals of the organization. Change is becoming the norm, not the exception. As some traditional functions are phased out, staff will be retrained to work on higher priority tasks. Outsourcing will be used where appropriate. A distributed support model is evolving, and computing staff functions are being leveraged by user/computing center teams and increasing expertise in the user departments.

Trends and Issues Affecting Computing

An environmental scan identifies several trends and issues which are affecting the computing environment of the future. The workstation is now central from the users' perspective. Distributed computing with transparent access to services and user-friendly GUIs are teaming up with mainframe systems. Networks are already moving away from proprietary solutions to open solutions: TCP/IP in the near term, OSI later. Relational database and easy to access data is becoming a reality, with open access to data being the default. Client/server applications are looking attractive as an alternative to logon terminal mode access.

A look at IU's hardware/network environment shows some changes. Now being installed and planned are additional central platforms to support the distributed environment. VMS, UNIX and Novell servers will be used to house systems that will be accessible from client applications on the workstation and will facilitate access to institutional data. These new servers will interoperate with other resources on the network. The application development process will have client/server among its options and in general will make applications easier to build and maintain and easier to use. The network will continue to grow until all university faculty, staff and students can access network services, both local and over the Internet. A multi-campus technology project currently underway will help to insure this goal.

In a paper entitled "Data Administration and Distributed Data Processing," (scheduled to appear in the Winter 1991 issue of *CAUSE/EFFECT*) three D's are discussed. These are:

> decentralization - the movement of business functions out to the operational units to foster independence,
>
> downsizing - moving mainframe applications to workstations and LANs, and
>
> distribution - physically distributing applications or data while maintaining logical integrity.

These three D's are trends that are generating issues such as responsibilities for systems administration, change management, security, increased end user involvement in systems development, support, training and funding.

As distributed computing increases in scope, the role of the central organization becomes more clear. Goals and objectives revolving around wide area network installation and management, new technologies planning, recommended standards, polices, procedures, data administration activities, database administration activities, security, data center management of shared servers, the support of legacy applications and the building of integrated core systems will dominate the central environment.

The issue of institution-wide standards vs solutions that the end-user needs or wants will need to be addressed in our planning. Are application needs driving the technology or is it the other way around? Should we be concentrating on the functionality of systems and not on the technology needed to run them? Or, does technology need to be introduced first to stimulate productivity? A blend of these two approaches may be reality.

An expanding user-base of faculty, students, and academic staff for administration systems is requiring some restructuring of traditional applications and raises questions of access, security, and training. University Computing Services has currently made available for this new group of users, systems in schedule of classes, student advising, personalized class scheduling, statement of accounts, purchasing and the administrative information center. This one is piece of the overall strategic initiative to make institutional data easier to access.

An issue for us all that seems to be here to stay is doing more with less. In order to use our limited resources well, strategic planning is even more crucial. We must focus our energy and resources on those activities, services and technologies which are among the highest priorities of user needs. We must look to techniques such as total quality management to help us offer high quality services while containing costs.

At IU, our president has reemphasized the importance of the academic agenda. In support of this effort he has resolved to put more resources into strengthening the academic enterprise while making the administration leaner and more efficient.

Within such an environment of today - having a relatively mature set of academic and administrative information systems, and a sophisticated set of users - and moving toward a computing environment of tomorrow where these types of trends and issues need to be addressed, University Computing Services has put together a process for strategic planning resulting in a strategic plan that addresses the future of computing and information technology at Indiana.

Why a Strategic Plan?

The strategic plan can be an effective tool for leading a computing organization into the future. The experiences of the past three years at Indiana University indicate that the strategic plan and the strategic planning process serve four important purposes.

The first is *communication*. The planning process and the resulting plan are a vehicle for beginning to translate ideas into realities. Specifying directional goals and measurable objectives to be achieved, then committing these goals and objectives to writing, provides the computing organization and its many users with a concrete understanding of what will happen (the objectives) and the reasons why (the goals).

A second value of the planning process is that it puts the computing organization in the mode of *listening* to its users and advisory groups. Attending to and understanding the needs of users is an on-going process in any service organization. The strategic plan, however, provides a formal opportunity to seek out user input and incorporate it into the proposed activities of the computing organization.

Third, the strategic plan establishes a formal *decision* process for the computing organization. There are always more good ideas than there are resources to elaborate on and implement them. Establishing goals and objectives, and specifying a time-line for their completion, helps the computing organization set priorities for the use of its resources.

Finally, the strategic plan is a vehicle to *focus attention and resources* on achievement of the computing organization's highest priority objectives. A well-designed planning process will identify a small number of strategic initiatives which are central to the long-term direction of the entire computing organization. It can also have a direct effect on the more specific operational objectives of units and sub-units within the computing organization and on the individual performance objectives of staff members in that organization.

User Input to the Planning Process

One of the key success factors to an effective strategic planning process for the computing organization is user input.

Planning for Academic Computing: User Advisory Groups

User-driven planning for computing has become well-established at Indiana University. In the realm of academic computing, there is a substantial history of user-directed planning efforts. The chief planning body for these efforts is the *Academic Computing Policy Committee* (ACPC), a group made up of faculty members and chaired by a member of the faculty. With some adjustments and refinements, this group has employed a consistent planning model for academic computing since the early 1980s. The long-range component of the ACPC planning process is a set of five-year plans in the areas of: 1) Humanities, 2) Physical, Biological, Medical Sciences, 3) Social Sciences, 4) Instructional Computing, and 5) Academic Information Systems.

To supplement these long-range plans, the ACPC produces short-range (one-year) plans in six specific application areas: 1) Database and Spreadsheet, 2) Programming Languages and Operating Systems, 3) Graphics, 4) Mathematics and Statistics, 5) Textual Processing (including wordprocessing and desktop publishing), and 6) Networks.

Both long-range and short-range plans are reviewed and updated annually. The long-range plans lead to strategic objectives for academic computing at Indiana University. The short-range plans produce tactical objectives that guide the operational and unit-level activities of the computing organization.

Planning for Administrative Computing: Ad Hoc Planning Groups

Formal planning for administrative computing does not have as long a history at Indiana University. The creation of University Computing Services in 1989, through the merger of academic and administrative computing, provided the impetus for a more structured planning process. During the 1989-90 year three *ad hoc* planning processes were undertaken by the administrative computing user community at the request of University Computing Services. Each of these planning groups was made up predominantly of end users and was chaired by a member of the user community.

In spring of 1989 the *Administrative Computing Needs Committee* issued its report. This group gave significant guidance in establishing strategic goals and objectives for the newly-formed computing organization. Among its priorities and recommendations were:

- To make administrative, institutional information more available to all users.
- To provide a network infrastructure to better connect people, computers and information.
- To maintain the high quality of current administrative information systems and services.
- To promote the exploration and implementation of new technology.
- To give users a voice in the planning process for administrative computing.

In fall of 1989 a second group, the *Access to University Information Task Force*, issued its recommendations to University Computing Services. Among them were:

- o To "unlock" data and make it more accessible to users.
- o To develop access services targeted specifically to the novice user.
- o To enhance the computing environment available to the "power user."

Finally, in spring of 1990 a third planning group, the *End User Computing Task Force*, issued its report and recommendations. Among them:

- o To establish a formal structure for shared responsibility between end users and University Computing Services for the development of information systems.
- o To leverage the technical expertise available in user departments.
- o To recognize systems development "partnerships" between users and the computing organization.

The recommendations of these three groups are well-represented in the goals and objectives of the University Computing Services strategic plan.

Planning for Administrative Computing: User Advisory Groups

In order to formalize the user planning process for administrative computing, and to address the recommendation that users be given a voice in this process, the *Administrative Computing Advisory Committee* (ACAC) was formed in the fall of 1989. The 1989-90 year was primarily one of organizational development for the ACAC. During 1990-91, this group undertook its first formal planning effort, focusing attention on a set of plans for distributed computing at Indiana University. The results of this effort were three planning documents addressing: 1) Data Administration Issues of Distributed Computing; 2) Management Issues of Distributed Computing; and 3) Technology Issues of Distributed Computing.

In 1991-92, the advisory group undertook a more formal planning process. This effort, which is still in progress, is to establish long-range (five-year) information resource plans in four areas of administrative computing: 1) Student Information, 2) Financial Information, 3) Human Resource Information, and 4) Physical Facility Information. Each planning group is chaired by an end user and users make up the membership of these groups almost exclusively. The roles played by University Computing Services in this effort are: 1) to provide organizational guidance to the planning groups; 2) to provide a staff member who serves as a group process planning facilitator; and 3) to provide technical support for the data modeling component of the planning effort. The results of these plans will be a set of goals, objectives, and priorities for the development and delivery of administrative information systems and services over the next five years. An additional outcome of this planning process is development of a university-wide institutional data model that will be used by Data Administration and the university's data stewards in implementation of Indiana University's information access policy.

Strategic Planning in University Computing Services

University Computing Services has completed three years of formal strategic planning. What follows is a brief description of the general planning model and process employed, a history of the computing plans developed over the past three years, and a summary of the strategic goals that have emerged from this planning process.

The Planning Process

There are four chief inputs to the strategic planning process: user plans and recommendations, evaluation of the organizational and technological environment, prior year performance of the computing organization, and the participation and input of the organization's entire management team in establishing the final plan. The formal planning efforts of the academic and administrative computing advisory groups provide a structured and reliable means for gathering user input. In addition, the reports and recommendations of *ad hoc* user committees and task forces can provide valuable insight into the computing needs of the user community. Finally, an annual survey of user satisfaction is conducted by University Computing Services which can help identify areas of needed improvement or emerging interest and importance.

It is also important, on an annual basis, to re-evaluate the organizational and technological environment in which the computing organization operates. In our most recent strategic planning update, this environmental analysis focused on six topics:

- Changes to the organizational structure and mandate of Indiana University.
- Changes to the organizational structure and mandate of University Computing Services.
- Changes or trends of change in user needs.
- Changes or trends of change in technology: products, services, standards, etc.
- The effects of resource constraints on the ability to meet increasing demand.
- The experience of other university computing centers in meeting increasing demand during a time of resource constraints.

Prior year performance of the computing organization and its staff is an additional input to the planning process. Regular reporting of progress against objectives is always a good management practice. These periodic reports, plus an annual summary at an organization-wide level of total performance against strategic objectives, provides an additional source of material for revisions to the strategic plan: What objectives need to be emphasized (or de-emphasized)? Which objectives have been completed and can be "retired" from the plan? What new objectives might be identified based on activities in the prior year? And so on.

Finally, the entire management group of University Computing Services is given the opportunity to provide input to the overall strategic plan: at the time goals and objectives are initially established or reviewed, during the process of making the objectives operational and measurable, and as a final review group for then finished plan.

The University Computing Strategic Plan

The strategic plan itself is composed of three parts: a Mission statement, a series of Goal statements, and for each Goal a series of Objectives. The Mission statement is the most stable component of the plan. It should be reviewed each year, but unless there is significant change in the organizational structure or mandate will be modified only slightly. The Goal statements, if done well, will be relatively stable over a number of years. With each annual update there may be some revision, fine-tuning, adjustment of emphasis, or the addition of one or two new Goal statements -- but typically the Goals of an organization represent long-term intentions that persist from one year to the next. The Objectives are the most volatile elements in a strategic plan. They are sensitive to changes in the environment: new opportunities created by a technology breakthrough, new obstacles presented by a change in resource availability, etc. (Note: Indiana University's strategic plan is available through the CAUSE Exchange Library.)

By reviewing and updating the strategic plan on an annual basis, it serves as the point of reference and origin for: unit operating plans, base budget requests, strategic initiatives, and budget requests for strategic initiatives. Unit operating plans represent the annual work plan for a division or work-group within University Computing Services. These plans consist of one-year, operational objectives each of which either represents a greater specification of one of the objectives from the strategic plan or describes an on-going, operational responsibility of the division or work-group. Unit operating plans also form the basis for the annual base budget requests prepared by each of the divisions.

The first strategic plan of University Computing Services was published in the fall/winter of 1989, approximately eight months after the formation of this new organization. The scope of this plan was a five-year vision and a one-year focus on specific activities. The plan also included a presentation of the service, systems, and network architectures for the University Computing Services and a definition of the new organization structure.

Following the first strategic plan, later in the winter of 1989, an Operating Plan/Budget Request was produced. This budget request had a three-year focus (1990-93) and was a means for University Computing to identify its strategic initiatives for this time period.

In the fall/winter of 1990 the first annual update to the strategic plan was published. This updated plan moved the focus of the Operating Plan/Budget Request forward one year, covering the three-year period 1991-94.

Currently, during the fall/winter of 1991, the second annual update to the strategic plan is in process. Using last year's three-year (1991-94) plan as its basis, this update is giving particular focus to the goals and objectives for the upcoming fiscal year of 1992-93. It is also the intent of the group working on this effort to produce a plan that is briefer, is more focused in its objectives, and communicates more clearly and directly within the computing organization and with our users.

Strategic Goals

The core of a strategic plan are its long-term goals. These are the intentions and directions toward which the organization will exercise a sustained effort, and around which the more detailed objectives and activities of the organization will be clustered. The eight strategic goals of the University Computing Services strategic plan are:

1. Develop distributed computing services and applications.
2. Develop a high-speed network.
3. Provide sufficient and cost-effective shared computing resources.
4. Develop a workstation-based computing environment.
5. Expand and improve access to institutional data.
6. Enhance the student computing environment.
7. Support effective use of computing and network technologies by students, faculty and staff.
8. Enhance quality and contain cost.

In these goals can be seen the direct influence of user input (e.g. improve access to institutional data; develop a high-speed network), the environmental assessment of technological opportunity (e.g., develop distributed computing services and applications; develop workstation-based computing), response to the organizational environment (e.g., enhance quality and contain cost), and recognition of the basic missions and functions of a university computing organization (e.g., provide shared computing resources; enhance student computing; support effective use of technology by students, faculty, staff).

Taken together they provide a coherent foundation for the role and function of the computing organization of today. They also identify and focus attention on important trends that will help chart a course toward the computing organization of tomorrow.

The Effects of Strategic Planning

The value of a strategic plan to an organization is directly related to the success of the plan in directing and influencing the behavior and performance of the organization. The experience of University Computing Services has identified two key factors to this success: the development of strategic initiatives, and the relation of strategic planning to objectives and performance measures.

Strategic Initiatives

An outcome of the first strategic plan developed by University Computing Services and its associated three-year budget request was the identification of three strategic initiatives for the organization:

1. Workstations and Distributed Computing.
2. Network Expansion.
3. Making Data A Resource.

Each of these initiatives was represented by a cluster of objectives contained in the strategic plan. Each also had associated with it a specific commitment of resources by the organization to further its achievement. And each initiative has effected a real change in the way the computing organization is structured, in the services it delivers, and in the focus of its attention since the winter of 1989.

The initiative related to *Workstations and Distributed Computing* is reflected in the organizational structure of University Computing Services which now includes an operating division focused on the support of workstation technology and the deployment and management of public workstation clusters on the Bloomington campus. There was also created a cross-divisional unit (the Program for Distributed Computing) charged specifically with evaluating and selecting distributed computing technologies and developing distributed computing applications.

The initiative related to *Network Expansion* has resulted in the rapid deployment over the past two years of a high-speed, multi-protocol network on the Bloomington campus with connections already in place to most of the campus buildings. It has also resulted in expansion of the high-speed inter-campus network that provides data services among all eight campuses of Indiana University.

The initiative related to *Making Data A Resource* has resulted in the establishment of a Data Administration function within the computing organization, the selection and implementation of a relational database management system as a standard for information access, and the introduction of data modeling as a standard component of the systems development methodology.

The focus provided by these initiatives continues to propel the computing organization toward its desired future. Within the context of these initiatives is found the germ of ideas for additional organizational objectives. The focus on distributed computing has dovetailed with development of a distributed support model: a program of shared resource commitment by the computing organization and end users to provide on-site computing support personnel in user departments. The network expansion initiative has led to a consideration of network services and networked information as a means of adding value to the physical network infrastructure already in place. The data resource initiative has helped give momentum to the formal adoption of a university data access policy and guidelines for data management.

Objectives and Performance Measures

Strategic initiatives function at a macro level within the computing organization, providing focal points for the commitment of organizational and budgetary resources. At the individual staff person's level, the influence of the strategic plan is best achieved by a direct relationship between strategic goals and objectives and individual performance objectives. The following example illustrates the chain of events that connects the strategic plan with the performance of a staff member at University Computing Services.:

> *User Input (Access to University Information Task Force)*: "Information is a valuable institutional resource to which faculty, staff and students need access...A relational database is important to the long-term development of the institution's access efforts."
>
> *Strategic Goal (UCS Strategic Plan)*: "Expand and improve access to institutional data."
>
> *Strategic Objective (UCS Strategic Plan)*: "Implement relational database for administrative data."
>
> *Unit Objective (Information Systems - Data Administration)*: "Establish relational database technology and data modeling methodology as the foundation for information systems design and information access."

Staff Performance Objective (Database Administrator): "Implement standards and procedures for design and development of DB2 databases and mainframe RDBMS applications."

Performance Outcome (Database Administrator): "Coordinated development of 'Database Administration Standards and Procedures.' This first draft is complete and is being used in the initial DB2 development projects."

Using this model to relate performance objectives to the strategic plan gives each staff member the opportunity to see his or her activities in the context of the goals of the entire organization. Moreover, the individual staff member will have many performance objectives. Each may be derived from a different unit objective, which in turn may be related to a different strategic objective and strategic goal. Thus, the collection of any individual's performance objectives may show a connection to many facets of the organization's strategic plan. This context for personal planning and for appraisal of performance gives each staff member a sense of participation in the direction of the organization and can give the entire organization a greater coherence in its direction and activities.

Observations and Conclusions

There are a handful of lessons that we have learned through the use of a strategic planning methodology in University Computing Services at Indiana University.

Listen and Learn. User input is essential to the strategic planning process. An established planning structure in the user community is quite valuable, and worth the effort of the computing organization to encourage and support. Established channels of input may be successfully supplemented by *ad hoc* user input, especially when issues or events brings together a new constellation of users.

Less is More. A strategic plan that people read is infinitely better than one that no one reads. Fewer words, fewer pages, and language that is clear and direct all add to the quality of a finished planning document. Fewer objectives, too, add to readability -- they also help the organization focus on the highest priority objectives.

Establish Ownership (and Co-ownership) for Objectives. Many objectives defined at the organization-wide level will require the cooperation of more than one unit or sub-unit within the organization. The single-owner objectives are simple, and are usually successful. Cross-unit objectives take planning, commitment, and early identification of the stake-holders. Follow-through to the unit planning level (and communication of unit plans throughout the organization) can help assure that the commitment is made. Widespread management participation in the planning effort helps, too, in establishing ownership of objectives.

The Importance of Strategic Initiatives. The selection of a small number of initiatives -- especially those that provide a unifying theme to many of the organization's activities -- can help the organization focus attention on its highest priority goals and apply the organizational and budgetary resources needed to achieve those goals.

Stick to It -- And Follow Through. The place for a strategic plan is not on the shelf (or on the file server!). It needs to be incorporated into the regular management activities of the organization, most especially in the development of unit plans and individual staff performance objectives. Each of us needs to be able to see how our performance is contributing to the goals of the organization.

In summary, the strategic plan is one of the most important communication vehicles an organization can develop. It provides the organization a means of communicating -- internally as well as externally -- about its intentions, expectations, directions, and actions. Taking the computing organization from the present to the future requires a shared vision of where we're headed and a shared understanding of what we're doing to get there. The strategic plan should help describe that vision and build that understanding.

A Reverse Engineering Approach to Information Technology Planning

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Abstract

The University of Kansas successfully developed a planning process for information technology through an approach which is not consistent with those used recently at other universities around the country. It is characterized as a reverse engineering approach to planning because it began with existing plans, separated them into elemental components, and then reassembled them to produce a new, improved plan. Rather than starting to write a new plan from the beginning, this process was developed to build upon existing plans. It proved to be very effective in the development of a strategic information technology plan for this multi-campus university.

Introduction

The University of Kansas is a single university with two primary campuses, the main campus in Lawrence, Kansas, and the Medical Center campus 40 miles east in Kansas City, Kansas. In September 1990, the separate mainframe computers at each location were consolidated into a single set located on the Lawrence campus to support academic and administrative computing. This new arrangement brought about a significant change in the operations of the computing staff. At the same time, it left faculty and staff with many questions about the direction of computing. These events offered an excellent opportunity to review, update, and expand comprehensive plans for information technology at the University of Kansas.

Each campus, however, had previously developed its own plans for its own set of mainframe computer systems to service the specific needs of its own activities. The new configuration forced the coordination of those plans and needs, but also offered opportunities to provide integrated service to the entire University. It was decided to dedicate a significant effort to development of a comprehensive information technology plan for the University. It was understood that new directions should be explored and that new faculty and staff needs should be incorporated, but the intent was to build upon the existing plans rather than to start over from the beginning. These efforts are described in the following sections: Campus Differences and the Previous Planning Process, Development of a New Planning Strategy, and Development of a Strategic Plan.

Campus Differences and the Previous Planning Process

The two primary campuses differ significantly in three areas: their basic demographics, their computing facilities, and their advisory committees. The Lawrence campus is typical of a large full-service doctoral granting research university. The Medical Center educates health professions students, conducts health related research, and operates a large teaching hospital. These differences are further illustrated by the following data:

Descriptor	**Lawrence campus**	**Medical Center**
Students	26,661	2,489
Faculty	1,257	621
Schools	12	4
Staff	2,723	4,868
Hospital	None	464 beds
Operating Budget	$235 million	$228 million, including $107 million for hospital

Computing Environments

The computing facilities under the new consolidated configuration are also quite different. The mainframe computers on the Lawrence campus now support the academic and administrative computing needs of both campuses. The only other mainframe is one located at the Medical Center and dedicated to the hospital operation, including patient care and billing.

Function	Lawrence campus	Medical Center
Administrative	Amdahl 5890-300E	shared
Academic	IBM 3081KX	shared
	VAX 9000-210	shared
Hospital		IBM 3081K

Advisory Committees and Planning

Finally, the routine involvement of faculty and staff in the oversight of the computing operations differed greatly. The advisory groups for each campus were:

Lawrence campus

Information Systems Advisory Committee
Academic Computing Advisory Committee
Faculty Senate Computing Committee

These groups are very active, meeting regularly to provide direction and suggestions for academic and administrative computing. Members reflect a typical large university environment.

Medical Center

Information Resources Committee
Administrative Advisory Committee on Information Technology
Faculty Assembly Informatics Committee

With the focus of the Medical Center on patient care, many faculty simply don't take time for active participation in these committees. Consequently, little direction is provided to on-campus computing services.

Planning for computing and telecommunications on both campuses has originated in the departments with the operational responsibilities. The advisory committees provided regular mechanisms on the Lawrence campus for review and feedback. There were, however, no similar opportunities for input at the Medical Center — the committees were less active and lacked the information to fulfill an advisory role. In fact, the second committee at the Medical Center was created as an outgrowth of the first with the intent to provide greater input on information technology issues.

Development of a New Planning Strategy

Setting the Stage

The lack of information among Medical Center advisory committees, combined with the consolidation of the mainframe sites, provided the primary stimulus for development of a new planning strategy for the University. It was also expected that the Kansas Board of Regents would soon be interested in developing a comprehensive information technology plan for the whole group of six state universities in Kansas. As a result, the University administrator in charge of these technology areas initiated a new planning process as soon as the new mainframe configuration became operational.

Since the previous planning process had not fulfilled the necessary advisory role throughout the University, it was decided that a new approach was needed. There was interest among some advisory committee members in taking a more traditional approach of simply asking faculty and staff to list their needs. Often however, the problem with the lack of information left many faculty and staff unable to fully state their needs for information technology. This traditional approach also ignored the fact that many plans already exist in information technology departments because of the long-term lease arrangements in place and because of the advance preparations necessary to make certain changes.

This analysis led to the decision to apply a reverse engineering approach to the planning process. The existing plans in information technology were the product we wished to improve. The strategy was to split the existing product — the plans — into the component parts for review and enhancement, with the intent of putting the components back together as a new and improved information technology plan. The effort was facilitated by the fact that computing and telecommunication departments on both campuses report to a single administrator at the vice chancellor level, the University Director of Information Resources.

Information Technology Providers Status Report

The first step in this approach was the development of an **Information Technology Providers Status Report** in the spring of 1991. The purpose of this report was to provide an overview of the status of current activities and plans from those departments responsible for making information technology services available. These departments were referred to as information technology (IT) providers throughout the document and planning process. They included the computing and telecommunications departments plus the libraries on both campuses, and media services on the Lawrence campus. In addition, Institutional Research and Planning at the Medical Center, also reporting to the University Director for Information Resources, became involved to coordinate the planning process. The IT Providers Status Report was organized in three sections:

Current Campus Plan Priorities Related to Information Technology
This section identified the subset of overall campus planning priorities for each campus which involved information technology to provide a frame of reference for the campus' direction for information technology initiatives.

Information Technology Provider Activities, Current Priorities, and Strategic Directions
Current activities and immediate plans were summarized for each IT provider and cross-referenced to pertinent campus planning priorities. Strategic directions were indicated from the IT provider's point of view.

Information Technology Issues and Needs
This section presented the perspectives of the information technology providers on significant IT issues that would affect the campuses for the next three to five years.

Encouraging Broad Based Input

Since lack of information and input were key obstacles which this process was trying to overcome, several different efforts were made to encourage broad based input from advisory committees and faculty and staff. The IT Providers Status Report was circulated to the following groups:

Lawrence campus	Medical Center
Information Systems Advisory Committee	Information Resources Committee
Academic Computing Advisory Committee	Administrative Advisory Committee on Information Technology
Faculty Senate Computing Committee	Faculty Assembly Informatics Committee
Vice Chancellors	Hospital Administrative Staff
Deans	Wichita Campus Administration
	Vice Chancellors
	Deans

Recipients were asked to review the IT Provider Status Report, identify additional needs or issues, determine appropriate directions for information technology, and develop priorities for all of the needs identified. It was emphasized that the report was to serve as a starting point for the development of a plan for information technology for the next three to five years. The report was characterized as groundwork to enable the advisory committees and other recipients to spend more time identifying needs which had not yet been addressed, evaluating current activities, and making suggestions about the directions in which the campus should be headed.

The University Director and the Director of Institutional Research and Planning at the Medical Center met with each of the advisory committees on both campuses to promote the process and answer any questions. At least four weeks after distribution of the report, an open meeting was held on each campus for review of the IT Providers Status Report and discussion of information technology needs. The meeting on the Lawrence campus was well attended and provided extremely valuable discussion of the IT issues. The meeting at the Medical Center had fewer faculty in attendance, but was very helpful in formulating directions for future efforts. Separate review meetings were held with the Hospital administrative group and the administrators and faculty at the second campus of the School of Medicine in Wichita, Kansas.

This review process accomplished the designated tasks of soliciting input from a slightly broader base of faculty and staff than those involved on the advisory committees *and* providing more in-depth consideration of information technology issues facing the University. This improvement is considered an incremental step in a long term plan to increase awareness and involvement in the information technology planning process.

Development of a Strategic Plan

Incorporating Input

The primary source of new information was the input from the various review meetings. In addition, detailed comments were received from several of the other vice chancellors and deans, confirming a high degree of interest in information technology planning as a University priority. Another unexpected source of information was the group of information technology providers. The focused activities promoting the information technology planning process caused them to take even further in-depth looks at their own immediate plans and the issues which were being discussed with advisory committees. Possible adjustments and new approaches were already being considered before the information gathering process was complete.

Finally, other input considered was the interest of the Kansas Board of Regents in reducing duplication and increasing cooperation among state universities. During this process, each state university was required to provide a report on its computing and telecommunications activities and plans. Even though the planning process was still under way, the University of Kansas was able to incorporate several of the results in its report.

Focusing the Plan on Strategic Direction

As work began to incorporate the information into a comprehensive information technology plan, the IT providers were encouraged to focus on the strategic direction for the major issues. The direction was distinguished as that which was necessary to support or advance the missions of the University and the Medical Center, and to take advantage of developments in information technology. Much of the previous plans were long-range plans scheduling improvements which require significant lead time.

Each campus is presently concluding discussions among the information technology providers and the University Director to finalize priorities for the plan based upon the input from faculty and staff. The plan will have sections which are focused upon the unique aspects of each campus, such as the University Hospital at the Medical Center or the microcomputer laboratories for students at the Lawrence campus. It will also have a section for the whole University which will address the services which are available university-wide through the consolidated computer configuration.

Planning an Ongoing Process

It was acknowledged from the outset that this plan would need to be dynamic in order to keep pace with the rapid advances in information technology. This planning effort was intended to be the beginning of an ongoing process. The cycle will be repeated on a smaller scale this next year. It will still consist of the three basic steps.

- Organization of information about functional areas into the planning components: campus plans, IT provider activities, current priorities, strategic directions, including recent technology developments, and IT issues and needs.

- Distribution of the planning information components to faculty and staff for review, and conducting open meetings for discussion, input, and setting priorities.

- Reassembly of the improved components in an up-to-date information technology plan.

Advisory committees and other faculty and staff will be asked to review both the current IT plan plus the updated IT Providers Status Report. Open meetings will again be held to solicit input and set priorities. It is possible that extra meetings will be scheduled to encourage the greatest participation possible. In addition, the IT providers at the Medical Center expect to be able to include information from a survey and interviews conducted by one of its advisory committees.

Strategy for Implementation

As soon as the first version is complete, the University's Information Technology Plan will be distributed to all of the groups who received the IT Providers Status Report. It will also be provided to all institutional governance groups and made available to all faculty, students, and staff. It will be clearly identified as *the first step in the new information technology planning process*. Provisions will be made for collecting comments from these groups on an ongoing basis so that input is not limited exclusively to one time each year.

As noted earlier, departments which provide information technology services have already begun to utilize input from the planning process before the final document is published. The completed IT plan will be used to guide all information technology activities *and* input to all related planning documents such as campus plans and reports to the Kansas Board of Regents.

Summary

As a new effort in IT planning, this approach was very successful in bringing together new input and focusing thinking on information technology issues. It has enabled the University to develop its first comprehensive IT plan across both campuses. As a result of the first time through this process, several observations were made which will be enhanced or implemented in subsequent cycles. These observations may also be interpreted as key success factors for any other institution considering use of this or a similar process.

- Keep the IT Providers Status Report as concise as possible *but still cover all major functional areas and important issues.*

- Circulate the IT Providers Status Report as widely as possible, being sure to include all faculty and staff active in the use of information technology.

- Promote input and discussion among all persons receiving the IT Providers Status Report — schedule as many meetings as necessary to cover all areas, but include a final review with a representative cross section of the campus or institution.

- Contact key administrators to solicit input necessary to integrate the IT plans with the campus or institution plans.

Implementation of this very different approach to IT planning seemed particularly timely given the significant change in the configuration of the mainframe computers at the University of Kansas. Applicability in other university settings may be affected by the state of the information technology environment. It may be best that any approach radically different from the current planning process coincide, or follow, a significant change in the IT environment. Even if there has not been a significant change, an organization may wish to renew and refresh its planning efforts by utilizing a different approach. This second objective was also an influential factor in the decision to undertake this project at the University of Kansas.

Although the concept of reverse engineering is usually applied to manufactured products, it is becoming more frequently used in regard to information systems and computing environments. In these efforts at the University of Kansas, it has also proven to be very effective in the planning process as well.

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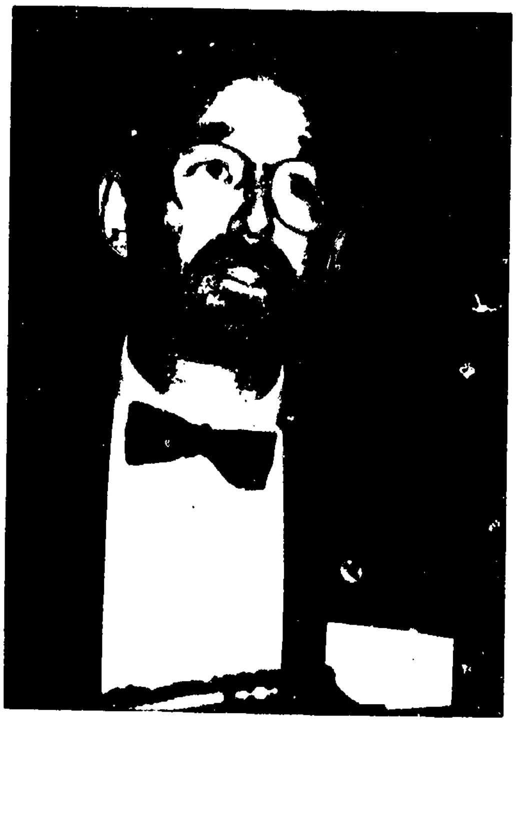
TRACK II

MANAGING AND LEVERAGING THE TECHNOLOGY INVESTMENT

Coordinator: Geraldine MacDonald

During the last twenty years the presence of information technology on campus has made fundamental changes in higher education. Expenditures have been justified by improvements to the instruction and research environments for our students and faculty. In light of the current economic climate in higher education, calling for tighter budget controls and greater accountability, continued investments in information technology will require even greater focus on cost benefits or cost avoidance. Papers in this track offer some strategic solutions to such problems.



ELECTRONIC APPROVAL:

Not just another electronic mail system.

by Kenneth C. Blythe
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Electronic approval is like electronic mail only its different. Electronic approval requires controlled routing of documents: authorized approval: proxy designation: data verification at the source: rerouting of disapprovals or major changes: and many other functions that are unique to the internal operations of an institution. Electronic approval, if it is to be effective, must span the complete administrative operations of an institution because users don't distinguish between a personnel action, purchase order, general stores requisition, request for check or any other administrative action. All forms must be converted to the system if it is to be effective. This paper presents the electronic approval system (known as EASY) that has been in operation at Penn State University for more than 18 months. EASY currently handles more than 14,500 electronic actions per month at a considerable reduction in paper consumption and handling. The system was awarded NACUBO's top prize this year for cost reduction and avoidance.

ELECTRONIC APPROVAL:

Not just another electronic mail system.

by Kenneth C. Blythe
Dennis L. Morrison

Gene Roddenberry's STAR TREK described a world (or at least a Starship) without paper. Never, in the STAR TREK episodes, did you see Captain Kirk operate a pen or approve actions on paper forms. Imagine that; the day may come when we too may conduct our daily affairs without pen, paper or manual typewriters. *This paper describes a method of doing business electronically which may replace paper forms altogether.* It is a method which compliments other electronic activities, such as electronic mail. In particular, the paper will describe an electronic approval system that has been successfully implemented at the Pennsylvania State University; an implementation known as EASY (Electronic Approval SYstem). With EASY, paper is reduced and delays associated with paper are eliminated.

If you use electronic mail, it is not hard to imagine how EASY works. Instead of documents of text, as with electronic mail, *EASY handles documents of data known as electronic forms.* EASY forms are created at the source, then forwarded to all individuals on a path that are required to approve the form in order for it to be effective. In contrast to electronic mail, electronic approval is distinguished by these other features: (1) data recorded using EASY forms are validated and corrected at the source, (2) EASY forms have mandatory/predetermined recipients for approval, (3) the mandatory recipients are defined in approval grids which are maintained apart from the form and (4) database interface.

BACKGROUND

Electronic approval is a part of Penn State's Integrated Business Information System (IBIS) which is transforming the business activities of the University. IBIS was conceived in 1981 by a group of University officers who developed a plan for an altogether new Administrative Information System, known generically as AIS. It was a comprehensive plan to re-engineer all of the University's administrative systems to bring them in line with modern, fourth generation computing technology. The AIS plan, as it came to be known, was to re-engineer the student systems first and business systems afterward. By 1984, the first parts of the Integrated Student Information Systems (ISIS) were brought on-line and by 1987 most of the student system re-engineering had been completed.

In 1987, with the increasing complexity of business activities, attention shifted to the Integrated Business Information Systems (IBIS). Some of the existing business systems at the time were more than twenty years old and had to be replaced. With IBIS, the University was able to start fresh on new business systems that were viewed not as a collection of subsystems but as an integrated whole. Electronic approval (EASY) was the first part of IBIS. EASY operates on a common data base and serves all business activities equally. A single EASY form can affect multiple subsystems simultaneously (for example, one form can and does affect budgeting, accounting, personnel and payroll). Users view IBIS through the electronic forms that they submit and approve. The University operates more efficiently with a common database that provides consistent information for decision making.

Electronic forms originate at the source and, as such, bring the entire University community into the information age. People who have avoided computing otherwise have now joined in. From electronic approval they are branching out to electronic mail other computer applications. As such, and electronic approval has ushered in a whole new era of computing at Penn State with a large community of people joining the network. *EASY is the "glue" that brings all parties to the network.* Whereas electronic mail is optional, *EASY is mandatory* throughout the University for anyone who wants to authorize employment, issue purchase orders, reserve fleet vehicles, etc.

GLOSSARY

Since electronic approval is a relatively new concept, it might be helpful to define a few of the terms:

Electronic approval - The process of approving administrative actions electronically, using computer workstations or terminals, in lieu of the traditional paper forms with manual signatures. Electronic approval is a "paperless" method of doing business.

Electronic forms - In many cases electronic forms are identical to paper forms that are used to process vehicle reservations, budget amendments, personnel actions, etc. Electronic forms are a computer metaphor for paper forms. The computer forms are routed through electronic approval paths.

Approval path - A "path" or "table" which indicates the order of designated approvals for each electronic form. Generally, electronic approval paths are the same as paper paths for traditional paper forms.

Phase 1 approvers - Local approvers of electronic forms who are below the College or Administrative Office level.

Phase 2 approvers - College or Administrative Office approvals required by Penn State's Signature Policy (AD-17).

Central action cycle - The path that is followed after a form has passed through the Phase 2 approval cycle. This cycle includes all central offices who must approve each particular type of form. All forms have a Central Action Cycle which can only be modified by the central administrative computing office.

Mnemonic - A meaningful word or abbreviation representing a long string of numeric values which make up the organizational access code. A mnemonic consists of one to many budget numbers within an administrative unit. Electronic forms are routed according to the budget that is specified within them which is associated with organizational access codes, hence with mnemonics. Forms are said to route according to mnemonic, which means that they will route only within their organizational area.

Electronic approval is the foundation of IBIS. Electronic approval replaces paper procedures with electronic procedures. People use Money Access Machines (MACs) to withdraw, deposit or transfer funds through electronic terminals, instructing their financial institution to debit or credit accounts. People use electronic mail to exchange routine and confidential business correspondence electronically. Now people can use electronic approval to exchange standard business documents, such as purchase orders, invoices, and personnel actions. When they are approved, EASY forms update the IBIS database directly as shown in *Figure 1*.

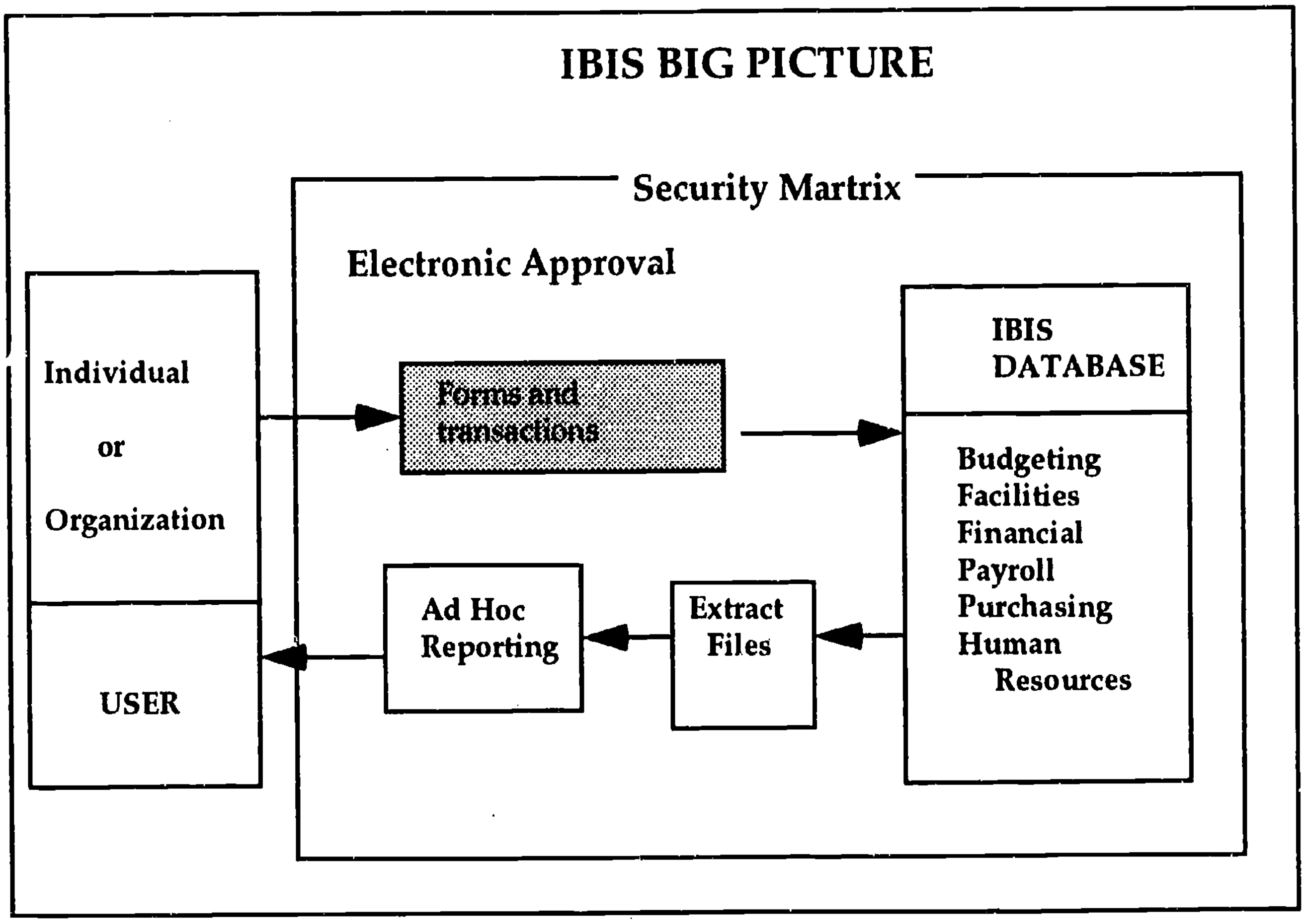

Figure 1 - IBIS Big Picture

EASY Benefits

Why would people want to use an electronic approval system? First and foremost, EASY streamlines the flow of forms. Because the system is electronic, there is no distance between approvers. There is no lag-time with mail. Remote campuses process forms as quickly as the central campus; turnaround time is reduced significantly. In these days of increasing demand for service, *EASY is timely and responsive.*

With EASY users can reduce the amount of paper that they handle and file. EASY forms are retained in electronic "file cabinets" and easily retrieved with a lot less effort. Data entry at the source is combined with data editing at the source to insure that forms are created and submitted as *error free* as possible. Forms that reach approval levels are assured of being logically correct. Approval, therefore, is simplified.

EASY also allows users to track forms after they have been submitted for approval. EASY lets users look at the form's history, to see if it has been processed or is still waiting for someone's approval. The form's history is also an audit trail which simplifies auditing.

Electronic forms reduce redundancy. Forms on file can be called up again and reproduced automatically so that an old form can be used as a template for a new one, saving time in the preparation of the new form. EASY also helps the person preparing the form by displaying messages if data has been entered incorrectly, catching mistakes at the beginning. EASY simplifies the data entry process by retrieving data from the data base whenever possible to save key strokes. EASY eliminates redundant data entry to multiple subsystems because one form updates all subsystems. Funds availability can be checked early in the approval cycle before monies are encumbered.

All of these factors contribute to the greater accuracy of the system as a whole.

EASY Security

With the ultimate outcome of electronic approval *being expenditure of University funds*, Penn State auditors (both internal and external) had to be assured that electronic methods were at least as secure as the paper method that they were replacing. This assurance was achieved by a "security matrix" which surrounds the electronic approval process *(see Figure 1)*. The matrix involves access control, functional authorization, approval authorization, data authorization and form processing logic. As long as the user does the right thing, and operates within the limits of his/her authority, the system operates efficiently. If attempts are made to commit fraud, the security matrix frustrates those attempts and retains a complete audit trail for review.

The security matrix is an electronic metaphor for organizational placement and functional responsibility. Although we are not generally aware of it, our minds are continually scanning for the familiar. We know that Sam, as a hypothetical example, works down the hall and is responsible for purchases below $50,000. When Sam operates within his range of responsibility, he operates within a context that is familiar. Security alerts are not activated. If Sam acts outside his range of responsibility, however, he quickly draws attention to the act and human security alerts are activated. This is the traditional context of security. People are placed in an organizational and functional context in which they operate with a low level of review.

Access control is important. Penn State is adding SMART card security tokens to its traditional userid and password. Logging on to EASY requires a combination of "something you know" (userid and password) and "something you have" (the randomly generated six digit numeric value displayed by the SMART card). This combination reduces the probability of penetrating security to less than one chance in a billion.

The SMART card frustrates hackers but it does not prevent users from intentionally or inadvertently exposing passwords and tokens. Access control, as always, is only as good as the user's attention to security. If users tape passwords to SMART cards and leave SMART cards lying around, access control is compromised. For this reason, there is renewed attention to security, security policies and security training.

Consider the alternative, however. *With paper forms and manual signatures it is infinitely more easy to commit fraud than with electronic forms.* Anyone can type a form. Anyone can forge signatures. The interesting thing is that people do not often forge signatures because they know that it is against the law. With electronic approval, there is a new set of computer laws which supplement the traditional laws of white collar crime. People are no more encouraged to commit crimes electronically than they are with paper forms.

Even if access control is compromised, the security matrix prevents the perpetrator from operating with impunity. The security matrix places the "forged" user in an *organizational and functional context.* The userid that is being used illegally is limited in its functional breadth and organizational breadth. The userid "lives" in a specific organizational context, controlling specific budgets, involving specific employees and authorized to take only specific types of actions. If it happens that the criminal stumbles on a lucrative userid, the security matrix requires the collaboration of other organizational partners who operate in their own security matrix. The likelihood of violating the events required in a complete approval path are slim indeed. The perpetrator is required to steal the userid, password and, at times, the SMART cards of three to ten or more individuals. The chances of doing this are much smaller than the chances of forging signatures on traditional paper forms.

Finally, there is a complete audit trail for every EASY action including date, time, location, sequence, invalid signon attempts, form content and much more. When a fraudulent action is attempted, it is preserved indefinitely in an electronic audit trail even if the attempt is abandoned.

The internal and external auditors of Penn State have been assured that EASY's security matrix and audit trail are as secure, if not more secure, than the traditional paper forms and manual signatures. This assurance was essential to progress with EASY.

EASY Auditing

As explained above, documents produced in EASY provide a complete audit trail. Each document has its own unique history, listing the person who began the form, who changed it, who approved it, etc. University auditors can periodically check that the proper approvals are being given.

Once a form has been added and submitted, and even after it has been processed, it cannot be removed from the system. Documents remain available on-line for a minimum of seven years after they have been processed, and are archived forever on magnetic tape and microfiche. Auditors have access to all documents of the University. Thus EASY provides the auditors with an accessible on-line audit trail that can be reviewed at their discretion without advance notice.

HOW EASY WORKS

The first step for an organizational unit to start using EASY, is to authorize three or fewer individuals to establish and maintain Approval Designation Tables. This authorization is accomplished with a paper form (oh my gosh!) manually signed by the unit head (Dean, Vice President, etc). In other words, *it takes a traditional paper form to start the electronic forms process.* This contradiction is explained by the fact that organizations can not submit electronic authorizations until the Approval Designation Table is in place.

Approval Designation Table Creation and Maintenance

The Approval Designation Table is part of the security matrix that surrounds the EASY system. A sample table is shown in *Figure 2.* It indicates, by userid, the individuals in the organization that may submit, add and approve electronic forms. At Penn State, the responsibility for establishing the approval tables (paths) for phase 2 of the administrative approval cycle is that of the Financial Officer (or their designate). The Financial Officer may also be involved in establishing approval tables for phase 1 of the administrative approval cycle, although this is not required; the Financial Officer may delegate this responsibility.

The Financial Officer establishes phase 2 of the approval table because Penn State Signature Authorization Policy, AD-17 requires it. This policy requires approval at, and above, the level of Budget Administrator. Phase 2 may also contain approvers below the Budget Administrator, given that they are followed by the Budget Administrator at some point. Also, this policy requires that the Financial Officer be the final default approver on the Phase 2 administrative approval cycle.

Financial Officers are able to create separate approval paths for each form, if they like, or they may consolidate many forms or all forms into one path. However, each form can only appear on one path for each mnemonic within that area. If a form is not specified on a path, it will automatically default to a *standard path* within the organization. The *standard path* allows forms to be added to EASY without the Financial Officer having to add these forms to existing approval paths (these forms will be routed in the manner prescribed by the standard path). Using the *standard path* reduces the number of paths that must be created and maintained.

APPROVAL DESIGNATION TABLE									
LEVEL	1 DEFAULT	2 ------	3 ------	4 Optional	5 ------	6 ------	7 ------	8 ------	9 ------
1	RTH3	RTH3/ COT1	MLW2						
2	COT1	RTV2	COT1/ BYR2						
3	JTC4 $500	AGK2	SJL1						
4	AGK2	DRN1							
5	TOB1	ERN3	PNN4						
6									
7									
8									
9	MJB3	ANR2	RTS						

Figure 2 EASY Approval Designation Table

Figure 2 is a sample Approval Designation Table. The table illustrates that there may be as many as nine levels of approval designated, with the capacity of nine individuals across at each level designated as valid approvers. Most offices, however, will use only two or three levels.

Users on *Level 9* have a different status from those on levels 1 through 8. Users on levels 1 through 8 can generally perform any action on the form. Level 9 people can *only* add, submit, change and print forms; they cannot approve or reject them. The table also depicts several characteristics of the approval cycle discussed briefly above. First, the entries in the table are userids. Before a user can be designated to approve actions, they must have requested and received a userid and access to FORM from the Security Office.

Second, the entries in the table proceed from left to right. The first person at the left is called the *default approver*. Forms will automatically route to the default approver unless the previous user has designated another valid userid at the same level as the next approver.

Third, the table shows the use of delegated approval designation, or *proxy*. Any authorized approver on the table may have proxy delegated to another user within their administrative area, but a person delegated as a proxy cannot delegate that proxy to another proxy. A proxy appears on the approval table as RTH3/COT1, where COT1 is the proxy for RTH3. This use of proxy corresponds to Penn State's Signature Authorization Policy (AD-17) and can be used by the proxy at any time, though it should be limited and used only in the absence of the responsible individual.

Finally, the table includes the use of dollar limitation on approvers. *Figure 2* shows an individual who has a dollar limitation on the actions they can approve (JTC4 at level 3 can only approve items under $500). If an approver on Level 2 attempts to forward a form in excess of $500 to JTC4, the system will notify them that JTC4 is not authorized to approve the form.

How Paths are Created and Maintained

There are several methods for creating and maintaining approval paths.

1. On-line Updating

The first method is on-line updating. Financial Officers can use on-line functions within EASY which allow them to create approval paths, add approvers, designate default and non-default approvers, assign dollar limits, update approver information, and add or delete forms from the paths. These changes are made directly to the EASY approval tables.

To simplify on-line updating, the Financial Officer can use higher level mnemonics. Each administrative area has one mnemonic which includes all lower-level mnemonics in that area. This is called the highest level mnemonic. Creating one path associated with the highest level mnemonic allows one type of form from many different units to route on the same Phase 2 path. The higher level mnemonics option is helpful in many ways, but its greatest benefit is for campuses or colleges which process actions centrally (i.e., the same central people approve paperwork for all organizations within the college or campus). While higher level mnemonics can drastically reduce the number of approval paths it makes the jobs of central officers much more intense because they have to originate and approve all forms. This is the trade-off. For smaller colleges and campuses, where the volume of documents are small, it may make sense.

2. PC Path Maintenance Program

The other way to simplify the task of creating and maintaining paths for all the units within an administrative area is to use the PC Path Maintenance program. This is a program which runs on a personal computer linked to the University's mainframe computer for uploading and downloading of paths. The PC Path Maintenance program can be used for *approval path maintenance, mnemonic maintenance, user maintenance, document maintenance,* and for uploading and downloading.

The *approval path maintenance* function allows the user to add, delete and modify paths. The user specifies mnemonic, path id (path name), phase number, the forms to be routed on that path and indicates the encumbrance level. The *mnemonic maintenance* function allows users to add, delete or modify mnemonics or organizational access codes. The *user maintenance* function allows users to add, delete and modify information about approvers. The *document maintenance function* will add, delete or modify forms and attach a description to each. The EASY approval path data base is updated from the PC files. Individuals with the proper access can start by downloading their paths from the EASY data base for approval path maintenance.

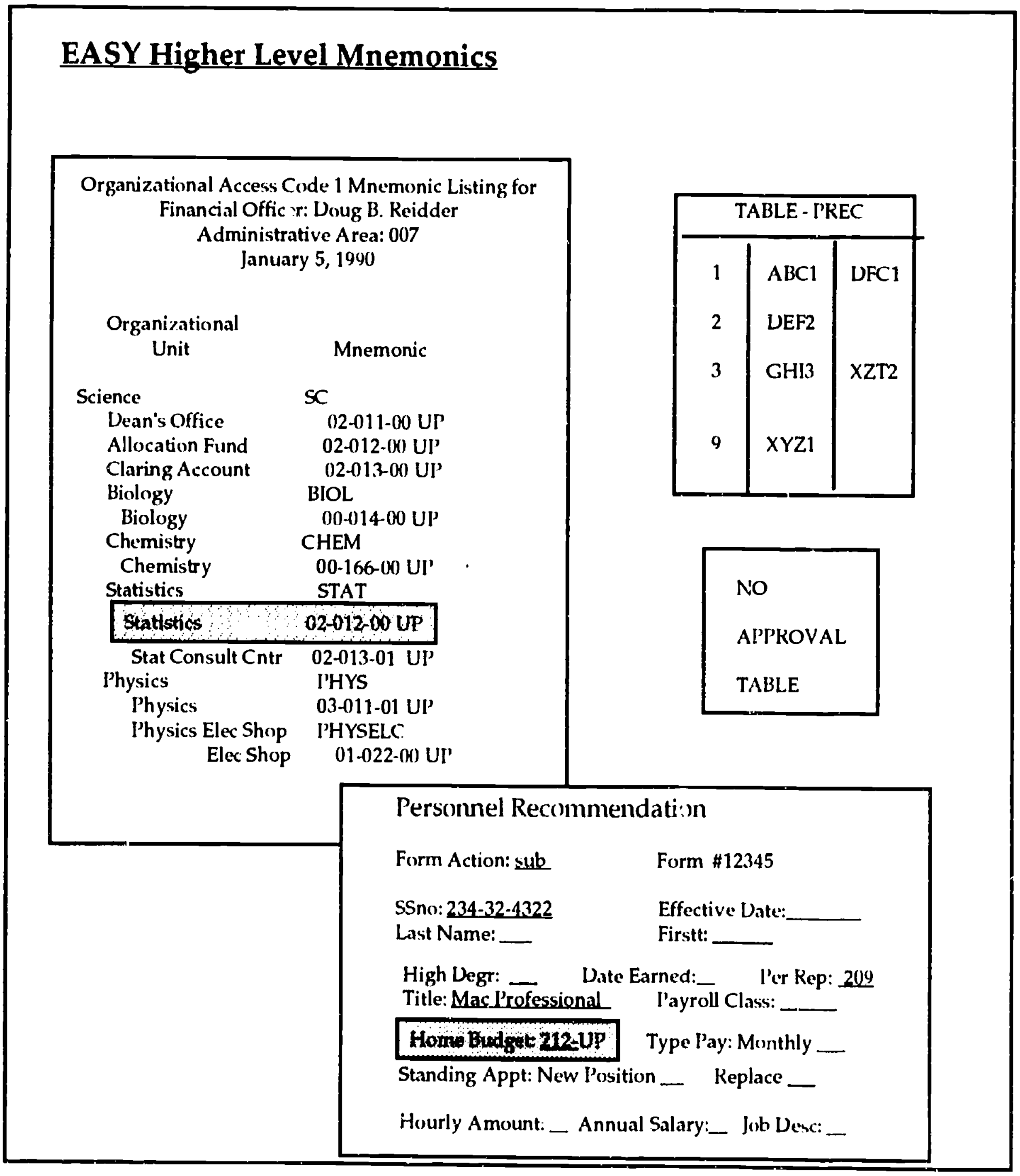

Figure 3 - EASY Higher Level Mnemonics

Forms Flow and the Approval Cycle

EASY forms may flow through up to three approval phases before they are completely processed. These approval phases are set up in advance and the forms follow them automatically to their conclusion. Each organization may have separate approval paths for each form type. The approval paths for a budget form, purchasing request, personnel requisition, or payroll change could be different.

There are two separate cycles involved in form approval: the administrative approval cycles (phases 1 and 2) and the Central Action Cycle, as illustrated in *Figure 4* below.

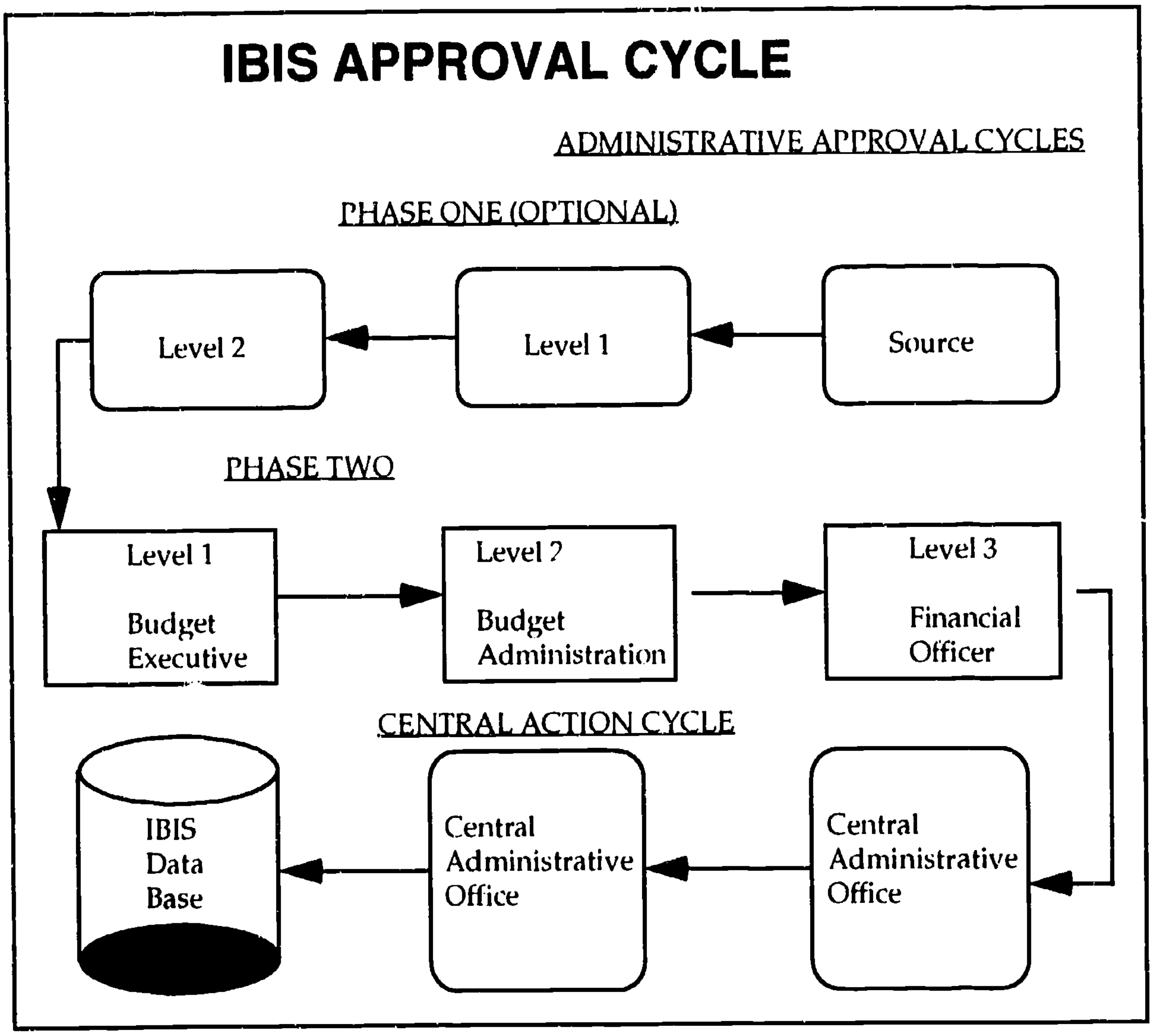

Figure 4 - EASY Approval Path

1. Administrative Approval Cycles

Forms are created by a user at the "source" who adds it to the system. When it is added, the electronic form is stored in the IBIS data base. The user can then make changes and/or submit the form to the area's phase 1 approval cycle. The form name and budget number enable the system to decide which approval path is used.

When the form is submitted, the system will automatically route to level 1 of the phase 1 approval cycle, if it exists (phase 1 approval is optional.) As the form continues to be approved it will pass automatically from phase 1 approval cycle to phase 2. A form is processed forward through each approval level in the path and cannot be forced past a level. The form can be changed, approved or rejected by each approver.

If a change is made or the form is rejected, a "notepad" area can be used to describe the change or explain why the form was rejected. If the form has had a major change, it will be automatically rerouted to the first approver. If the form is rejected, a copy of the rejected form will be sent to all approvers who have acted upon it for information purposes.

At the phase 2 approval cycle, the form is routed to the Budget Administrator, who may change, approve or reject it. Next it is generally routed to the Budget Executive for the same actions. The Financial Officer is the last approver in phase 2. Encumbrance occurs at the approval level specified by the Financial Officer.

2. Central Action Cycle

Once processed through the administrative approval cycles, the form automatically routes to the Central Action Cycle, where it passes through the necessary central offices. Individuals in the central action cycle cannot change data (with the exception of certain form-specific items) as could be done in the administrative approval cycle. The form is either processed or rejected. If the form is rejected, the encumbrance is removed and a message is put in the notepad. A copy of the form is returned to the source and to all the form's approvers to notify them that the form has been rejected.

Once a form has passed the Central Action Cycle it is processed and the information from the form updates the IBIS data base. Once in the data base, the action is considered to be approved.

OTHER FEATURES OF EASY

Data Entry

One of the goals of the EASY is to make data entry easier for the end-user. One way this is accomplished is by enabling the user to use old forms as templates for new ones, thus having the needed information already in the form, and making only small changes necessary.

Another way EASY simplifies data entry is by its use of the capabilities of the data base. In many personnel forms, for example, a user will type in the employee's social security number, press the enter key, and all of the associated information about the employee will be pulled up into the form. Thus the user does not have to type information which is already on the data base.

A third way EASY assists data entry is the availability of help screens. Help screens exist for nearly every field on every screen in the forms. Help screens often list the valid codes for the particular field, or give sample formats for data entry.

Encumbrance

Financial Officers can designate a level in the phase 2 approval path at which funds can be encumbered. The point of encumbrance is specified by each area and need not be consistent across the University.

When a transaction is approved at the specified level, the system will automatically check to insure that funds are available. If funds are not available, the transaction cannot be processed. If funds are available, an encumbrance is recorded, fund availability is reduced and the transaction is sent to the next approval level. If the transaction is rejected at any higher approval level, the funds will be automatically disencumbered. The history of the form will show whether or not the encumbrance was successful.

Access

Once a transaction is entered for a form in EASY, it becomes part of the permanent record of the "forms file". To "access a form" refers to bringing a particular form onto a user's terminal so that it can be viewed or processed. If there are forms awaiting a user's approval the user can call up a browse screen to show all the forms awaiting action by that user. The forms to be processed will appear numbered on the screen, displaying the form name, the form number, the form status, the form date, and a brief description of the form. The user can then display the form by selecting it. A user can also browse forms file by budget, by mnemonic or by employee's name.

Confidentiality

A form may be marked "confidential" at the option of either the source or the approvers. The confidential designation may be changed at any level in the phase 1 or 2 approval cycles. Some forms, e.g., Human Resource forms, will be marked confidential automatically with no option to change to non-confidential. A form which has been marked confidential may be viewed only by the form's source and by the other individuals listed in the approval path.

IN CONCLUSION, NOT A MAIL SYSTEM

Although it uses many of the techniques of electronic mail, electronic funds transfer (EFT) and electronic data interchange (EDI), electronic approval is different. Electronic approval is a business management system that facilitates day-to-day flow of internal business documents. With electronic approval, internal business data is recorded directly on electronic forms at the source. This provides all of the known benefits of source data automation and validation. Furthermore, it provides the ability to set up self-sufficient business units (campuses, offices or departments) removed in distance and geography from the Dean's office or President. As long as there is an electronic link, remote offices with electronic approval have the same logical proximity as that enjoyed by the office next door.

Electronic approval is also different in that it has mandatory/predefined recipients of each electronic form that will approve it. It is not enough to create electronic forms at the source; they must also flow through an authorized approval path similar to the paths that were used with traditional paper forms. Only a few individuals, in a College or University, have the authority to approve paper forms and those same individuals have to approve electronic forms. It is for this reason that electronic forms has the capacity for converting the entire institution to electronic methods of communication. Once a senior officer has learned electronic approval, it is natural for them to extend this learning to include electronic mail and other computer applications. Since electronic approval is required to be used university-wide, it is used by University officers across the board; all colleges, departments and campuses use it. At Penn State there are as many as 14,500 electronic forms being processed monthly.

Although Captain Kirk did not reveal his methods for conducting business on the Starship Enterprise, it is probable that electronic approval was an inferior predecessor to the method he used! Electronic approval, and the benefits it brings, are likely to grow in popularity in the next few years.

QUALITY OF SERVICE

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This paper discusses the concept of Total Quality management (TQM) and its application to college and university computing services. Under TQM, customers and their expectations become the base for defining quality and quality service. This and other key components of TQM including mission, quality standards, systems and procedures, measurement, and management style are discussed.

TQM suggests managers should lead rather than direct employees. Specific behavior changes required of managers to become leaders are outlined with a focus on problem-solving through teamwork and employee participation.

Obstacles to implementing TQM including perceived cost, resistance to change, and time are addressed.

QUALITY OF SERVICE

Introduction

A major national movement to introduce Total Quality Management has begun. Businesses were the first to embrace Total Quality Management as they rediscovered that quality of service and products translate into survival at the least, and more often than not, into more customers, increased revenue, and reduced costs. In the last few years, several universities have also embraced Total Quality Management (TQM). However, the profit motive so basic to business is missing or at least substantially altered in the university environment. Therefore, it seems reasonable to ask: What is Quality and what is TQM? What can TQM do for universities and for their computing and information technology operations? Can TQM work in the university, not–for–profit environment?

What is Quality?

Quality, according to Webster's dictionary, is the "degree of excellence of a thing" or "that which makes something what it is." Something is not what it is supposed to be if it does not work or does not meet expectations. However, different people expect different things from a product or service. Therefore, they define quality differently. To some, higher cost may mean better quality. To others, quality may be related to performance. For example, the more efficient a sort program works, the better the program and the higher the quality. And to another group, quality may be related to ease of use.

If a person expects a computer program that is easy to use, but instead receives a highly efficient but difficult to use program, that person will judge quality as low. Quality, therefore, is in the eye of the beholder.

Total Quality Management

What, then is Total Quality Management? It is a philosophy, a way of life for successful organizations under which the customer is the beholder of importance, the true and correct judge of quality. This belief in the importance of the customer is more than just a slogan. It is a primary principle which, once adopted, often requires major changes in the operations and management style of the organization. The following are key elements of TQM:

- Customer expectations define quality.
- Quality must be managed.
- Systems and procedures, not employees, are the primary cause of poor quality.
- Teamwork is essential.
- Managers must be leaders, not directors.
- Employees are an organization's largest and most important investment.
- The organization's mission must be clear and embraced by everyone.

Customers

The focus on customers seems natural because businesses do not exist without customers. And yet, businesses repeatedly make the mistake of determining for themselves what quality is rather than looking to their customers to define quality. As a result, many companies invest heavily in what *they* think are high quality products and services, only to be rejected in the marketplace.

When the customer is ignored, a service that is judged as high quality by the company may be seen as poor quality by the customer. For example, if customers expect superb color from the local photography shop but do not get it, they will judge the quality of service as poor even if their pictures are delivered to their door free of charge within one hour. If customers expect superb color and friendly service, they will judge the quality of service as poor when a counter attendant treats them rudely, even if the color is perfect.

Smart companies ask their customers: "What are *your* expectations and are we meeting them?" The only way to know is to ask your customers.

Managing Quality

Quality does not just happen. It must be managed. Performance standards, based upon customer expectations, need to be established and actual performance must be measured against those standards. Under TQM, the goal is to meet or exceed standards 100 percent of the time. The goal may not be reached, but the point is to continue to try to improve even when 90 percent or 99 percent or 99.4 percent performance is obtained. If you are not at 100 percent, there are still customers who are not getting the service they expect.

Quality Standards

It is important that the quality standards chosen are measurable and reflect customer expectations. If a customer sees "Prescription glasses made in one day," he or she might reasonably expect to return within 24 hours to pick up glasses. However, if the offsite lab is making glasses in 24 hours but the glasses do not reach the customer for another 6 hours because of the delivery route, the wrong measure is being used. Total time is the relevant measure from the customer's viewpoint. Time to submit an order to the lab, make the glasses, and deliver them back to the customer fitting area are relevant to the company because they help pinpoint problem areas.

Besides working with customers to pick the right measures, it is important to regularly check with your customers to be sure their expectations haven't changed. If your quality standard is providing glasses in less than 24 hours, but one hour service has become the norm, you may need to change your standard. On the other hand, if you change it without checking with your customers, you may be taking on added expense needlessly and perhaps lowering your customers' perception of the quality of your product.

The only way to know is to keep asking your customers.

Solving Problems through Good Procedures

After customer expectations are determined and quality standards chosen, procedures are developed to deliver the required products and services. According to 3M, 85 percent of the time faulty procedures are the root cause of failure to meet standards. In the above example, the driver who picks up orders and delivers finished eyeglasses to the company's sales offices might be an excellent, hardworking driver. However, if orders are being delivered late, it might be because the delivery route or schedule established by the company managers is inefficient. Instead of reprimanding the driver, ask the driver how to get orders back to the stores more quickly!

If good procedures are not established, employees may create their own with varying degrees of success. Some will select a procedure that is reasonable and error–free; however, it is best to get the consensus of all the employees involved, set a common procedure, and measure its effectiveness.

Teamwork

Teamwork is a product of good management, and good managers involve their people in the decision–making process. They share company problems and information with the people, seek their input, and advise and act accordingly. Involving the customers, managers, and employees to build effective procedures is the process of teamwork.

Front–line people are especially important because they work with the customers directly and are more knowledgeable about a customer's needs, desires, and complaints. It makes sense to involve front–line employees in the decision–making process.

The answer to reducing turnaround time may come from a combination of changes in procedures but only after we listen to our employees. They may recommend if we make eyeglasses in one central site with 10 people grinding lenses, building a lab in each store, distributing the staff, and using a delivery truck to deliver the necessary inventory. A solution such as this may only come about through the collective knowledge and insights of a group of people.

Managers as Leaders

Management has been defined as a process of setting and achieving goals through the five functions: Planning, organizing, directing, controlling, and communicating. Under TQM, the employees are explicitly included as part of the planning, organizing, and communicating functions, and directing and controlling give way to leading and guiding. Participatory management is not a passing fad, but a natural shift in management style brought about by the shift from an industrial society to an information society.

The old military management model is not as effective as it once was because the nature of work has changed and the workforce along with it. John Naisbitt and Patricia Aburdene note in *Megatrends 2000* that "mental tasks have replaced mechanical ones" and "it is almost impossible to 'supervise' work that is . . .going on inside people's heads."[1]

> *The dominant principle of organization has shifted from management in order to control an enterprise to leadership in order to bring out the best in people and to respond quickly to change. . .*[2]

This is perhaps the toughest part of implementing TQM, partly because this is the area that requires the most change and partly because this is the area most resistant to change.

The 3M Corporation, in their TQM Instruction Program, provides an excellent list of behavior changes that are required of management:

From	To
Managing	Leading
Directing	Guiding
Competing	Collaborating
Relying on Rules	Focus on the Process
Using Organization Hierarchy	Using a Network
Consistency/Sameness	Diversity/Flexibility
Secrecy	Openness/Sharing
Passive	Risk Taking
Isolated Decisions	Involvement of Others
People Costs	People Assets

This is a tough order for most. However, if managers can move away from directive behavior and instead seek out and value their employees ideas and input, they will be able to forge strong teams of loyal and motivated employees. It is these teams who will be best able to meet the challenges of an information society.

The word "value" is extremely important here. If a manager seeks out an employee's ideas and then ridicules or dismisses the input, few ideas will be offered in the future. The same is apt to occur if ideas are taken but credit is not afforded the employee. Value must be recognized.

Leading employees, rather than controlling them, requires a more positive management style, one in which managers look for good performance rather than for mistakes. This is a principle espoused by Kenneth Blanchard in *The One Minute Manager* and it is a good one. Under TQM, it is very important to use performance measures as a guide rather than as a club. If standards are not met, the manager and employees must look at the data they have and determine how to improve quality. On the other hand, if standards have been met or exceeded, it is imperative that the team be rewarded. Rewards do not need to be large to be effective. In fact, it is best to let the employees themselves establish recognition awards programs ahead of time. This way they will know what is expected of them and what they can expect in return. Who can decide better what they would value?

Participation, openness, delegation of responsibility and authority, empowerment of employees, and a positive work environment all lead to better service to the customer and to happier employees and managers, too. This management style is a highly important aspect of current quality management thought that differentiates it from earlier quality programs.

<u>Organization's Mission and the Employee Job Function</u>

When the mission of a company, organization, or department is clearly stated, managers and employees alike have an overriding guiding principle to follow. They are better able to move together as a team. The importance of issues and problems can be judged and decisions can be tested against the mission statement. Blind procedures that might hinder quality of service can be more easily removed and replaced by understanding. Thus, employees are enabled to make decisions when a situation arises for which a policy or procedure is unclear, counter-productive or non-existent.

Distributed responsibility, distributed authority, diversity, and minimal organization hierarchy can be frightening (if not disastrous) when the mission is unknown or unclear. Without a clear, common mission statement embraced by every employee, chaos can erupt. This is why one of the first exercises of a company or organization implementing TQM is the generation of a mission statement. This is not a simple exercise. It often takes several hours to several days to complete, but it is an essential starting point.

Total Quality Management in the University/Computing Environment

<u>What is Your Mission?</u>

Most people think they know their mission. It is basic and understood, isn't it? Why then is it so difficult to *write* a coherent, concise mission statement? It is important to get a statement in writing, and the statement must be something that can be supported. At the university level, a statement of "Education, Research, and Community Service" describes what a university does, but it has little sense of mission. "To become one of the top ten undergraduate engineering schools in the country" reflects a concrete goal that can be pursued.

Likewise, within the computing environment, "to support academic, research and administrative computing" carries less of a sense of mission than "to provide a leading–edge computing infrastructure to best support the university's goal of being one of the top ten undergraduate engineering schools." It is certainly easier to state the mission of a computing center if the mission of the university is known. If the computing center's mission is clear, it is also easier for its departments to develop more refined mission statements pertinent to their particular service areas and customers.

There are several different models and processes for developing mission statements, but one key element to keep in mind is that the mission statement should contain an outward component. If it focuses internally, there is a danger that the customer will be forgotten as the organization focuses on itself. The President of an east coast university made the point very clear during a keynote address to a group of computing center directors in 1984 when he stated that he was tired of computing center directors asking him for more money to solve *their* problems. He wanted the computing center director to help him solve *his* problems.

Who are my customers?

The concept of customer seems outright foreign to many people in the college and university environment. Some people do not believe colleges and universities have customers. Students are somehow not customers, but just students in these peoples' minds, and yet they are certainly paying handsomely for an education. Under TQM, students are definitely customers and schools are not just "doing students a favor" by imparting knowledge to them.

You may or may not serve students directly in your particular area, but in computing as in any other area, you must know who your customers are and what they expect of you. This is crucial to TQM. So just as it is important to go through the exercise of developing a written mission statement, it is important to seriously answer the question: "Who are my customers?"

Students, parents of students, faculty, administrators, and perhaps external clients come to mind first. However, your boss, the board of trustees, alumni, development team members, your employees, or your co–workers can also be your customers. The test is this: Do you serve any of their needs or desires? Are you supposed to be serving them? If so, they are your customers.

An example might be helpful. Who are the customers for an application programmer working on a student financial aid system? Students (and their parents) are the end recipients, but the programmer may never see them. In fact, the programmer may seldom see the employees in the financial aid office who use the system. The people the programmer interacts with may be other programmers, a systems analyst and a supervisor. Thus, these may be the only customers the applications programmer ever interacts with and they may be the most demanding.

It is not possible to meet the expectations of all customers all of the time. Sometimes the desires of one customer are directly opposed to the desires of the other. One customer, a user department, may want the computing center to make costly changes to an administrative system to allow them to serve students better. Another customer, the budget office, may demand that the computing center cut costs by 10 percent during the fiscal year. The student customer may be ignored if the budget office is the most demanding customer and decisions are made without teamwork and without the university mission in mind. In the end, the organization's customers must be served in line with the organization's mission.

Managing and Measuring Quality

We in the computing and information technology arena are as guilty as any when it comes to failing to manage quality. We do have many standards and many measures of performance, but often these are not measures of importance to our customers. What measures do you use and report in your organization now?

- Number of workstations added to network
- Percent uptime on mainframe
- Gigabytes of disk storage used
- Number of pages of output printed
- CPU cycles used
- System implemented on time

All of these are measurable, but do they measure quality of service from the customer point of view? Does CPU uptime measure availability at the desk of the end users? Is response time so slow in some areas that people won't even use the system even though it is up? Does disk storage increase because customers are frustrated with the lack of access to tape drives; hence they move everything online even though it's used only once a month? Are users printing more paper because they cannot wait for a screen to refresh? Are they printing less paper, not because you've implemented a "paperless office" but because it takes three days to get printed output? Was the system you're so proud of brought up on time? Was it brought up without the utility the customer wanted? Was it brought up according to your timetable or according to theirs?

The point of all these examples is that customer expectations are what is important and your measures of quality must reflect the degree to which you are meeting *customer* expectations.

Sometimes expectations are beyond your ability to meet because of insufficient staff, time, expertise, or funding. You can either work with the customer to obtain the necessary resources or work with them to alter expectations. Either way, you must work with them. Proceeding as if you can deliver when you know you cannot is not good for your customers or for you.

Written statements are once again helpful in this regard. Quality statements which outline standard levels of service that customers can expect are extremely helpful. Statements explaining what your organization can do to meet special needs and the appropriate are also good people to control. On a larger scale, written agreements between the computing center and campus departments are often very useful, not so much to fall back on when an argument erupts, but more as a working tool to define expectations on both sides at the very beginning of a service arrangement.

<u>Procedures</u>

Most computing centers have policies and procedures. How many of these have been set by the computing center management without input from customers or from employees? How many have been set with quality of service in mind? How many were created with the computing center's needs in mind to "protect it from the customer?"

Procedures should be created with a clear understanding of the mission of the organization and the expectations of customers. Since procedures are most often the source of quality of service problems, they should be the first place to look for ways to prevent problems from recurring.

Front–line employees and customers themselves can often provide the best suggestions for changes in procedures. However, they will not normally provide them unless they are asked. Employees may complain to each other and customers will do likewise. Even if the computing center holds a monopoly on service, the customer may try to find a way around policies and procedures and get help elsewhere rather than communicate with the computing organization.

This behavior is not atypical. Customers generally do not complain. They just go away. So, lack of complaints does not mean that the computing center is doing well. Just as in the commercial world, it is important that computing centers actively poll their customers. Surveys, focus groups, and independent consulting groups can all play a key role in helping a computing center examine its service quality.

Through the use of these techniques, problems may come to light as well as some suggestions for change. Teams organized within the computing center with appropriate managers, front–line employees, and customers can then take this information and develop solutions. The team approach provides a broad spectrum of information and ideas, and also provides a certain ownership on the part of employees. Anyone is less resistant to change if they have had a hand in creating that change.

Quality of service depends upon solving problems, problems generally centered in procedures. The teamwork approach is the best approach to improving procedures, teamwork which combines guidance and leadership from management with input from employees and customers.

Will Total Quality Management Work in the University Environment?

Total Quality Management has been applied in the university environment only recently. Since it takes two to three year ..o really permeate an organization, it is too early to tell how well it will work here. Certainly a number of major corporations can attest to its usefulness in their environments.

The hurdles to making TQM work in the college and university environments do not appear to be all that different than in business and industry. Costs, resistance to change and the underlying fears that lead to the resistance seem to be the biggest obstacles. Colleges and universities may have r ' led cost burdens because they cannot necessarily assume increased revenues to offset their investment in TQM training. However, not all businesses seek increased revenues. Retention of current market share combined with profitability through reduction in operating costs, may be their goal.

Resistance to Change

Those of us who work in computing/information technology often refer to ourselves as agents of change. However, we are probably not that much different than all of those *other* people who keep resisting our efforts to change them. TQM calls for us to stop trying to change others to fit us, and instead, to listen to others and see how we might change to better serve them.

Should user departments need to deal with data flow diagrams, learn our methodology, fit into our patterns of work, meet our deadlines? How much computing do they need to understand? How much should we be learning about accounting, purchasing, financial aid, government reporting regulations, student registration, and all the problems of running a college or university? How can we change to better support these other departments, our internal customers?

We need to ask these questions and more, and be very aware that our old habits and old attitudes are difficult and sometimes impossible to change. For example, someone in the computing environment may feel that he or she is the local expert and the author and owner of the administrative accounting system. As a result, they may react very negatively where the accounting department states *they* own the system and they want to fix some of its inadequacies. The reaction can be very strong when this expert, the self-appointed source of wisdom in computing matters, is treated as if he or she is an advisor or consultant whose role is to serve the *ignorant* user group.

Should users own administrative systems or should the computing center? The right answer depends upon what is best for meeting the college or university mission, and it also depends upon what the customer expects. If a survey of our customers indicates that we are in the wrong place, changing ourselves and moving to the right place with the right attitudes will take quite some time and energy. Given the depth and breadth of the change that may be required, it is no wonder that two to three years may be required to effect a cultural change of this magnitude.

Most computing centers have held a monopoly for many years. Academic and administrative users did not have many choices when it came to computing, even with minicomputers, because of the costs involved. Academic computing was the first to break away with the advent of microcomputers, but much of administrative computing is still tied to the central machines. Nonetheless, it behooves computing centers to behave as if they do not have a monopoly, and as if they must work to retain their customer base.

Some managers and employees embrace the concepts readily and see TQM as a workable means for making things better. It becomes almost a religion to them. Others are equally polarized, but in the opposite direction, and converting them is not an easy task.

Managers

Upper management, preferably throughout the college or university, must be sold on TQM. Most of the change that is required by TQM is at the management level, so TQM has little hope of succeeding without executive commitment. This commitment may be very difficult to obtain because of fear. Empowering employees, delegating authority, allowing employees to take risks without upper level approval of every decision is risky and sometimes outright frightening to managers.

Transition from a directive style to a leading style is also difficult. It is very easy to slip back to directing when things get tough. Trust and confidence in staff must be built up over time, and managers must see this as good for their own welfare before they are comfortable in a guiding role. When a deadline is missed on a development project, it is very easy to jump in with "the solution" rather than listen to the employees involved and work with them to develop a solution.

Employees

Some employees seem more ready to adopt TQM than are their managers. Perhaps this is because the employees are anxious to have their voice heard, to play a role in making things better. Other employees seem eager to adopt TQM, but their eagerness stems from a misunderstanding of what TQM is about. They mistakenly think it is "their turn to get back at management." Still others want nothing to do with TQM, again because of misunderstanding. TQM, rather than being something that will empower them, appears to be just another way for management to monitor their work and punish them if performance is not up to par. After years of feeling ignored by management, they are not about to believe that managers want their input.

Customers

Some customers do not see themselves as such and they, too, can be distrustful or skeptical of a computing center that is suddenly seeking their input. It is a challenge to establish credibility. It is a challenge to convince customers that you care about what they say. It may be even more of a challenge to get any response if the customer believes the computing center will not get the resources to implement meaningful changes anyway.

Costs
A considerable investment is required to communicate the goals of the TQM process and its implementation within a college or university. Some elect to hire TQM pioneers such as Xerox or 3M to assist. Others elect to conduct their own process. Either way, the investment of time is considerable to teach each and every manager and employee what TQM is about, and then to put TQM into practice.

The need for initial investment to implement the TQM process is another reason why executive level commitment is essential. Based upon the experiences of for–profit and not–for–profit companies, the investment should pay off in the university environment. However, executives must be convinced before they will fund it.

Other costs arise because solutions are not necessarily free. However, clear mission statements and a teamwork approach provide guidelines and processes for choosing priorities and investing in them accordingly. If we do a good job of working with our customers, we will have valuable allies when we ask for funding for *their* projects.

Results
A noticeable return on the investment in TQM may take some time. This is why 3M recommends that demonstration projects be undertaken which are narrow in focus and short term in duration. These projects can be used to show tangible improvements in service quality, and they also serve as models of the team building process and problem solving approach. Demonstration projects may be especially important in the computing environment because so many of the tasks in computing are large and long term. The first project to be addressed under TQM should be relatively easy to do, not the implementation of a major system. Early successes help reinforce attitudes and behaviors which may be very new to many of the participants, but which will be invaluable later on as tasks are engaged.

Summary
Hopefully, you now have an understanding of Total Quality Management. First you have to understand what quality is and how you measure it before you can manage it. Essential to TQM is the customer and customer expectations. Everyone you service is your customer, and quality service requires participative management to establish common procedures based on well defined goals for your organization.

Listening to your employees, creating and encouraging teamwork, and allowing your employees to participate in the decision–making process are necessary ingredients for TQM.

Does TQM work? We believe it does, and that it will work for you. Its success depends upon your ability to change yourself, your management style, and your organization.

Remember, quality is not by accident. It is the result of listening to customers, exercising good management, encouraging employee participation, and maintaining total commitment to quality.

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MEASURES OF PERFORMANCE

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ABSTRACT

There is a recognized need to demonstrate the concrete benefits of Information Technology, and to measure the productivity and cost-effectiveness of our operations.

This paper describes the metrics that can be used to quantify workload, spare capacity, service levels, staff productivity, resource distribution etc. It also presents ways of measuring aggregate costs and return-on-investment in Information Technology.

1. INTRODUCTION

"Measures of Performance" in any enterprise are necessary to demonstrate to senior management, users and to functional managers that a given function is managed effectively for the benefit of the entire enterprise. These measures, once compiled, become a "report card" on the "health" of the organizational unit. Equally important, they also allow functional management to continuously improve their operation and productivity. Given the increasing cost, the growing strategic impact of Information Technology (IT), and the rapidly diminishing timeframes for taking action, the collection and analysis of "Key Performance Indicators" is critical.

The proposition in this paper is that for IT, "Measures of Performance" means collecting and analyzing indicators in the following three categories:

- **VALUE** Designed to assess and quantify IT's contribution to the achievement of the institutional objectives.

- **RESOURCES** Designed to assess and quantify how, where and how much is spent on IT.

- **PERFORMANCE** Designed to assess and quantify how efficiently and how well IT operates.

None of the functions within a typical IT operation can be called a precise science or even engineering. Thus some of the measures are difficult to obtain, others are less than 100% accurate. However, if consistency is maintained trend-lines of the indicators should be meaningful and useful (absolute values may not). Change and/or improvement should become visible. There really is not a perfect measurement program. One has to start with what is possible and make gradual improvements.

Since, typically, our institutions do not have extra resources that can be assigned to this task, the data must be easy to collect and must be seen to be useful by those who have to collect it. This, we have learned, is the most important prerequisite for success. Graphs of the indicators, forms for recording data and sample reports are available from the author. The remainder of this paper outlines the indicators Mount Royal College is or will be collecting.

2. INDICATORS OF VALUE

2.1) THE BUSINESS CASE APPROACH

Identifying and monitoring the benefits of IT is much more difficult than is the tracking of costs. One of the better approaches is to measure the results evident in operating departments before and after the implementation of IT projects.

This approach relies on formal project proposals, with clearly identified costs and benefits. The institution's Financial System should be used to track these, and the project's sponsor(s) should be held accountable for them. The logic is deceptively simple. With every new application of IT the overall cost/benefit picture of the department or institution should show a change. i.e.

$$\left[\left(\Sigma\text{op.benefits}-\Sigma\text{op.costs}\right)_{\text{after}} - \left(\Sigma\text{op.benefits}-\Sigma\text{op.costs}\right)_{\text{before}}\right] >> 0$$

This assumes that all other variables are constant when a significant change in the use of IT is made. It also assumes that this type of macro-analysis done year after year will tend to make the unavoidable inaccuracies in measuring the variables involved rather insignificant.

Finally, it is very important to have the operating departments and the IT units evaluate the above inequality **JOINTLY**. That will lead to unusually productive partnerships capable of identifying business opportunities, minimizing costs, and exhibiting real synergy.

2.2) THE OPINION SURVEY APPROACH

Using this approach, users are questioned regularly and formally in order to obtain their opinion on the importance of and satisfaction with IT. The surveys might ask:

- How important is IT to you in doing your job?
- How satisfied are you with IT services?
- Could additional IT improve your productivity?
- Could you do your present job, equally well, without IT?

Scale of 1 - 5 is used, and the total number of responses of each score is tallied.

This is somewhat subjective, but will indicate changes over time and is least expensive to implement.

2.3) THE SERVICE AGREEMENT APPROACH

A Service Agreement is a signed contract between a user department and Information Systems (IS), defining precisely the user's expectations of IS.

Users define the services they require, along with the quality, benefit and cost measures that are meaningful to them in their own business situation. For example, for our LIBRARY, the benefits may be expressed in terms of:

- The size of the collection being managed
- Number of loans processed
- Number of volumes purchased
- Fees collected (in dollars)
- Client delays (due to system problems).

Users also define their satisfaction indicators which might include:

- Terminal response time (in seconds)
- System availability (in %)
- Number of "bugs" encountered
- Response to calls for assistance (in minutes).

Annually, or once each semester, a joint report is produced indicating whether the terms of the Service Agreement have been met, and if so to what extent. Tying all IS services to such agreements allows quantification of the value and the quality of service delivered. Specifically, the number of Service Agreement targets met should be reported.

Service Agreements also have the virtue of building bridges of understanding, and are valuable for that reason alone. They fall between the Opinion Survey and Business Case approaches in terms of cost, complexity and effectiveness.

This is the approach we are now introducing at Mount Royal College.

3. INDICATORS OF RESOURCES

Value contributed to the success of the institution is hard to quantify. The associated costs are much easier to define, and are equally important. The prerequisite is a well designed Financial System. The source for cost data are the actual and budgeted expenses by project, function, organizational unit, external supplier etc. These cost figures can be combined with other data (such as FTE) to derive key ratios designed to put the costs into perspective.

Measurement of costs allows management to remain "in-control", by understanding where the IT dollars go, how much is spent, by indicating what part of the organization could benefit from the use of IT, and by showing how effectively resources are being used.

The following highlights the most important measures of cost:

3.1) AGGREGATE MEASURES

The following should be quantified annually:

- Total operating budget for the IS department
- Total IT capital budget and lease costs for the institution
- Total user-related IT costs

  where

  $$\text{USER "IT" COSTS} = \begin{pmatrix}\text{No. of users}\\ \text{involved with IT}\end{pmatrix} \times \begin{pmatrix}\text{Ave. user}\\ \text{salary/hr.}\end{pmatrix} \times \begin{pmatrix}\text{No. of hrs. spent using}\\ \text{IT per year per user}\end{pmatrix}$$

- Total spent on new IT projects, indicating breakdown between hardware, software and people costs
- Total spent supporting IT applications already in place (as per 3.2 below).

It should be noted, however, that every new IT project increases the cost of on-going IT operations. Therefore, if "\$" is the money an institution has available for IT in any one year, and "i_n" is the annual operating cost of the "n^{th}" project, then all that remains for new undertakings is

$$\left[\$ - \sum_{1}^{n} i_n\right] \quad = \quad \text{Discretionary Funds Available.}$$

Management must clearly understand that $\$ - \sum^{n} i_n$ must be substantially larger than zero, if the institution is to continue to introduce new uses of IT. This is why IT budgets keep growing year-after-year.

3.2) ON-GOING COST BY APPLICATION

To gain an understanding of how the IT dollars are spread out within the organization and to identify new opportunities, the cost of applications by organizational unit and functional area should be compiled annually.

If you list all organizational units and all business functions comprising your enterprise, you will have an excellent overview of what parts of the organization are served by IT and at what cost. Clusters and holes in the matrices indicate which areas you need to look into. Directing new IT investment should be much easier with these data in front of you.

3.3) COST OF MAJOR FUNCTIONS WITHIN 'IS'

The expenditures on the main functions within IS should be recorded annually to demonstrate, where within the IS department, the operating budget is applied. The impact of changing workloads, new technologies and of efforts made to improve productivity may be observed. It should help to make more effective use of the IS resources.

3.4) COST OF NEW PROJECTS

Any significant new activity (over 30 m-days) should be defined as a project and its costs monitored using the Financial System.

This will allow management to understand the cost of implementing new projects, relying on data from Time Reporting, Job Accounting and the Purchasing Systems.

As an aid to monitoring on-going costs, and to show the impact of each new project, its expected operating costs should also be estimated and recorded.

4. INDICATORS OF PERFORMANCE

Measures of workload, productivity, utilization etc. are the ones most frequently collected by heads of IS departments. They require this type of information to discharge their responsibilities and to support their requests for resources.

At Mount Royal College we collect performance data by functional areas within Information Systems as follows:

4.1) COMPUTER OPERATIONS

- MEASURES OF AGGREGATE WORKLOAD

These monthly averages provide an indication of the work done by our VAX-cluster.

- Process count (no. of concurrent VAX-cluster processes)
- Connect time (in hours)
- CPU time (in hours)
- No. of direct I/O's
- On-line storage (in M bytes)
- No. of active VAX accounts
- No. of pages printed.

These figures are obtained from the VAX Job Accounting utility, averaged monthly, and used to show trends of the most recent 2 -3 years. Thus changes in load are highlighted (daily, monthly and annually) and are explained by variations in user-workload presented to the VAX.

- MEASURES OF SPARE CAPACITY

This is a critical group of indicators for planning and managing service levels. Maximums during prime time are recorded in order to ensure that we can handle peak loads. The source for this data is the VAX System Performance Monitor.

- [100 - % CPU use]
- [100 - % Memory in use]
- [100 - % Disk space in use]
- $\left[100 - \dfrac{\text{Actual \# Direct I/O's}}{\text{Max. Direct I/O's}} \times 100\right]$.

We try to leave 10 - 15% spare capacity, based on the load forecast for the next 12 months.

- MEASURES OF UTILIZATION

These monthly totals answer the question "which organizational units and which applications are using the system". The absolute value and % of total use for each organizational unit reporting to a Vice-President, and for each application image (e.g. Library System) of the following is reported:

- CPU hours used
- Direct I/O's performed
- Disk space used
- Connect time utilized
- Processes initiated on the VAX.

These are obtained from the VAX Job Accounting and the VAX Performance Analyzer utility. Historical trends by organizational unit show changes in utilization by that group. The results of optimizing applications, as well as of changes in workload presented by applications, are summarized.

- **SERVICE LEVEL INDICATORS**

- Response time being experienced by users is estimated by running a predefined "benchmark process" at fixed intervals and measuring the time it takes to complete. This allows us to predict the response times users are seeing with reasonable accuracy.

- No. of users unable to LOG-ON is monitored at frequent intervals. For a properly managed system this should always be zero.

- Cost of hardware unavailability is estimated as:

$$\text{COST OF 1\% UNAVAILABILITY} = \begin{pmatrix}\text{Cost of}\\ \text{1 hr. Downtime}\end{pmatrix} \times 0.01 \begin{pmatrix}\text{CPU Hrs.}\\ \text{possible}\end{pmatrix}$$

Where

$$\text{COST OF 1 HR DOWNTIME} = \begin{pmatrix}\text{Ave. hourly}\\ \text{salary + benefits}\end{pmatrix} \times \begin{pmatrix}\text{Ave. no. of}\\ \text{people affected}\end{pmatrix}.$$

4.2) SYSTEMS DEVELOPMENT AND SUPPORT

This is the group that delivers new applications, supports existing ones and assists end-users. The key indicators here have to do with productivity, workload, quality, and ability to meet targets as follows:

- **PRODUCTIVTY/WORKLOAD MEASURES**

- Support Productivity $= \dfrac{\text{Support LOC}}{\text{Support Staff FTE}}$

where LOC # Lines of Code

- Development Productivity = $\frac{\text{Development LOC}}{\text{Development Staff FTE}}$

- Number of LOC supported and new LOC delivered
- Number of packages/systems supported
- Number of enhancement requests
- % FTE deployed for each major organizational unit.

- QUALITY MEASURES

- Support quality = $\frac{\text{No. of Error Reports}}{\text{No. of LOC in Production}}$

- Development Quality = $\frac{\text{No. of Error Reports}}{\text{No. of LOC developed}}$

- Total time spent correcting problems.

- MEASURES OF ESTIMATING ACCURACY

- Schedule estimate = $\frac{\text{Projects on or Ahead of Schedule}}{\text{Total Projects}}$

- Budget estimate = $\frac{\text{Projects on or Under Budget}}{\text{Total Projects}}$

At Mount Royal College, we use non-comment LOC, and assume that when applied consistently, LOC will yield meaningful results. As an alternative, and because it is easy to record, we are experimenting with "number of modules/programs" in place of LOC.

5. THE REPORT CARD

Every institution needs a small number of key indicators at the summary level. The following may be reviewed on a regular basis:

STAFF & BUDGET

- 'IT' budget
  Institution budget
- 'IT' budget
  Student FTE
- 'IT' FTE
  Institution FTE

CAPITAL COSTS

- 'IT' Capital Assets
  Institution Capital Assets
- 'IT' Capital Assets
  Student FTE
- 'IT' Capital Expenditures
  Institution Capital Expenditures
- 'IT' Capital Expenditures
  Student FTE
- Purchase cost of CPUs managed centrally
  Total MIPS under central management

COST & VALUE OF SYSTEMS

- Total spent on new IT projects
- Total spent on supporting existing applications
- Net benefit realized
- % of users reporting that IT is important
- % of Service Agreement targets met
- System support costs
  No. of LOC supported
- System development costs
  No. of LOC developed
- User-related IT costs

AVAILABILITY OF COMPUTING

- $\frac{\text{No. of workstations}}{\text{Employee FTE}}$
- $\frac{\text{No. of student workstations}}{\text{Student FTE}}$
- $\frac{\text{Total VAX-MIPS}}{\text{Employee FTE}}$
- $\frac{\text{Total VAX-MIPS}}{\text{Student FTE}}$

6. CONCLUSIONS

Performance measures such as the preceding, are not revolutionary. In fact, they are all based on common sense. Nevertheless, collecting them consistently, analyzing them regularly, and producing meaningful reports from them is not easy. Sometimes the desired indicators are not readily available (we even had to struggle with the collection of VAX performance indicators), and then people resist making the effort to collect the necessary data.

There is substantial work involved (made easier by automation), but there really is not another way to create a sound basis for the effective management of IT on campus. What specific indicators are used depends on the institution's needs and management philosophy.

The foregoing indicators are still rough and are not perfect. Much more work remains ahead, but just thinking about "Measures of Performance" as a package has been a useful exercise. These measures have provided us at Mount Royal College with many useful insights into our resource utilization, improving productivity, the costs and benefits of IT, etc. Treating new projects as "business cases" with firmly committed costs and benefits has been particularly difficult, but we are moving in that direction.

We are proceeding with the refinement of this package of measures, in the hope that we will be able to define what is easiest to collect, is most meaningful and what contributes most to the effective use of IT on campus.

Measurement of the Business Value of IT in Higher Education Administration

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ABSTRACT

In an era of rapid change, increasing costs and decreasing enrollments, the effective and efficient performance of academic administration becomes increasingly important. Information Technology (IT) may be, because of the myriad goals toward which it can be employed, an especially valuable resource. Because of its typically high cost, and the difficulty in measuring its business value, however, the actual utility of IT is being questioned. In addition, most "valuing" techniques seek only to look at the costs and benefits of providing and employing information, while neglecting to assess the contribution of that information to the management process or to an ultimate organizational outcome. The Return-on-Management[3] (ROM™) metric proposed by Paul Strassmann attempts to assess both the cost of providing the information and the contribution of this information to the overall management process. This paper argues the need for new methods of valuing information systems; demonstrates the use of ROM™ as a tool to compare the administrative and information technology performance in selected four-year academic institutions in the northeastern U.S.; assesses the contribution of this tool; and characterizes its place within the overall justification/evaluation process.

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3 Trademark of Strassmann, Inc.; discussed in: Strassmann, P. A., Berger, P., Swanson, E. B., Kriebel, C., and Kaufman, R. J., (1988). **Measuring Business Value of Information Technologies.** ICIT Press, Washington, DC.

INTRODUCTION

This paper is intended to serve multiple purposes. First, we wish to suggest that traditional methodologies are no longer appropriate for justifying investments in information technology (IT) -- probably not a very controversial claim. We suggest instead the use of productivity-based measures and evaluate the performance of one such measure: Return-on-Management (ROM™). We propose a procedure for employing the ROM™ measure and then examine some possible uses. For example, is it better used for internal evaluations or for comparison with others? Does it help us decide "how to" implement an IT investment (what hardware/software to use) or does it provide insight on "whether to" make the investment at all? Finally, we assess the fit of ROM™ in the context of a larger collection of evaluation/justification methodologies.

THE PROBLEM

Colleges and universities face a growing need for more effective and efficient administration in the face of:

- population-based decreases in the pool of traditional applicants
- greater competition for resources coupled with decreasing enrollments
- escalating costs and a resistance to continually raising tuition at current rates
- the need for increasing investment in information technology to support academic activities.

While IT has the potential to improve administrative efficiency, its effective application is often frustrated by four factors. First, examples of successful applications usually carry high dollar costs. (We hasten to add, however, that high cost is not a prerequisite for success!) Second, it is seldom obvious which one(s) of several applications, all competing for limited and scarce resources, will contribute most to achieving organizational objectives. Third, the actual "value" of an application is difficult to measure. Finally, we have come to recognize, as demonstrated by Cron and Sobol (1983), that the level of spending on IT is not necessarily related directly to administrative productivity. These factors suggest that careful and complete justification of IT applications is especially important if we are to allocate our scarce resources in the most effective manner.

In addition to these rather daunting factors, we need to recognize that the nature of information systems is changing. Traditional systems have been used primarily to enhance operations and process transactions (Lederer & Putnam, 1986). Penrod & Dolence (1990) suggested that systems are changing from promotion of transition or innovation to promotion of transformation, while Anthony's framework (1965) would suggest change is from operational/tactical to strategic applications. In either view, the nature of the systems is changing: complexity is increasing; support is required for multiple linkages within the organization and between the organization and its environment; secondary or indirect impacts are becoming more significant (the direct effect of a new financial aid system may be to improve financial control; the indirect effect, to improve competitive position by improving timeliness of response to applicants); we are looking toward the management of "relationships" rather than of "things"; and the most important impacts of systems are often indirect and intangible. Benefits stem not from the nature of the technology itself, but rather from our ability to utilize the technology so as to achieve significant benefits from other, existing resources (Clemons, 1991A). In addition, systems which would in the past have enabled strategic advantage are now becoming strategic necessities. As a consequence of so much change, measuring the "value" of information technology is becoming more necessary and increasingly difficult.

TRADITIONAL METHODS OF JUSTIFYING THE USE OF INFORMATION TECHNOLOGY

Traditional methods of justifying information technology:

"• Use the same procedures as in buying machine tools;
- Focus on high volume, homogenous transactions;
- Concern themselves with operational applications;
- Employ a bottoms-up approach and a technique based on unit costs;
- Emphasize cost reductions;
- Adopt a short-term and payback orientation;
- Emphasize justification by the analyst;
- Rely on proposals by providers of the tools;
- Apply to routine clerical work."

(Strassmann, 1988)

The following examples suggest some of the problems and limitations in traditional justification methodologies.

a. Cost/Benefit Analysis - a pragmatic approach

One of the more popular ways of justifying investments in IT is cost/benefit analysis. The procedure typically consists of the following five steps (Lay, 1985):

1) Define the scope of the project
2) Evaluate the direct and secondary costs and benefits of the project
3) Define the life of the project
4) Discount the dollar values
5) Perform sensitivity analysis

There are a number of problems with this approach. Step 2, for example, requires an attempt to identify in detail <u>all</u> tangible and intangible, direct and indirect, costs and benefits. Tangible costs and benefits are often easy -- costs for staff and purchases from vendors, benefits such as reductions in staff or delivery time. The intangible, indirect costs and benefits (e.g., the impact of user sophistication, increased customer satisfaction, or client confidence) are often far more important, and are not easily defined or measured for inclusion in the analysis.

In step 3, the lifetime chosen for a project is often arbitrary. Benefits that continue to accrue throughout the expected life automatically make longer projects look better. However, lifetimes chosen on the basis of "investment" criteria may bear no relation to what's appropriate for strategic necessity. Furthermore, the very concept of "lifetime" implies a point in time where project or system utility ends -- a concept irrelevant to systems that provide strategic infrastructure for an organizational future.

In step 4, we have found that an arbitrary choice for discount rate can mask the effect of errors made in predicting costs and benefits. In particular, prediction errors have less effect on results for higher discount rates.

The traditional cost/benefit approach may be extended in various ways by using techniques such as: Incremental Analysis (predicting expected work load and considering alternate ways of meeting this load), Expected Value (estimating costs or benefits and assigning probabilities in order to compute "expected" costs or benefits), Value Analysis (developing and testing a prototype, then extrapolating costs and benefits from prototype results), Benefit Profile (developing an extensive list of benefits, noting degree of improvement or potential improvement) (Smith, 1983), or sensitivity analysis to include the effects of uncertainty. There is, however, no inherent structure for including "risk" in a cost/benefits analysis -- a major shortcoming for strategic systems. As an aside, sometimes assessing the risk of <u>not</u> doing a project can be the most important aspect of a strategic systems investment decision.

Finally, cost/benefit analysis emphasizes the "cost" basis, relying on the fundamental notion that benefits must "outweigh" costs in order for an investment to be worthwhile. We suggest that this aspect makes cost/benefit analysis most useful in deciding in which of several ways something should be done, rather than whether it should be done at all.

Other types of pragmatic approach, such as the grid-based impact/value framework of Hammer & Mangurian (1977), provide guidance with respect to general investment strategies but are less useful for evaluating a specific investment decision. Critical Success Factors (Rockart, 1979) has the potential for developing unified priorities for investment decisions, but tends to fail when most sorely needed, i.e., at times when members of a management team cannot agree on a single set of appropriate objectives or goals.

b. Utility Analysis - a theoretical approach

Ahituv (1980) suggests establishing the value of an information system used for reporting from a multi-attribute utility function that puts values on "Timeliness" (how soon and how often the report is available), "Contents" (whether the report contains what you need to see), and "Format" (the nature and manner of its presentation). Given that such a function can be developed, Ahituv suggests means to identify the information system providing the greatest utility.

This methodology has several problems. First, a working knowledge of the concept is needed to develop individual utility functions for each attribute, codify the tradeoffs between attributes, and express all of this in the form of a mathematical function. We expect few users may be familiar with the mathematical concept of utility theory, so many may be uncomfortable with this methodology.

Second, it is difficult to get all members of a group to accept a single utility function. Individuals may differ on the choice of appropriate attributes, and may argue about weighting factors for similar attributes. Without agreement on a single function, the group will not effectively champion any specific alternative.

Third, Ahituv suggests that utility functions containing parameters describing system performance (such as response time or error rates) can be "solved" for optimal values of the parameter, and then a system for which the parameter values are similar can be sought. If no such system exists, the utility function could be used to evaluate and rank order existing systems. Attributes for evaluating operational/tactical systems (e.g., transaction processing or reporting systems) can often be tied to system performance parameters for fruitful application of the utility function approach. For strategic systems, however, we may find that we cannot identify the critical attributes to develop the utility function, or that the utility function we can develop does not contain system performance characteristics. In either case, how to adapt Ahituv's process for identifying the "best" system becomes unclear.

Other theoretical approaches for valuing information systems (see for example Hilton, 1981) are based upon uncertainty reduction as originally suggested by Shannon (1948). In these, value is assigned to the contribution of specific pieces of information in a particular decision, as opposed to the system as a whole. Such methods are more suited to helping decide which of several pieces of information to acquire, rather than to choosing the information system with which to acquire the pieces.

In summary, while traditional methodologies may be satisfactory for the evaluation or justification of operational and tactical systems, they have several major limitations. They:

- are cost (input) rather than benefit (output) based;
- fail to adequately include intangible or secondary impacts, or the effects of risk;
- place value on the technology or the acquisition of information, rather than on the derived outcome;
- are more suited to evaluating the merit of alternative implementations than to deciding whether an implementation should take place at all;
- may require a level of mathematical knowledge and a degree of sophistication not widely available.

In short, traditional methodologies are inappropriate for evaluating strategic or transformation-oriented information technology investments.

ROM™

looking to improve the performance of administration and management, a measure of management performance that can be tied to a measure of information technology performance should be particularly useful. Strassmann's Return-on-Management (ROM™) is such a measure.

For our present purpose, we will consider ROM™ to be a management productivity measure founded upon three basic concepts:

- value added by management is any value of a product over and above the cost of raw materials, operations involved in, and services required for its production;

- the fundamental purpose and effect of IT investments are to improve the performance of management; and

- the value of information comes only from use, not simply from acquisition.

In the most simplistic view, we would first calculate "management value added" by subtracting all non-management costs from total revenues. We would then calculate ROM™ by dividing this management value added by the cost of management. The resulting ratio corresponds to the overall "productivity of management." A similar figure for "IT productivity" is computed from the management value added divided by the cost of information technology.

Calculation of Management Value Added

The calculation of management value added is not a straightforward process of simply totaling a set of numbers representing management's contribution in some sector of an organization. Rather, we must start with the total revenues of the organization, subtract the value added from capital, costs incurred to all suppliers, and all non-management operational costs, leaving what we actually define to be management value added.

Note: In the following discussion, we use the term "management" to include both the traditional management and administrative functions.

An Illustration

We have found that schools use rather different accounting systems and charts of accounts. To compare institutions, we chose data from the Integrated Post-Secondary Education Data System (IPEDS) Financial Survey for the years 1988, 1989, and 1990. While these data do not provide the detail we would have liked, they do allow a reasonable first approximation. Our calculation of management value added proceeds as follows.

Total revenue is taken directly from Part A: CURRENT FUNDS REVENUES BY SOURCE, line 16 (Total Current Funds Revenues). This includes tuition and fees, federal, state, and local government monies, private gifts, endowment income, and monies from other sales and service activities.

Value added due to capital is given by Part J, PHYSICAL PLANT ASSETS, lines 01 (Land), 02 (Building), and 03 (Equipment) summed and discounted at the estimated cost of capital for that year. In each case, we estimated the average cost of capital from the experience of our own institution, by dividing the total interest paid during that year by the total value of bonds outstanding.

Non-management operational expenses: A first approximation to the total of supplier and non-management operational expenses is given by Part B, CURRENT FUNDS EXPENDITURES AND TRANSFERS, line 22 (Total Current Funds Expenditures and Transfers). This figure, however, includes both the non-management operational expenses we want and the management costs. Management costs in this instance include all salaries, wages and bonuses, office space, and costs for technology directly supporting management activities. Institutional support, Part B, line 07, includes expenses for general management services, executive direction and planning, legal and fiscal operations, public relations, and development. We chose Institutional support to approximate adminstrative costs. Non-management operational expenses then becomes Part B, line 22, CURRENT FUNDS EXPENDITURES AND TRANSFERS minus Part B, line 07, INSTITUTIONAL SUPPORT.

Table 1, below, illustrates the calculation for a sample school.[4]

Table 1

Total revenue {A.16.3}:		$37,200 +
Capital:		
Land {(J.01.1 + J.01.4)/2}:	$2,499	
Buildings {(J.02.1 + J.02.4)/2}:	$47,002	
Equipment {(J.03.1 + J.03.4)/2}:	$10,518	
Value added due to capital: (@ 9.72%)		$5,834 -
Total non-management operational expenses:		
Total current funds expenditures and transfers {B.22.3}	$34,308	
Institutional support {B.07.3}	$5,731	
Total non-management operational expenses:		$28,577 -
Management value added:		$2,789
Management productivity = Management value added / Institutional support		0.49

(All dollars in thousands)

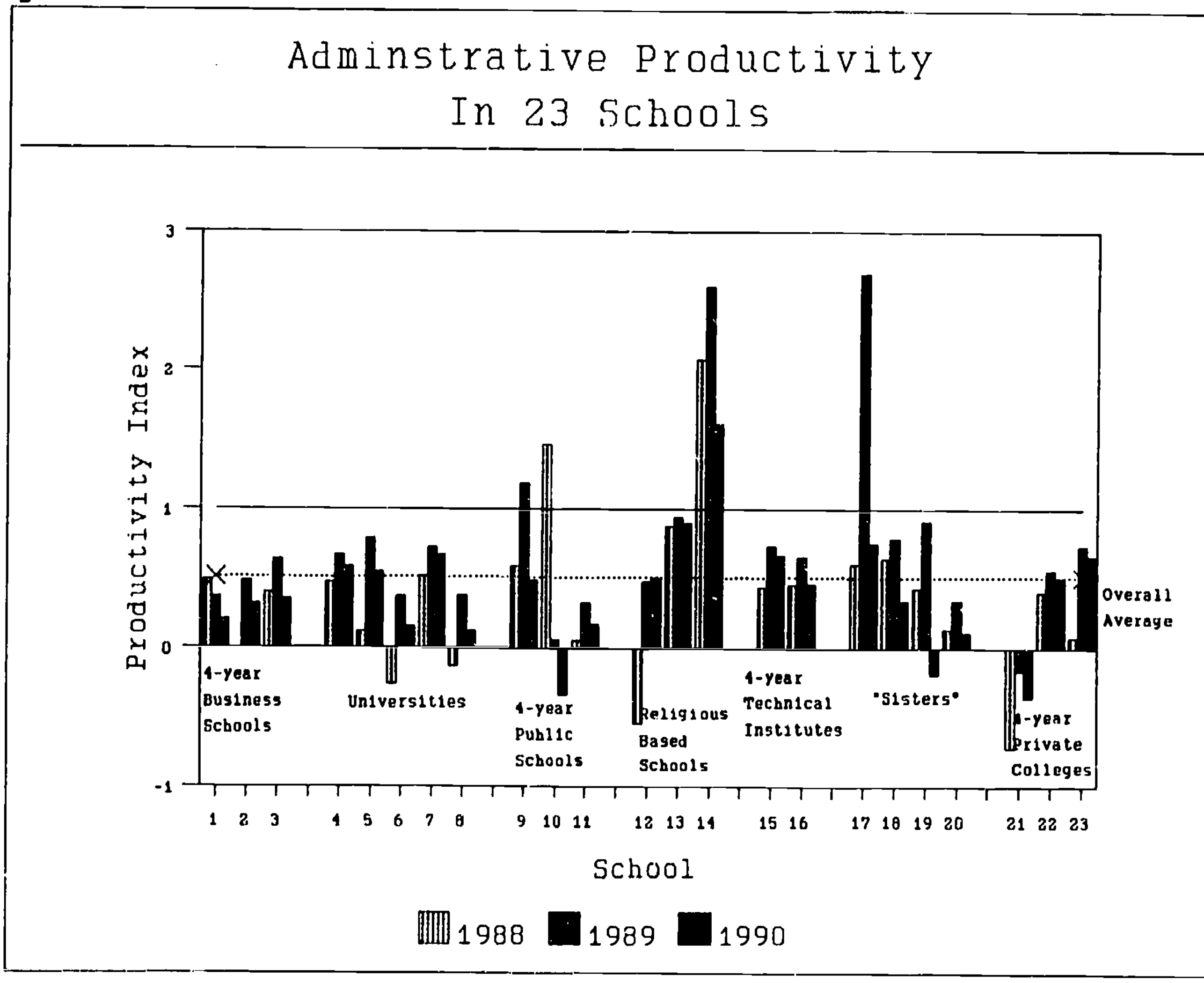
RESULTS

Comparison Across Schools

Figure 1 displays administrator productivity for a sample of 23 New England colleges and universities during 1988-90. One need not pour over this figure

[4] The notation {A.16.3} in the figure expands to: Part A, line 16, column 3

Figure 1



to see that administrator productivity varies widely. We may, however, make several additional observations.

First, our definition of the productivity index as:

$$Productivity = \frac{Management\ value\ added\ (Includes\ Cost\ of\ Management)}{Cost\ of\ Management}$$

leads us to expect a ratio greater than one. But it seldom is! This suggests there may be considerable room for improvement in administrator productivity. Remember, however, that we used an aggregate measure based on approximations made with survey data. While the approximations were made consistently within that data set, individual schools may have responded differently to the survey. It is therefore inappropriate to place too much confidence in the specific values of the productivity index.

Second, choice of a set of schools for schools needs to be done with care to provide any validity. Even within the loosely defined "groups" of schools, wide variation still exists. Comparison with overall or group averages may seem to be a good thing if the productivity of your school lies "above" the average, but it fails to tell you whether you are obtaining the most from your resources. A productivity index falling much below the average, however, could suggest that the situation warrants further investigation.

Third, comparison across schools may suggest that your school is experiencing unique difficulties. For example, the data presented in Figure 1 suggest that the middle year (1989) was a "good" year for most schools -- administrator productivity either rose from 1988 or stayed approximately the same, and productivity in 1990 tended to decrease somewhat. Schools #1 and #10, however, showed a decrease in productivity in both 1989 and 1990, while school #21 tended to show a consistent negative productivity. If any of these were our school, we would want to seek further explanation.

Finally, administrator productivity, as measured by Return on Management, is a function of many parameters. We must recognize that a significant financial investment will lower this measure of productivity if the benefits are not immediately realized. That does not make the investment unwise. In addition, the calculation is relatively sensitive to "cost of capital." We assumed in Figure 1 that the cost of capital is constant across schools, in fact equal to the average cost of capital experienced by our home institution for the particular year. We realize, however, that the cost of capital changes as the financial position of an institution changes. Let us suggest, therefore, that the really interesting comparison is not the year-to-year absolute value of administrator productivity, nor a comparison across schools, but rather the manner and degree of change over time.

Comparison Within a Single Institution Over Time

Figure 2 portrays administrator and IT productivity at a single institution over time. Notice that the IT productivity index is roughly an order of magnitude greater than the index for overall administrator productivity. This difference is to be expected because information technology costs are only a portion of total "management costs."

Figure 2

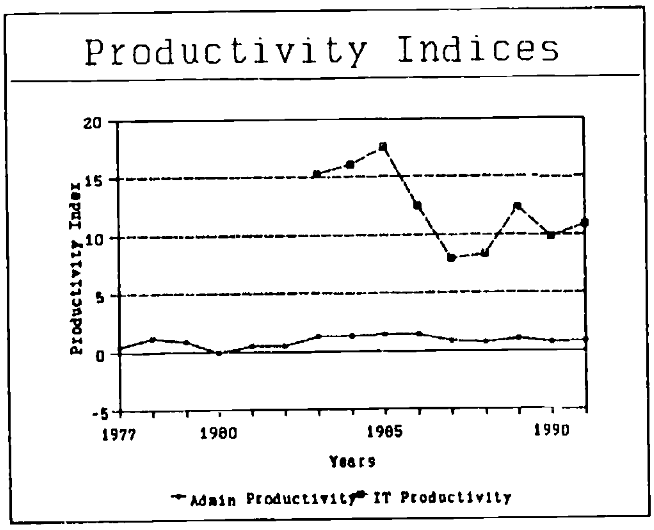


Figure 3

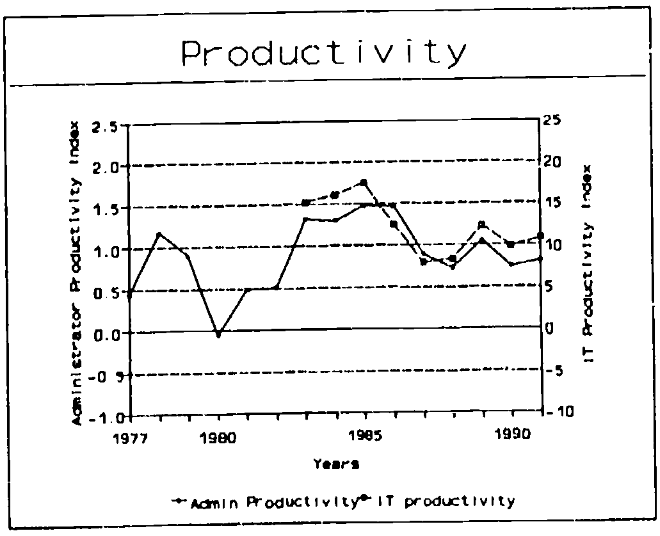
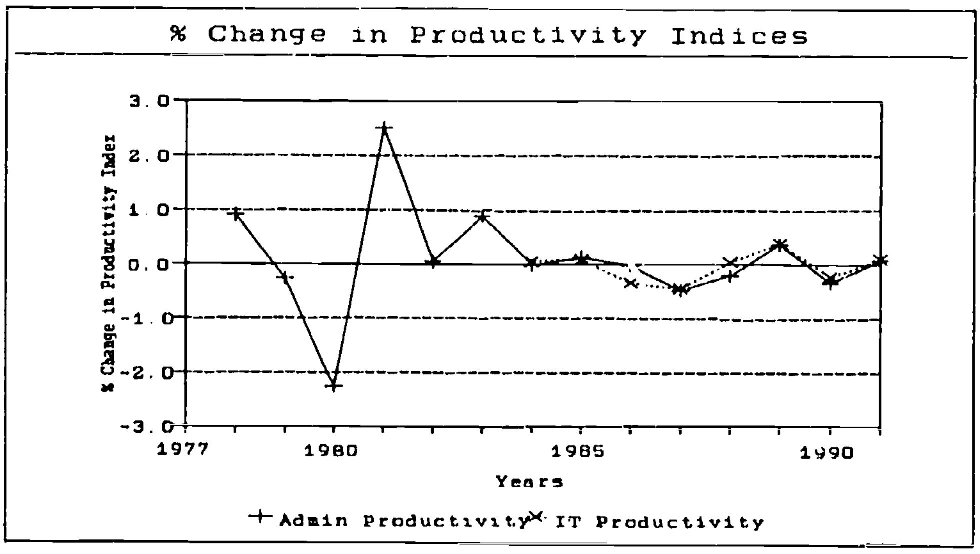


Figure 3 also portrays administrator and IT productivity over time, but now the data are plotted on different scales to make visual comparison easier. Notice that the two productivities appear to track fairly well, and from 1983 on, that both have a slightly downward trend. It would also appear that changes in IT productivity (increases or decreases) tend to lead those in administrator productivity. We have not yet, however, answered a question of fundamental interest: "Do our investments in Information Technology contribute to improved productivity?"

From the year-to-year changes shown in Figure 4, we see several important features in both administrator and IT productivity. First, from 1984 on, most

Figure 4



changes appear to be negative. This observation confirms the impression obtained from Figure 2 that productivity is decreasing. Second, in 1986 the change in IT productivity is more negative than that in general administration. This could suggest that the IT decrease contributed significantly to, or was even the predominant cause of, the general decrease in administrator productivity for that year. Third, during 1987-91, the change in IT productivity is more positive than that for general administration. This might suggest that, at the very worst, IT was not the entire cause of any decrease in administrator productivity, and at best, improvements in IT productivity kept overall administrator productivity from decreasing still further.

At this point, we must turn to other tools if we wish to identify specific causes of productivity changes. Standard ratio analysis, for example, might be used in the present example to suggest whether the observed decreases in productivity were due to increases in the number of personnel or to changes in the work process. As an aggregate measure, ROM™ cannot provide such detail.

Justification of Specific Investments

Return on Management analysis may also be useful to justify individual investments in information technology. Consider for example, a financial-aid management package costing $40,000 that is expected to increase enrollment by ten students. If we assume a resultant increase of $160,000 in total revenues (total tuition, room, board, and fees, net of financial aid), Table 2 shows the calculations that might be used to evaluate such an investment. Note that Total Revenues are increased by the $160,000 amount of the net revenue gain from increased enrollment, and Total current funds expenditures and transfers, Institutional support, and IT costs are increased by the estimated IT system cost of $40,000. Administrator productivity increases from 0.81 to 0.83 (a 2.07% increase); and IT productivity decreases from 10.86 to 10.41 (a 0.42% decrease). This suggests that either (a) the project is relatively low payoff with respect to customary IT investments, or (b) costs have been inappropriately allocated to IT.

Table 2

			Without Project	With Project
Total revenues:			$52,065	$52,225
Capital:				
Land:	$3,158	$3,158		
Buildings:	$61,092	$61,092		
Equipment:	$9,461	$9,461		
Value added due to capital: (@7.78%)			$5,736	$5,736
Total non-management operational expenses:				
Total current funds expenditures and transfers:	$47,739	$47,779		
Institutional support:	$7,530	$7,570		
Total non-management expenses:			$40,209	$40,209
Management value added:			$6,120	$6,280
Management productivity:			0.81	0.83
Change in management productivity:				2.07%
IT costs:			$563	$603
IT productivity:			10.86	10.41
Change in IT productivity				-0.42%

(All dollars in thousands)

CONCLUSION

ROM™ provides an aggregate measure of both Administrator and Information Technology productivity. Using ROM™ in a comparison across schools may provide evidence that Administrator productivity at a particular school is high or low in comparison to its competitors; or may suggest that a school suffers from unique problems. Careful choice of the set of institutions used for comparison and recognition of the impact of cost-of-capital estimates are both important in generating absolute measures of productivity.

Application of ROM™ can be used within an organization to track Administrator and Information Technology productivity over time, and to evaluate specific investment decisions. As an aggregate measure, ROM™ is better suited to evaluating "whether" to make an IT investment than to "how" it should be implemented (i.e., what technology to use). In addition, we must recognize the general limits of all aggregate measures with respect to providing detailed information (in this case such desired information as specific problem identification) and utilize ROM™ in conjunction with other, more traditional methodologies.

Finally, application of ROM™ both within and across organizations would be greatly enhanced if a comprehensive database such as that described in Buzzel & Gale (1987) were available for academic institutions. We look forward to working with the CAUSE ID group on defining appropriate information.

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SECURING TCP/IP AND DIAL-UP ACCESS TO ADMINISTRATIVE DATA

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ABSTRACT:
Open systems are the rule in most institutions these days and it's only natural that administrative systems should participate. However, the kind of general access available to academic systems via TCP/IP can easily expose an institution's administrative data to unauthorized access or modification. Connection to the Internet substantially increases the risks. This paper discusses the exposures, enumerates several potential solutions, and discusses the solution implemented at Arizona State University. It turns out that this same solution -- authentication -- can also be used to secure general dial-up access to administrative systems.

Background
Arizona State University (ASU) is the fifth largest single campus university in the nation. It has recently expanded to a multi-campus university with the addition of the ASU West campus on the west side of Phoenix. (The main campus is located in Tempe which is in the southeast portion of the Phoenix area.) There are ~43,000 students between the two campuses.

The University is blessed with a substantial communications capacity: three separate CATV cables (only one of which is presently activated), 18,000 twisted pair of copper, and 12 strands of fiber in each campus' tunnel infrastructure. A broadband-based Ethernet backbone network, as described by [Bowker], is run on the one activated CATV cable.

Academic Affairs has sponsored a "microcomputer infusion" funding program for several years; the consequence of which is that literally every faculty member that desired a microcomputer now has one. The emphasis is now shifting to networking all this compute power together. At present, roughly 50% of the buildings on the main campus and 100% of the buildings on the West campus are connected to the campus backbone Ethernet. Our campus inter-system networking standard is the TCP/IP suite of protocols (as described by [Bowker]), running on Ethernet, with plans to exploit OSI in the future (as also described by [Bowker]) as the result of recommendations by a campus task force [Brink and Felder].

Information Resources Management (IRM) is responsible for operating and supporting the University's administrative applications as well as the campus network. The administrative systems are fairly mature and run on an IBM 3090-500E running MVS/XA for the traditional set of applications, e.g., student information system, financial aid, alumni, purchasing, A/R, A/P, G/L. We have a significant (~2500 connections) SNA coax network connecting administrators and staff in addition to a rapidly growing (1000+ connections) Ethernet connecting primarily the faculty. Historically, there was little pressure for faculty access to administrative systems; however, that has changed. A new financial system was installed a few years ago and a new Human Resources system is being implemented at the end of this calendar year. Both require direct data entry by the using department/Principle Investigator. Plus a new Mandatory Advising system is available which also requires faculty/academic department access to the Student Information System. This trend towards direct access to administrative systems will only accelerate, so the pressure mounted to provide TCP/IP access to the administrative systems.

What is TCP/IP?
TCP/IP is a fundamentally different way for devices and systems to communicate than has been available before on IRM systems. In the past, we have implemented mostly *proprietary* communications mechanisms (protocols) such as SNA on the IBM systems and DECNET on the DEC systems. This was fine as long as customers with one vendor's equipment had no need to communicate with another vendor's system. This was not supported because each vendor utilized proprietary protocols that other vendors would not necessarily support. TCP/IP, on the other hand, is a *non-proprietary* protocol -- developed by the U.S. Government -- that most computer and communications equipment vendors do support. Using TCP/IP, it is possible to communicate freely between different vendors' systems and equipment. This capability provides a tremendous degree of freedom and flexibility to the campus community and has allowed us to achieve one of our key strategic goals: "any-to-any connectivity"; that is, the ability to connect between any workstation and any system anywhere on campus.

What is the exposure?
The campus backbone Ethernet is the vehicle for transporting TCP/IP traffic. When TCP/IP was selected as the protocol standard for inter-system networking at ASU, it was recognized there is an increased security exposure inherent in the use of Ethernet and IRM was urged by

another campus task force to take the app:opriate steps in ensuring administrative data is adequately secured [Askins, et al].

Per [Voydock and Kent], potential security violations can be divided into three distinct categories:

- unauthorized release of information;
- unauthorized modification of information; and
- unauthorized denial of resource use.

We felt the potential for unauthorized release or modification of information were of most concern and that the most likely way this could occur would be by compromising logon password security. Once an individual's logon id and password have been obtained, all of his/her access privileges are available. Information about logon ID's is ge ,ally available on campus, so securing the passwords became our primary goal.

The following were identified as potential abuses if logon password security was compromised:

- checks could be illegally "authorized";
- grade point averages could be "improved";
- salary increases could be illegally "granted";
- any receivable could be "forgiven" (parking/libr , fines, tuition, housing, etc.);
- academic credits -- indeed entire degrees -- could be fabricated;
- students could be illegally admitted/registered; and
- financial Aid could be illegally "granted".

These were identified as some of the potential abuses. It was recognized the responsible units may have other procedures or mechanisms in place to audit and catch such violations, thereby reducing the risks. However, we felt considerable mischief could be done in the interim even if these abuses could be detected and recovered from at a later date. It should also be noted that the above abuses are just as possible on *any* kind of network if logon passwords are not properly managed and protected.

[Voydock and Kent] describe two types of attacks that can occur during logon and that must be addressed by any proposed solution:

- attempting to logon under a false identity, and
- playing back a recording of a previous legitimate logon sequence (also mentioned by [Cole]).

There is nothing inherently more or less secure about the Ethernet media (coax, twisted pair) or protocols (TCP/IP, DECNET) compared to the prior administrative communications environment (coax, twisted pair, 20ma current loop, dial-up -- SNA, Ascii). However, the fact that Ethernet is a "bus" architecture as compared to a "star" architecture, as described by [Bowker] (see Figure 1) does introduce a new significant security exposure . In a bus architecture, all information destined for workstations sharing the same "bus" (or subnet) are transmitted along the same wire as opposed to the point-to-point "star" connections where each workstation has a dedicated wire that only carries information destined for that workstation. In Figure 1, data destined for Workstation #3 from Host A will also pass through Workstations #1, #2, #4 and #5 with a bus (e.g., Ethernet) connection. Whereas with a star (e.g., SNA) connection, data destined for Workstation #3 from Host A would not pass through any other workstation. This is the inherent security exposure of the Ethernet bus architecture referred to by [Kirkpatrick].

Moving from the generic Ethernet exposure to what the ASU exposure is, please refer to Figure 2 for a representation of the Ethernet wiring configuration at ASU. In this configuration, we have isolated Ethernet traffic as much as possible in building "subnets" via connections we at ASU have called an EPOP's (Ethernet Point-Of-Presence) using routers (see [Bowker]). This improves network management, maximizes the performance of the network and helps to minimize the security exposure. How that exposure is minimized is illustrated in the following examples: In Figure 2, I have added some letters -- A, B, C and D. When passing data from A to B, the EPOP keeps that traffic localized on Building #1's subnet; that is, no workstation outside of those connected to the Building #1 subnet can see the traffic. When passing info from A in Building #1 to C in Building #2, all workstations in both buildings can see the traffic, however, no other workstation in any other building can see it. When communicating between A and Host D, only other workstations in Building #1 can see the traffic. As [Voydock and Kent] recommend, we ensured the gateways between subnets -- routers in our case -- were adequately secured to prevent a hacker from reconfiguring our network.

The above scheme significantly reduces the security exposure. However, we were concerned it did not go far enough to provide adequate security for administrative data. Protocol analyzer programs have been written -- and are readily available -- that can allow someone at an Ethernet workstation to capture information not intended for his/her workstation, but which is "available" because of the Ethernet bus architecture. No additional hardware or network "taps" are required. All that is needed is for that workstation to run a readily available program. Many vendors distribute this kind of program as an aid to network management (see [Barker]).

Now, a university thrives on diverse opinions and several key individuals on our campus discounted this exposure. We had a number of spirited debates over just how easily this could be done. After one particularly heated discussion, one of the Computer Center staff members logged on to a new Sun workstation that had just been delivered, fired up the protocol analyzer program that was delivered along with the system, and in less than 90 minutes had captured a viable logon id and password from someone else in the department. End of debate.

What could we do?

We identified five potential solutions to handling the risk of these two types of attacks:

0) Accept the risk (do nothing different).
1) Enhance existing security measures.
2) Place workstations needing access to administrative systems on separate building subnets from those not needing this access.
3) Secure some or all administrative data by using encryption.
4) Use logon "authentication" devices to secure administrative logon passwords.

Options #0 and #1 do nothing to reduce the exposure, but rather rely on the present set of security measures. Options #2, #3, and #4 offered additional measures to be taken to reduce the risk. Each of these options have advantages and disadvantages which are outlined below. It should be noted that we did not consider a "trusted server" or "Trusted Network Base" solution [see Ward] because the TCP/IP product for MVS did not support it.

0) Accept the Risk

Description:

Do nothing beyond existing security mechanisms. The following summarizes these mechanisms:

- a terminating employee's management must request deletion of his/her logon ids;
- 90 day enforced password changes;
- minimum passwords of 6 characters;
- generic user ids allowed;
- no limit on the number of times a logon can be attempted with the same id; and

- limited audit trail logging for transactions.

Advantages:
- No cost;
- no delay in providing TCP/IP access to administrative data;
- no additional mainframe or workstation overhead;
- no modifications required to mainframe applications; and
- would not increase the complexity of network management/support.

Disadvantages:
- Administrative logon passwords and data would not be secure -- unauthorized access to data and use of logons/passwords could occur; and
- no protection against someone recording and playing back a logon sequence.

1) Enhance Existing Measures

Description:

Tighten present security measures which could include:
- implement automatic revocation of all of a terminating employee's logon ids;
- enforce more frequent password changes -- perhaps every 60 days instead of 90;
- require longer passwords -- perhaps 8 characters minimum instead of 6;
- eliminate generic user ids;
- limit the number of times a logon can be attempted before disabling the logon id altogether -- perhaps 5 logon attempts; and
- full detailed logging of all transactions which would provide a detailed audit trail.

Advantages:
- No cost;
- little or no increased delay in providing TCP/IP access to administrative data;
- no additional mainframe or workstation overhead;
- no modifications required to mainframe applications;
- would not increase the complexity of network management/support;
- would tighten control and management of logon passwords; and
- no new measures or expense would be introduced to impede access.

Disadvantages:
- Administrative logon passwords and data would not be secure -- unauthorized access to data and use of logons/passwords could occur;
- some flexibility would be exchanged for improved password management;
- no protection against someone recording and playing back a logon sequence; and
- increased system overhead due to full detailed logging.

2)Separate Subnets

Description:

Establish separate Ethernet subnets in each building for customers needing access to administrative applications and those that do not.

Advantages:
- Would reduce the exposure in that we could separate student access from staff/faculty access (or further breakdowns as needed);
- no additional mainframe or workstation overhead;
- no modifications required to mainframe applications;

- no increased delay in providing TCP/IP access to administrative data; and
- would be a general solution -- that is, this approach would provide improved security with *any* workstation: IBM PC, Macintosh, Sun/SGI, etc. -- would also work for "dumb" terminals.

Disadvantages:

- Would increase the cost of Ethernet building connections by roughly 25% and hence increase the Ethernet flat rate charges for connections;
- improved security would be location specific -- that is, access from some workstations would be more secure than others;
- administrative logon passwords and data would still not be secure -- unauthorized access to data and use of logons/passwords could occur;
- would make management/support of the network more difficult; and
- would reduce -- but not eliminate -- the threat of someone recording and playing back a logon sequence.

3a) Hardware Encryption

Description:
Install data encryption hardware (outboard) on both the mainframe and workstation ends.

Advantages:

- Fast -- no additional mainframe or workstation overhead;
- no modifications required to mainframe applications;
- would secure administrative logon passwords and data; and
- would be a general solution -- that is, this approach would provide improved security with *any* workstation: IBM PC, Macintosh, Sun/SGI, etc. -- would also work for "dumb" terminals.

Disadvantages:

- Expense -- Ballpark cost of $1000/workstation;
- improved security would be location specific -- that is, access from some workstations would be encrypted (and hence more secure) than from others;
- may delay providing TCP/IP access to administrative data;
- would make management/support of the network more difficult; and
- would do nothing to protect against someone recording and playing back a logon sequence -- however, little could be accomplished once a connection was established.

3b) Software Encryption

Description:
Install data encryption software (inboard) on both the mainframe and workstation ends.

Advantages:

- Would secure administrative logon passwords and data; and
- would be a general solution -- that is, this approach would provide improved security with *any* workstation: IBM PC, Macintosh, Sun/SGI, etc. -- but would not work for "dumb" terminals.

Disadvantages:

- Expense -- we found surprisingly few products available on the market which means this option might have required us to write or contract out the required software -- costs could exceed those for hardware encryption;

- slow -- added overhead on both the mainframe and the workstation-- could significantly reduce available Administrative MVS capacity;
- modifications required to the mainframe applications -- ongoing maintenance workload;
- may delay providing TCP/IP access to administrative data;
- would make management/support of the network more difficult;
- would be platform specific solutions -- that is, different solutions would be required for each type of workstation: IBM PC, Macintosh, Sun/SGI, etc. requiring additional support -- would not work for "dumb" terminals; and
- would do nothing to protect against someone recording and playing back a logon sequence -- however, little could be accomplished once a connection was established.

4) Logon Authentication

Description:

[Gasser] and [Voydock and Kent] identify authentication as an effective technique to ensure connections are made only for authorized users. We chose to look at a "challenge and response" authentication approach as recommended by [Voydock and Kent]. Logon password generating software is installed on the mainframe end with a separate "key" for each logon-id. Each Administrative MVS customer requesting TCP/IP access is equipped with a hand-held "authenticator" device that has the same password generating algorithm and key as the mainframe software. Every time a TCP/IP customer logs on, he/she is prompted for a new one-time password that is simultaneously generated by the mainframe **and** the authenticator card. A different password is generated *each* time the customer logs on. With this approach, even if someone **is** monitoring Ethernet traffic, any logon passwords they might get would be worthless as a different password would be required for a subsequent logon.

Advantages:

- Relatively low cost -- $30K on the mainframe end plus $40/userid;
- would secure administrative logon passwords -- but not the data;
- fast -- no additional workstation and very little mainframe overhead;
- improved security would not be location specific -- customer could use authenticator device anywhere;
- would be a general solution -- that is, this approach would provide improved security with *any* workstation: IBM PC, Macintosh, Sun/SGI, etc. -- would also work for "dumb" terminals;
- can be administered at a logon-id level;
- would protect against someone recording and playing back a logon sequence.

Disadvantages:

- Would not secure administrative data -- but would secure logon passwords;
- modifications required to the mainframe applications -- ongoing maintenance workload;
- delay in providing TCP/IP access to administrative data;
- would make management/support of the network more difficult;
- must have authenticator device to gain access; and
- customers with authenticators would not be able to work on the system if they inadvertently left the device at home -- analogous to needing your key to get into your office -- (although we have implemented a scheme to *temporarily* allow access in case of hardship)

Selected Option:
After presentation of this material to various customer advisory groups, we selected Option #4 -- logon authentication -- as the best compromise for our environment. This approach secures logon passwords and ensures there is no increased exposure to the unauthorized modification of administrative data. Although it is still possible for someone to monitor Ethernet traffic with this approach, they will only be able to see what someone else chooses to look at and then only someone else on their (building's) subnet. Our Community felt this was a very slight exposure, particularly since much of our data is of public record anyway. We felt authentication coupled with the subnet per building aspect of our wiring topology would reduce our exposure to an acceptable level.

Dial-up
For many years, ASU has been using a call-back system as the mechanism for providing secure dial-up access to administrative systems. This is the technique where you call the system, enter an identifier, hang up, and the system calls *you* back at the phone number on record with the system (see [Cole]). This is an effective method, however, it has a number of disadvantages. Chief among them is a lack of flexibility. Since the number used to call you back must be recorded in the system, this approach cannot be used easily while traveling. Secondly, the process is a bit convoluted and hence error-prone. Our customers have been quite vocal in their dislike of this approach.

After we selected logon authentication as the solution for TCP/IP security, we realized that the same approach could be used to secure dial-in access in a much more effective manner than the call-back approach. It is flexible, since it can be used via a connection from any location, and it is much simpler to use, thus less error-prone. Virtually no additional work was required to implement authentication for dial-up after the TCP/IP logon authentication was in place.

Side-Effects
There were some further side-effects of our efforts to educate our customers about the exposures associated with TCP/IP:

- We agreed to review and tighten the present security mechanisms in addition to implementing authentication -- in effect, also implementing Option #1.
- We agreed on the need to initiate an increased security education and-awareness program for all administrative MVS customers.
- The EPOP's are loaded/managed using Simple Network Mail Protocol (SNMP) -- this process has been secured to avoid someone altering the type of traffic allowed into and out of a particular building subnet.
- Generic logon-ids are an additional security exposure in an Ethernet-TCP/IP environment given the ability to access our systems from the Internet -- we need to look at requiring authenticators for all generic logon-ids.

The first two items are presently being worked on, the third has been addressed, and the last item will be looked at in '92.

Current Status and Summary
We began an authentication pilot in July of '91 with full implementation for TCP/IP and dial-up in November. The implementation went very smoothly. Existing dial-up users will be converted to authentication over the next six months or so. We are presently charging $40/authenticator and guaranteeing the device for one year. We also offer a $20 refund to encourage departments to turn in authenticators when an employee terminates or if a device

just isn't being used anymore. The device is easy to use and requires very little training. However, we have had some quality control problems with the cards that we are addressing with the vendor.

Some work is required on each application to be supported. We initially are supporting access to production our CICS/DB2 and IDMS data base applications. TSO access and FTP support are not yet available, but are being worked on.

Authentication only will not be an adequate solution for installations whose general security requirements are more stringent than ours. However, we believe this approach addresses the majority of the problem at a reasonable cost without introducing onerous restrictions on our customers. All in all, we feel authentication is a good choice for ASU.

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Figures:

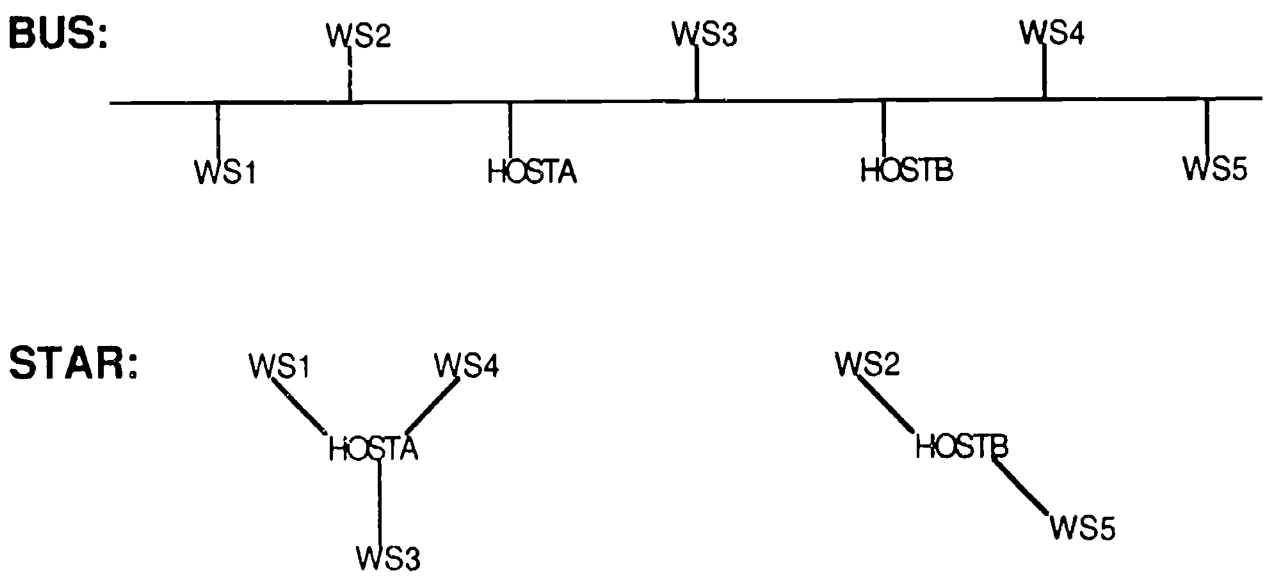

FIGURE 1: BUS VS. STAR ARCHITECTURE

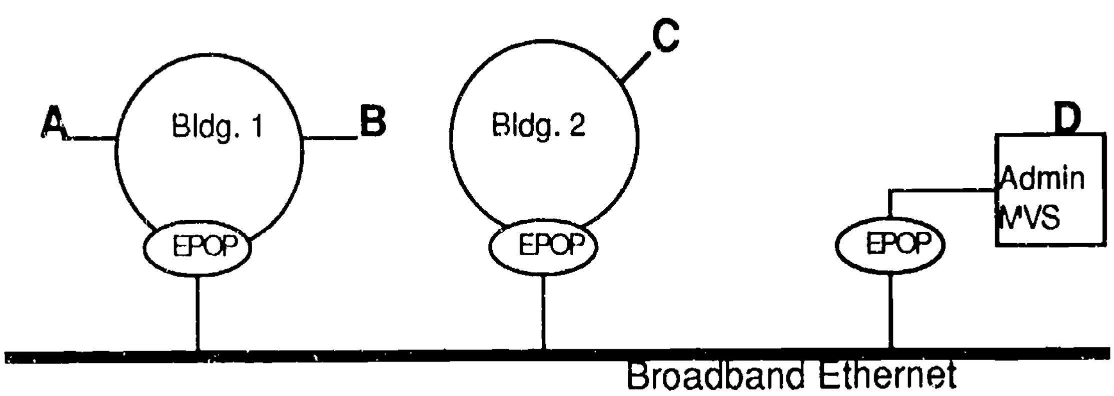

FIGURE 2: ASU ETHERNET WIRING CONFIGURATION

Using Planning Models In Times Of Financial Crises

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Abstract

Financial planning models are central to the planning efforts of many colleges and universities. In the information services area the use of such models to study the impact of decisions over a multi-year time-frame has become routine. However the fiscal crises facing many institutions are forcing information services managers to focus on current budgets rather than long range plans. As many are putting aside their planning models others are asking if such tools can be used to help manage the current crisis. This paper explores one way a traditional planning tool could be modified to include current year activity and hopefully assist the information services manager in his or her current crisis while at the same time allowing them to keep open their options for the future.

A Call For Action

In the Summer 1991 issue of Chief Information Officer Joseph P. Castellano, Vice President for Information Services at Citibank, wrote about a new approach to managing information system expenditures. The need for a new approach was brought about by the view many senior managers currently have of their computer center operations. Unchecked growth in recent years along with questions about the value of information services to end users, as well as the lack of financial accountability in some IS organizations, will mean that some IS managers will have to do business in a very different way in the coming days.

Mr. Castellano's prescription for IS organizations was straightforward, they must start to practice basic business disciplines that will help them to become cost effective. Such disciplines as proper budget preparation and tracking, organized procurement of equipment and services and hiring of personnel may seem overly simple to many business units, but such disciplines have been sadly lacking in many IS organizations. The idea of having a "chief finance officer" of the IS organization who is able to not only oversee basic accounting activity but also to advise on the financing of major equipment purchases or develop strategies for a multi-year financial plan is another idea whose time may have come. With many IS organizations having multi-million dollar budgets and senior management demanding accountability in all expense areas this prescription may be right on target.

Although the CIO article was written to IS organizations in the corporate sector the idea of managing IS expenditures applies equally as well to colleges and universities. After unprecedented growth in computer system expenses in the 1980's many senior administrators are questioning the amount of institutional funds that are spent each year for new equipment and software, or to support a growing computer center staff. Recent budget cuts in both the public and private sectors have shown that although many campuses wish to continue providing quality computer services to their user community, they are being asked to do so with stable or reduced financial support. The result is that for the first time many IS organizations are not only being expected to provide more with the same resources but more with fewer resources. Certainly the strategy of having more business discipline in the IS organization applies just as much to higher education as to the corporate word.

Focus On Financial Planning

Although a discussion on proper business practices could take many avenues, in this paper we shall be concentrating on the use of financial planning models for budget preparation and tracking. Financial planning models have been around in the business world, and in higher education, for many years. Early models built in FORTRAN by operations research specialists were large, cumbersome, and often failed to have much of an impact on institutional management. Their "black box" image along with a popular 1970's misconception that computers could resolve most of our management problems doomed such efforts failures. In the late 1970's and early 80's model building programs like EDUCOM's Financial Planning Modeling System and EXECUCOM's Interactive Financial Planning System allowed those without expertise in programming or operations research to design, build, and run simple yet powerful models. Still such systems seemed too esoteric to many middle managers who desired something that required little if any training to use. The answer was of course the spreadsheet.

With the development of early spreadsheets and the proliferation of microcomputers in the mid 1980's many managers had for the first time a computer tool that they could tailor to meet their information needs. The growth curve of the spreadsheet allowed novice users to benefit from the technology without having to learn all of its functions or capabilities. As their knowledge and usage of the tool grew new commands and functions could be utilized and the sophistication and hopefully the benefits of their activity also increased. Some even predicted in the mid 1980's that after a time those who were doing long range planning on spreadsheets would soon outgrow such programs and seek to use a "real" modeling program which would allow for goal seeking with multiple independent variables, tradeoff analysis, feasibility searches within predefined constraints, and even optimization modeling using linear programming techniques. Yet despite the increased sophistication of spreadsheet software and modeling programs and the availability of powerful desktop machines to perform these tasks, most spreadsheet users continue to perform very elementary spreadsheet operations. Operations that hardly reflect the sophistication of their IS organizations or the importance of their multi-million dollar budgets.

From Spreadsheets To Models

Most IS managers who use their microcomputer to build and manipulate financial plans and budgets do so using what we may term "flat spreadsheets". Budget categories are often represented as rows in the spreadsheet and time is represented in columns. Often the numbers which are placed in the cells are aggregate values which represent not only many component parts of the budget category but also the dynamics of how that category works from a financial perspective. Unfortunately these component parts and the financial dynamics are not part of the spreadsheet and thus not available to the person who wishes to consider various budget scenarios. Spreadsheets that are built in this way then force the user to conduct much of his or her analysis outside the interaction with the software. In this approach the possibility for errors increases as everything including the logic of the model is left to one person. And the likelihood that others will work with and trust model results is decreased.

One improvement from the flat spreadsheet concept is where the individual cells of the spreadsheet contain not aggregate values but formulas. Although these formulas may be rather simple such as adding the numbers used to represent a particular category (e.g., such as the employees salaries in a particular department), this method at least gives some degree of detail to the budget and planning process. As the user begins to work with the spreadsheet he is able to edit particular parts of a budget category without changing other components of the same category. Thus for example we might increase maintenance on an older mainframe while at the same time eliminating maintenance on a mini-computer that we are taking out of service. In such a way the user begins to bring all calculations to the spreadsheet that he or she may have done on paper separate from the worksheet. But this method is still a very simple way of working with the software and as such it has some drawbacks. First, it does not give definition to the various component parts of the formulas being used. And second, it depends upon the user to be able to edit formulas and work "within the cells" of the spreadsheet. In both of these cases the likelihood of error in editing is high and non-spreadsheet users who don't feel comfortable editing long formulas are left out of the process of working with the spreadsheet.

A better method of using spreadsheets to perform financial planning is that of the spreadsheet model. Like flat spreadsheets, models seek to represent common financial budget categories that the user is already familiar with. Like expanded spreadsheets, models seek to show the detail of factors that make up a budget category. But models also seek to define the dynamics that determine those values, and at the same time allow the user to work with those factors so that different scenarios can be explored and strategies for financial planning and budgeting can be made. Example A shows how a self-generated revenue area of one IS organization could be modeled. Here we see that the final number for self-generated revenue is made up of component parts representing usage of the machine, programming resources, and other charges. These component parts could even be broken down further by having computer time shown with different rates or the other category defined into its component parts. In fact an actual model for the total organization could include many sub-models such as this which may interact with each other as financial plans are developed.

The advantages to this type of spreadsheet modeling are many. First, such models allow the model developer and user to clearly see all of the values and formulas that are used in the model. By just looking at the spreadsheet one can usually understand the flow of the model and the dynamics that have been incorporated into the model to calculate certain budget areas. If this is not obvious a quick look at a particular spreadsheet cell can usually reveal what the user needs to know. This was a significant improvement over early modeling languages which often had separate files for variables and calculations, thus supporting the "black box" image many managers had of modeling activity.

Another major advantage a model offers is that it allows the financial dynamics of the organization to be defined and taken into consideration when financial plans are made. Unlike many parts of the college or university budget which don't show much dynamic change from year to year the IS budget is a constantly changing area. As technology changes from year to year and prices for this technology and the human resources to support it change, the IS manager must be able to deal adequately with the financial implications of these changes. The spreadsheet model provides a flexible framework to define and work with the dynamics of any budget area. Thus should the rules change for how users are charged for computer resources the spreadsheet model could easily be re-configured to accurately reflect these new rules. One could even have two different models reflecting two methods for charging users for services and test different financial scenarios using two very different models. Only a few brave souls attempted this level of usage with FORTRAN models or model building software, but with spreadsheets it is commonplace.

Although there are other advantages to using spreadsheet models one that stands out is the ease of using the models and of communicating results to middle and senior managers. Input screens for primary planning variables and summary reports allow the manager to work with a powerful model without being overwhelmed with detail. A few simple graphs can also be incorporated to allow the manager to quickly change assumptions and see the results in the long term. As the manager works with the model they are able to gain insights as to how the organization functions from a financial perspective. These insights might prove just as beneficial as any numbers the model may generate.

Budget Tracking Activity

The task of keeping track of expenses has been an especially difficult one for many IS managers in recent years. Changing products and pricing has meant that one can not often predict very far in advance what will be available and how much it will cost. Added to this problem has been the practice of some computer centers to manage their finances in a less than disciplined way. Low level managers or account clerks may keep the books but the decisions about financial allocations are made by those with expertise in other fields. Is it any wonder that the practice of identifying the same dollar to pay for several different pieces of equipment, finding out there are not adequate funds to cover the total cost of a new employee, or being surprised by how much (or little) there is left in the budget at the end of the year are common problems in many IS organizations?

The most effective way to deal with budget tracking may well be the use of some common microcomputer programs. Certainly the task of logging transactions with codes to represent account numbers, vendors, amounts, dates, and projects can be done through a simple database application. The ability to extract totals from these records to produce reports for management can also be done with a database package or an advanced spreadsheet program. Since we are interested in eventually merging our tracking database with the planning model we will need to either set up the tracking database in a package which is accessible by our spreadsheet (e.g., dBase III Plus with Lotus 1-2-3 r.3), or incorporate the tracking system right within the spreadsheet package itself.

The structure of the database which has been identified above could be modified to include any fields which may prove useful in reporting to management. For example, records may not necessarily mean that expenditures have been made. Like most good finance systems we may be able to identify funds that have been encumbered for a particular project either because a purchase order has gone out but the goods have not yet been received or because funds have been targeted for a future project. Codes in this special field could be changed as progress toward spending the funds are made. Another special field might identify what particular project the funds are being used for. For example, a manager may be given funds to set up a special computer lab for one department on campus. By giving that project a special identifying code the manager can track expenditures as they are made or identify funds for certain purchases before they are actually made. The manager can then check to make sure that progress is being made on a particular project without exceeding the budgeted amount.

On the spreadsheet side of the application many software features could be utilized in reporting results to managers. Like the database software most spreadsheets have some type of a data query capability. This means that the manager can quickly bring up all of the records in the database that match a particular criteria. So the manager concerned about spending in a specific project could use codes in these fields to identify and examine all expenditures and planned expenditures in this area. What is nice about these software features of course is that someone with only intermediate level skills in the software package could develop an easy to use menu driven system that would allow the manager to enter in the criteria they wish to search for and let the software do the rest. Even if they are only novices in working with spreadsheets they could then take the results of this type of query and examine it further with some simple calculations or with a graph.

Another powerful yet easy to use spreadsheet feature is the use of database functions such as the @D functions in the Lotus 1-2-3 package. These functions allow the user to get quick summary information on records within a database, again with the power to select which records to have in the calculation by setting a criteria for the query. (Lotus 1-2-3 r3 even allows you to do this with an external database such as a dBase III file.) Thus if we wished to know the total amount expended by a manager during a given time period on a certain project, we could set the criteria for these parameters and quickly see the results in the cell with the @D formula. What is particularly nice about these functions is that they are "live" and can be set up so that they always reflect the records in the database even though changes have been made or records have been added. While the use of methods like these are nothing new to finance professionals they are rarely used in IS organizations. Hopefully the use of such methods would allow IS managers to better track their finances and thus make better decisions with the funds they have available as they seek to address campus needs.

Merging Tracking And Planning

If financial planning and budget tracking are such important tasks; and if both are able to be done on microcomputer software; perhaps they should be done as part of the same application. The benefits for this approach are many. First, such an approach would take the planning process out of the realm of "blue sky" activity and link it with budget reality as plans are forced to work from the current operating year activity. Second, it would allow IS managers to possibly gain something very useful from their budgeting and tracking activity, the ability to see how current year decisions might play out on a multi-year time frame. Managers might at last be able to make the transition from thinking of budgets on a year to year basis to strategists able to "budget" within a 3 or 4 year time frame. The benefits to an IS organization in the long term from the decisions that might come from this perspective can not be underestimated. But even if one is convinced of the merging of these activities how can this be done?

The trick in merging tracking and planning will be to retain the best of what both do yet still keep the applications simple enough that it will not be seen as a "black box" by IS managers or even those outside the organization. The best thing the tracking program does is to allow us to quickly see summary information on what has been spent or encumbered in a current time period and how much is left for the remainder of the time period. The best thing the planning model does is to take summary numbers and work them back into the component parts that we often use when we plan for the future (e.g., revenue = rate X usage). Thus a good tracking system might allow us to quickly see how much revenue has come in from year to date or how much we have spent on equipment for project Y, and also how much we are above or below revenue for the year or for spending on this particular project. A planning model might go further than this however in taking the summary number and working it back into its component parts. Thus we can perhaps see why we are above or below our budgeted amount and whether this represents a trend that we will have to take into account in future planning.

Let's stick with the revenue example to see how this might actually work in a spreadsheet that seeks to merge tracking and planning. (Please see Exhibit A.) In our example the financial officer in the IS organization enters in monthly summary information from a separate billing system into the tracking database. Since we wish to use this information in different parts of our model separate records are input for CPU charges, programming work, and other charges which might include disk storage and printing charges. Because we have included fields in the database that will allow us to identify this revenue by type and date we will be able to draw it from the database and use it in our financial modeling work later.

Meanwhile in the modeling part of the worksheet major budget categories have been set up along with the variables that make up these categories and the formulas that link them together. In the self-generated revenue area we have CPU charges that are made up by multiplying usage by the rate per hour. A similar formula is used to determine the total programming charges. And for the sake of illustration we have left other charges as a "plugged" number although it could also be broken down into component parts. In a typical financial planning application we would use these independent variables such as usage of the CPU or our programming resources along with the rates we charge for each to drive the model into the future. For example, we could determine that the usage of the CPU by our "paying" customers is decreasing by 5% per year. By assigning a "growth" function to that variable we are able to quickly see what such a trend would mean in terms of CPU charges as well as total self-generated revenue.

Again for illustration purposes we have chosen to work only with a simple way of looking at self-generated revenue. Fully detailed models would have all budget categories represented and perhaps much more detail to account for the way the dynamics of the budget actually works. For example, our revenue model might be developed further to allow for different CPU rates based on discounts for evening or late night work. And programming charges could be expanded to include other service areas like installation, user training, or maintenance work Further detail would allow us to tie our self-generated revenue number to another part of our model like an equipment replacement fund. As the self-generated revenue numbers change we could also see what impact this might have on our plans to upgrade or replace our equipment. This is the type of activity which helps IS managers to get into the habit of thinking, planning, and budgeting in a multi-year time frame.

The merging of tracking into the planning model will take place in the second column of numbers as we move from the budget amount to the tracking of actual activity. Here we will want to draw from the values in the database which will be the amount received in a particular budget category in determining the independent variables such as CPU time and programming hours. Given stable rates for these activities this will be a simple task as we identify in our budget tracking database occurrences for CPU charges for the particular period (in the example we look at quarters) and then using database functions place that amount in the CPU charges cell. The CPU hours value is then an easy calculation as the spreadsheet divides the charges by the hourly rate. To avoid misinformation or confusion we might have a check in the function that draws from the database so that if no records are found that meet the criteria a zero appears in the charges cell and the usage cell for the quarter.

Advanced Tracking And Planning

For those who wish to get past the basics in this activity some additional features may be added to the application. First, a section could be added to compare quarterly activity with the budgeted amount. In the self-generated sub-model an expected activity category has been added which breaks down the budget amount into quarters. In the case of the CPU charges this calculation has been kept simple as the budget amount is divided by four thus assuming even usage throughout the year. But in the programming area the assumption has been made that more activity will take place in the second and third quarter than in the first and fourth and thus the expected charges have been weighted according to this assumption. A status per quarter section allows us to see how each area is doing on a quarter by quarter period well as the cumulative status in a year to date line.

A second section that could be added to the model appears in the columns after the fourth quarter. This area allows the model user to see the status of a particular line in the model whether it be an independent variable such as CPU usage in hours or dependent variable such as CPU charges. Again it is important to include checks so that quarters that have not yet been entered do not produce mis-leading information. Care would also have to be taken when interpreting this section while working with the model in the middle of a budget quarter. An additional column in this section estimates the yearly actual for each line by adding the status value to the budgeted amount. In the case of the CPU area in the self-generated revenue area we see that this brings the actual to below the budgeted amount since the status for CPU hours and thus CPU charges is below expected amounts. When these techniques are used for all areas of the IS budget a manager can quickly see where the total budget stands as values for sub-models in both the revenue and expense areas are brought together in a summary report.

But the value of this activity can go far past the tracking of the current year. As estimated actual values are projected for the current year these values can then serve as a base for future planning activity. The projected value for CPU usage for example can be adjusted either by using a growth variable or by specific manipulation to provide a value for the next budget cycle. And this method can then project the value out for the third and fourth years. On the expense side one can even incorporate a zero-based planning methodology by the creation of a database for each of the budget years. Expense areas such as new equipment purchases can draw from this database and insert the summary number from the database. As items are adjusted in the database either through adding or subtracting records or changing values in existing records the expense area in the plan which draws from the database for that particular area is automatically adjusted. If the database is sorted on project code within budget category adjustment would be a relatively easy task as various planning scenarios are considered.

By using the methodology of combining tracking and planning IS managers begin to see planning as a natural extension of carrying out their normal management of financial resources in the current budget cycle. Certainly they will need to take into account anomalies that will occur during the current year that may throw off the forecast such as extensive work on a one time project, or setting up a lab with special grant funds. But so long as the model allows for adjustments and the user is careful to make these adjustments the modeling activity can be very beneficial.

Leveraging The Investment

Although better financial management is a worthy goal for IS managers the use of spreadsheets for tracking and planning can yield other benefits. One such benefit is the ability to include values in the model which will allow IS management to show meaningful ratio values to senior administration. For example, one technique many IS managers are using is to keep track of how computing facilities such as microcomputer labs are being used by students. This can be done by actually counting students using lab facilities, hours being used per machine, or the number of students who are in classes which have a lab assignment. These numbers can be placed in the model for the budget year and can be adjusted in the planning years to be in line with academic plans for microcomputer usage as expressed by the teaching faculty. If the model can be built in such a way to identify expenses associated for the lab a ratio can also be made which shows the cost of the lab per student. What will prove important in this ratio is not necessarily the value of the ratio itself but the trend that will most certainly be shown as more students from outside traditional computing areas make use of lab facilities. More than one IS manager has used this technique to justify more equipment or labs for their schools.

Another way to leverage the investment in computing resources is to show the possible cost of not providing service to the campus community. For example, in the administrative computing area some offices such as admissions or financial aid have been able to increase the quantity and quality of their work in recent years due to the usage of computer technology. Prospective student tracking programs, mailing list generation, and even searches of external databases (e.g., from testing agencies) have all helped to get more work done with fewer people on staff. While it is hard to honestly quantify the benefit to the institutic of these activities few administrators would want to attempt to work in the 1990's without them. Using computer based information systems, whether it be in the admissions office to gain a competitive edge or in the finance office to make more informed strategic decisions, is very much a part of higher education administration not only now but for years to come. Managers of IS organizations should not only realize this but use it as a method of gaining increased support for their activity from senior administration.

Using Computer Information

Chief financial officers who have been involved in building and working with computer models point out that there seem to be three key factors necessary to the successful use of this activity. First, the manager must have a good grasp of the technology they will use in building the model. Fortunately spreadsheet packages are easy to learn and finding support on one's campus is usually not a problem. Second, managers must have a good understanding of how to build and use financial models. This is perhaps the weakest link in the chain at this time as those who are in charge of IS organizations may be very skilled in information systems but have limited skills in financial management. Taking Joseph Castellano's advice in establishing a business office in the IS organization with talented management level professionals may be one way to deal with this problem.

The third factor in successful use of modeling activity is perhaps the most important. It involves how the model or information from the model is used in the decision making process. Successful chief financial officers have found that the openness of the spreadsheet has allowed them to get rid of the "black box" syndrome modeling activity has often carried with it in the past. Such CFOs have invited interaction on their modeling work by inviting those from outside the IS organization to examine their model, put in their own assumptions, and seek to find better ways to "leverage the investment". They have seen their modeling work then not so much as a way to generate a set of numbers as much as a tool to educate policy makers. And such education may lead to valuable support not only when funding is sought for next year's budget but when new systems are installed in the administrative area or resources are made available for student use. By involving decision makers from throughout the campus IS managers also make sure that their work is focused on providing for the goals of the entire organization.

Exhibit A

	A	B	C	D	E	F	G	H	I	J
1		BUDGET	QRT 1	QRT 2	QRT 3	QRT 4	STATUS	PROJECTED	YEAR 2	YEAR 3
2	Self-Generated								-5.00%	5.00%
3	CPU Usage Hrs.	1,600	350	325	300	0	(225)	1,375	1,306	1,372
4	Rate Per Hour	135	135	135	135	135			135	130
5	CPU Charges	216,000	47,250	43,875	40,500	0	(30,375)	185,625	176,344	178,303
6										
7	Programming Hr	400	120	135	80	0	15	415	420	400
8	Programming RT	55	55	55	55	55			55	60
9	Programming Cg	22,000	6,600	7,425	4,400	0	825	22,825	23,100	24,000
10										
11	Other Charges	40,000	10,000	7,500	12,000	0	(500)	39,500	40,000	42,000
12										
13	Self-Generated	278,000	63,850	58,800	56,900	0	(30,050)	247,950	239,444	244,303
14										
15	Self-Generated Expected Activity									
16	CPU Charges		54,000	54,000	54,000	0				
17	Programming Cg		4,400	6,600	6,600	0				
18	Other Charges		10,000	10,000	10,000	0				
19	Self-Generated Activity Status									
20	CPU Charges		(6,750)	(10,125)	(13,500)	0	(30,375)			
21	Programming Cg		2,200	825	(2,200)	0	825			
22	Other Charges		0	(2,500)	2,000	0	(500)			
23										
24	Year To Date		(4,550)	(16,350)	(30,050)		(30,050)			
25										
26										
27										
28										
29										
30										

	A	B	C	G	H	I
1		BUDGET	QRT 1	STATUS	PROJECTED	YEAR 2
2	Self-Generated					-0.05
3	CPU Usage Hrs.	1600	+C5/C4	+G5/G4	+B3+G3	+H3*(1+I2)
4	Rate Per Hour	135	135	135		135
5	CPU Charges	+B3*B4	@DSUM(DATABASE,2,Q1..R2)	+G20	+B5+G5	+I3*I4
6						
7	Programming Hr	400	+C9/C8	+G9/G8	+B7+G7	420
8	Programming RT	55	55	55		55
9	Programming Cg	+B7*B8	@DSUM(DATABASE,2,Q4..R5)	+G21	+B9+G9	+I7*I8
10						
11	Other Charges	40000	@DSUM(DATABASE,2,Q7..R8)	+G22	+B11+G11	40000
12		------------	------------------------------	------------	------------	------------
13	Self-Generated	+B5+B9+B11	+C5+C9+C11	+G5+G9+G11	+H5+H9+H11	+I5+I9+I11
14						
15	Self-Generated Expected Activity					
16	CPU Charges		@IF(C3=0,0,$B$5/4)			
17	Programming Cg		@IF(C9=0,0,$B$9*0.2)			
18	Other Charges		@IF(C11=0,0,$B$11/4)			
19	Self-Generated Activity Status					
20	CPU Charges		+C5-C16	@SUM(C20..F20)		
21	Programming Cg		+C9-C17	@SUM(C21..F21)		
22	Other Charges		+C11-C18	@SUM(C22..F22)		
23			============================	===============		
24	Year To Date		@IF(C16=0," ",@SUM(C20..C22))	@SUM(G20..G22)		
25						
26						
27						
28						
29						
30						

TRACK III

ORGANIZING FOR INFORMATION TECHNOLOGY

Coordinator: John Bielec

As the use of information technology has changed over the years, organizations have had to make corresponding changes in the structure for managing information technology as well as for managing personnel impacted by technological change. Papers in this track provide an opportunity to see how others are preparing organizationally for the challenges and opportunities of managing information technology in the 1990s.

Drucker's Right: Let Your People Grow

by
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Introduction

Growing your staff implies trusting your staff. When you trust your staff, it is not just that you expect that they will do their jobs to the best of their abilities given reasonable direction and guidance. It is also that you trust them to accept and absorb information about themselves, about the jobs they do, about the group they are in, about the institution in which they work, no matter whether the information is pleasant or unpleasant. You trust them to absorb this information and continue to function.

Trusting your staff requires communication channels to be open, clear of barriers, and used often. It is not usually enough to just tell the staff what is happening. They may need to be taught what it means (e.g., how many members of our staff really understand the complexities of a major departmental budget within the context of the institution's accounting system?). Coaching and teaching are a part of effective communications. And even more important than providing information to your staff, is obtaining information from them. Listening is the most critically important communication skill a manager can have.

Two different universities, on opposite ends of the country, have made progress using quite different approaches by following these principles.

The Manager's Universe of Knowledge

An effective manager needs to know, and often does know, a great deal about a great many things that are necessary in order to carry out the duties and responsibilities of the job. This will often include general knowledge about management, technology, politics, budgeting, personnel, problems, issues, organization, and so on. It will also include specific knowledge about individuals on the staff, particular technologies of interest, understanding of institutional plans, etc. For illustration purposes, we'll let the shape drawn in ***Figure 1*** represent everything the manager knows that is relevant to his or her job.

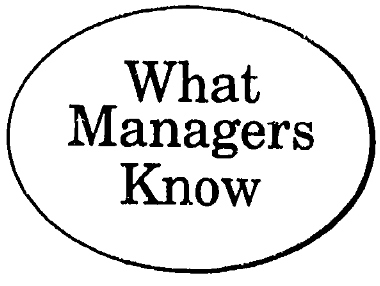

Figure 1

But effective managers know more than just the things they know. They also know that they don't (and shouldn't) know everything. In fact, in most situations, managers know that the members of their staff know much more about the jobs they are doing than the managers do.

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Most of us aren't aware of all the details of TCP/IP, the precise forms to fill out when making sure that sick leave is properly accounted for tax purposes and for employee reimbursement, how to restart a mainframe, where the conference room is in that new building, how to write a daemon process for a Unix server, etc. Knowing that they can't know everything, most managers put processes in place to make sure they have access to the knowledge or the people who have that knowledge. For example, many of us will setup regular meetings with other key staff members in order to obtain the latest information about the status of an important project. And we may have other processes designed to just keep us generally informed about all the activities in our organizations. Again, for illustration purposes, we can let ***Figure 2*** represent the relationship between what the manager knows they know and what the manager knows they do not know. Although the drawing is not to scale, the idea that there is **much, much more that managers know they don't know than they do know**, is very probably correct.

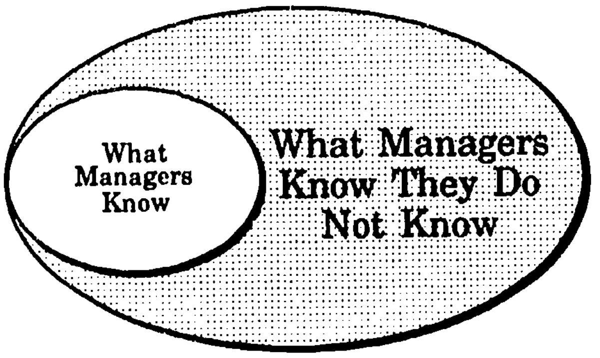

Figure 2

But the big shock to most managers is the volume of knowledge or information that they **don't know they don't know**. And it is often this very information that could make a positive difference to an operation if only the manager were aware of it. Staff members have knowledge about which processes in their areas work well and which processes don't work well. In most cases, they have learned to live with the situation the way it is and make the best of it. But, if they were asked, they could very likely provide some insight into how to make the process function better. These are the situations where a staff member knows that if only they had a telephone in a certain location, they could service their clients better. But no one else has thought of it, and the staff member believes that there is no point in asking (probably feels that it is a dumb idea for reasons that she or he doesn't understand). Let ***Figure 3*** represent the relationship between what the managers know, what managers know they don't know, and what managers don't know they don't know. Again we get a good idea of the relative volumes of each.

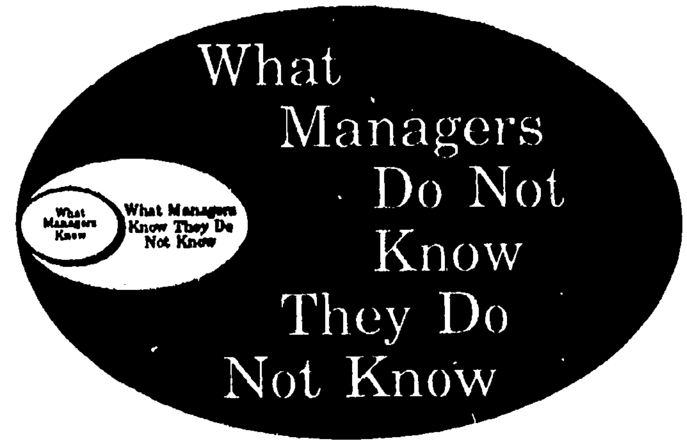

Figure 3

And this illustrates just one of the reasons it is so important to maintain open communications. Regular channels must be opened up and maintained so that managers can make more of the "what they don't know they don't know" into things "they know" (or at least into "things they know they don't know"). Processes should be setup which are designed to share information and to receive information feedback. If information is provided to staff members they will respond by trying to understand. And they will actually work more effectively if they are better informed (among other things, it will cut down the amount of time spent passing on rumors and worrying about them). Listen to staff members, and act on what is heard, and they will respond by teaching you what you don't know you don't know. An outcome of this process is that staff will grow (and it is likely that the manager will grow also).

Using Teams

Communications are important not only vertically, up and down the organizational chain, but also horizontally, between groups of peers. It is often the case that work groups within organizations become so focused on their particular projects and responsibilities that they are unaware of what may be going on in other parts of the organization. This lack of awareness may mean that they miss out on important ideas or other information that could help them solve problems or improve the performance of their jobs. One method which has been used to good advantage to improve communication in any direction is the use of teams. There is a great deal of material already written about teams of various kinds; here we will look at just one example of an ad hoc team that was setup to accomplish a particular task.

During a relatively recent re-formation of the information technology organizational entity at Stanford (actually, this took place in the middle of 1987) the new management felt that communications within the organization had not been all that it could have been. Rather than just designing some *solutions* designed to *fix* the *problem*, or even just assuming that there was a problem, a Communications Task Force team was established to examine the issue and to recommend solutions. This team was made up of volunteers (that is, staff members who indicated a desire to work on the problem) from various parts of the organization. The team formed its own internal organization, met openly over a few months, conducted individual interviews and surveys, and produced the following set of recommendations:

- Make the recommendations public.
- Establish an ongoing communications advisory group.
- Add *communications* to performance appraisals.
- Circulate minutes from Director's meetings.
- Provide quarterly reports and roundtable meetings.
- Install a suggestion box.
- Establish organization information electronic bulletin boards.
- Setup a process of orientation within the organization.
- Setup *open office hours* for staff to see managers.
- Encourage staff interaction through professional/social events.

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The management team had already decided that it had to do its utmost to accept each and every recommendation or provide a substitute suggestion back to the team to replace any suggestions it felt it could not implement as recommended. In nearly every case, the recommendations were accepted and implemented (in several cases, the managers believed the recommendations might not work, but implemented them anyway). In one case (minutes from Director's meetings) it would have cost too much to implement the suggestion since minutes were not already being prepared. The substitute recommendation was that agendas for the meetings be circulated ahead of time and that each director report back to his or her staff on the outcome of the meeting. The task force accepted the recommended changes.

Today, the ongoing communications advisory group is still in place and is still functioning. Most of the original recommendations are still being followed; a few didn't work particularly well and have been dropped or modified by the group. Membership on the group is still voluntary and changes from time to time. The group continues to provide excellent and necessary feedback on various management proposals and continues to make suggestions for change and improvement on its own.

More importantly, a clear signal was sent to the staff that communications were going to be open. Since that time, even during the several budget crises that Stanford has been through (and is still going through), information has been shared with the staff continuously. The result has been a staff that trusts that they are getting the best information that can be provided and a willingness to communicate issues and problems back.

Jump Level Leadership

In 1986, with the integration of the Telecommunications Department, Information Resources at the University of Miami was reorganized into a taller hierarchical structure by adding an additional operational level in order to integrate computing and telecommunications.

This new organizational structure was designed to allow the Director for Computer and Network Services the ability to increase his participation in the strategic processes and lessen his involvement in the daily crises of the unit. It was also intended that he participate, evaluate, and recommend new state-of-the-art technology for the University by heading a study for information technology in the 1990's. In fact, the Vice President had hoped a benefit from this organization would be for the Director to also serve as his Chief Technology Officer. Unfortunately, the organization was unable to harvest the fruits of these changes.

There is no best way to manage an organization. The new span of control, authority, and responsibility relationships instituted in Information Resources was often violated in the everyday practice of management. The effective *open door* policy of jump level leadership brought to our attention the unwillingness of our staff to accept the rigid autocratic system implemented in some of the operational areas and its side effect of illegitimate power equalization.

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Jump level leadership was and is implemented by involving all levels in the organization. The Vice President for Information Resources meets with his senior staff to schedule the first meeting with the senior staff's direct reports. These next-level meetings are conducted with no senior staff present. The middle managers were instructed to schedule meetings with their subordinates. While the Vice President was conducting his jump level leadership meetings with all the units reporting in his organization in an organized matter from top to bottom, the senior staff started their jump level leadership within their units. At the same time, the lower levels were also (middle management and supervisory levels) instructed to commence their jump level leadership process.

The Vice President begins every one of his meetings by describing the reason for the meeting, information giving and gathering, and ended each meeting with "what can I do to help you do your job better?" His first meeting with the second-shift computer operations included his being given a list of 27 items he could "do to make their job better" from the operations perspective. The first item on the list was rechargeable batteries for the computer room to use when blackouts occur and they have to rapidly power down. Apparently, the request was previously made of "management" and nothing ever happened. By 11:00 am the next morning a charger with batteries was made available through the manager of operations. Some of the other 26 items were as easily solved, some took longer and some were refused. But the staff saw results and were kept informed of the status by the manager and became better served by management.

The results of these meetings were categorized as: critical, common sense inputs, and improvement suggestions. These results showed a rigid bureaucratic structure, poor customer service results internally and externally, and the need for this process to be recursive.

The first round of interviews showed incredible apprehension and insecurity at all levels. Without a doubt, one of the major problems in implementing a jump level leadership program is insecurity. The line management feels it needs to have control. Its leadership is questioned. No one said, however, getting people to do things would be easy. Often, the staff does exactly what they are told whether it makes sense or not. Doing the *right things* right was emphasized. Therefore, additional jump level meetings were scheduled at all levels of the organization. This time, the meetings were scheduled at random, rippling throughout the organization. Currently the process has been institutionalized and occurs three times a year.

All levels of the organization benefitted as well as our customers; the department started working as a team by treating each other as allies, not subordinates. The entire organization's support has been enlisted to implement suggestions and provide career paths. Whether dealing with peers or subordinates, sooner or later you will need help. If you have a large number of allies throughout the organization, you will have a good internal network willing to put out the extra effort to help you and the organization reach for those tough and hard goals. When you accomplish this, even those that are not your allies pitch in because they want to be a part of the winning team.

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The most important step was to shift control downward, giving those who do the work more say about how much they do and how they do it. Each member of the staff has been placed in a more instrumental position. By transferring more responsibility for the unit's success or failure onto their shoulders, the staff is becoming more actively involved. The tasks and objectives of the units are well understood and established by the employees. This allows free discussion of the objectives and goals in such a way that the employees can commit themselves to them. We are not overselling participative management. The staff is free to communicate their feelings and ideas both on the problems and on the operation of the units. In fact, the leadership shifts from time to time, depending on the circumstances.

A key factor in implementing jump level leadership is to gain the support of the staff at all levels. Understanding jump level leadership, and the reasons behind it, is not easy. The staff cannot thoroughly support what they do not understand. Therefore, the more we communicate with them about goals, constraints, and department needs, the better they can understand and support the process.

Conclusion

The fundamental take-home lesson for the authors is that we can never stop looking for ways to improve communications and we can never stop looking for ways to grow the staff. No matter how well we think we are doing, it can always get better. It is best not to wait until a problem is at hand before beginning to establish processes which will inform managers about the things they don't know they don't know. In the words of John F. Kennedy,

"The time to repair the roof is when the sun is shining."

Does Integrated Software Create an Integrated Management Environment?

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ABSTRACT:

There is an on-going, dynamic relationship among the design of software, the utilization of that software, and organizational structure. A case study of the implementation of an integrated, rules-based, 4GL Student Information System at the University of New Hampshire is presented in this paper. It describes the organizational changes which occurred at the "start-up" of the project, those effected during the implementation phase and resulting structure left after implementation. Future organizational directions are explored in the conclusion. The overall focus of the case analysis is on the role the applications software played in altering management style.

Implementing new software systems in any organization means change will result within the organization: some managed instances will occur, others will simply happen. Whether the change factors which resulted in the need for new software were purposefully introduced within an organization, or imposed from the outside, the best way to deal with any change is to take part in creating it, and to be in charge of it. One way to manage this change is to introduce supportive structures within the overall organization which will guide the change factors. This will create an environment that is more receptive to adapting current management practices to suit the new influences of the software, not only during its implementation but, also for its long-term use. Willing and open responsiveness is especially critical when introducing an integrated software package where the involvement of disparate offices is made implicit through the very design of the package. Effective organizational changes which support the integrated nature of the software can then enhance the success of a complex software systems implementation. A successful implementation will in turn lead the way to an even more responsive, and effective organizational structure that will support a unit's objectives and make the best use of the new software's potential. The new software and the new management structure thus create a truly symbiotic relationship that frees an organization to maximize its resources, eliminate duplication, and streamline the layers of administration. This forged relationship then has the potential to realize financial savings and better service to affected constituencies.

This paper discusses the implementation of an integrated software package, the impact its implementation had on interim management structures and styles, and the resulting long-term organizational impact. In essence, does the implementation of a integrated software package create an integrated management environment? To answer this question a case study of the implementation of the integrated, rules-based, student services software package, BANNER, from Systems and Computer Technology Corporation, at the University of New Hampshire from 1988 through 1991 is depicted and examined.

In this case study, the organizational changes made to support the implementation, and the management structure left behind to cope with the routine oversight of the system and its user offices are analyzed. The paper then explores the change factors, both technological and organizational, that heightened the need for new software, and thus influenced management organization and style. It describes the actual implementation process and how it evolved, and details the resulting organizational structure and its implications.

CHANGE FACTORS

Technological: As early as 1985, the University had developed a long-range plan to move toward the new Digital Equipment Corporation's VAX/VMS technology. In this plan, the older generation Digital Equipment Corporation hardware, model 10, dedicated to student services and related functions, was scheduled for phase-out in early 1990. In accordance with this plan, by 1987 the institution's student service offices had to prepare for the demise of this outdated computer hardware and consider the related implications it had for their software and internal procedures, and prepare a plan in conjunction with the overall upgrade scheme.

Corresponding application software utilized by student services related offices, (the Registrar's Office, the Financial Aid Office, the Admissions Office, the Business Office, the Graduate School, and the Division of Continuing Education), was a mismatched series of outdated systems utlizing primarily batch methods of operation, and comprised of in-house developed subsystems or purchased software that had been redesigned, modified, and patched through a ten year period. There were related feeds to a variety of subsystems, but there was little consistency with regard to data elements, reporting, file structure, documentation, and updating. Data entry was duplicated by offices, updates often required outmoded keypunch operations, and changes in the various systems required the services of computer programmers to make even the most routine of rule changes i.e. tuition rates, report format alterations, and so forth. Student service with regard to timely admissions application and financial aid processing, registration, and transcript generation needed to be upgraded to meet the needs of an expanding and more sophisticated student population. The impact of this environment went well beyond the internal difficulties experienced within each student services office in its daily operations and yielded significant operational difficulties for the University. As examples:

---it was nearly impossible to provide executive management with the information needed to plan strategically, or assist in tactically managing resources;

---ad hoc reporting across departmental lines, critical to the budgeting and related legislative hearing process was nearly impossible to accomplish;

---and, the institution felt in jeopardy of losing a competitive edge in retaining students and attracting applicants when the University's student services were examined against those of comparable schools.

Acknowledging the situation, several University committees had over time explored the need to migrate to a more efficient computing environment including hardware, fourth generation language, and applications software that would meet the needs of various University units. Urged on by the hardware plan to upgrade, these committees found a new purpose for their work. By late in 1987, a preliminary decision was made by one of these bodies to formally evaluate new student service related packages that would compliment the new VAX cluster, VMS environment being planned.

Organizational: The University was also entering an era where staff resources were being reduced as the organization faced a need to downsize adminstrative staff and redirect resources in support of academic support. The institution began to explore the enrollment management concept of operation and decision making in conjunction with national trends. Additionally, the institution's computer services operation which supported administrative offices was experiencing change as it moved away from a highly centralized approach. A movement was underway to put more computing power into the hands of the user offices making them less dependent on a staff of programmers. This direction however required a software system that could be managed by users and was another factor that led to the purchase of a new student services software package.

This environment was also influenced by the recent experience of a poorly planned implementation of a financial/purchasing package on the campus that made users wary of planned implementations, their impact on user offices' operations, and the possible harm resulting from superimposed change not carefully planned. As per the case of numerous institutions, the University found its way through this situation with the assistance of outside consultants. These were other relevant considerations that would play a role in the future both in terms of product selection and the actual implementation.

Given the combination of both technological and organizational factors the University, after study and consideration, eventually decided to purchase and implement the Oracle based, 4-GL, rules-based package called BANNER, from the SCT Corporation, Malvern, Pennsylvania. It was well suited to meet the requirements of the institution as defined by the various change factors at work, both technological and organizational. Containing the needed functionalities of admissions, catalog/scheduling, registration, academic history, billing and more, it pointed the way to a new approach to systems management for student services on the campus both for the implementation and long term and created an environment for management reporting which up to this time had been impossible to produce.

THE IMPLEMENTATION PHASE, THE EVOLUTION OF THE MANAGEMENT STRUCTURE, AND THE PROCESS OF INTEGRATION

The memory of a painful system implementation process can provide an extremely potent learning experience. It was from such an experience that the University was emerging when it came time to implement BANNER. This memory, combined with the work of an effective Selection Team which was used to initially evaluate software packages and related alternative solutions for the institution, led to a series of recommendations. These stipulated how the new system should be implemented. Chief among the items was the insistence that a designated project leader devoted to directing the project 100% was required.

Secondly, the committed participation of core user offices, (the Registrar's, the Business Office, the Graduate School, Continuing Education, Financial Aid, Administrative Computing, etc.), needed to be insured through appointment of specific individuals charged with the actual implementation work in each unit, including coordination with the other offices involved. If necessary these individuals were to be released from other duties in order to direct their attention to the implementation. The fundamental nature, i.e. integrated functions, of the various packages reviewed demanded a new attention to inter-office cooperation and decision-making never before seen. No single office could completely dictate the usage of a table, field or form. It had to be created and defined in cooperation with all the relevant users, both those doing the data entry and those reporting from it as a source.

Finally, the third recommendation dealt with the issue of communication and support from the higher administrative levels. The Selection Team knew both from experience, and through consultation that the installation of the new software would require not just the financial support of the institution, but also senior level support in order to coordinate offices and deal with the possible policy and procedural issues involved. Most importantly, senior levels had to set priorities, and deal with expected inter-office conflict. Additionally in matters where the software and specific institutional policies or procedures, were in conflict, some authority was needed to determine which was to be modified: the policy, the procedure, or the software. (Indeed the installation of the software presented an unforeseen opportunity to examine many administrative practices that had grown out of mythology, rather than actual institutional policy.)

Given these recommendations, requirements, and scenarios, the following structures were created to oversee the implementation process of BANNER formally to be known on campus as the Student Information Systems Project (SIS):

1. An Executive Committee was assembled to establish institutional policy for student record keeping. Comprised of the principal vice presidental staff in the division of academic affairs with such representatives as the directors of academic computing and administrative computing, two deans, a representative from the faculty senate, and the vice president of financial

affairs, this senior level body also had final authority on all project issues including those of a fiscal nature, and served as the ultimate review level insuring that the implementation project proceeded as scheduled. It was proposed to meet quarterly or as needed.

2. The next level of authority and decision making for the implementation project was represented in the Steering Committee. Department heads of the units principally involved in the installation of the package with related office representatives such as the registrar, the director of admissions, the dean of continuing education, the director of institutional research, assistant dean of the graduate school, were brought together to meet monthly and charged with:

---establishing rules to govern the access to student data and resolving inter-office issues;

---reviewing and approving all requests to modify the baseline product in some fashion;

---monitoring the progress of the implementation, and approving any alterations to the proposed implementation plan and timetable, as well as prioritizing the implementation tasks required;

---coordinating inter-office policy issues.

3. The final level of formalized organization was the actual Project Implementation Team. Drawn together from the primary user offices and the administrative computer services' units, this Team was actually two committees in one. The actual user members and the resource group from computer services formed an entity that was actually the heart and "work horse" of the implementation project. Given the intense nature of the product implementation, financial and organizational arrangements were made so that those assigned or recruited were able to dedicate a significant part of their time to the project. As an entity the group was formally charged with:

---making the final selection of the package, thus solidifying the groundwork of the Selection Team, and presenting it as part of a formal proposal for approval by the Executive and Steering Committees;

---preparing and then executing a plan for the actual implementation including timetables, testing, etc.;

---identifying all modifications to the product that might be justified, and submitting them for approval to the Steering Committee;

---altering and testing all subsequent modifications and SCT product releases;

---preparing all user documentation materials and instructional guides for in-house use;

---establishing and executing a training plan;

---and successfully initiating the new system.

The Team was headed by a project director and an assistant project director. Harkening back to the two issues raised by the

Selection Team, that of having a full-time project director and the need for outside help after the earlier implementation project, the Executive Committee decision was to avail itself of an outside consultant to be the project leader. The associate registrar became the assistant project leader.

Such was the planned organizational structure that began the implementation phase. But the actual dynamics of the project and the work of the Project Team, proved to be change factors in themselves that contributed to the life of the project, significantly enhanced the integrated nature of the product, and subsequently impacted on institutional management styles. During the course of the implementation the role of the Executive and Steering committees would wane somewhat, as many management issues relating to the system were left to the Project Team.

As cited earlier, the University offices brought together for the implementation of BANNER had previously worked in an environment that in terms of software and hardware was fragmented, but held together by a myriad of interfaces. Additionally, various offices reported to different vice presidents, or to deans. While these offices cooperated to accomplish the primary institutional mission, that of servicing and educating students, and on specific short-term ventures, ie. freshman orientations etc., these offices had never been placed in a position where long-term, inter-related management and decision making was required. The role played by the rules-based nature of the BANNER software in this emerging environment has to be emphasized. Being a rules-based system, where key aspects that characterize how an institution creates and enforces its policies (therefore its operational procedures) must be quantified and inserted into the system to drive all aspects of the system's transactions, it forced new methodologies of cooperation to emerge to define the roles. In many cases this led to the examination of institutional policies and office procedures and produced conflicts and problems that had to be negotiated and resolved by the team. These rules once inserted into specific tables and forms underlying the system's functions would be changed dynamically over and over again by the team, and related end users, in response to changes in institutional policy and procedure.

Thus given the integrated, rules-base nature of the BANNER product, the units brought together on the Project Team not only faced the challenge of implementing a new software package and all the offline, and computing procedures that accompanied it, but also faced the challenge of finding new channels of communication in order to properly install and then manage the system. New means of consensus building had to be sought and implemented as well given the diversity of offices and their varied reporting lines.

In order to tackle this undertaking, the Project Team proceeded to meet and interact as a unit on a regular basis and assign tasks based on a unit's needs and objectives. For example, general "ownership" of BANNER's underlying rules tables was assigned to specific units such as the Registrar's Office, Admissions, or the Business Office--key components of the Team. These units' appointed members on the Project Team would then work with relevant users on the Team such as the Graduate School, Continuing Education, Financial Aid, and the branch campus of the University etc. to insure that rules were defined in the product so that all affected users could use the related forms tied to the rules. This was also done for specific data elements and forms. To illustrate, several offices register and fee assess students using the same forms and rules behind the forms. The Business Office was responsible for the overall integrity of the components of student billing. Recognizing that other units accomplish similar objectives, this office sought consensus on how data elements would be defined and used and how rules tables would be keyed. At times the decision was to have the Business Office maintain data, and in other cases, it made more sense to have another office maintain their own rules such as tuition rates.

This process occurred over and over again with various offices coordinating the effort to define the use of elements and forms, but with very few instances of strict dictation on how such items were to be used. There was always a sensitivity to the fact that information was entered into BANNER by many offices, maintained by many, and reported on by many. In addition the fact that information was also entered into the system in an assembly line-like method played a key role. Students were entered initially into the system through undergraduate or graduate admissions, and continuing education. Then other offices: the registrar's office, the business office, student affairs, credit and collections, and even the honors program, added data into essentially the same student record. Suddenly the computer record of a student became one main chain-like formation with many linkages. Of course some offices created or accessed only one link in that chain, and other offices many links, but some elements like a student's name, identification number, and address would be shared and updated by several units.

Key activities such as admitting a student and defining their characteristics as a student in BANNER, i.e., college attending, residency, major, etc., or registering them, drove related functions throughout the system automatically especially student billing. The whole system was not only integrated in functions but was truly a mass of co-dependent transactional areas, each highly impacted by the actions of each other. This further accentuated the need for complete managerial cooperation among the student service offices.

The Project Team that started this process gradually altered in attitude, and in individual objectives for being on the team. Members began to strongly identify with the core group mission, and a unique group persona developed. The members found they could defend Project Team decisions to their own units, sometimes even those decisions that were best for the institution and the success of the product's installation, but perhaps ones not so popular with the team members' home departments. Project members became champions of the project itself and a cooperative, more integrated style of decision making developed.

Another layer of management was thus created at the institution in a rather unintentional way. The Project Team went on through the various stages of implementation to emerge as a true management team dealing with routine, daily issues. The Team gradually increased in size and scope as new units began to use BANNER and over time a distinct group was recognized that would actually manage a layer of activity in the heart of the institution. The Team became as the filling of a peanut butter sandwich connecting the upper management structure with the various units and their internal office users of BANNER. This evolved operational "Management Team" sought to maintain the integrity of data in the system, to train new users, attempted to recruit other operational units to utilize BANNER, and continually tried to educate the users in their own offices on the sensitivity of a integrated data base system. The Project Team worked with the upper layers of administration to point out new ways to use the system to provide better student services, save resources, and in general enter the age of integrated computing and management reporting. The Project Team clearly began to act more like a management team in these later stages of implementation.

As also noted earlier, the Team sought to examine those policies or procedures that were obscure in their origin, or perhaps were illogical and impeded the installation. In some cases, simple procedures were now required to replace outmoded, intricate ones, others could simply be eliminated after certain concerns were addressed. Initially this seemed outside the range of the Project Team's mission but working with the other layers of committees involved in the process made the task more relevant and manageable.

In sum, during the heady days of implementation and shortly after, a new style of management appeared to erupt on the campus, at least where the management of student systems was concerned. It was cooperative, distributed, and integrated. It met the challenge posed by the characteristics of the new student information package.

CONCLUSIONS

Before the installation of BANNER at the University the situation relative to the student information systems management was one of variety, and fragmentation. After the installation disparate offices had to come together routinely first to install, and then to manage the system. Characterisitics of a truly integrated management approach began to emerge and take on new life forms. Does this mean then, to harken back to the question in this paper's title, that the installation of integrated software creates and integrated management environment?

In truth, the answer to that question really has to be "yes", "no", and "maybe".

"Yes" because in actuality during the key phases of implementation the Project Team in conjunction with the other two layers of SIS Commmittees was able to effect change at the institution in a coordinated and thus integrated manner. The Team managed to continue that pattern during the post-implementation phases, and onward through subsequent product upgrades when SCT Coporation released new versions requiring installation and retraining within user offices. Currently the Project Team (now in the routine course of things renamed unofficially the SIS Management Team) continues to meet on a regular basis to decide the general course of use including who has access to the system and its data. In part thanks to the wonders of electronic and voice mail the members of the Team keep in contact regarding matters of system usage such as changes in record coding, problems with data originating from a specific unit, the need for reports and so forth. This Team has contir to function as an entity capable of making decisions that cros the boundaries constructed by normal channels, and it is done with the sanction of other administrators...[perhaps because no one else wants the task,...or completely understands it,...or perhaps because the system has proven itself successful].

"No" because even though BANNER possesses the capability to do more for the institution some offices are not willing to change any business procedures in order to use the software. Others may find it threatening to work in an integrated computing environment. For example, housing and conferencing, and commercial accounts receivable components are currently available in BANNER. However, rather than use these capabilities separate systems might be purchased or developed in-house. Perhaps the exhibited capabilities are not perfect in every way for these administrative units. Nevertheless, using a system that is already integrated into student functions rather than re-inventing the capability has a lot of merit especially in terms of economic savings, and eliminating the need to develop interface pathways from the existing system to new and unrelated ones.

Overcoming a unit's anxiety regarding implementation, resolving organizational conflicts, and emphasizing the positive aspects of this integrated system and management style have been part of the Project Team's role almost from the beginning of the project. Unless the campus political and organizational realities that often allow units to function and make systems decisions in isolation are resolved, the future ability of the Team to spread this integrated style of management and type of student system is jeopardized.

"No" also has to be the answer because the Project/Management Team must constantly re-educate in-house users as to the nature of an integrated system and what it means in everyone's day to day work. Preventing offices from falling back to old methods of operation that showed a lack of understanding of related offices and their functions remains an objective of the team.

Thankfully, the answer can also be, "maybe" because there is a bright spot on the horizon indicating that all the education on campus regarding the nature of the system is beginning to bear fruit. Talk is currently underway regarding the possibility of re-designing offices and functions to take advantage of the integrated nature of BANNER. Campus administrators have realized that the assistance they need to meet the challenges posed by state funding reductions inflicted every year may exist in some small way in BANNER. Offices doing registration, advising, and billing may have the capacity to be consolidated and still perform a vast variety of functions for a diverse student body. In addition, the system might be made more available to users across campus such as granting increased on-line access to the various deans' offices, thereby cutting down the need for the usual paper flow, and the ever ceaseless stream of paper across campus for transcripts, progress reports, grades, address changes, student lists and so forth.

At one time the campus possessed a student information system that was falling behind in its ability not only to service students but also was unable to keep pace with changes in the organization, and its style of management. With the implementation of BANNER and the changing styles of management that resulted, namely one of integration and decision by consensus, especially at the middle management level of the Project Team, the institution finds itself in the unique situation of possessing technology which has become not only a potent computing tool, but a valued catalyst for organizational change.

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Merging Academic and Administrative Computing at MIT

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ABSTRACT

In April 1991, MIT merged its central computing organizations: Project Athena and Information Systems. The process, designed by MIT managers assisted by consultants, brought together people with different organization cultures, missions, and constituencies who face demands for service synergies, minimal disruptions, and substantial funding reductions. The paper describes the process and its outcome.

Project Athena began in 1983 as a grant-funded experiment, ending in 1991. With corporate partners, the project developed a state-of-the-art educational computing environment of distributed workstations and servers. By 1990 Athena staff delivered computing services for over 100 subjects each term and to nearly 4,000 individuals logged in every day.

The Information Systems group of central departments supports MIT's overall information technology infrastructure. Information Systems staff have served administrative and academic users of phones, cable TV, computer networks, mainframes, and personal computers. The reshaped Information Systems aims to deliver computing services at MIT that facilitate universal access and exchange by building upon the best of what once seemed separate worlds.

Merging Academic and Administrative Computing at MIT

This is the story of how Project Athena, an eight-year long externally funded educational computing program, was brought to a successful conclusion, becoming an integral part of the information infrastructure at MIT, through merging its service functions into Information Systems. The story has evolved over the last nine years. This paper focuses on the most recent year of the story.

We'll tell you a bit about MIT and provide some background information about the two organizations that have been merged: Information Systems and Project Athena. We'll walk through how MIT decided to merge the two organizations and present the two key issues we faced: money and culture. Finally we'll describe the merger process itself, closing with where we stand, now that the merger has been completed.

Massachusetts Institute of Technology

MIT is a relatively young institution by many standards. We came into existence in the mid 1800s, right around the time of the Civil War. We were founded to be a new kind of independent educational institution, one that was relevant to an increasingly industrialized America and that stressed the pragmatic and the practicable.

Today MIT is organized around five schools: engineering; science; management; architecture and planning; humanities, arts and social sciences. In the schools are 22 academic departments; we also have a college of health science and technology. Some 100 interdepartmental programs, laboratories, and centers have research and instruction activities extending beyond traditional departmental boundaries. MIT has five administrative service groups: finance, information systems, resource development, operations, and human resources. There are roughly 1,000 faculty; 4,400 undergraduates and 4,800 graduate students; 8,000 academic, administrative and research staff. The Institute's annual operating budget is approximately $1.1 billion.

Information Systems

Information Systems at MIT is organized into six departments. We often talk about what we do in terms of nine business areas. Some businesses cross departmental boundaries; some departments operate more than one business. Today, following the merger, our businesses are:

Information Systems Businesses	
Academic Computing	43 staff
Administrative Applications	37
Computer Sales and Service	20
End-user Computing	24
Networks	21
Mainframe Computing	66
Facilities Management	7
Voice Communications	25
Transmission Facilities	6

These activities are supported by the Office of the Vice President for Information Systems, with 7 staff, including a number of functions which support all of Information Systems — planning, finance, personnel, information security — as well as the intellectual property counsel for the Institute.

Project Athena

Project Athena was organized in 1983 as an experimental educational program, reporting to MIT's chief academic officer, the Provost, through a steering committee chaired by the Dean of Engineering. Athena was conceived to seize a unique window in time defined by three factors: Digital and IBM were willing to make large investments in universities to explore workstation computing in education; the advent of the microcomputer chip put significant computing power on a desktop in a single-user platform; and large displays became available.

The project had two fundamental goals: to develop, implement, and operate a distributed, ubiquitous computing system by networking advanced workstations; and to explore the use of such a computing environment in MIT's educational programs. Project Athena was a very large educational experiment, funded by some $100 million over its eight-year lifetime. The funding included the Digital and IBM contributions, valuing hardware, software and maintenance support at list prices, plus the moneys that MIT put into the effort. Project Athena's life included notable milestones.

Project Athena Milestones

1983	Digital, IBM, and MIT announce Project Athena.
1984	Deploy VAX 11/750s, terminals, and PCs; begin client/server design
1985	All undergraduates have accounts; debut the X Window System.
1987	Large scale deployment of workstations.
1988	Digital and IBM sponsorship extended for three additional years
1989	External sites begin to install Athena.
1990	OSF/DCE selects Kerberos authentication system.
1991	Merger of Project Athena and Information Systems

Use of the Athena Computing Environment

Project Athena produced a large distributed computing environment at MIT. In 1989 about 500 workstations were deployed around the campus in both public and departmental clusters. Figure 1 shows how MIT's use of academic computing has grown in terms of the number of unique individuals logged into the Athena Computing Environment on each Friday of the academic year. The first bar is the first Friday in September of each of the three academic years: 1989-90, 1990-91, and 1991-92. The stacked sections of each bar show the increase in succeeding years.

Merging Academic and Administrative Computing at MIT

In 1989 the fall term began with 1,500 unique individuals using the environment each day. Nearly 3,000 people logged in on the last Friday of the spring. In 1990 the number of workstations available grew from 500 to some 700. Almost 2,500 people used the environment on the first Friday, and on the last Friday nearly 4,200 logged in. This September, the first Friday opened with 3,500. Before classes began we had exceeded the maximum of the previous spring. We now have 4,500 unique logins each day, and we expect to reach 5,500 by the end of this academic year. Today one out of every four members of the entire MIT community use the Athena computing environment every day, a number we did not anticipate a few years ago.

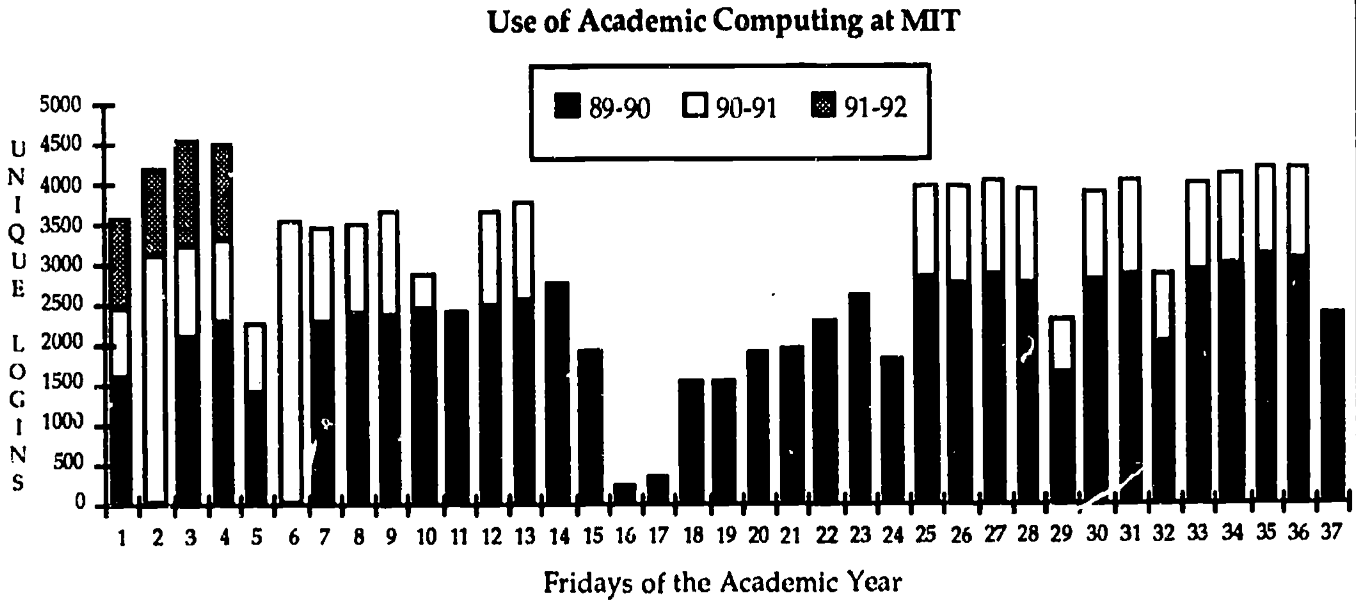

Figure 1

Some metrics illustrate the scale of the Athena Computing Environment at MIT today:

Current Activity in MIT's Athena Computing Environment

- 1,000 workstations and 200 servers are deployed, with 400 workstations in public clusters, and the remainder in departmental clusters and faculty and staff offices.
- Over 100 GB disk space on servers is consumed.
- About 100 of 1,000 subjects use the environment every semester.
- OnLine MIT Staff and Student Directory gets over 10,000 requests per week.
- Athena OnLine Help with 2,600 documents gets 500 queries every day.
- TechInfo gets 150 queries daily with 450 documents referenced.
- Electronic Library Catalogue gets 60 network queries daily; many more by dialup.
- 70,000 email messages go to 170,000 recipients each week, 50% above last year.

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Committee on Academic Computing for the 1990s and Beyond

In the spring of 1989 MIT began to anticipate the end of Project Athena. The project's external grants had already been renewed after five years and would not be renewed again. What would MIT do for academic computing?

To examine that question, the Provost appointed the Committee on Academic Computing for the 1990s and Beyond (CAC90), chaired by the Dean for Undergraduate Education. The committee included the key leaders in computing on the campus, as well as a number of faculty drawn broadly from across the Institute. It spent a year investigating the experiences and possibilities at MIT and elsewhere. CAC90 reported its results in the middle of calendar year 1990, with four key findings:

- Computing has become an essential part of the MIT educational process. We would not have said that in 1983, when there was relatively little organized educational computing at MIT. As Figure 1 clearly shows, that has changed.
- Platforms — both hardware and software — must be broadened beyond the UNIX engineering workstation on which Athena was based to include a small set of low-end platforms: DOS machines and Macintoshes running Mac OS.
- Merge operation of Athena production environment into Information Systems to exploit synergies where both organizations offer similar services.
- Continue research efforts underway in Athena, such as investigating multimedia authoring environments, in the "traditional research mode."

In the traditional research mode, a faculty member writes a proposal, submits it to an external funding agency for funding, and, hopefully, the proposal is funded. The research project involves faculty and students in exploratory work, not the operation of production services. Research results may move into the production environment over time, typically after further work to turn out a bulletproof product.

To move forward, MIT had to face two facts implied by the CAC90 findings. Continuing the Athena environment for academic computing would:

- Cost MIT real money
- Require merging two existing organizations with two distinct cultures.

While the CAC90 recommendations were under consideration, MIT was also going through an administrative transition. Both the Institute's outgoing and incoming presidents and provosts, as well as the faculty, endorsed the direction that CAC90 proposed. In the fall of 1990 the Vice President for Information Systems was handed the opportunity to make it happen. At that time we began the process described here to implement their recommendations.

Academic Computing Costs Real Money

In FY1991, the last year of Project Athena as a separate organization, its real cost was approximately $7.5 million. This figure has three elements:

- An estimate of costs MIT would have incurred had it competitively bid the hardware, software, and hardware maintenance services from the grants.

- An estimate of the costs of the 15 vendor staff who worked at the project.
- $2.4 million from Institute funds plus financial contributions from sponsors to support the 62 Institute staff and 50 part-time student employees at the project and their operating expenditures.

In the Institute's deliberations about how to go from a sponsored activity to an Institute funded service, we negotiated a budget for academic computing in FY1992 of $3.8 million in Institute funds. This funding level covers expense items such as hardware maintenance, software licenses, and supplies for printing. Though it retains the 50 or so part-time students, it funds only 43 staff. We also reached an understanding that there would be no equipment renewal in FY1992. At the close of the project in June 1991, however, we were able to use some remaining grant funds for equipment, replacing the oldest machines.

In the discussions there was recognition that a hardware renewal program was required. At deeply discounted vendor prices, the value of the imbedded hardware base of workstations and servers was estimated at $8 million. It was agreed that, beginning in FY1993, we will have to begin an ongoing program to replace the oldest machines. Assuming a four year renewal cycle, this program requires $2.0 million a year in addition to the $3.8 million for operating costs.

In steady state, then, we will have a $6 million budget for academic computing. It is safe to say, however, that steady state is elusive. Every year Information Systems' budget requirements must be defended in the face of other priorities. Typical is the outcry, "This much for academic computing? MIT could run the entire [supply your favorite example] program, which all agree we must have, for only a fraction of it!"

We also have identified new needs for academic computing that were not previously stated. For example, we are exploring extending high speed network connectivity for the Athena Computing Environment into the dormitories and independent living groups, a possibility that was not factored into the budget negotiations a year ago. We are also considering putting workstation clusters in the dorms.

Two Cultures

Early on, Project Athena was primarily a software development activity. It focused on defining and developing a large scale, heterogeneous distributed computing environment. No one who has looked at Athena can deny that they did a remarkable piece of work. Project Athena's work has literally impacted the concept of how distributed computing environments are evolving worldwide. They worked on such issues as reliability, scalability, security, and heterogeneity, while offering some computing services. As the effort matured, the project continued to develop software, but there was greater emphasis on the service environment and on service delivery.

While this was going on, Information Systems' focus was and still is on mature, production services. Since 1986 we've had formal processes that focus on customer service, performance measurement, and team work. A good way to illustrate the differences between these two cultures is to examine the stereotypical ways people in each organization characterized each other.

Project Athena staff perceived:	
Themselves as	*Information Systems staff as*
Academic,	Administrative,
Innovative,	Pedantic,
Creative,	Procedural,
Diverse,	Predictable,
Fun.	Dull.

Information Systems staff perceived:	
Themselves as	*Project Athena staff as*
Responsive to clients,	Self absorbed,
Fiscally responsible,	Unconcerned with financial reality,
Practical,	In an ivory tower,
Focused,	Distracted by bells and whistles,
Team-oriented.	Prima donnas.

Many of these characterizations are, of course, exaggerated. Prior to 1991 there had not been a lot of contact between staff in the two organizations. Some of the contact that had occurred had not been very productive. In addition Information Systems was the much larger organization, with about 250 people and an annual operating budget of $40 million. There was a prevalent suspicion that Information Systems was empire building. David and Goliath stories could be heard in the corridors.

The challenge in merging the two organizations was to overcome the stereotypes and anxieties and, instead, to maintain a focus on the current situation and the current facts. It was important to dispel the David and Goliath myth, so that change was not seen as takeover by big Information Systems gobbling little Athena. The entire Institute, especially the staff immediately involved, needed to see the merger as a process that valued and preserved the special and unique contributions that all of the parties involved could bring to MIT. In this context we set out to develop a process to bring these two organizations together.

Leadership

Our goal was an open process, one in which we openly sought the best organizational fit. A major factor in designing and carrying out the process was the approach to its leadership that Jim Bruce took. This approach was informed by his participation about a year earlier in the Leadership Challenge Workshop sponsored by The Tom Peters Group. Workshop participants explore five principles of leadership. The merger process was guided by these principles.

- Inspiring a shared vision.
- Challenging the process.
- Modeling the way.
- Enabling others to act.
- Encouraging the heart.

Merging Academic and Administrative Computing at MIT

Jim had been involved in Information Systems and Project Athena for years. He was a member of the planning team that conceived Project Athena. He served on its executive and operating committees throughout the project. During the same period, he was MIT's chief information officer. He was a member of CAC90 and served in the group that negotiated the funding and staffing levels available for continuing academic computing after June 1991. He had one of the most complete pictures of where academic computing at MIT had come from and where it must go. He had a clear idea of what the merger result must look like in order to be successful. However, at the outset of the process, it was only his vision. It had to become shared.

This design team had to find a way to challenge how we normally do things at MIT. For starters, we were letting a group from within the organizations decide what the new one would look like. People had to think out of the box. We had to ignore the stereotypes about one another that the members of the design team brought to the table. To be successful in creating a new organization that functioned as a single unit, we had to get the staff on both sides to see one another as real people.

Whenever someone starts a process like this, the leader models the way. Jim could have made a unilateral decision outlining the result of the merger. However, we believed that a more successful result would come from a team working together. The members of that team had to be willing to be vulnerable to each other. Jim began by announcing that he did not have all the answers to questions that would arise. The team was going to have to find them together. He said he hoped that this way MIT would have a stronger, more lasting, and more functional result than we'd have if he or any one else declared an answer. Discussions were long and often heated, but throughout the process we insisted upon civility and decency. It was hard sometimes, but we did learn to listen to one another. We became willing to say, "Hey, that's a good point. I didn't think of it thataway." or "What was it that you said?"

We probably could not have done it had we not been willing to obtain outside help. A member of an organizational development consulting firm attended every meeting of the design team. Deborah Heller was the principal participant from that firm. Deborah did an extraordinary job of keeping us on track and making sure that we did listen to one another. She insisted we ask questions. Not being a computer scientist, she was very willing to say, "I don't understand what you're saying. Is it germane?"

It wasn't enough that Jim was able to act, and it wasn't enough that the people on the design team were able to act. We had to enable all of the members of the staff to feel empowered to act in this process. So, when we reached the point of deciding how to staff the new organization, we literally created a "Rush Week." Existing members of the staff applied for openings in the new organization. Managers, who for the most part had not served on the design team, decided who was going to work for them. We enabled the managers to make decisions and the staff to look for opportunities.

Our goal was for everyone to feel good about their personal and collective accomplishments in Project Athena. We wanted people to feel good about the merger, even though we began with sixty people and were going to end up with forty-three. This meant finding ways to encourage the heart. We closed Project Athena in June 1991 with a picnic and a conference, inviting all the people who had ever worked at

Project Athena back to MIT to participate in that celebration. About a week later we inaugurated the new Information Systems at the annual luncheon for all of the staff of all the Information Systems departments. One of the things we've learned is important about occasions like these is symbols. We've traditionally presented gifts to all of the staff at the annual Information Systems luncheon. This year's gift was a zippered portfolio embossed with both the Information Systems logo and the Project Athena logo, a sign of bringing the two organizations together.

The Design Team

The design team consisted of eight senior managers whose functions would be directly involved in the merger process. Four were from Project Athena, and four, including Jim, were from Information Systems. Five of the eight are still in the merged organization. The work of the design team involved approximately 20% of each member's time for three to four months. We spent workdays, holidays, and evenings meeting together. The intensity was valuable, because we built a functioning team. Meetings focused on defining the objectives of the merged organization, on staffing, on staff morale. We tried to determine what the Institute wanted out of this merged organization. We wondered if we would get the necessary resources. Some conversations were productive; others were not.

The team came up with nine objectives for the merged organization. Jim shared this list with the staff from both organizations when he announced that there would be a merger and described the results of the design team's work.

Objectives of the Merged Organization

- Keep service levels as high as possible, given reduced resources.
- Minimize disruptions in on-going services.
- Maintain critical mass in those functions which will continue.
- Provide a focal point for academic computing.
- Achieve synergy and economies of scale by combining overlapping functions.
- Continue creative environment.
- Extend the Athena Computing Environment throughout MIT.
- Simplify service access for the user.
- Operate within budget limitations.

Though the items can be organized in several ways, there are three central themes:

- There is a focus on service delivery. We wanted the merged organization to deliver high quality computing services to our students and faculty.
- We wanted the merged organization to continue to be visible as the academic computing agency of MIT.
- We did not want to be seen as simply maintaining the status quo, but rather as an organization actively looking to the future.

The design team had a number of issues that we worked through. How many staff will stay? How will they be organized? What process will be followed in deciding who stays? How do we merge two very different organizational cultures? How do we minimize impact on the work – in particular, the production environment – while the merger process is unfolding? How do we maintain staff morale?

These took hours to talk about. It's safe now to admit that when we started this process, Jim was not entirely convinced that so much participation and deliberation was the way to go. In fact, it was the organization consultant who persuaded him to do business this way. He expected to have to spend some time talking, but not to work through all the details in the team. He is now certain that every hour the design team spent talking about details probably saved many hours of his own time dealing with people on the fallout after the merger plan went into effect.

The Decisions

Three fundamental decisions came out of the design team:

- The organization structure.
- The staffing process.
- The transition plan.

The guiding principle we had as we began to think about organizational structure was synergy. We wanted to bring the two organizations together in such a way as to maximize the delivery of services. We wanted to extend the benefits of the Athena Computing Environment to the rest of the MIT community. We wanted it to become our campus-wide distributed computing architecture. We wanted at the same time to extend the service delivery concepts and focus of Information Systems into the academic computing area. We wanted to do it as inexpensively as we possibly could. Based on what had happened to the budget in the transition, we had to do it cheap.

Using those principles, the design team very early in our discussions eliminated the possibility of simply downsizing the Project Athena organization, leaving its structure intact and attaching it as another leg in the Information Systems structure. That alternative provided no synergy. Instead the design team started to analyze the functions in Project Athena's organization. We asked, "What's it made of?" and concluded that there were really three sets of functions in Project Athena:

- Production and service delivery, with three broad categories:
  - Outreach to the faculty,
  - Operating the environment of servers and workstations and porting the Athena Computing Environment to new platforms,
  - User service functions.
- Research, which would move into a new Institute interdepartmental research organization called the Center for Educational Computing Initiatives.
- Outreach, which includes moving the products of Project Athena out into standards organizations, such as the Open Software Foundation, and into other universities and into the corporate world. We realized we needed to provide for

outreach. That's the one piece of the grand plan that we have not yet addressed. Within the next couple of months, we expect to announce the Athena Consortium, which will be a mechanism for exporting components of the Athena Computing Environment outside the walls of MIT.

As we considered the production and service delivery pieces that would move into the new organization, we looked for the synergies that would let us pair comparable functions from Project Athena with similar activities in our existing organization. Figure 2 shows the resulting organization structure.

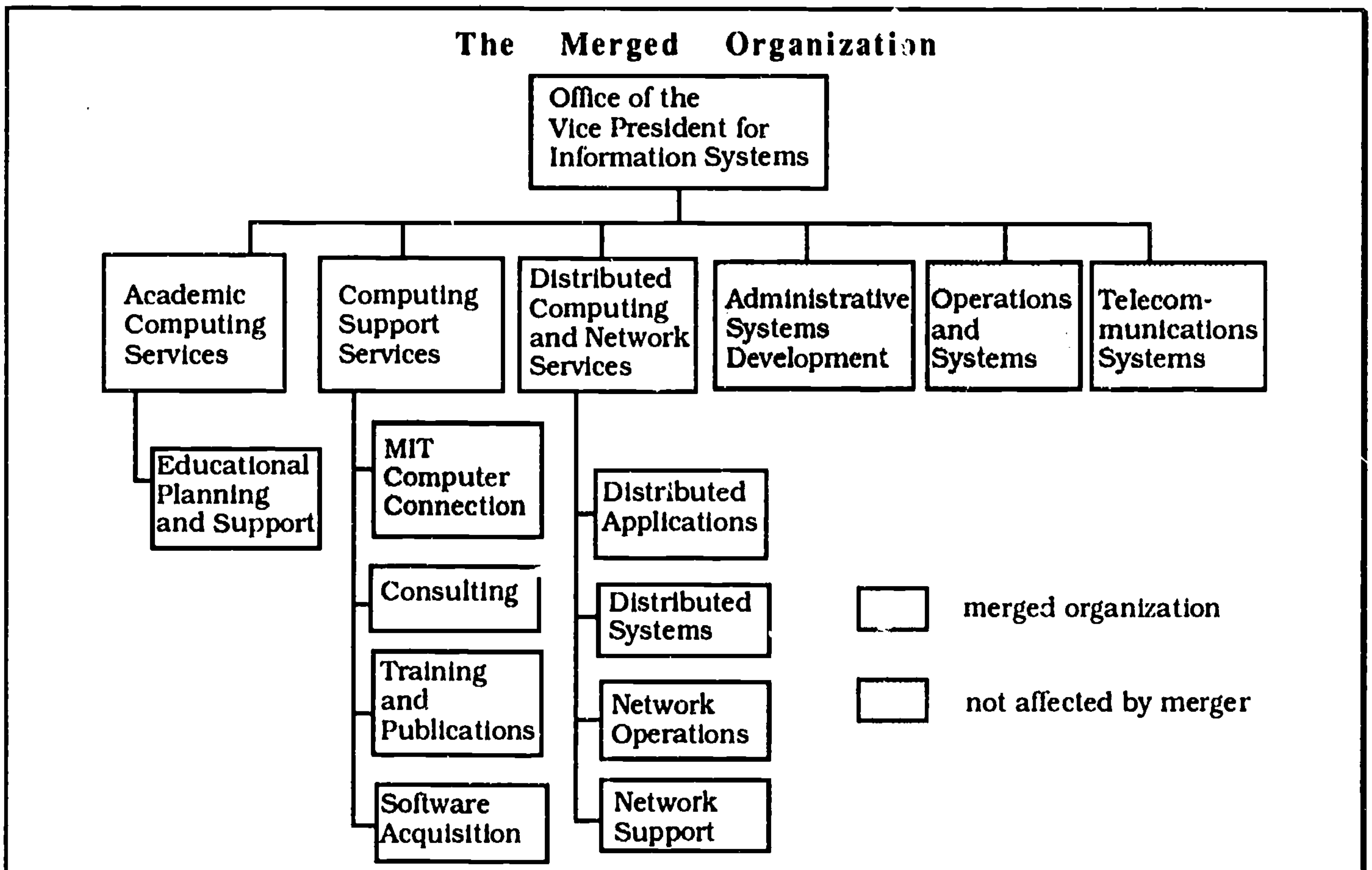

Figure 2

Three Information Systems departments experienced essentially no change from the merger: Administrative Systems Development; Operations and Systems, our mainframe data center; and Telecommunications Systems, our telephone business.

We created a new department, called Academic Computing Services, a small group with two basic responsibilities:

- To interact with faculty so that we can learn what their academic computing needs are and help them find out about academic computing possibilities;
- To provide the oversight and coordination of academic computing functions performed in other Information Systems departments.

Computing Support Services combines end user support functions that had been in Information Systems — consulting, training, and publications for users of personal computers — with their counterpart activities from Project Athena. Distributed Computing and Network Services brings together Information Systems functions associated with operating the campus network and developing network applications, such as TechMail and TechInfo, with functions for operating Athena workstation clusters and servers and maintaining and developing Athena software.

The Staffing Process

In February 1990 we convened a general meeting to announce the merged organization and describe its functions to all the staff from the affected Information Systems departments and from Project Athena. We declared all positions in all the merged functions to be open. If an employee's job in Information Systems was now part of that merged organization, such as the consulting and the training groups, then the employee needed to apply for a position in the new organization. We urged employees from both organizations to seek out managers in the merged groups and learn about open positions. We encouraged them to talk to all the managers they might like to work for. It was "Rush Week."

The managers made hiring decisions based upon interests of employees and needs of organization. Once the hiring decisions were finalized, the layoff decisions were made. The design team reviewed the results of the hiring decisions. Then we notified individuals, with either an appointment letter or a layoff notice. Staff who decided to accept appointment offers were responsible for responding to Jim in writing by a designated date. The people whom we had to lay off received at least three months' notice, in conformance with Institute policy. We also provided them with special outplacement support, including career counseling. It took about three weeks from the day that we announced the merger plan to the point that we knew who would be staying and who would leave.

The Transition

Early on we decided that we did not want to walk the existing Athena organization up to June 30, then jumped people off the cliff, with some dropping out before others got across the chasm into Information Systems on July 1. Instead, we began the transition process shortly after the staffing process ended. The concept was to have a phased merger, making the transition for each part of the Athena organization at an appropriate point in time for its functions. The goal was to complete the transition before the end of the 1991 fiscal year on June 30.

We celebrated the conclusion of the design team's work and created the Academic Computing Management Group (ACMG), chaired by Jim. ACMG brought together the senior managers from all parts of both organizations involved in academic computing, about twenty people altogether. ACMG met on a weekly basis to coordinate the normal activities of all the groups involved as well as the transition from the old organization structures into the new one.

The transition took us about a month and a half. We looked for a convenient point in the Project Athena annual cycle for a particular activity to make the transition of the staff from their former management structure to the new one. For example, our academic computing usage has a normal peak at the end of the spring term, in the first weeks of May. After that, usage drops rapidly. All the parts of Athena having to do with end user support and operations support made their transition as the term ended. The system development people had a natural break much earlier in the spring, so we made their transition earlier.

The Result

On July 1 when Project Athena officially ended, we already had a working organization. It was well on the way to developing the new release that we deployed in late August. The proof of the pudding is that this past fall startup was the most successful one ever. None of this could have happened without strong, flexible leadership throughout the organization or the willingness of the staff to accept change and adopt new ways of working.

We're not all the way there. Some future issues include:

- Greater availability of the environment in living groups.
- Continual renewal of workstations and servers, some of which date from 1986
- Evolving toward Basic Educational Services and Tools (BEST), a set of common applications on our UNIX workstations, on DOS machines, and on Macintoshes.
- Ergonomics. Our public clusters have not a single workstation in the correct ergonomic configuration.

The transition has been completed, and its outcome has been effective. We successfully tackled this opportunity for leadership in a style that shared the vision, challenged the process, and enabled all those affected to take an active part. In doing so, we modeled the way for everyone in the new Information Systems organization to approach thorny issues and accomplish further change in the years ahead. We encouraged the confidence of everyone in our organization that it is possible — and can even be fun — to succeed at breaking out of boxes and dispelling stereotypes. Institute faculty, students, and senior officers seem quite satisfied with the results of a process which took a lot of energy but was well worth the work.

DESIGNING A STRATEGIC ROLE FOR AN INFORMATION TECHNOLOGY ORGANIZATION

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ABSTRACT

Designing a strategic role for information technology organizations is a critical step in the health and welfare of higher education. The academe is at a critical crossroads. A crossroads that demands from our institutions increases in productivity, efficiency, effectiveness, service quality, and impact on societal woes. We are challenged to provide more access with relatively fewer dollars.

We must understand the magnitude of change needed. We must create and understand the vision of future. We need to understand the external conditions that work against the status quo. We must identify and secure support of key players and find the necessary resources (at all levels of the organization). We must understand that this change will not come quickly, we can expect resistance, but must respond with a commitment to educate and continually improve information flow. To guide us on the journey we need a strategic plan as a map. But we must remember that the map is not the journey!! But on any journey a map is very important. We cannot predict change and so the process is always more important than the plan. We must strive to take advantage of opportunities and minimize the impact of wrong turns

Transition

Over the past two decades a rather rapid transition from an industrial to an information economy has begun to take place in the U.S. and around the globe. This shift in economic paradigms has significant implications for both higher education and information technology organizations. The last major economic shift, of this magnitude, was from an agrarian to an industrial economy. This new shift to an information economy will bring about as many, if not more, changes than the last.

The advent of the information age is concomitant with other significant forces at work reshaping higher education. Strong economic forces such as severe shortfalls in state appropriations for higher education, and growing consumer uneasiness over the cost, price and value of a college education have caused institutions around the country to begin to retrench. Colleges and universities everywhere are beginning to feel the pressure to deliver more service and higher quality with fewer resources.

The information age is an era where information is a prime source of both value and competitive advantage. It is an era where organizations that flourish will be characterized, in part, by their information strategy. The information strategy, rather than being ancillary to the core function of their organization, will be integral with the strategic intent of the enterprise. For this reason the executive team and the operating or governing board of the institution must come to understand the importance of an information strategy to the success of the organizations mission, goals, and objectives.

No longer are IT organizations expected to simply automate existing processes and be supportive of other "more legitimate" organizational functions. This is true in business, industry and higher education. Colleges and Universities of today are expected to provide the same quality and convenience of service that business provides. Consumers, students, faculty, and staff have grown to expect, even take for granted, highly accurate and responsive service from the organizations and institutions that serve them.

In todays modern information environment individuals have developed some rather profound and unyielding expectations. They expect to be able to have access to their money through automated (24 hour) tellers. They expect to be able to manipulate their funds via full service touch-tone information systems. They expect monthly statements to be accurate, easy to get, read and understand. They expect to be able to order (toll free) a wide variety of products via telephone, often without human intervention. They have become rather intolerant of errors in data, records, processing, or reports. They expect information when they want it, at their convenience, in a way that makes sense to them.

These are the characteristics of service in the information age and the future of higher education depends upon the development and implementation of successful IT strategies to meet or exceed these expectations. The strategic role IT plays will necessarily be unique to the institution. To play a strategic role the IT organization must: improve the competitiveness of the institution, be more responsive to educational and service challenges, and help make the institution more effective and more efficient.

The Vision

The design of a strategic role for an IT organization must be guided by a vision that sets the service agenda. The vision should fuse the IT strategy with the institutional mission. It should describe a culture for the technology organization that is synergistic with the institutional culture, and it should facilitate the systematic reengineering of core campus functions to achieve magnitudes of improvement in effectiveness, efficiency and service.

Fusing the IT vision with that of the institution's mission means that IT must be designed into the core functions of the institution. The IT strategy and organization must have as its primary function the achievement of the institutional mission. IT perspectives must be represented and understood at the executive level of the institution and IT performance must be evaluated on how well it helps the institution achieve its mission.

The IT culture must be synergistic with the institutional culture. This means that IT organization members must identify with the institutional mission. This requires that they not only know what the mission is, but they must come to know how they can contribute to its achievement. Much of this synergy is derived from IT organization members sharing the values of the institution. IT organizational members must understand and communicate a concern for solving institution-wide problems. and must help others understand and use IT to advance the institution.

The IT organization must facilitate the systematic reengineering of core campus functions. Reengineering is: (1) the process of reexamining all basic assumptions about the way we do things and rejecting those that fail to capitalize on the technological capabilities of today; (2) redesigning work processes based upon new assumptions; and (3) "thinking out of the box," that is, refusing to be limited by traditions of the past. Technology is the enabling force behind reengineering. Technology organizations must help bring this to bear on improving institutional operations. Profound change is possible given the information systems infrastructure now emerging if these concepts are put into practice. [1]

Technology played an enabling role in the transformation of the agrarian economy into the industrial economy. The change occurs in three general stages. During the first stage, the new technology does what the technology it has replaced does but faster (transition). In the second stage, the new technology begins to initiate modifications to old processes, resulting in greater efficiencies and enhanced effectiveness (innovation). Finally, during the third stage, new ideas and concepts which were previously impossible are made possible by new technology resulting in major breakthroughs and significantly increased effectiveness and productivity (transformation or reengineering). This general pattern is also being seen in the transformation to the information economy, and we observe that the majority of changes to date, brought about by computing and communication, have resulted from stages one and two of this paradigm. [2]

Another view of the transition breaks the process into five more specific evolutionary stages. They are proposed by Michael S. Scott Morton in the seminal book on transformation that culminated from the collaborative "Management in the 1990s" research project conducted by the Sloane Management School at the Massachusetts Institute of Technology. The five evolutionary stages are; active facilitation of localized exploitation of information technology, internal integration, business process redesign, business network redesign, and business scope redefinition. [3] IT organizations play a strategic role by helping their institutions move along this evolutionary path.

Stage one of the evolutionary path is the localized exploitation of information technology. The benefits derived for the institution during this stage are primarily the result of automating existing processes. Existing processes are identified and then computerized, creating islands of automation. Since the key concept is "automating existing processes," policies and procedures remain largely unchanged. This process is often referred to as brute force automation and the benefits accrue as marginal improvements in efficiency and effectiveness.

The second stage in the evolutionary path is achieving some internal integration. The benefits derived here are primarily the result of tying islands of automation together with an organization wide information infrastructure. Institutional leaders begin to recognize that synergies can be achieved from getting the automated systems to work together. During this stage hardware and software standards begin to emerge and data begins to be seen as an organization-wide asset regardless of where it exists or who owns it. While benefits during this stage accrue as further marginal improvements in efficiency and effectiveness, this stage is key in preparing the way for transformation.

The third stage along the evolutionary path is called process redesign and represents the first step in reengineering. During this phase there is recognition that simply automating isn't enough. Processes are redesigned to fit the IT capabilities and benefits can accrue in magnitudes of improvements in efficiency and effectiveness by fully capitalizing on information system potential. This stage requires that hardware, software, data, and communications standards be in place. During this stage transformation leaders have recognized that in order for existing capabilities to be fully utilized job descriptions must begin to be recast and organized around outcomes instead of traditional task lists. This coupling of technology capability with behavioral transition is a primary engine for the transformational process.

The fourth stage along the evolutionary path is network redesign. IT benefits are primarily the result of fusing organizational form and function with IT capabilities and futures. IT facilitates new working relationships between organizational members forming new human networks. A network culture begins to emerge, characterized by open communications, ad-hoc work groups, and connected and empowered individuals. Benefits that accrue during this phase achieve further magnitudes of improvements in efficiency and effectiveness

The fifth stage in evolutionary development is the ability to redefine organizational scope and mission. As a function of creating an organization that can learn through the first four stages, new niches and competitive positions emerge. As a result organizations have the capacity to realign themselves with the environment in order to capitalize on new strategic opportunities. Benefits accrue from these new activities, roles and functions of the organization and from further magnitudes of improvements in efficiency and effectiveness.

Information technology is the primary enabling force in this evolutionary institutional change process. But while absolutely necessary, alone it is still insufficient to facilitate progress along the evolutionary path described here. In order for the evolution to occur there needs to be an organization wide focus on information technology by the people of virtually every unit. This focus must be nurtured. All must come to understand that fusion of IT with the organizational mission means everyone will have IT responsibilities. Therefore, managing IT resources will be a function shared by everyone and maximizing IT resources will result from an institution wide intolerance of wasted potential and functionality. This transformational consciousness begins the emergence of a new type of organizational member--the knowledge worker. We anticipate that the knowledge worker will exhibit a rather distinct set of characteristics and behaviors.

The Knowledge Worker

Perhaps the most important factor that will distinguish the knowledge worker is attitude. Knowledge workers as a rule will like what they are doing and project this through favorable attitudes toward clients and colleagues. They will exhibit enthusiasm about their fields of interest and expertise and will be eager to share. They will be fair to their colleagues and clients and feel empowered to help solve the enterprises problems.

The primary challenge in developing this attitude during a period of transformation is to overcome bureaucratic conditioning and defensive reasoning. These conditions are characterized by blaming the system or others for past decisions, arguing "If it ain't broke don't fix it," prolonging organizational inertia by sticking to the old way, fear of negative reactions fostering blockage of upward communications for difficult issues, playing budget games and perpetuating a myth of teamwork.[4]

Empowerment of the individual is one of the first acts in breaking these bureaucratic barriers It is largely a personal process but must be supported by management. An empowered persons authority to act comes from within the person. This is derived from a trust in ones own instincts. An empowered person assumes responsibility and judges success by their contribution to the strategic goals of the organization such as service, productivity, reputation, and competitiveness. Rewards for such a person come from doing meaningful work, learning, creating, and having the opportunity to grow. A culture to nourish such workers is one where individuals are honest, share information, share control, and take reasonable risk. This requires individual courage supportive management and a commitment to fairness. [5]

Another set of characteristics and behaviors that will distinguish knowledge workers revolve around their knowledge base. The foundation of the knowledge base is information technology literacy or ITL. ITL is the knowledge which allows a person to function efficiently and effectively in whatever role the individual has in an information/service economy. While a critical level of ITL in the organization is one of the perquisites for institutional transformation the knowledge base cannot end with ITL. Individuals must be literate about the goals, objectives, and real work of the organization. This means that the real work of the organization must be both well defined and understood. This is often not the case and not always obvious!

A knowledge worker must also be an excellent network navigator. A network is defined here in a broad formal sense as a recognized group of individuals assembled by executives to work across functional areas, sharing information, and using IT infrastructures, where appropriate, to facilitate good decision making. This not only requires the know how to effectively use the electronic infrastructure but means individuals must have social interaction skills, teamwork skills and leadership skills. [6]

Acquiring and maintaining the skills required to engage in real knowledge work means that individuals must learn constantly. Some estimates are as high as 30 percent of a knowledge workers time should be devoted to learning. It is this commitment to education and learning that constitutes the basis of being able to continually grow and become more effective. This means that on-going professional development is essential. But it also means that individuals need to experiment with new techniques and methodologies. They need to "network" with other knowledge seekers, read pertinent journals and magazines on a regular and ongoing basis, and be empowered to pursue learning as a natural course of their work lives. The more each organizational member learns the more strategic their role in the organization.

The knowledge worker's culture will be a somewhat unique one. The environment will be one for the intellectually excited and curious, experimenters, communicators, highly self motivated people possessing high but reasonable standards. To create this culture we must remember that people need to feel challenged by their work, they must be given the opportunity to grow, and they need feedback In the absence of positive feedback, many give themselves negative feedback. Because individual innovation will lead to productivity breakthroughs people must be encouraged to take reasonable risks. It is a culture where individuals must get used to the idea of continuously raising standards and improving quality. To encourage this culture organizations need to seek ways to couple rewards with performance, give recognition, show appreciation and help build individual self esteem.

The Information Technology Organization

> Either address change and take advantage of the unique opportunity it offers for you to successfully serve your enterprise, or face consequences that can range from the loss of your organization's important role in the enterprise to the loss of your job...Of course, other challenges face you and your enterprise,...But in light of the current acceleration of change...and its potential impact on IS careers, this particular challenge must take priority.
>
> Mario M. Morino [7]

If IT organizations are to play a strategic role they must assume the role of rudder in the change process. Remember the rudder is directed by the person at the helm (not in the engine or machine room) and is a mechanism for steering the ship (or enterprise) in a new direction. While a relatively small part of the whole ship or organization, even a turn of a few degrees has a major impact over the course of the journey. How then does an IT organization begin the journey of evolutionary change?

Because information technology organizations have leadership responsibilities in this evolutionary institutional change process they must learn to manage change then teach others. They must create a change culture in their own ranks. They must manage expectations by setting realistic high goals and standards then achieving them. They must play an essential role in coordinating critical components of the change process.

To do this requires credibility. The only real way to acquire credibility of this nature is to provide solutions to institutional problems within current people, budget, and system capabilities. Cast in another way--dleivering solutions with what you have is the single best way to be allocated new resources, new confidence of decision makers, new leadership position within the organization. With this strategic delivery process underway, it is time then to look at the future.

In order to lead the way, IT organizations must dedicate themselves to the design and implementation of systems that serve not only primary clients but executives and the ultimate clients of our institutions--the faculty, students, and staff. The IT organization should be significantly involved in the redesign of institutional processes, procedures and in some case restructuring organizations. IT should help functional mid-managers across the campus move rapidly towards coordinated management of IT resources. This all requires ongoing interchange with the client community and the skilful use of committees, task forces, and formal, as well as internal, networks.

Information technology leaders must learn to translate the IT vision to the broader institution. One of the best ways is through strategic planning. The optimum development of a strategic plan is guided by a vision and institutional information strategy that is derived from or completely embraced by the executive officers of the institution.

The plan should set forth a strategic direction for IT including voice, data, image transmission, the nature and architecture of enterprises database, and scholarly access. The plan should define IT support mechanisms, and policy with respect to standards, privacy, security, and intellectual property rights. The plan should also begin to redefine roles and responsibilities for institutional entities such as the division, school, department, and individual and set forth strategies for information access for executives, knowledge workers, and front line workers.

Strategic planning of this focus is best guided by a formal model to frame decisions. The model should be designed to expand strategic planning to a strategic management process thereby linking planning and management.(including budgeting). To be effective the process must embrace the values of the organization and be cognizant of both internal and external strengths, weaknesses, challenges and opportunities. The process needs to be iterative, cycling decisions through a process of mixing and matching the variables with institutional capabilities and tweaking the information strategies.

The information strategy must be articulated in a succinct mission statement. This mission statement should answer such questions as; What is our purpose? Who do we serve? How do we provide and maintain services? etc. Then it must be translated into action through goals and objectives. To be effective there needs to be a linkage between the Strategic Plan, Unit Plans, and each individuals Work Plan. The effectiveness and efficiency of these plans need to be affirmed and modified based upon meaningful evaluation. This is a strategic management process that drives the strategic action of individuals toward a common goal.

In order to maintain credibility and keep a keen eye on reality the client community should be involved in specifying evaluation criteria. Evaluations should include a periodic survey of client perspectives of service (and these need to be compared against standards), a quarterly evaluation of progress toward annual objectives, an annual strengths/weaknesses analysis, a periodic review by external evaluators and an annual report of achievements and disappointments.

The information technology organization must pay meticulous attention to designing and maintaining the IT infrastructure. The infrastructure is a means to achieve institutional objectives and must serve to integrate information resources. The ends/means question is an important.one that must be better understood throughout the IT enterprise. The infrastructure itself must accommodate growth and change. This emphasizes the importance of an information strategy and good architecture. The integration and use of information resources (the means) must be designed to improve communication, decision making, innovation, and accomplish the mission of the institution--this is the <u>end</u> to which we must strive.

The infrastructure must connect virtually everyone. This will require us to pay more attention to social interaction, managerial coordination, and the change management process. We must recognize that linking basic elements already in place may problematic to some.individuals. We must also address th[illegible]ues of navigating through the information system.. The technical aspects of th[illegible]tructure should be transparent. While we have recognized this for some ti[illegible]eality is they are not! There are growing problems related to connectin[illegible]eryone including rapid obsolescence (of hardware, software and skills), increasing demand for education and training, maintenance, and dealing with growing expectations. Dealing with these problems in an era of limited resources represents a major challenge.

The ultimate success of the information technology organization will depend more upon people more than on technology. They must be able to overcome the alienation common now with the technocracy. They must be as connected with the core mission and functions of the institution as they are with technology. They must be empowered to play a critical role outside the IT organization. The role will require more IT staff to have leadership characteristics. They will need to play a role as consultants, coordinators, facilitators, coaches and team builders. They must be nurtured (encouraged, trained, supported, evaluated, and rewarded) along these critical paths. Achieving these will require managerial initiatives including an increased willingness to share information, an entrepreneurial perspective, and the empowerment of the individual.

Closing Observations

> All successful organizations in the 1990s will have to pass through [transformation], a stage characterized by leadership, vision and a sustained process of organization empowerment so basic as to be exceptionally hard to accomplish ... the concept of transformation includes the broad view of quality but goes beyond this to address the unique opportunities presented by the environment and enabled by it.
>
> Michael S. Scott Morton [8]

Constructing a strategic vision for information technology at your institution is a most critical step. Vision here has two meanings in Strategic Planning Terminology: What are the significant values that will be emphasized in the organization?; and What scenario do we aspire to in the next 3-5 years? Both of these must be derived and understood by executive leadership of the institution. Input from clients and constituents is important in determining appropriate values and the strategic scenario that follows. Unless this was done recently, "what is" may not address "what needs to be."

Progress depends upon getting buy-in to the vision. To get buy in the vision must be clearly articulated in terms the broader institution can understand. Even the most rational approach will not get 100% agreement but will garner understanding and support. The key is that it must fit the institutional decision making structure, it must reflect the institutional value system, and it must establish values for the proposed future. To maintain buy-in it must be supported by a process beginning with formal strategic planning model, and the recognition that it is not a one time event, it is on going, never ending, constantly improving.

Creating a strategic plan to translate the vision into reality is critical. The strategic plan defines the process for input,.defines how decisions are made, helps establish and clarify expectations, defines accountability, provides an important communication mechanism, and over time establishes credibility.

Designing an infrastructure to support the vision must be a prime focus. Most institutions do not have the option to look at the ideal. The infrastructure is shaped by: what exists, available and potential resources, what is desired by the institution. It is important to make known both the givens and the essentials. Executive decision makers need a basic understanding of what the standards are and what is needed.

Developing the organization and management structure to implement the vision must be done at the same time. The number of CIO positions has doubled in 3 years. If the IT leader is not at the executive officer/President's policy committee level then IT needs an executive officer champion. Organizational structures in IT units are likely to change significantly over the next 5-10 years

Success will depend to a large degree upon acquiring and developing the human resources needed to implement the vision. The journey that we have described will clearly need more leaders and fewer managers. These leaders need different skills than in the past. They need to build shared vision, balance inquiry and advocacy skills, discern between what people say/believe and their actions, be able to focus on inter-relationships not detail, move beyond blame, and avoid symptomatic solutions. There will be a far greater need for teamwork, group interaction, on-going education, and a different reward structure

Creating a culture where change can thrive is a major challenge. In order to create a culture where change can thrive we must break down the bureaucracy, empower people, challenge them and hold them responsible. We must also encourage innovation and reasonable risk taking. Change is NOT OPTIONAL!!! Will it be a positive or negative force?

Creating meaningful evaluation mechanisms is essential. In the process of creating meaningful evaluation mechanisms we must reexamine most of our measurement criteria, accepted standards are woefully outdated, comparisons to "like institutions" are useful only to judge progress not to measure absolutes, accounting framework based on industrial model, does not lend itself to value added or distinguishing between creative versus routine tasks with respect to investments. As the nature of jobs shifts from task to outcome orientation and individual performance relates more to team or group activities, individual assessment mechanisms need to be changed. There are no easy answers--and this very important to remember and convey!!

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DATA ACCESS SERVICES

A Key Component of Central Support for Distributed Computing

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ABSTRACT

Recent and continuing investments in computing technology have expanded the capability of administrative and academic units to provide internal computing support. The role the Information Services department plays within the institutional computing arena must evolve to effectively leverage this investment. Highly integrated central applications have been created to capture and maintain institutional data. The inability of end users to make effective use of this institutional data is an emerging problem. Michigan State University is addressing this problem through the establishment of the Data Access Services function. This paper will review this function and the factors which led to its creation.

"The new source of power is not money in the hands of a few but information in the hands of many."[1]

JOHN NAISBITT, 1982

In 1982, John Naisbitt's Megatrends: Ten New Directions Transforming Our Lives postulated a set of major sociological changes occurring due to the transformation of industrial society to an information society. This *megatrend* has continued and expanded in many ways during the past decade. The information technology industry has grown at a rate beyond even the most optimistic predictions of the early 1980's. This *megatrend* has also manifested itself on college and university campuses across the nation and around the world. The development of distributed computing capabilities and rising demand for institutional data are characteristics of this trend found throughout higher education.

Michigan State University is currently in an era of profound change reflecting the sociological *megatrend* postulated by Naisbitt. In the past decade, distributed information processing capabilities have been developed outside the central support organizations in every area of the University. In addition to distributed capabilities, a centrally supported end user computing environment enables a large and growing segment of the MSU community to make extensive use of the administrative mainframe for production of reports, labels and data files from centrally maintained institutional data resources.

This era of profound change is reflected at MSU in three emerging trends. These trends are: continuing investment in information technology, evolving and expanding end user computing, and the presence of institutional application systems characterized by large volumes of highly integrated data.

A Continuing Investment in Information Technology:

In this era of shifting technical capability, demands for information are rising. New means to use and deliver information have become available. The table below details the acquisition pattern for workstations used in centrally supported academic computing laboratories. This pattern is presumed to serve as a model indicative of the purchase behaviors of the MSU campus as a whole. Accurate data on all workstation purchases, campus-wide, is not readily obtainable.

COMPUTER LABORATORY WORKSTATION PURCHASES

1982	23
1983	51
1984	100
1985	64
1986	178
1987	159
1988	258
1989	97
1990	320
1991	99

Source: MSU Computer Laboratory[2]

The purchase pattern indicates that investment in information technology, as reflected in budgeted workstation purchases, has progressed in a consistently upward direction. The years 1989 and 1991 show a drop in the number of workstations purchased. This is due to a shift to the purchase of SUN and NEXT workstations, respectively. Thus, a growing budget commitment to information technology has remained evident.

Evolving and Expanding End User Computing:

End user computing on the central host has increased at a consistently high rate for the past several years. The table below illustrates a trend in the growth of end user submitted batch jobs on the central host as an indicator of this expansion. Tools, support, training, and an execution environment are provided for end user access to institutional data resources.

END USER SUBMITTED BATCH JOBS

1984-85	41,062
1985-86	51,264
1986-87	61,282
1987-88	65,367
1988-89	79,421
1989-90	76,120
1990-91	88,001

Source: AIS Consulting Services[3]

The end user computing volume on the mainframe has consistently represented approximately 25% of the total number of batch jobs executed annually. The end user computing community includes 50 of the 170 academic and support units from across campus and over 300 individuals. End user computing growth and expansion is expected to continue at a rapid rate for the foreseeable future.

Large Volumes of Highly Integrated Institutional Data:

MSU has experienced significant growth in the volume of centrally stored and maintained administrative data. This is due, in large part, to the recent implementations of the Alumni / Development Fund system and the Payroll system, as well as, the Student Information System.

The growth of this data is indicated in the amount of direct access storage on the administrative host mainframe. During the 1985 - 86 fiscal year, the amount of total disk storage was approximately 20 gigabytes. The 1991 - 92 fiscal year puts that figure at 90 gigabytes, representing explosive growth.

Earlier end user computing experiences at MSU were, and still are to a great degree, oriented around the use of daily backup copies of production administrative data. These are copies of function-specific files which are maintained throughout the day by online application software. Each of the recent and future major implementations have been characterized by large, complex database structures and large volumes of data.

"We are drowning in information but starved for knowledge."[4]

JOHN NAISBITT, 1982

Institutional data resources have become complex and significantly more voluminous. At the same time, end user computing demands continue to escalate, not only in sheer volume, but also in the greater sophistication on the part of the end user computing community. Over the past decade, our clients have become extremely computer literate. The level of sophistication and complexity in the end user computing arena has risen significantly, often challenging the knowledge of the central support organizations.

These trends indicate that a major challenge for the Information Technology (IT) organization will be in addressing the issue of meeting the increasing demand for access and support, while building end user self-sufficiency, in a period characterized by budget cutbacks and other funding difficulties. We are clearly moving away from a paradigm in which data services are mediated and controlled solely through the central IT organization. Central support must evolve in response to these changes.

At MSU there have been two watershed experiences, or *change agents*, which have led to a radical shift in the approach providing support to end user computing and in the delivery of, and the access to, institutional data. These two experiences were the Development Fund Information System Project and the Student Information System Project.

The Development Fund Information System Project:

The purchase and subsequent implementation of the ADVANCE system for the MSU Development Fund was a major project undertaking. The ADVANCE system is a large, transaction oriented development fund information system. The system includes a transaction-oriented Computer Associates CA-IDMS/R network database structure maintaining very high volumes of data.

The ADVANCE system was also characterized by a lack of vendor-supplied reporting support. This forced MSU to deal with the issue of reporting and extracting data for use by University Development Fund Officers from a large and complex database. The organization approach to this situation was to try to anticipate and accomplish support through existing structures both in systems development and in, what we then termed, the administrative information center.

This approach was not as successful as had been anticipated. Part of the reason was that, in regard to data access, a constantly reactive posture was taken when a more proactive approach was required. Success required anticipating, not merely accommodating, the needs of end user computing.

"Uncontrolled and unorganized information is no longer a resource in the information society. Instead, it becomes the enemy of the information worker."[5]

JOHN NAISBITT, 1982

When the system went live, considerable effort by members of the Information Center staff and the application support team was spent on day to day support activities. Four to five full time staff worked to make extracts and logical records work in order to complete reporting required to run the central business functions of the Development Fund.

Further, data access and end user computing should have been viewed as a project kind of activity. Development and implementation of end user accessible data resources, as well as, client portfolio conversion must today be an integral part of the systems development lifecycle.

Finally, it was discovered that data needed to be placed, not found. For the first time, MSU was implementing a large, complex database. Nearly five gigabytes of development fund data are stored and maintained by the system. The use of backup files as a data resource for end user computing is impractical. MSU was forced to place data in forms that end users could use and understand.

The Student Information System (SIS) Project:

The second major *change agent* at MSU is the Student Information System (SIS) Project. The SIS project is, by far, the largest effort ever undertaken at MSU. The system encompasses a wide spectrum of student related processing including: admissions prospect and application management, enrollment and registration, holds and accounts receivable, degree audit, academic history and transcripts, and financial assistance. Additionally, the system maintains information on background institutions, student organizations and participants, as well as, intercollegiate athletics and student athletes. Thus, SIS is an extremely large system. The database is projected to encompass on the order of 50 gigabytes of disk storage.

The SIS database is highly complex and complicated. The database is a Computer Associates CA-IDMS/R network structure currently maintaining in excess of 35 million record occurrences. The database structure is made up of nearly 500 record types, 750 network set relationships, and 5000 data elements. The online application software includes more than 1 million lines of code and 850 maps. The sheer volume and complexity of the database itself creates the prospect that without dealing with a strategy and a set of tactics to achieve end user computing success, essential components of University business functions would be adversely impacted. SIS also lacks vendor-supplied reporting support. Thus, a significantly greater dependency is placed on end user computing to enable and execute basic business functions.

These factors, combined with knowledge from prior projects, created the necessity to integrate data access and end user computing into the SIS development lifecycle. The role of the central IT organization must evolve to address these issues for SIS to be an institutional success.

"Information technology brings order to the chaos of information pollution and therefore gives value to data that would otherwise be useless."[5]

JOHN NAISBITT, 1982

Recent experience demonstrates that it is possible to provide computing tools and the technical capability for access without achieving the substance of the goal which is to make institutional data truly useable and understandable.

The role of the central IT organization needs to be to act as an agent to promote the organization and distribution of the institutional data resource to the appropriate University offices. Toward this end, MSU has implemented a revised strategy. The recognized need to pro-actively address the problem of data resources and end user computing requires dedicated resources to deal with this issue. An organization is needed to focus and support these resources. Fundamentally, a new service offering from the central IT organization is needed.

The new service needs to be initially integrated into the SIS project team. The new function needs to take a planning and designing approach to the provision of data access and to the provision of end user computing. The new service needs to enable the central support organization to involve clients in a cooperative venture to define the needs of the information required from SIS.

In response to these needs, MSU has created the SIS Data Access Services function within Administrative Information Services. SIS Data Access Services is charged with the mission to define, articulate, and advocate a coherent large systems data access strategy.

It is anticipated that what is developed in conjunction with the SIS project will be applicable across the spectrum of administrative information systems. This new function becomes a way to look at the provision of access and the delivery of data to end users for the foreseeable future.

In addition to strategy, the service component of the Data Access Services function needs to be identified, designed and implemented. A primary goal of the function is to foster, encourage, and enable a greater degree of client independence through a strong program of education and support. SIS Data Access Services must reach out, advocate, and train clients to truly understand and effectively utilize institutional data resources.

SIS Data Access Strategy:

The SIS Data Access Strategy is made up of four components. The implementation of SIS, coupled with the University conversion to the semester calendar in 1992, will have unprecedented impact on central support offices such as Admissions, Registrar, Controller, and Financial Assistance. The goal of this strategy is to help enable SIS to be a positive impact upon University end user computing.

Survive:	The primary offices involved with the SIS project are also the heaviest consumers of the end user computing community. Consulting support must be provided to enable an effective and efficient conversion of established end user computing portfolios.
Facilitate Access:	Maximize data availability in accordance with University Need to Know policy and procedures.
Maximize Understanding:	Through effective training, documentation, consulting, and support.
Position Resources:	SIS data resources must be designed to accommodate relational database models found in client / server and distributed database environments.

Organization:

The SIS Data Access Services function, reports in a matrix management relationship both to Administrative Information Services (AIS) and to the MSU Student Information System (SIS) Project. The matrix relationship is accomplished through AIS SIS Manager and SIS Assistant Project Director Patricia W. Croom whose position within AIS reports to AIS Assistant Director of Information Systems and Services, Bruce K. Alexander and within the SIS Project reports directly to the Project Director.

Both AIS and the SIS Project are departments within the MSU Computing and Technology major administrative unit. This unit is led by the Vice Provost for Computing and Technology, Dr. Paul M. Hunt. The AIS department is led by Scott D. McGill and includes approximately 125 full-time staff. The SIS Project is led by Dr. Marshall Hestenes and includes nearly 80 full-time staff drawn from the University community, AIS, and Coopers and Lybrand. Coopers and Lybrand is the prime contractor for the SIS Project.

The SIS Data Access Services team is led by a Senior Systems Analyst / Supervisor. The team includes: a Systems Analyst, two Programmer/Analysts, a half-time Graduate Assistant, and two half-time Student Programmers.

Philosophy:

The SIS Data Access Services operating philosophy comes, in large part from the Administrative Information Services Total Quality Service (TQS) initiative. As prescribed by AIS Director Scott D. McGill, the TQS program asks each function w[illegible]n the department for leadership and a commitment to excellence, teamwork and active participation o[illegible] staff members, a commitment to strategic planning, continuous improvements of work processes, and total cooperation between units.

Maintaining a propensity for action is another element of the SIS Data Access Services philosophy. Due to the scope and urgency of the project schedule, reasoned action is required. Standardization activities, enterprise data modeling, and other more traditional data administration activities would normally precede the design of access and delivery services. However, the situation at MSU demanded a data access and delivery focused approach in order to meet SIS objectives.

Staying close to the customer, the AIS client, is the final element of the operating philosophy. A primary goal is to build on-going com[illegible]g partnerships with SIS client offices. In order to achieve this goal, client office staff and management are involved early and involved often in SIS Data Access Services activities. Client office participation in design and implementation activities increases client knowledge and builds a sense of ownership of the data resource products.

"If users - through information utilities - can locate the information they need, they will pay for it." [7]

JOHN NAISBITT, 1982

Taken literally, the quote would seem to indicate that SIS Data Access Services has been established to create a revenue center. This is not the case. The interpretation here is that if end users are provided access to institutional data in forms that they can truly use and understand, in a form that they perceive as having value, that they will invest in the technology and in the resources to access institutional information and use it to their benefit.

The label Information Warehouse or Data Warehouse has been used extensively lately in reference to relational data repositories which serve client / server or distributed database applications. A warehouse, in this sense, is a place where data is placed for later access or delivery.

The services provided by SIS Data Access Services go beyond data resource creation and storage. The label *data clearing house* has been used as an illustrative metaphor. The SIS Data Clearing House includes four primary functions. These functions are data resource design, data resource filtering, data delivery, and education, consulting and support.

Data Resource Design:

The primary goal of data resource design is to provide users the information they require, arranged for easy and effective use while minimizing the direct access of the SIS database for end user computing. This will be accomplished by extracting significant amounts of SIS data from the SIS database for use by end user computing. These extracts will serve as a basis for a re-engineered reporting database allowing distributed processing or direct query. Additionally, the extracts will provide the basis for a variety of reporting files created through the process of data resource filtering. Where required, direct access will be accomplished using logical records designed to emulate extract files.

An additional goal is to design the extracts for use in a relational database environment without requiring significant redesign. This basically requires that extract designs be normalized to third normal form. This positions the data resources for use with emerging end user tools which generate Structured Query Language (SQL) statements from a "friendly" user interface for data query.

Data Resource Filtering:

Protecting unauthorized access to institutional information is one example of a data resource filtering operation. In order to comply with University *need to know* policy and practices, operational extracts must be subdivided to provide specific subsets of data. This, in combination with dataset level security, provide the capability to adhere to requirements to deliver only the appropriate level of access to institutional data.

A specified group of student directory type information such as student name, address, phone, major, and dates of attendance as considered public information. However, each student has the option of requesting that any or all of the defined directory elements be kept confidential. This designation prohibits release of the information outside the University *need to know* definition. Confidential information filtering provides an element of protection against unintentional release of confidential directory information.

Special purpose filters include providing small subsets of highly specific information to various units. Examples of such special filters include intercollegiate athletes, international students, and office-specific holds. In each case, a small population of student data is required for specific functions.

Reporting filters are designed to ease the transition from current, single-file, reporting to the multi-file extract environment. Reporting files are creating by de-normalizing the extract design by increasing data redundancy on commonly used fields, limiting repeating group occurrences, and deriving flag values and aggregations where required to ease reporting.

The purpose of the reporting filtered file is to accommodate the majority of end user computing requirements for lists and labels. This will provide for increased single-file reporting solutions. More ambitious analysis of SIS data can be accomplished using the pre-filtered system extract files, in relational table format.

Data Delivery:

To support the large and growing mainframe computing community, mainframe files must be created and maintained. Specially filtered files can be transferred via File Transfer Protocol using TCP/IP for local processing. Data must also be available via tape and diskette. Finally, for units which have limited requirements and a limited computing budget, data must be delivered in the finished form of lists and labels.

Education, Consulting, and Support:

The most critical operation of the SIS Data Clearing House is the education, consulting, and support function. Education is required in the new meanings of familiar data, redefined as part of the SIS implementation. Education is also required in the increased availability of data. Finally, hands-on training in the use of the SIS data resources is required for a successful transition. Clear, concise and useable documentation is also required as reference material following client coursework.

Consulting in program design, data access and manipulation and data presentation is a critical support operation. Familiar problems require new, unfamiliar approaches for resolution. SIS Data Access Services staff actively participate in the identification and design of end user outputs required to ensure a successful conversion to SIS.

Support for the use of the end user computing tools and environment is accomplished primarily through the AIS Help and Support Center. All client calls for problem resolution are first handled by the Help and Support Center. In cases where SIS Data Access Services expertise is required, assistance is requested and progress toward resolution monitored by the Help and Support Center. Problem tracking and coordinated problem resolution are essential elements of the support function.

"The emphasis of the whole information society shifts, then from supply to selection."[8]

JOHN NAISBITT, 1982

MSU Institutional Data Reporting Model:

Beyond the SIS Project, the strategies and services developed can be expanded in scope to include a wider range of institutional data. An institutional data reporting model will enable this expansion to be strategically planned and clearly visualized. Creating this enterprise data model will likely be a priority activity following the implementation of SIS.

Expand and Refine Data Resource Products and Services:

Data resource products and services will continually expand and evolve. An aggressive program of effectiveness review and utilization analysis will be undertaken following the SIS project in order to gather quality control information. Using this information, SIS data resources will be enhanced in response to client needs. In addition, new specially filtered files and other files suitable for transfer to the local processing environment will continue to be created for distributed end user computing.

Expand and Develop Client Base:

A continually expanding client base will also be a characterization of the Data Access Services future. The most rapidly growing segment is the academic community. In addition to the colleges and academic support units, a number of non-traditional clients of central support services will evolve. Examples of these units include Intercollegiate Athletics, Performing Arts, Grounds Maintenance, and the MSU Students.

MSU, through the development of the Data Access Services strategy, has pro-actively addressed the increasing problem of effective and efficient end user access to institutional information. As this service matures and expands, a wider section of the campus community will be empowered to access and effectively use a widening segment of institutional data. Success with this function could provide the credibility and user level support for more traditional data administration activities which are often difficult to initiate. Data Access Services has become a key component of central support for distributed computing at Michigan State University.

NOTES

1.John Naisbitt, Megatrends: Ten New Directions Transforming Our Lives (New York: Warner Books, Inc., 1982) p.7.

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2. Dr. Lewis Greenberg, Director MSU Computer Laboratory, November 1991.

3. Shawn Fulton, Acting Manager Consulting Services, Administrative Information Services, November 1991.

4. John Naisbitt, Megatrends: Ten New Directions Transforming Our Lives (New York: Warner Books, Inc., 1982) p.17.

Reference:
Naisbitt, John Megatrends: Ten New Directions Transforming Our Lives. New York: Warner Books, Inc., 1982.

All subsequent notes (5, 6, 7, and 8) are from the same noted page and reference.

Student Administrative Services - Rethink, Reorganize, Re-implement

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It is becoming increasingly evident that the critical factors in a student's decision to attend or remain at a particular college or university go beyond the caliber of academic programs and campus life to include the quality of administration- the ease of registration, accessing records, resolving problems, and relieving financial concerns.

The classic Registrar, Bursar, Financial Aid organization represents an antiquated model that inherently impedes an institution's ability to deliver quality service. Pratt Institute has engaged in a fundamental redesign of the traditional model. Consolidation and reorganization of the three existing operating units allows service improvements that should aid recruitment and retention. Other benefits are improved operating efficiency and reduced costs despite an increasingly complex and demanding administrative environment.

Student Administrative Services - Rethink, Reorganize, Re-implement

What Type of Institution Should Consider Reorganization?

Reorganization should be considered by any institution concerned about retention and cost effectiveness. Few institutions can claim the enviable combination of growing enrollment and adequate financial resources. For many institutions, the term "right-sizing" is one of several strategies under consideration as a means of addressing the financial challenges associated with enrollment declines. But staff reductions, without a corresponding analysis of organization and procedures, is a very dangerous undertaking. As students become more informed consumers, they demand a level of service only a well-organized service unit can deliver.

Higher education's traditional model for delivery of administrative services to students is ineffective and inefficient. Maintenance of students' academic and financial records by three separate offices- the Registrar, Bursar, and Financial Aid offices- contributes to poor service in several ways. Pratt Institute's reorganization of these functions in a consolidated Student Administrative Services department addresses the following problems common to the traditional structure:

1. **Lack of advisement services.** In the traditional model, staff who interact with students have responsibility for both counseling and transaction processing. At peak times such as registration, processing takes precedence to the detriment of advisement. One result is that students take little responsibility for planning or managing their educational finances.

   Lack of administrative advisement impacts particularly heavily on economically disadvantaged students who lack family role models for financial management. Increasingly, given the recession, students from middle income families are also "on the edge" financially. Without personalized financial advice and intervention, such students risk joining the attrition ranks. Too few staff members in the traditional structure can provide such advisement because the usual registration focus is on processing.

   A common occurrence at the bursar's window illustrates this problem. A student is prevented from registering because of a prior semester balance. He or she is having difficulty interpreting the account statement. A growing line of frustrated students listens as the student tries to resolve a complex financial problem in a very public arena. Aware of the growing lines, and unable to quickly determine which expected financial aid did not materialize, and why, the cashier refers the student to another long line at the financial aid office across campus.

2. **Lack of staffing flexibility.** Registrar, bursar and financial aid staff typically have narrowly defined areas of skill and expertise. While registration is a time of peak activity in all three offices, other key processing deadlines are generally staggered. Organizational structure typically stands in the way of cross-training and staff sharing. The lack of staffing flexibility inherent in the traditional model can also contribute to overstaffing, reduced service quality, and lack of promotional opportunities.

3. **Lack of coordination in policy-making.** In many institutions, the three offices report to different institutional divisions. The Bursar often reports to the Controller, and ultimately the Vice President of Finance. The Registrar generally reports to the Provost or equivalent. The Financial Aid Director may report to the Vice President for Student Services. This reporting structure lends itself to policy inconsistencies and fragmented decision making. The three offices haven't traditionally maintained or analyzed the data needed to contribute to debates on important topics like tuition pricing.

   Academicians, an important source of information for students, are often unaware of financial policies and their underlying rationales. Registration and payment deadlines may be established without a clear understanding of the implications for an institution's cash flow.

More effective use of administrative resources is of increasing concern to educational institutions. Enhanced service to students is a key factor in recruitment and retention. Pratt's new administrative service model furthers both goals in a cost effective way. It has broad applicability at a time when fiscal constraints at the state and federal levels are increasing. Expectations of better financial and student service performance from boards of trustees, and more importantly students, make this innovative approach to administration relevant to a majority of higher education institutions.

Key Steps and Measurable Results

Involving Constituents in Planning

Over a four month period, the design of the consolidated department took shape. An important part of the design process was involving department constituent groups in the planning phase. Faculty and student committees provided input on service strengths and weaknesses. A benchmark survey was made of student views on service quality. The findings have guided many of our procedural changes this year. A follow-up survey is planned for spring registration to help gauge our achievements.

In a unionized environment, the input of Human Resources and open communication with union representatives were critical. Finally, the Institute's audit firm evaluated the proposed new organization for potential control weaknesses or regulatory problems, as we would no longer have a "Registrar", for example.

Using A Competitive Internal Interview Process

New job descriptions were drafted for each position in the reorganized department. to facilitate this task, we developed a processing calendar. This helped to identify less busy times for particular staff, and those positions requiring help at that time. Flexibility was "built in" to the new position descriptions.

Positions were grouped according to function, with Administrative Advisement, Operations, and Information Services units supplanting Registrar, Bursar and Financial Aid departments. Both administrative and clerical staff interviewed for the revised positions. Placement depended on interest in and potential for excellence in counseling (Administrative Advisement), processing efficiency (Operations), or analysis and reporting (Information Systems). Union support for the process was one key to its success.

In the year of reorganization, eight of the existing thirty-five positions were eliminated. The consolidated departmental budget declined by $210,000, a 19% reduction of the prior year expenditures. Two approaches were taken to address staff concerns about productivity in a "streamlined" department. First, optical scanning technology, programming to automate standard penalties, and tape download of external financial aid information were employed to reduce time consuming manual processing. Second, an intensive training program was instituted to allow greater sharing of responsibilities. (Careful crafting of the new job descriptions facilitated this flexibility.)

Focusing on Staff Development

Professional development initiatives were key to improving efficiency and service quality. Staff at all levels were involved in development and instruction of technical and service skills training. Information Systems unit staff worked with Administrative Computing to develop a "counseling module". It provides efficient read-only access to student academic and financial records without the need to log in and out of three separate modules. A major focus of staff training was how to use this tool to provide comprehensive advice in a single student visit.

An employee recognition program was initiated, along with regularly schedules staff meetings. The recognition program emphasizes both accountability and positive reinforcement. Monthly awards for quality service and quarterly awards for suggestions increased staff involvement in the changes taking place. With name tags allowing identification of individual staff for praise or criticism, service quality improved. Measurable improvements in attendance and promptness were noted, a result of their inclusion as evaluation criteria for monthly awards.

Enhancing Analysis and Reporting
Personal computer training and writing skills workshops have also enhanced staff effectiveness. These skills, along with creative data extraction from the mainframe system, have allowed meaningful policy analysis and improved management reporting. Reporting initiatives included deferred payment plan analysis, space utilization review, faculty course load reporting improvements, and creation of more sophisticated registration and financial aid reports.

Creating an Information Center
Students needed a consistent place to start the process of problem resolution. Faculty and staff needed to know they could refer students with problems a to a caring, knowledgeable staff member. The Information Center was established, and it's staff selected with those needs in mind. Information Center Assistants, part of the Advisement unit, use the new counseling module to do preliminary research on the students' problems. This screening process helps insure that students don't wait for simple solutions.

If a problem is more complex, students are encouraged to make appointments with the staff member best able to help them. The Information Center summarizes the problem in writing, the other staff member has time to research the problem and evaluate alternatives. Service and productivity are enhanced through this process. Of course, one or more staff members (in addition to the Information Center Assistants) are available to see "walk-ins" when necessary.

Advisement member staff also participate in outreach and education efforts. They organize financial aid workshops. They contact students with financial holds to offer assistance. They accept and process student appeals. These efforts make our job easier-reducing lines at on-site registration, reducing errors on financial aid forms submitted-and they create goodwill for the department.

Key Challenges Remaining

While significant challenges remain, including new technology to provide students independent access to their records, we are encouraged by the progress to date. Changing the attitudes of our constituents-and some of their bad habits-will take additional time and increased effort. As a department and an Institution, we are still working our way through the transition period. It would be misleading to say that our changes are over, or that our successes were easy, but the response to the changes has been very favorable.

We feel the new student service model has real relevance in the current environment and in the increasingly competitive environment that lies ahead, and welcome questions and comments from other institutions on our approach.

TRACK IV
MANGERIAL SUPPORT THROUGH POLICIES AND STANDARDS

Coordinator: Robert Blackmun

As we begin this decade with the prospect of still greater demands for access to expanding information resources in a rapidly changing technological world, we are all faced with the knowledge that our fiscal and personnel resources may not grow at the same rate. Policies and standards however, may help us stretch those resources. Papers here offers some ideas.

Herding Cats and Networked Resources

a progress report from the
Working Group on
Directories and Networked Resource Services
of the
Coalition for Networked Information

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ABSTRACT

The title of the working group, Directories and Networked Resource Services, has two key components that help explain its mission: directories and services. Initially, the working group focused on the concept of collecting information about networked resources into a central clearinghouse. But, since the fall of 1990, this group has accepted the broader challenges: directories and services. The broader challenge is being met through a number of channels such as focus group meetings, information collection, white papers, and an electronic conference.

Herding Cats and Networked Resources

George H. Brett II

Background and Problems

The networks and the networked resources -- too much - too fast (feral information)

It's a jungle out there. The international information infrastructure is maturing quickly. Many institutions, organizations, and coalitions of associations are working to ensure standards, to provide services, and to facilitate development of applications. Indications of this maturation can be seen by the variety of resources available via the Internet. The Internet Resource Guide lists more than 105 resources, more than 200 libraries on the network offer information services, and thousands of mailing lists, public and private, use the net. These resources are being added to the network on an hourly basis. Amidst all this growth there is also increasing concern about effectively locating and using these resources.

Moving targets: here today, gone tomorrow (cats and resources)

An effect of the rapid growth of networked information is transient nature of the resources. As a result of adding hardware or adding network addresses, a file archive may move from one host system to another. Or perhaps the person who maintains the resources changes jobs and moves from one state to another, taking her files with her. The publication of paper and electronic guides to networked resources is not always the solution -- especially if these guides are not kept current with up to the second information.

Now that I found it, what can I do with it? (speaking 'cat')

We have a basic infrastructure for networked information with the Internet and the many published, publicly accessible resources. But, what can I, the individual user, do with it? I have a specialty, a particular discipline. Are you prepared to assist me with that specific topic area? Can I keep electronic copies of the information I recover? Can I work from the desktop in my office with my 1987 Five-&-Dime-PC clone using Kermit and WordStar? Are there any hidden costs: copyright clearance, unit charges, license charges to campus or department? These questions point out the fact that locating resources is just the beginning of the journey on the information superhighways. These questions are like the wild cat lurking in the jungle. They can be elusive, avoiding our attempts to bring them under control.

The challenge of herding these 'cats' has been accepted by a recently formed organization, the Coalition for Networked Information.

The Coalition for Networked Information

Constiuency

The Coalition for Networked Information (CNI) was established in March 1990 by CAUSE, Association of Research Libraries (ARL), and EDUCOM. Early on CNI formed a Task Force which is made up of constituents of the three parent associations. There are more than one hundred and forty members of the Task Force now. Among these members are universities and colleges, computer organizations, telecommunications organizations, publishers, public and state libraries, and network service providers.

Mission

CNI was formed to "explore the promise of high performance computers and advanced networks for enriching scholarship and enhancing intellectual productivity. ... Its specific purpose is to promote the provision of information resources and services on existing telecommunications networks and on proposed interconnected networks."[1]

Vision Statements

Ten vision statements presented at CNI meetings have provided a framework for the Task Force to move towards a broad goal of a viable national networked information infrastructure. Topics covered by the vision statements include: imaging, electronic publishing, digital libraries, networked information resources and services, and public policy issues. Many of these statements have been published in the publications of the parent associations, CAUSE/EFFECT, and the EDUCOM Review.

Working Groups

Initially seven working groups were formed by the Coalition to provide focus on particular areas of interest. At the most recent meeting, November 1991, the seven original groups were expanded to eight. As noted by the topics, these groups cover as many of the issues and topic related to networked information and services as possible. The Coalition will continue to expand and evaluate the focus of these groups in order to keep them current with the evolving national network infrastructure. The eight Working Groups include:

1. **Modernization of Scholarly Publishing** which was formerly known as Commercial Publishing. This group is looking into issues such as how networks can be used to distribute scholarly journals, the potential of "site licensing" of networked information, high volume networked printing, and the economic analysis of networked information distribution, access, and delivery.

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[1] Coalition for Networked Information. "First Year (March, 1990 -- June, 1991) Report."

2. **Transformation of Scholarly Publishing** which was formerly known as non-commercial publishing. This group explores the potential of network as a medium for scholarly communication, as well as the "promises and challenges" of networked information for scholarship and pedagogy in all disciplines.

3. **Directories and Resource Information Services.** This is the group that this speaker is co-chair of. The priorities and activities of the group will be discussed later in this paper.

4. **Architectures and Standards** As described by the name this group is working to enhance standards and issues that are related. A consequence of the broad reaching impact of standards is that this group is active with other working groups on particular projects. Among the specific issues being dealt with recently are digital document identification, standards for digital graphic file structures, and extension of the Z39.50 protocol.

5. **Legislation, Codes, Policies, and Practices**. This group is focusing on the legal, social, and professional issues that surround networked information policies, principles, and practices. One of the projects is the creation of a clearinghouse for and a register of statements from organizations with positions, principles, codes, statutes, etc. pertaining to networked information.

6. **Access to Government Information**. This is the newest of the working groups, created in response to the increasing role of the federal government in the creation and dissemination of networked information. Issues include the US Government depository library system, government electronic bulletin board systems, and the "WINDO" initiative of the US Government Printing Office.

7. **Teaching and Learning**. This group focuses on the "E" in NREN by evaluating educational applications of networked information resources and services. The group is also developing "information packets" about networked information for these new user communities.

8. **Management and Professional and User Education**. This group is evaluating metrics for measuring and comparing institutional excellence in networked information access, management, and delivery.

The Working Group on Directories and Networked Resource Services

This group is co-chaired by Peggy Seiden, Head Librarian at Pennsylvania State Unv. - New Kensington, and George Brett, the author of this paper. We have been working together since 1987 on various projects that relate to academic software and networked information resources. Our work with this group has enabled us to synergize our personal experiences from the two cultures of academic libraries and academic computing.

The official priorities of the Directories group are:

- The need for open systems, standards, and therefore interoperable products and services based upon a distributed architecture of servers that draw upon a common or at least comparable set of data elements
- A (printed and networked) directory of directories and resources information services that provides qualitative (consumer) as well as descriptive information.
- The Library of Congress efforts to enhance the MARC formats to account for the cataloging requirements of networked resources and services.
- The National Science Foundation effort to procure a new NSFNet Network Information Center.

What it has done

The working group first met at the 1990 Fall Task Force meeting. There was much conversation about issues, solutions, and projects that surround the topics of directories and networked resource sources. A crucial point is that there are few if any comprehensive directories or catalogs that point to resources. So, one of the priority points was to begin the development of such a comprehensive document. An electronic mailing list, listserv, was established to provide a forum for discussion about the directory issue and other related topics.[2]

This past summer we had an invitational meeting to refine our agenda. The meeting was hosted by the Research Libraries Group (RLG) at Stanford University. Twenty-eight experts from various agencies represented directory providers, software developers, and user service agencies. There were a couple results of the conversations of the two days. One was that the recommendation that the Coalition should implement a catalog of catalogs or "TopNode." The group also recommended that the working group with the Coalition respond to a discussion paper released by the Library of Congress. Finally the group suggested that the Coalition should consider how to participate and assist with the National Science Foundation call for proposals for an NSFNet Network Information Center.

[2]The list serv is CNIDIR-L. To subscribe send mail to LISTSERV@UNMVM.EDU with the message: SUBscribe CNIDIR-L Your_Name. (eg. SUBscribe CNIDIR-L George Brett)

What it is doing

Since the meeting last summer we have been working on the recommendations.

Peggy Seiden has been working with the Library of Congress on the "Dictionary of Data Elements for Online Information Resources."[3] There was more discussion at the American Library Association meeting later in the summer. At present the principals are waiting further suggestions.

TopNode has been the focus of most of our efforts. We are working with other agencies to develop a useful set of fields or descriptors that would be used for the directory. Peggy has written an "Editorial and Business Plan" that has been disseminated as a "Call for Statement of Interest and Experience." The Call was presented to the working group at this year's Fall Task Force meeting last month (November 1991). We spent a majority of our time at the meeting discussing the nature of the TopNode directory and its components.

This past November 5th the CNIDIR-L listserv celebrated its first anniversary. Currently there are 650 plus subscriptions to the list. The list has focused on a number of topics lately including the TopNode directory and public spaces on the Internet. Recently the list has become an information gathering site for the Internet Resources Project of the Online Catalog Library Center (OCLC). The purpose of this project is "to study the nature of electronic information available on the Internet and the problems of providing systematic access and traditional library services.[4]"

Where it is going

The working group will continue to evaluate solutions to the problems of directories and networked information services. Already we are receiving responses to the Call. Soon there will more tangible work on TopNode taking place. After that we will begin to focus on a white paper that will study the issues and make recommendations for a directory infrastructure.

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[3]Library of Congress Network Development and MARC Standards Office. "Dictionary of Data Elements for Online Information Resources (MARBI Discussion Paper 49)." Comments, information, and suggestions related to this discussion paper can be forwarded to: Sally H. McCallum, Chief, Network Development & MARC Standards Office, LM 639, Library of Congress, Washington, DC 20540 email: smcc@seq1.loc.gov

[4]Martin Dillon. "The Internet Resources Project." CNI Fall Task Force Meeting. Nov. 1991. Office of Research, OCLC, Inc., 6565 Frantz Rd., Dublin, OH 43017-0702 email: mjd@rsch.oclc.org

Areas of Particular Focus

As we move to the future there are areas that we will be paying special attention to. These include:

Directory Services: what solution(s) best provide appropriate information

As mentioned earlier we will be working on TopNode to provide a possible solution in this area. Also, later we will be developing a white paper to evaluate the TopNode approach as well as other alternatives we know of.

A theme worth briefly mentioning here is the fact that there may not be a single resource that effectively or efficiently captures all other resources. This should not keep associations or individuals from attempting to create their own TopNodes. We believe that for some time that there will be various entry points for users, there will be catalogs of catalogs that will service only specialists like reference librarians, there will be general purpose directories like we see on the Internet currently, and finally there will be commercial solutions from providers such as Faxon, OCLC, or Dialog. In time there should emerge a few primary directories that may point to other access points. If directories are not the solution perhaps software tools will evolve to fill the growing gaps.

Software: emerging solutions to finding and using networked resources

This is the area where excitement is happening. Developers and researcher are looking to provide tools that will help users to navigate the networks. Software tools that will not only find information resources, but also retrieve appropriate resources. In just the past year we have seen the introduction and application of software solutions such as: the Wide Area Information Server (WAIS)[5], The McGill School of Computer Science Archive Server (Archie)[6], the Prospero distributed operating system[7], and the WorldWideWeb hypertext document retrieval software[8].

In particular we will be using and evaluating the Wide Area Information Server (WAIS). WAIS establishes a new paradigm for electronic publishing by delivering directly to the desktop information tailored to the user's interests and preferences. It can be described

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[5]Brewster Kahle, "An Information System for Corporate Users: Wide Area Information Servers", April, 1991. Thinking Machines technical report TMC-199. Also in ONLINE Magazine Aug 1991. Available via anonymous ftp: /pub/wais/doc/wais-corp.txt@quake.think.com or WAIS server wais-docs.src. email: brewster@think.com

[6]Peter Deutch, Bunyip Information Systems, 266 Blvd. Neptune, Dorval, Quebec, Canada. email: peterd@cc.mcgill.ca

[7]B. Clifford Neuman. "The Prospero File System User's Manual" Department of Computer Science and Engineering, Unv. of Washington, Seattle, WA. Draft of June 8, 1991. email: bcn@isi.com

[8]Tim Berners-Lee."WorldWideWeb - Executive Summary." WorldWideWeb project, C.E.R.N., 1211 Geneva 23, Switzerland. email: tbl@cernvax.cern.ch

simply as an interactive, integrated browsing tool for networks. Using a WAIS client (query and display software which resides on the user's computer), an individual queries multiple resources provided by WAIS servers (indexing and delivery software and information resources which reside on Internet-accessible computers). The results of plain English questions -- regardless of the physical location of the information or its native data format -- are presented to the user as they are retrieved from the servers. Searches can be narrowed based on feedback relevant to the user's personal "acceptability" criteria. Currently only text and graphics can be retrieved, but because of the inherent extensibility of the WAIS protocol, other media such as sound or full-motion video could be delivered.

There are another set of tools that are being developed that work for the user as active agents that go out onto the net to search out the information resources you need. Best known of these are the "Knowbots" from the Corporation for National Research Initiatives (CNRI)[9]. Less well known but similar is "Netfind" a result of the Resource Discovery Project at the Department of Computer Science, University of Colorado - Boulder[10]. Approaches such as these may well be the end solution to the problems of directories and related services.

Standards: need for descriptors that can be uniformly applied in varied electronic environments

As we begin to develop solutions in print or in digital form we need to be mindful of standards. It has become evident that there are multiple participants. Previously I mentioned two cultures: academic libraries and academic computing. These environments place differing priority on elements of directories and catalogs. This comment is based on a notion that libraries will not release any service until it is done right, perhaps never. Where as on the other hand academic computing release quick prototypes which don't always work well and rarely are "finished" or made bullet proof. There has to be compromise. Some parts of the directories problem can be dealt with in a timely fashion, others will take longer.

No matter how fast solutions come to be, it is important that they can be universally applied. These solutions must meet the rigid criteria of international standards committees. At the Coalition we will adhere to accepted standards in our projects.

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[9] Vinton G. Cerf. "The Digital Library Project:Volume 1: The World of Knowbots" March 1988. Corporation for National Research, 1895 Preston White Drive, Suite 100, Reston VA 22091. email: vcerf@nri.reston.va.us

[10] Michael F. Schwartz. "Supporting Resources Discovery Among PUblic Internet Archives Using a Spectrum of Information Quality." September 1990. Technical Report CU-CS-487-90. Department of Computer Science, University of Colorado, Boulder, CO. Available via anonymous ftp from ftp.cs.colorado.edu in directory /pub/cs/techreports/schwartz/RD.Papers. email: mfs@boulder.colorado.edu

As evidence of this we will be working with the Architecture and Standards Working Group on at least one of their projects: the Z39.50 Interoperability Testbed.

User Services: demand for information, training, and related services from a community that is growing rapidly

Currently the working group is not addressing these issues directly. Although, often when we have discussions about the directories talk about user services are not far behind. Clearly, as Naisbitt has said, there is a need for "high touch" to go with the "high tech."

The working group is staying abreast of activities in the field that relate to user services. The call for proposals from NSF for the NSFNet Network Information Center is one such activity. There is another project with the EDUCOM Educational Uses of Information Technology (EUIT) that is working on a layperson's guide to online resources. We will keep the Coalition informed about these and other such projects.

Wrap up and invitation to join in the work

There is much to do as I mentioned earlier with the the jungle and the wild cats. Efforts of the Coalition and other associations should help to cultivate the jungle and reap productivity. As far as herding those cats, I don't know. Perhaps the best we can do is to entice them to share with the work, to agree to standards, and to draw them into a circle of interoperability. Time will tell.

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Developing Standards for Quality Information From Distributed Administrative Systems

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Data Administration Today

The term, topic, and organizational entity called *data administration* has been around since the mid-seventies. In earlier times the focus was on cataloging and standardizing data base definitions in order to maximize the efficiency of systems development and applications, usually for one data base management system. This was done primarily through implementing a data dictionary closely coupled and integrated with the particular data base management system in use.

Today we are more likely to hear about *information resource management* than *data administration.* The function now goes well beyond the initial data base support function of most early data administration departments. The following data administration mission statement proposed by the Data Administration Standards and Procedures Working Group of the Data Administration Management Association (DAMA, 1991) is both concise and comprehensive and a mission that clearly has relevance for the information management issues we face today:

> To combine activities, standard methods, human resources and technology for the central planning, documentation and management of data from the perspective of the meaning and value to the organization as a whole.
>
> To increase system effectiveness by controlling data through uniformity and standardization of data elements, data base construction, accessibility procedures, system communication, maintenance, and control.
>
> To provide guidance for planning, managing, and sharing of data and information effectively and efficiently in automated information systems.

This mission is significantly more expansive than earlier mission statements. It describes an essential management function that optimizes the use of the information systems resources even as technology rapidly changes and expands capability, users become more diverse and increase in numbers, and the information support environment continues to become more complex. It recognizes that while data administration must be acutely aware of evolving technology and must be involved in the resulting change management, the data administration function itself is not driven by technology. In fact, the reverse is true: Effective data administration enables an organization to quickly respond and take advantage of technological innovation. Moreover, with people throughout the institution creating, managing, and disseminating electronic data, it is apparent that the data administration function must be executed throughout the organization. Data administration or information resource management must go well beyond control activity within the information systems organization and must be understood and embraced by all of an institution's management.

The majority of Virginia Tech's administrative systems were developed in the 1970s and 1980s to run within IBM's IMS data base environment. The customers served by these systems were, by design, operational offices such as registrar, admissions, purchasing, and payroll. Recently the in-house student information system underwent major re-engineering and revision, still within the IMS environment. At the same time, however, Virginia Tech purchased a large financial system that operates outside the IMS environment. Thus we had the beginning of a distributed administrative systems environment.

All Virginia Tech administrative systems have emphasized on-line user access, primarily to support source-point data capture for administrative operational functions. System support groups exist for each major administrative area. Management information is supplied from a series of extracts produced by these system support groups from each operational system. The office of Institutional Research and Planning Analysis is a primary user of these extracts, integrating data to create merged extracts for institutional reporting. It is important to note, however, that across the University there is increasing interest in accessing and using this extracted, merged, and downloaded data for decision support activities. It is apparent that the customer desire for information from these operational systems has expanded well beyond the operational offices. The inherent challenge of integrating diverse and non-standardized data from a variety of systems is magnified considerably as demand continually broadens both the customer base and the scope of information desired. This phenomenon has led to a special Institutional Research project to improve the quality of data through the standardization of data elements and codes across all administrative systems.

Karen Miselis in her paper **Organizing for Information Resource Management** (Miselis, 1990) discusses possible organizational processes and structures for *information resource governance*. She makes the important point that since information is an institutional resource that is developed and used campus-wide, the management structure charged with ensuring that there is an effective and efficient use of computerized information should also be campus-wide. At Virginia Tech, **Guidelines for University Administrative Information Resource Management** provides the policy basis for data administration activities (Balkan and Sheldon, 1990). This policy describes the distributed data administration function by defining a variety of roles and responsibilities for managing information:

- The University is considered the **data owner** of all University administrative data.
- University officials, such as the Controller, the Associate Vice President for Personnel Resources, and the Registrar, are responsible for data in their functional areas and are considered **data custodians.**
- Staff delegated the responsibility for information management activities related to maintenance and dissemination of data are considered **data stewards**.
- Individuals who have need for University data in order to perform their assigned duties and are therefore authorized access are considered **data users.**
- The function of applying formal guidelines and tools to manage the University's information resource is termed **data administration.**

Although the ideal is to have a senior executive, such as a Chief Information Officer, oversee the coordination of the data administration mission for the institution, the success or failure will always depend on management's understanding and support of distributed data administration roles and responsibilities, as well as the active participation of those in the various roles. Failure to obtain participation will cause the organization to raise barriers as discussed in McLaughlin and McLaughlin (1989). The most obvious obstacles to overcome are:

- those who in the past have written administrative systems and screens tend to be set in their ways of operation,
- hardware and software vendors try to sell what they have,
- operational personnel have numerous individual pieces of automated support that they want to keep,
- managers are concerned more about making the next deadline than about improving "their" data for someone else's needs, and
- everyone is already overwhelmed with just trying to meet existing commitments with little or no time to scale another learning curve.

Clearly operational, managerial, and executive personnel must buy into the belief that improving data quality is worth the cost. This requires that data administration provide these individuals with a product that has value and can be marketed. This product is an *integrated tool-set* that has four sequential supporting parts: **People** who perform activities; **Activities** that utilize data; **Data** that is manipulated using tools; and **Tools** that assist with creation, reference, update and deletion of data (**Computerworld**, Feb. 6, 1989). The entire tool-set needs to be engaged to assure that the institution effectively performs data administration and thus has *quality* information.

Our approach has been to build a foundation under the tool-set and this foundation is standardization. In building a supportive distributive environment for data administration, we have focused on data element definitions and code standardizations. The essence of standardization is the adoption of a common language that enables shared understanding and provides capability to integrate multiple data sources. As such, it is a never-ending process that produces a continually improving information resource as a quality product.

Standardization for Quality

The process of continually improving the quality of information starts from a set of values. In the book **Data Administration, A Practical Guide to Successful Data Management**, William Durell provides us with an excellent perspective on these values: *The Ten Commandments of DA Standards* (1985). These commandments provide a general framework and one approach for developing standards. They also help humble us and help keep perspective about our undertaking. The ten commandments are:

1. The first rule is that there are exceptions to every rule. No standard is applicable in every situation. However, the DA staff must not allow exceptions to become the norm.

2. Management must support and be willing to help enforce standards. If standards are violated, management must assist in assuring that the violations are corrected.

3. Standards must be practical, viable, and workable. Standards must be based upon common sense. The less complicated and cumbersome the standards, the more they will be adhered to. ***Keep standards simple.***

4. Standards must not be absolute; there must be some room for flexibility. While some standards must be strictly adhered to, most standards should not be so rigid that they severely restrict the freedom of the data designer.

5. Standards should not be retroactive. Standards are to control and manage present and future actions---not to undo and redo past actions. In most cases, standards enacted today cannot apply to data design that began several months ago.

6. Standards must be easily enforceable. To achieve this, it must be easy to detect violations in standards. The more the process of auditing for the compliance of standards can be automated, the more effective will be the standards themselves.

7. Standards must be sold, not dictated. Even if upper management wholeheartedly supports DA standards, the standards must be sold to employees at all levels. DA must be willing to advertise the standards to all employees and to justify the need for such standards. DA standards demand that programmers and analysts change the way they design data. Any lasting and meaningful change must come from the employees themselves.

8. The details about the standards themselves are not important---the important thing is to ***have*** some standards. DA must be willing to compromise and negotiate the details of the standards to be enacted.

9. Standards should be enacted gradually. Do not attempt to put all DA standards in place at the same time. Once standards are enacted, begin to enforce them, but do it gradually and tactfully. Allow ample time for the non-DA staff to react and adjust to new standards. The implementation of standards must be an evolutionary, rather than a revolutionary, process.

10. The most important standard in data administration is the standard of consistency---consistency of data naming, data attributes, data design, and data use.

The **Standardization of Data Elements and Codes** project at Virginia Tech is our second step in following these commandments. It is a direct follow-up from the **Guidelines for University Administrative Information Resource Management** policy mentioned earlier. As noted in the **Guidelines**:

"Standards and procedures should be developed to conform to the objectives embodied in these **Guidelines**." Like the development of the **Guidelines** (Balkan and Sheldon, 1990), development of standards is a consensus building process and as such, requires a great deal of coordination, cross-functional interaction, and cooperation.

The purpose of the *standardization project* is to increase the value of University administrative information by implementing standards for description, definition, and validation of administrative data. The goal is to create both the policy and the technical tools to obtain, store, and manipulate the administrative operational data for University-wide decision making. While we focus on the tools, we do so in the context of the entire tool-set. We want our standards to serve as a foundation for generalized access and use of information from the variety of administrative data sources by a broad base of users. Moreover, we want to institutionalize an on-going standardization process to continually improve the quality of the data. We contend that standardized data are "quality data" with the following attributes:

1. Assignment of data custodial responsibility.
2. Audits for accuracy and measures for accountability.
3. Systematic edit and validation.
4. Clear and meaningful usage.
5. Consistency over time.
6. Cross-reference to all occurrences.
7. Accessibility.

Each of these requires that the institution provide the following support:

People and Activities

1. Data custodial accountability.
2. Data Stewardship to assure proper edit and on-going completeness and accuracy.

Data

3. A single official source of critical entities such as facility or department with the list of standard values for a unique coded representation across data sources, a long name, a short name, and a standard abbreviation at minimum.
4. Standardized data descriptions, definitions, and documentation.

Tools

5. Procedures for retaining and successfully using historical data.
6. Query capability for users to identify appropriate data sources and procedures to answer specific information needs.
7. Ready access to timely and properly secured data by trained users.

The *standardization project* adopted a goal statement to address the above data quality issues. It is based is on a **Plan, Do, Check, Act** cycle known as *The Shewhart Cycle*. Dr. W. Edward Deming, respected world-wide for his philosophy that *quality* must be the prime goal for every employee, insists that quality can be achieved only through commitment to never-ending improvement. He believes that the steps required to manage never-ending improvement are:

> Step 1--**Plan** (P): Collect data upon which a plan can be constructed for what needs to be accomplished, in a given time-frame. Next, determine what actions must be taken to realize the plan.
>
> Step 2--**Do** (D): Take the necessary actions that further the plan developed in Step 1.
>
> Step 3--**Check** (C): Check the results of actions by collecting data to make sure achievements match the plan.
>
> Step 4--**Act** (A): Act by making the changes to the plan that are needed to better achieve improvement and to continue what was done that proved successful (Gitlow & Gitlow, 1987).

The PDCA cycle provides a paradigm upon which all project activity is based and is reflected in the four project goals:

> To discover, define, document and apply tools and techniques for standardizing University information by:
>
> 1. Identifying critical and key University entities and related data elements and codes (P).
> 2. Defining and documenting entities and related data elements and codes (D).
> 3. Measuring and verifying data and code quality and integrity (C).
> 4. Establishing an on-going process of managing standardized entities in terms of data element edit, validation, update, alteration, audit, correction, and distribution (A).

The relevance of the PDCA cycle becomes even more apparent when you consider it as a Problem-Solving Cycle as Masaaki Imai (Imai, 1986) does in his book **Kaizen**. When we **plan** we consider the what, why, and how of the problem by defining it, analyzing it, identifying causes, and planning countermeasures. We then implement or **do**. Once a proposed solution has been put into practice, we **check** how effective it has been. If the proposed solution is found to be an improvement, there is the **act** of adopting it as a new standard. Thus, PDCA results in the development of standards.

It is important to emphasize that the PDCA cycle is iterative. Moreover, for large problems or projects, multiple PDCA cycles must take place within a larger cycle. The standard for identifying critical and key entities is **planning** for their inclusion. Standards for definitions and codes **do** the standardization. Standards for tracking data flow and measuring data accuracy before, during, and after each data flow provide for **checking** standardization. Standards for establishing the iterative process and changing as required are the **act** of continually improving the data. These four steps and the complimentary four standards embodied by our goal statement are, in essence, a prototype methodology commonly used in research and development endeavors. Figure 1 shows the cycle for standardizing data feeding the larger cycle for quality information standards.

Planning for a Standardization Project at Virginia Tech

The **Standardization of Data Elements and Codes Project** at Virginia Tech was initiated March 1, 1991. In keeping with the PDCA cycle, the *standardization project* devoted the first six weeks to developing a *project plan*. This *project plan* described the current environment, situation, and problems and identified the four standardization goals mentioned earlier. It also addressed project staffing, included job descriptions, established milestones, and identified the major project activities.

Two full-time individuals were initially assigned to the project. However, the *plan* clearly noted the need for support from additional technical personnel from the computing center and, even more critically, for project support from personnel in the various administrative operations offices. These individuals and their supervisors are critical in proposing and making necessary modifications to their own systems. It is basically their efforts that determine the long-term quality of the standardized data.

Project Milestones

The milestones established for the project are based on the four goals, thus providing checkpoints for measuring project progress. They were described in terms of developing both standards and prototype applications for each part of the four-part goal statement.

Three months were allocated to the first milestone, which involves completing a draft University standard for the first two goals of ***identifying critical and key University entities and related data elements and codes*** and ***defining and documenting entities and related data elements and related codes***. Additionally, a particular entity would be selected and used to do prototype work related to the these two goals.

A three month time-frame was again chosen for the next milestone, which involves refining the University standard for the first two goals through prototypes and on-going group work, thus establishing recommended procedures to continue standardization for other critical and key University elements and codes. Also during this three-month period, a preliminary standard for the last two goals, ***measuring and verifying data and code quality*** and ***establishing an on-going process of managing standardized data elements***, would be developed. Once again, data stewards, administrators, and information systems groups are involved in coordinating existing standards with the emerging University standard and prototyping applications.

The milestone that followed again projected three-months, bringing the time-line to January 1, 1992. As for the preceding milestone, a draft University standard would be refined, this time for the third and fourth goals. Again, this refinement involves establishing recommended procedures to continue standardization beyond the prototype. Additionally, other system areas for standardization would be identified and prioritized and work initiated in the next system area.

The final milestone in the *project plan* projected forward an additional six months to July 1, 1992. This milestone anticipates the promulgation of standardization results by providing user interfaces and access to standard definitions and code lists using available tools such as data dictionaries, relational data bases, and an on-line query to extracts. It is at this point that the results of the standardization project take the form of a widely available product. Additionally, this milestone projects the establishment of a recognized standardization function within the University with the support and cooperation of data custodians and a variety of working user groups.

Standardization Activities

The *project plan* received endorsement when it was distributed and presented to the University's executive management. Figure 2 shows the model, proposed in the plan, where data from operating systems would be merged together into an "administrative University data base" that would then support diverse users. The repository is the dictionary of information about information. One critical University entity, in particular, stood out as an obvious early candidate for standardization, in part because it was relatively limited in scope...*facility*. There was agreement that it should be the first entity targeted for standardization. We proceeded to identify sub-projects or smaller manageable *chunks* and prepared a plan for each. The identifiable *chunks* or major project activity areas are described below as parts of the tool-set.

Work With Formal and Informal University Groups (People)

This activity involves engaging formal and informal groups to provide insight and feedback to the standardization process and serve as a vehicle for promoting never-ending data quality improvement.

The following efforts have been met with encouragement, enthusiasm, and responsiveness: Periodic progress reports to an informal **Management Group**; meetings with a **Data Steward Group** to monitor and review project developments; identification and work with a **Facilities Focus Group** to assist with analysis and implementation of standards for the *facility* entity; work with **Census File Teams** to standardize the census point-in-time snapshot process and data; input to the **Human Resource System (HRS) Requirements Team**; interaction with the **Computing Center** regarding information dissemination strategies; and a presentation for the **Administrative Systems Users Group (ASUG)** to discuss project initiatives.

A final group of individuals is the custodian group, which is comprised of senior administrators who have managerial responsibilities for the various operating systems.

Develop the Process and Procedures for Standardization (Activities)

The standardization process is embodied in the four project goals. As the project progresses, procedures for addressing each goal are documented. A "living" document is created and modified as standardization procedures are discovered so it can be repeated for each identified *critical and key University element*. The analysis process is detailed and checklists and criteria for checking each step are included.

For identification of the *critical and key University entities and related data elements and codes*, the first of the four project goals, we rely heavily on the already approved **Guidelines for University Administrative Information Resource Management**. There we find the criteria for inclusion in a logical Administrative University Data Base (AUDB):

- It is relevant to planning, managing, operating, or auditing major administrative functions.
- It is referenced or required for use by more than one organizational unit. Data elements used internally by a single department or office are not typically part of the AUDB.
- It is included in an official University administrative report.
- It is used to derive an element that meets the criteria above.

As an entity is standardized, an official source or *Entity Master File* is either identified or created. At minimum, it must contain:

KEY data elements - those variables that provide validation and translate capability.

AUDB data elements - those variables that are required to answer University-wide questions about facilities and should be generally available to management, possibly via extracts.

The minimal KEY data elements that should be included are: coded representation across data sources, long name, short name, standard abbreviation.

A prototype of a standardized *Facilities Entity Master File* was created. A standard definition for *facility* was developed and is as follows:

> A University facility is a building, structure, site, or parking lot used by Virginia Tech. A ***building*** is a roofed structure for permanent or temporary shelter. A building must be attached to a foundation, be roofed, be serviced by a utility in addition to lighting, and undergo regular maintenance. A facility that does not meet this criteria is considered a ***structure*** and defined simply as something that is constructed. A ***site*** is an identifiable location. An example of a site is the "drill field". Parking lots are special sites that warrant a unique category. A ***parking lot*** is an identifiable and designated area for parking vehicles.

The next step has been to concentrate work with staff in the Facilities Planning and Construction office to: Refine and implement standardized facilities information; distribute the established standard and companion data definitions for the ***facility*** entity; replace existing facilities information with standardized facilities information; and turn over data custodial responsibility for standardized facilities information to the Facilities Planning and Construction office.

Develop Data Definition and Documentation Standards (Data)

Data definitions, descriptions, and documentation are being created for each data element in a *Entity Master File*. A second "living" document outlines a standard for data definition and documentation. In addition to identifying the particular descriptive information that must be supplied, this document also includes a standard naming convention to provide a common language for referencing and relating like data elements. As the standard evolves, it is applied to census files produced in Institutional Research, and then to other candidate entities for standardization such as the **department** entity.

Develop Measurements of Data Quality Improvement (Data)

In order to **check** progress during the standardization process, measurements of data accuracy must be developed. Moreover, these measures must be systematic and eventually automated so on-going quality assurance can take place on all information sources containing standardized data.

Techniques for measuring data quality are identified, tested, altered, and documented. An important step already taken is establishing a baseline, in the form of a *Facilities Entity Master File*, to assess the quality of facility information in a variety of of existing files.

Implement Tools to Support Standardization (Tools)

A primary tool is the data dictionary with data descriptions and definitions to provide both high-level and detail documentation, cross-reference multiple data sources, and support catalog type query, i.e., "what is available?" The project is involved with enhancing and populating the VT-IRD, an information resource dictionary developed at Virginia Tech based on the Information Resource Dictionary Standard (IRDS), ANSI X3.138.1988. The data dictionary rational and functions are discussed in the data definition and documentation "living" document mentioned earlier.

Another important "tool" receiving attention from the project team involves the method for disseminating standardized information along with standardized data definitions and descriptions. This effort is primarily one of communicating requirements to the University's information systems personnel. The objective is to be positioned to deliver standardized information in a consistent manner to a broad base of users operating in a variety of computing environments, both personal and mainframe.

Assess Project Progress (Tools)

At each milestone or every three months, a management report on project progress is prepared and presented. Feedback is solicited and current activity and direction re-evaluated. If unforeseen obstacles surface, a plan for addressing the problem is formulated. It is worth noting that so far these "obstacles" have led to the valuable discovery of a necessary step that we must include in the process for standardization.

Continuous Improvement Equals Progress

The future will continue to involve working with others to define and develop the standardization process. The project team will work even more intensely with campus groups and organizations, seeking expertise, assistance, and cooperation to implement standards in existing systems. Further work will also be done to develop and define ongoing roles of various groups in support of data administration.

Considerable progress has been made on standardizing the ***facility*** entity. In the next twelve months, work will be concentrated on refining the standardization process, collecting and disseminating standardized data definitions and standardized data for facilities and census snap-shots, promoting compliance with standards in all data sources, and standardizing the ***department*** entity. This will require additional analysis and coordination activities as well as a focused effort on the technical aspects of distributing standardized information and documentation to users.

It is important to take time to consider what has been learned when evaluating progress. In the short time of six months, we know considerably more about the process of standardization and will be able to move more swiftly when we take on the next entity. Additionally, we can see improvement not only in the particular entity on which we have focused, but more importantly, in the expanding campus awareness of the merits of standardization. We are observing greater understanding of the importance and specifics of doing good data administration at all levels of the organization.

Lessons Learned

1. If the distributed system support personnel do not find improving the quality of their data to be rewarding, then it will not happen. Benefits include the opportunity to expand and exercise their professional skills, more effective use of technology to make their lives easier, better service to their users, and recognition for their visible improvements in terms of both end-user product and end-user support. Modifying their job descriptions to reflect their DA activities is also a good motivation.

2. From the typical user's viewpoint, occasional incorrect coding is not as serious a problem as the symptom, i.e., the inability to understand the meaning of data elements or the use of unstable or unidentifiable criteria for including particular values in the data bases.

3. The warm, fuzzy feeling of "making progress" must be augmented and supported by setting and meeting visible milestones to maintain resource support and morale.

4. Success is very dependent on the project team's effective project management skills, as well as its ability to assemble and engage groups for both input and support. These skills should be reinforced and refined.

5. Team members must have access to custodians and have at least some champions in the upper administration. This is helped by treating standardization as a cross-functional project and stressing the importance of accountability and consensus building.

6. Core-team members should be physically located together and there should be a minimum of two people dedicated full-time to the project. This promotes the sharing of both technical and managerial skills, helps keep focus on the project goals, and provides a degree of shelter for coping with the inevitable frustrations of this type of project.

7. A focus on quality and never-ending improvement gets everyone's attention and shifts the focus from "why are we doing this?" to "what can we do, how, and when?" Endless debates and the telling of "war stories" are replaced with constructive discussions that purposefully build on recognition of those things that are already "better then they were".

8. Credit for all improvements and successes should be spread as widely as possible. Individual ownership of project results fails to acknowledge the importance of a broad-base of involved and empowered "team players", all working for good data administration.

9. There is no such thing as a tiny improvement. Every improvement is a "breakthrough", paving the way for the next....and the next....and the next. The PDCA cycle works well, providing prototypes which both demonstrate improvement and serve as a baseline for continued improvement.

10. There is still much we don't know. We have benefited greatly from the "lessons learned" and shared by other institutions and we recognize many commonalities. We will continue to seek out opportunities to learn by sharing as we all strive to continually improve the quality of our information.

Anticipating the Future

The final lesson learned is perhaps the most important and best describes the future. Much of the groundwork has already been laid for each part of the *integrated tool-set* necessary for distributed data administration. As discussed earlier, the basic sequential parts are: ***people, activities, data, and tools***

The future will see us formalizing the people processes by:

- Influencing data custodians to include the data administration functions in their system support job descriptions.
- Influencing formal and informal university groups to include attention to data administration in their mission and purpose.
- Recommending a larger core-team to provide better coverage of both the managerial and technical aspects of coordinated data administration in support of quality information.

Future activities will include those already started by the project. However, they will continually be expanded to include more of the university community addressing more of the total information resource. Additionally, greater attention will be paid to measuring improvement as the breadth of improvement expands. As our efforts bring forth end-user decision support products, there will likewise be new activity to support the users of those products with training, consulting, and continual product enhancement.

As expected, more progress has been made thus far with the people and activity parts of the tool-set than with the data and tools parts. Clearly, the prototype work we have done positions us to progress more quickly on our next entity. As mentioned earlier, we also anticipate additional technical support to assist with appropriate tool selection and development to support standardization, distributed data administration, and ultimately, readily accessible decision support systems with quality data.

We realized from the beginning that there was no "quick fix" to the apparent data quality problems. We also realized that our plan, in total, assumed a cultural change that would take time. Nevertheless, we set out with high expectations that we could make improvements and we have been successful. Keeping our goals before us every step of the way, we have tackled the job....*one chunk at a time*. We hope the future holds only more of the same, which includes celebrating each and every "non-tiny" improvement along the way.

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Shewart Cycle

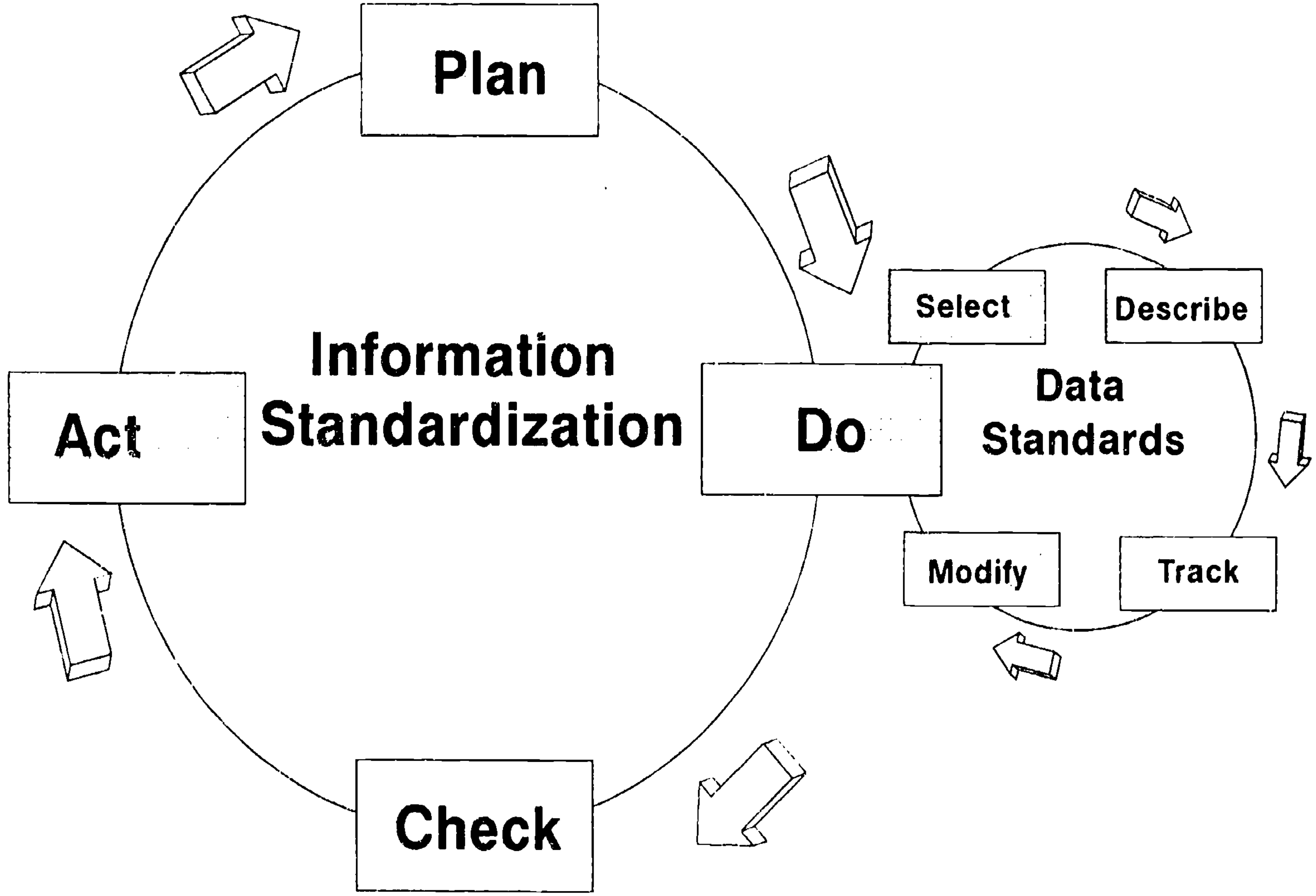
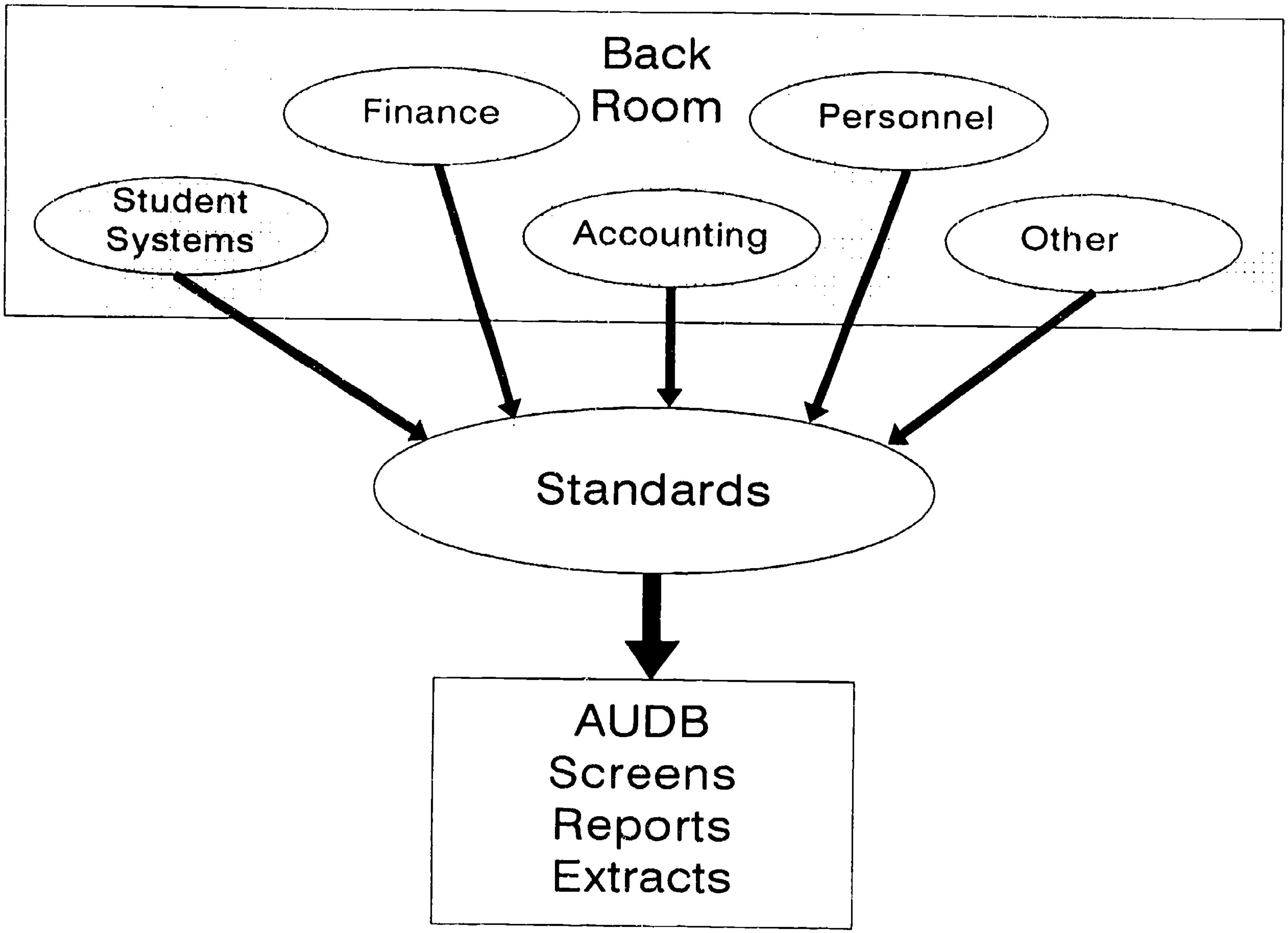


Figure 1

Adminstrative University Data Bases



272 273

Figure 2

Managing Information Technology Issues of Ethics and Values: Awareness, Ownership, and Values Clarification

by
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The University of Michigan recently instituted a university-wide policy to encourage ethical and responsible use of information resources. Issues of ethics and values abounded making the process of developing the policy itself, lively and interesting. The paper presents an overview of issues, dilemmas and value conflicts faced during the development of the Michigan policy. Implementation however is the most essential measure of any policy's effectiveness. Therefore, the paper also presents one model for policy implementation. The first year of implementation of this model has just been completed with encouraging results. Key steps for developing and implementing policy in this area are provided.

Managing Information Technology Issues of Ethics and Values: Awareness, Ownership, and Values Clarification

by

Virginia E. Rezmierski, Ph.D.

Introduction

The purpose of this paper is to provide a discussion of some of the ethical and value dilemmas that arise on campuses as the use of information technology increases, to identify reasons why administrators turn to policy to guide and direct their decision-making in the face of these dilemmas, and to discuss key aspects of the "Proper Use Policy" and the "Think About It" implementation project at the University of Michigan. The weaknesses and strengths of the Michigan model will be discussed. Readers will be encouraged to consider developing a similar model for implementing policy on their campuses.

Incidents Lead to Ethics and Value Dilemmas

Universities and colleges have incorporated the use of information technology into their systems at a very rapid rate. Members of these communities are exploring and experimenting with the capabilities of new technologies, for teaching and learning, for research and for administrative services.

Behavioral incidents involving the technology on University and college campus are raising questions about ethics and values. The incidences cover a wide range of topics. They include issues regarding copyright infringement in the use of software, freedom of speech, security violations, sexual and racial harassment via electronic communications and many others. Naisbitt and Aberdene, 1990 wrote:

> "The responsibility for what is happening has already been thrust upon us. Technology is not inherently evil. It is neutral. How we use it is key."[1]

Dilemmas occur for college and university administrators when they find themselves faced with incidents that enact two clearly conflicting sets of values, and also when they find themselves facing an incident where neither the issues nor the values are easily understood. A few specific incidents will illustrate the nature of the dilemmas confronting campus administrators.

A mid-west systems administrator recently reported that she received a complaint from an individual on the west coast. The complainant reported having received an electronic posting from a senior at the administrator's university. The posting indicated the availability of one hundred and thirty two files of pornography and requested a charge-card number from anyone wishing to receive a copy of the files. The woman considered the message intrusive and a sexual harassment. The posting was broadcast via the network.

Another college administrator reported an incident involving a faculty member who used the networks to solicit financial support. The funds were requested to support the court defense of a young man who refused to fight in the Gulf War. The faculty member used the electronic mail resources of the institution for his specific political cause. The administrator expressed concern about the appropriateness of such use of public institutional resources and about the ramifications of the wide spread distribution of this political request.

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[1] John Naisbitt and Patricia Aberdene, Megatrends 2000 (New York: William Morrow and Co., 1990) p.246.

Members of CAUSE have experienced and perhaps have had to deal with some of these dilemmas. For some, they may have focused upon topics of system security, violations of information access and privacy, or software copyright infringements. Whereas for others, these examples of network use and electronic mail are very familiar.

Conflicts for Administrators

At times when these incidents arise, it may be difficult to determine what is actually involved in the incident. People ask: "How can this be done?" Because these incidents are cloaked in the sometimes poorly understood capabilities of new technology, it may be difficult to see them for what they are -- to identify the moral, ethical and value issues that are central to the specific behavioral incident.

For administrators who are specialists in the use of the technology, incidents may quickly be reduced do the question: "Have these users been informed about appropriate use of the network and electronic mail resources at this institution?" The focus of the response may be neutral in regards to the political ramifications or the effects on other communities. Such responses sometimes remain focused on the information transfer aspects of the incident, the logistics and the standards. In their technical focus, they may miss the ethical implications of the behavior. For other administrators however, those who may not be familiar with what is required to transfer one hundred and thirty two files of pornography to the west coast, or who may never have thought about the possibility, the issues may focus less on the technical aspects of data transfer and more on the content issues, the political and social ramifications of the action. If the reactivity level is high, the educational, moral or ethical issues that are at the center of the incidents become very hard to distinguish.

As I have reviewed these incidents over time, it has become clear that such incidents seem most often to cause conflicts when an administrator receives a complaint, needs to respond quickly and is unclear as to what is technically involved. If significant political or media attention has already been focused on the event, administrators find themselves under additional pressure to respond quickly, often without sufficient time to understand or consider the range of issues. Conflicts also seem to arise when two parts of an institution value actions on seemingly opposite poles of a particular value continuum and the administrator must decide which set of values will be supported in responding to the incident at hand.

Value Polarities -- Conflicting Values Within the Community

While there are undoubtedly other value polarities that cause tension and conflicts on campuses, there are four that will be briefly discussed in this paper: 1) System Security vs. Ease of Use, 2) Public Ownership vs. Private Ownership, 3) Social Responsibility vs. Intellectual Experimentation and Learning, and 4) Representations and Preservation of Reality vs. Creativity and Art.

1. System Security vs. Ease of Use

The institutional need for system security and the user's need for easy access to data and easy use of information resources, sometimes cause conflict. On each campus there are those who, because of the nature of their data, value system security above easy access for users. For some the nature and history of their responsibilities as creators and managers of institutional data has necessitated their valuing and protecting security. For another portion of the community however, ease of access and ease of use take precedence over system security. For this set of individuals the data within the system is valuable only if it can be easily accessed and used in a more distributed environment. When does ease of access begin to threaten system security, data reliability and institutional record? When does security so dampen the processes for accessing data that those data become unused and duplication of effort springs up across the campuses? Many campuses are experiencing values conflicts in this area as they move increasing amounts of administrative and institutional data into the hands of personnel within the schools and colleges.

2. Public Ownership vs. Private Ownership
Conflict exists when we consider public ownership vs. private ownership. Institutions and individuals are struggling with these questions of ownership. This seems to be particularly the case within public institutions where the responsibility of individuals to the publics "right to know" now has new ramifications within the electronic environment. What is owned by the individual? Wh t information must be made public? Within a public institution, what part of the electronic communications of faculty, staff and students is private and what is public? Should communication be kept private, or, because it is taking place on publicly owned information technology resources, must all faculty, staff and student work and communications be made available, and public, if requested? How can we support the public's right to know without placing a chilling effect on the open and facilitated communications of our community of scholars? How can we encourage freedom of speech, exploration of ideas, exchange of information and sharing of intellectual products, while also maintaining public trust by assuring that the use of the resources is in accordance with the mission for which the resources were provided? Who owns the resources, the communications, the ideas? In this increasingly electronic environment, what must we as administrators tell our campus about the privacy or lack there of, for electronic mail and electronic files?

3. Social Responsibility vs. Intellectual Experimentation/Learning
Part of each of college community values experimentation with the technology as a driving force in their learning/teaching program. Exploring and trying new applications of the technology, is valued as an end, regardless of the effects of such exploration on the rest of the community. Rewards may be given for students who develop outstanding viruses or who identify creative ways to achieve access to files thought to be impenetrable because these acts represent intellectual achievements for this segment of the community. Much of the campus community however, does not see this as intellectual experimentation when a network is made dysfunctional or when such applications affect the specific files on which they are currently working. Rather, they label this as social irresponsibility.

On one campus, an extremely talented staff member within the computing organization argued that since he had the necessary expertise, it was his personal responsibility to test the stability of the campus system whenever time was available. He rationalized that if he was unable to find system security holes, the computing center administrators would know that the system was secure. If, on the other hand, he were successful, the center would have identified the weakness and would be in a position to make the necessary repairs. Though he was not assigned the responsibility for this behavior, he reasoned that anyone with such skills had an unauthorized obligation to try. The administrator assisted the staff member in reexamining his notions of social responsibility and the potential community effects of destabilizing the computing environment without specific authorization.

4. Representation/Preservation of Reality vs. Creativity/Art
The final set of value polarities to be discussed her, is not yet perceived as a conflict area on many campuses. It is an interesting and increasingly important area of discussion however. I have labelled this value continuum - "representation and preservation of reality vs. creativity of art". As we increasingly develop the capability to alter visual image, a number of ethical issues become obvious. They include issues of notification, validation, responsibility, preservation and archiving, and others. Questions include: What notification is required when a visual image has been electronically altered? What will inform the viewer that an image is altered? What is the ethical boundary between: a) altering a visual image and thereby changing or invalidating the representation (data) and b) altering the image by simply enhancing it, removing impediments, glare etc.? Who has the responsibility for the final product and the validity of the composition, the artist/illustrator or the researcher/professor?

Archivists express grave concern that institutions are failing to preserve records in this new electronic environment. The failure to preserve records including sketches and early versions of artistic productions, research slides and photographs PRIOR to electronic enhancements may leave the institutional record incomplete, or perhaps even invalid. Part of each community will value the final products (after enhancements) and will see little value in the original works, whereas others will question the integrity of the final works and even the intent of the academic or researcher in presenting anything but the original data.

In one incident, a medical researcher possessing a slide taken during an operation, took the slide to a medical illustrator who was equipped with computer hardware and software capable of altering visual images. He requested that the illustrator remove the glare on the slide, and also a fuzziness that was caused by a membrane, left during the operation. His goal was to have a clearer representation of the organ that lay beneath the membrane. The resulting picture would be included in a research paper reporting results of the surgical procedure. Many issues were raised by this incident. Who owns the final picture: the researcher who took the original or the illustrator whose art and skill produced the final version? If the final picture was a significant alteration of the original image, was this enhancement or falsification? Who is responsible for this final representation of the operation? What should be maintained for the records; copies of the original slide or the altered picture? What notice should be affixed to the final picture? Would anyone ever request enhancement of a picture or drawing by removal of the little c in a circle at the bottom, the copyright mark? Yes, incidents of such have already been reported by illustrators.

I have suggested that conflict arises when administrators are caught unaware of the issues involved in a particular action, both technical and ethical. Conflict also arises when administrators find that an incident falls between two opposing values held strongly by different segments of their community.

A Call for Policy Formation

When a sufficient number of these conflicts arise, when the incidents threaten the community resources or intellectual products, or when they gain significant publicity, a policy statement is often sought. It may be important to understand what policy is intended to do under these circumstances, how it will be used, and to define the expected outcome.

The reason for developing policy vary. For some, policy is written as a control tool for unacceptable behavior. Often, when this is the goal of policy, the resulting statement contains a listing of the "thou shall nots": the unacceptable behaviors. The statement acts as a guide for those who will need to take disciplinary action, as well as a warning for those who use the resources within this environment.

For some, policy is designed to clarify the community behavioral standard; it is a guidepost for citizenship within that community. A college or university, according to Ernest Boyer:

> "is a disciplined community, a place where individuals accept their obligations to the group and where well-defined governance procedures guide behavior for the common good."[2]

A policy statement may thoroughly spell out the rationale for the standard. It may reflect the mission and goals of the institution. Such policy may also identify limits in order to encourage responsible behavior relative to the resources.

Some statements of policy are actually secondary to the creation process. In these instances, the dynamic process of involving individuals is as much the goal as is the final statement. The process individuals undertake as they work to understand and define community standards, as they talk about issues, as they clarify values, as they form communities, is seen as valuable to both the final policy statement and to the implementation of the policy.

It is important to note that not only the motivation for formulating a policy, but the locus and scope of involvement implied by each of the three types of policy identified above. I am suggesting that as these examples move increasingly toward process, they also reflect movement away from central/administrative locus of control, toward a distributed/community locus of control.

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[2]Ernest L. Boyer, Campus Life In Search of Community (New Jersey: The Carnegie Foundation for the Advancement of Teaching, 1990) p. 37.

Key Aspects of Michigan's Policy and Implementation Model:
The Policy -- "Proper Use of Information Resources, Information Technology Resources and Networks at the University of Michigan"

I will not imply that on a campus as large as the University of Michigan, approximately 55,000 faculty, staff and students, we have established community through this process of information technology policy formation. Neither will I imply that all members of this community have participated or, for that fact, have even heard about this policy. In this instance, however, we have attempted to move policy making in the area of information technology towards the process model.

There are many different specific applications of information technology required on the University of Michigan campus. There are also many different values and ideas regarding how information, and information technology, should be accessed, and used. When we undertook the process of developing a policy, it was clear that there were enough different values and enough differences of opinion on the campus that in order to be successful we needed to understood these points-of-view and incorporate them as the standard setting process unfolded. It was also clear that unless the community believed in and supported the policy, it would not be implemented. Ernest L. Boyer also writes:

> A college or university is a just community, a place where the sacredness of each person is honored and where diversity is aggressively pursued."[3]

How to honor and aggressively pursue this diversity is not always clear.

We decided to take steps toward a dynamic process. It was the goal to allow people the opportunity to define and clarify their values, to define the issues with which the community was struggling as it applied information technology, through discussion to become aware of some of the different values within the campus, and ultimately to create policy that defined the community's valued standards and citizenship responsibilities. Implementation then, was perceived as much an individual responsibility as it was a departmental, school, college or central administration responsibility.

1. Establishing Need

A problem, drew sufficient attention and established the need for policy. The problem we experienced was relatively minor.-- However, you may have read about it in the New York Times. It was called the "bad jokes file".

There is extensive use of electronic conferencing at Michigan. Conferencing is an electronic communication process whereby individuals enter an item into discussion by keying information into the system. Other members of the conference may then read and comment on the item at any time. The comments are accumulated under the item header and, in effect, a non-real time discussion of issues is able to take place, with archival and cross referencing capability. Conferences each have a designated organizer whose responsibility it is, among others, to monitor the conference, stimulate discussion, maintain a focus on items when rambling begins, and remind members of the norms of behavior in the conference. Conferences are created for the discussion of topics among a wide and diverse population of users, as a forum for debate of issues among a narrowly defined group of participants, or to provide an open social forum for meeting other students and sharing information and opinions about any topic of interest.

In this incident, within a conference entitled: "Meet: Students", an item was entered called: "Let's tell jokes." Soon the conference organizer realized that the entries were becoming offensive. He reasoned that parcelling the jokes into "bad" and "good" joke files would help people avoid those jokes that they did not want to see. The bad jokes file deteriorated. Entries offended people of different races, genders, and ethnicity.

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[3] Ernest L. Boyer, Campus Life In Search of Community (New Jersey: The Carnegie Foundation for the Advancement of Teaching, 1990) p. 25.

The issue facing the administration was whether to terminate the conference in order to eliminate the complaints of harassment, discrimination, bad taste, and use of public funds for offensive communications, or to maintain the conference in support of Free Speech. Other campuses have been faced with this dilemma as well, each struggling with its own set of conflicting community values.

Some people argued that freedom of speech took precedence over other considerations in this matter. They stressed that, central to the considerations was that people should not be subjected to this "offensive" material by having it automatically appear on their screens, however, if an individual chose to read and contribute to this form of communication, (the bad jokes file), that they should be able to do so. It was the decision of the administration to open, rather than close the conference, to draw attention to the activity and ask people to participate by providing their points-of-view regarding the appropriateness of this activity. A discussion of Freedom of Speech issues and appropriate use of the resources ensued among conference organizers and others.

In this incident, Freedom of Speech was used to illuminate the community standards and to help define the responsibilities of community members regarding resources that have been given to them in this university environment. The overwhelming opinion of the community was that people should not be forced by virtue of the technology to read material that they felt was offensive, that individuals had the right to read and write such material if they chose, but that this was not considered a good use of information technology resources. The item was withdrawn by the person who had originally submitted it. The successful outcome of this process supports another of Ernest L. Boyer's notions of community.

> "A college or university is an open community, a place where freedom of expression is uncompromisingly protected and where civility is powerfully affirmed."[4]

2. Increasing Awareness of Incidents

Following the bad jokes incident, the University-wide policy committee requested that a policy be written to define appropriate use of information technology for the University. We began to systematically collect descriptions of the various incidents that were happening on the campus. This was one of the most useful tasks accomplished. Staff collected and systematically organized stylized vignettes of actual incidents, incidents that raised ethical and value issues. It was through the use of these vignettes that members of the community could begin to understand the kinds of value decisions that needed to be made. Without the real incidents, there was resistance to forming new policy statements which may saw as just "one more regulation". Once they participated in discussion of real incidents, the need for guide-lines became clear and they engaged willingly in the process. Such incident collections are valuable tools to increase awareness, to stimulate discussions, and overtime, to reflect changes that may be taking place within the environment.

3. Defining Expectation for Policy

The next step in the process was designed to define expectations for policy. Earlier in this paper I discussed the various reasons why policy may be created. Portions of every campus will want policy to control behaviors, portions will expect policy to set standards, and portions will expect policy to help create community and foster discussion. We found examples of all of these expectations. The outcome of these discussions was a compromise; The Proper Use Policy at Michigan attempts to describe the community standard and the information environment we are trying to create, while also defining unacceptable and irresponsible behaviors within that environment.

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[4]Ernest L. Boyer, Campus Life In Search of Community (New Jersey: The Carnegie Foundation for the Advancement of Teaching, 1990) p. 17.

4. Clarifying Community Standards and Values

Extensive discussions in large and small groups allowed the sharing of different points-of-view from key organizations and individuals within the community. Many questions were asked. What kind of policy is it that you want? What kinds of guide-lines would be useful to you? With what kinds of problems are you currently coping? In the process of clarifying community standards and values, we struggled with two outstanding value conflicts. I have entitled these: Law vs. Learning, and Individual vs. Institutional Responsibility. These will be briefly described because they represent common positions on many campuses.

Some members of the campus community, particularly faculty, felt that when these incidents arise, they should be used as learning/teaching moments, rather than causes for punishment. They felt that it was their obligation and opportunity to work with the individuals involved, to help them better understand the impact of their actions, and the responsibility they carried in the wider community. They saw such incidents as valuable teaching opportunities to advance the ethical reasoning and social development of members of the community, particularly students. Other members of the community, notably the auditors and attorneys however, were more likely to take a legalistic and rule oriented approach. They argued that a student violating a rule should experience the consequences of that behavior. Further, they argued that policy should help to delineate these consequences. The dilemma of law vs. learning was a conflict that had to be resolved in the process of establishing this policy.

Some members of the community asked:, "Who's responsibility is it to write a policy or to control these behaviors?" "Is this really individual responsibility?" Perhaps posting "reminders" for the community may be all that is needed--not a policy. Individuals then, are expected to be informed and to do what is appropriate--taking the consequences when violations occur. Other community members asked, "Does an institution, especially an institution of higher education, carry responsibility for informing its community, for setting the standards, for providing the guide-lines, for encouraging people to be responsible, for teaching them about the issues?" "The institution must take a stand and involve its community through information and/or process." In an appeal for public and private institutions to take a stand, Sissela Bok, 1978 wrote:

> "The social incentives to deceit are at present very powerful; the controls, often weak. Many individuals feel caught up in practices they cannot change. It would be wishful thinking therefore to expect individuals to bring about major changes in the collective practices of deceit by themselves. Public and private institutions, with their enormous power to affect personal choice, must help alter the existing pressures and incentives."[5]

Clarifying community standards and values, resolving the conflicts between law vs. learning and the individual vs. institutional responsibility was an important process at the University of Michigan. Though the process will differ at other institutions and these conflicts be even more rigorously debated, administrators, faculty, staff and students will find the discussions challenging, stimulating and beneficial in any case.

5. Gaining Administrative Endorsement

Though a key part in establishing any policy, administrative endorsement often is not given enough attention. At the University of Michigan, the Vice President and Provost as well as the President, repeatedly sent information to the Deans and Directors encouraging them to participate in the discussions and to assume their responsibility for the set of issues surrounding appropriate use of information technology. Not only does this reflect commitment from the highest executive officers of the institution to those responsible below them, but, as they send out the correspondence, their personal involvement is enlisted, thinking about the issues at hand.

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[5] Sissela Bok, Lying: Moral Choice in Public and Private Life (New York: Random House, 1978) p. 244.

The "Think About It" Implementation Project

As most of us know, a policy written in the books of a large institution often is little more than a policy on paper. It is distributed to department managers, read and filed. Often, the policy is not contemplated, as if it does not relate to the everyday duties and concerns of the manager, faculty, staff and students of the department. There is often only "hope" that it will be taken seriously and implemented. Personnel will be held responsible for the policy if an issue arises in the future.

The "Think About It" implementation project, also called the "Think About It Campaign", was instituted at Michigan in an attempt to activate the process of policy implementation. The goal was to extend the discussions that had taken place during policy formation and to open them to an even wider audience. We wanted to encourage personnel to share the current and real incidents with which they were dealing. In the process, we wanted to establish a broader understanding of the community values and to disseminate information about the "Proper Use Policy" that had been officially adopted.

A university-wide call for volunteers was issued; volunteers were recruited from the ranks of University staff and faculty. The request specified that volunteers would be expected to participate in a four hour facilitator training session, and then, with a partner, would donate two, one hour blocks of time during the Fall term to facilitate discussion of ethical and value issues the use of information technology. Facilitators would go wherever they were assigned within the university. The response was overwhelmingly positive. Fifty volunteers were identified and trained.

The Campaign was publicized on the campus network and in the campus newspapers. Additionally, posters announcing the Campaign were included with a letter from the Vice President to Deans and Department Chairpersons, encouraging students, faculty and staff to participate in the project and in the discussions. The Campaign was designed to stimulate thinking and discussion. It is important to note that disseminating information about the University policy was considered secondary to the goal of increasing discussion about ethics and sharing community values.

The "Think About It " implementation project, could certainly be an on-going project at any institution. Values clarification and community sharing seem beneficial at any time. However, this project was designed for a six month time period. It was evaluated following its termination in March, 1991. Approximately seven hundred people participated in small group facilitated discussions. Many hundreds of others participated in spin-off and informal, departmental discussions. The facilitators were nearly unanimous in volunteering to participate again should the project be repeated. They were also unanimous in their determination that more needed to be done in this area. Perhaps not surprising, of all the people who benefitted from the effort, the facilitators felt they had gained the most.

Policy Development and Implementation Model: Weaknesses and Strengths

Both weaknesses and strengths were identified as the Michigan "Proper Use Policy..." and the "Think About It " Implementation project, were evaluated.

1. Weaknesses:

- **People Intensive**

This model is very "people intensive". It requires person-to-person contact. The training of the facilitators, the scheduling of sessions, the support of facilitators, the small group discussions, the sharing of vignettes, the continuous contact with departments as questions arise, all are based on a personal contact. They build on trust and open communication. Short cutting this process for the sake of numbers or time, would likely destroy the essential openness, sharing and safety of the discussions. While the person-to-person design was one of the weaknesses of this model, it is also most certainly one of its strengths.

- **Time Consuming**

This is a time consuming process. Even if facilitators were given larger group assignments, many discussion hours would be required using this method, in order to involve a significant portion of the campus community. On a campus as large as the University of Michigan, the overall impact seems very small. Additionally, facilitators had to be invited by departmental personnel before being assigned. The departmental representative person made the necessary arrangements for the meeting, distributed information, and ensured participants. This involvement was necessary in order to spread investment in the project. Individuals and departments differed in their efficiency in setting up meetings. Sizes of groups varied. Scheduling, and accommodating the calendars of all those involved, was time consuming. Many of the facilitators felt, that while the number of direct contacts was small, (seven hundred), and the process-time consuming, the model promoted departmental investment, increased the occurrence of informal discussions and increased the overall spread-effect of the project.

- **Unpredictable**

"Where will the discussions go?" This was a question for both facilitators and department managers alike. Facilitators and department managers were anxious about unforeseen issues that might arise during the discussions. For facilitators, there was anxiety about preparation and whether or not they would be sufficiently knowledgeable. For managers, anxiety existed about whether or not negative discussions and/or policy violations, would be made public during the discussions. The unpredictable nature of truly open discussion causes anxiety. Once people become clear that they do not have to know all of the answers, indeed that there may not be "right" or, any, answers for the questions that may be raised, anxieties decrease. Facilitators were encouraged to admit when they did not know an answer and to jointly pursue more information with the participants as their partners.

2. Strengths:

- **Values Diversity**

This process values diversity and respects differences of opinion. It does not promote the idea that there is a "right" or "wrong" way to go about things. It places a value on understanding each other's points-of-view, with the promise and potential of building a community. It seeks to clarify community values, and to establish standards and guide-lines for behavior within the community.

- **Inexpensive**

Overall, this process is inexpensive in terms of what it achieved. If one calculates personnel costs, (time spent in training, discussions, and group facilitation), costs would be significant. However, enlisting the services of volunteers for the implementation program meant that overall, the program was inexpensive in its direct costs. We have found that faculty and staff are eager to contribute to community building within their institutions when they see the issues as significant and important. Many facilitators reported that this provided for them the opportunity to interact with others within their institution, to wrestle with issues of wider scope than was their usual focus, and provide service to the University.

- **Spread effect**

The design encourages replication, follow-up informal discussions, and an overall spread effect. As a result of this program, not only did facilitators complete their assigned two (one hour) sessions, but often asked to be assigned to additional sites as well. In some cases, facilitators as well as participants in the groups, have established electronic conferences to discuss the issues, have presented papers in their professional conferences, and have volunteered to participate in any future programs in this area.

Summary

All campuses are different. No two will address ethical issues and conflicts of values in the same way. In this paper I have provided a discussion of some of the ethical dilemmas that are arising on campuses as the use of information technology increases. I have discussed reasons why administrators turn to policy and have described key steps in policy development and implementation at the University of Michigan. A policy is but the starting point for the hard explorations of values and ethical issues that exist as communities mature in their new and increased access to information and in their use of information technology.

Implementing an Institutional Repository

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In most universities each information system addresses the functional needs of only one set of users. Data is application specific and is of little value to the institution as a whole since it is not up-to-date or often must be transformed before it can be used elsewhere. Data definitions are not readily available and assessing the impact of changes to business procedures is time consuming and error prone.

Creating a repository based on institutional data standards is envisaged as solution to these problems. However, creating a repository from the current state seems like an overwhelming task. This paper describes an approach to integrating existing databases and applications with a repository. Standard data are defined in the repository based on previously conducted data projects. As system databases are incorporated, existing objects are re-used and conflicts are resolved. Applications are modified to conform to new data definitions as they are integrated.

The Problem

Regardless of how cold it can be in Saskatoon in January, sometimes I force myself out of my office in the Physics Building. On one of those days in which the air was sparkling with sunlight reflected by particles of ice fog, I walked over to the Buffeteria to get some lunch. As I was waiting in line I met my good friend Al Novakowski, Head of Internal Audit. He asked me if I had a few minutes to discuss some things with him and as we wolfed down our submarine sandwiches he told me of a small audit task they were starting.

"Bob," he said, "Donna and I were thinking that she should use Datatrieve to match the vendors addresses from the Financial Records System (FRS) to the employees addresses in the Human Resources System (HRS). We should be able to do that, shouldn't we?"

I thought that was quite clever. What they were trying to find out was how many employees were selling things to the University. That seemed to be a reasonable auditing-type question. "Well, Al," I replied, "yes you **should** be able to do that. I just don't know if you can. You see, there's this problem with addresses..." As we talked, I could see that Al did not really appreciate "the problem with addresses" ("After all, we have Datatrieve," he kept saying.) and as we left to go back to our offices the only thing I could do was wish him good luck. (After all, they had Datatrieve, didn't they?)

In July I received a memo from Al. He summed up his frustration this way,

> "Therefore, we concluded that a match of addresses using Datatrieve was not possible. The most reliable approach we could follow was to extract all postal codes from FRS and HRS... and extract a listing of matching postal codes in order to decrease the amount of data we were working with. The electronic match yielded a list of 2013 matching postal codes. We then decided to select only 50 for a visual match...
>
> "We hope that this information is useful to you in your attempts to standardize the data bases at some point in the future. Until then, we will have to work with the limitations described above, which, in my view imposes a high degree of ineffectiveness in extracting sensitive data for information purposes from two of our major administrative applications."

Now they understand "the problem with addresses". In fact, the first part of Al's memo lists four factors that precluded their success:

- The formats were different. City and Province are entered in one field in HRS and in separate fields in FRS.
- The rules for entering the data were not defined or consistent. There were at least six different ways of entering "Apartment 100 at 1021 Kingsmere Rd."
- Data was incomplete. Street address or box number were sometimes omitted for some vendors.
- Data had been included that should not have been. Many employees were added as vendors because they had travel advances or received petty cash reimbursements.

I also noticed something that was very interesting: they had to do the match on postal code. The Canadian postal code is very well defined and its use is very well enforced. In fact, I do not know of anyone who makes up their own format for the postal code and if it is omitted then the letter does not get delivered; it gets sent back.

What I gained from Internal Audit's problem was a different perspective. I started to notice other data difficulties. In fact, once aware of data problems, they seemed to be everywhere. It soon became very clear to me that standard institutional data was a prerequisite for good application development. While we have application problems, our prime problem is data:

- The three different estimates of the cost of a contract settlement were given. In attempting to reconcile them, it became clear that the calculations were correct but the data stored in three different application systems did not agree.

- The institutional research group spends most of its time "laundering" contradictory or incorrect data. Worse yet, they often have to collect and re-enter data that already exists in inaccessible departmental databases, files and spreadsheets.

- Many departments on campus (including Computing Services) maintain their own (and duplicate) accounting systems because financial data cannot be shared and has to be transcribed or transformed in some way before it can be used.

- Senior management relies on verbal reports because the institution's operational databases assist clerks to process cheques or forms but do not collect data so that it could be utilized to provide management information.

- When asked for permission to read a list of current employees, the Director of Staff Relations had to admit, "The reality of the situation is that this university... does not know who its employees are at any specific current point in time. ...the closest that we come to this knowledge is usually through the payroll system which is a combination of guesses as to who will be employed through a certain date, and who was employed for those people paid on the hourly system."

In the meantime, we were being asked to make more changes to applications that academic units claimed were ineffective and did not meet their needs in the first place. This was most clearly stated in a recent review of our department:

> "...the committee examined the financial information system in some detail. Each college and unit... appears to have implemented some form of financial information system to augment the information provided by the Financial Records System (FRS). It is the opinion of the committee that FRS is primarily an audit and record keeping tool and that complementary systems could be developed to enable more effective planning and management on a decentralized basis. Similar opportunities for improved utilization of the information presently captured in the University databases exists with other administrative systems such as the Student Information System and the Human Resources System.[1]"

It became clear to a few of us that lack of data accessibility, integrability and quality were symptoms common to each of these problems. It also became clear that high-quality data to which access could be easily obtained could only be assured if it was seen beyond the context of an application system and its maintenance was standardized.

That was not a profound observation; data administrators have been saying that for at least thirteen years. However, having finally realized it, our problem was how to encourage and enforce the principle that information is an institutional resource comprised of standardized data components. There was also the question of what to do with the "Legacy Systems" -- systems we already had. But above all we had to think through how we were going establish institutional data standards.

Our Solution

The Institutional Repository is the tool that is used to develop, manage and promulgate the data standard. The notion of a repository is not new, either. In fact, there is even a standard emerging (IRDS). While we recognize the characteristics of a real repository, our focus was on the creation of an institutional (dare I use the word, enterprise?) view of data. This is data that is defined in terms of its value to the institution not by individual application constraints[2].

We already had a group of people working on recommendations for data dictionary organization, they expanded their view beyond the needs of individual systems. In addition, a consultant that knew the dictionary product well was also available. This group's proposal was to create a common dictionary **in addition** to "system" dictionaries. Using a new facility that allowed a relationship to be defined between objects in different dictionaries, we determined that we could build a dictionary for an application system and have selected metadata items defined in a common or institutional view.

Another facility that made this scheme more of a repository than a dictionary was the ability to store application objects such as procedures, sub-routines, generated code, etc. which might be shared by applications or systems. While there is one dictionary for each application system, we refer to the collection of functional dictionaries and institutional view as the Institutional Repository. See Figure 1.

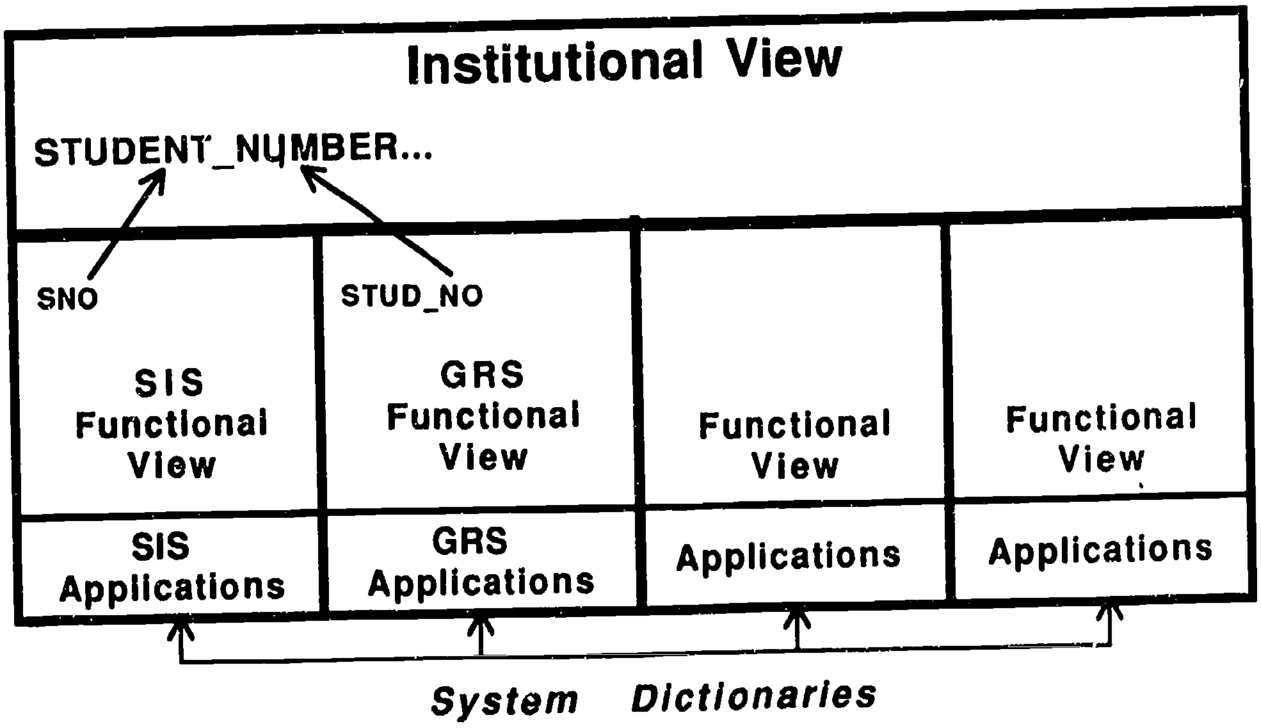

Figure 1
Institutional Repository Architecture

As functional dictionaries for any system are constructed, the individual definitions are matched against those in the institutional view. Non-controversial definitions such as STUDENT_NUMBER, ACCOUNT_NUMBER or EMPLOYEE_ID are placed directly in the institutional view and any occurrences of them in the functional dictionaries are related to the institutional definitions.

This approach to creating institutional data standards has a number of benefits. This allows us to preserve our current investment in application systems while developing and enforcing data standards. Next, it allows the institutional view to be populated with great control.

Another benefit is political. Academic institutions are not the most rigidly controlled and we recognize that standards or guidelines are not easily accepted. By populating the repository with non-controversial definitions first, Legacy System proponents must show why the institutional definitions cannot be used rather than the data administrator having to justify why they should. We refer to this as "shifting the burden of justification."

The greatest technical benefit is the ability to do "pieces tracking". As noted above, the Repository allows for the integration of applications. We are able to query the repository, asking in which applications its objects are used. This is extremely critical when assessing the impact of a proposed change and preparing estimates of effort for projects.

Method for Repository Implementation

With guidelines for a repository structure established, we developed a method to integrate existing databases and applications into the repository environment, keeping in mind the target to create subject databases for the institution.

The replacement of all Legacy Systems at once was not considered to be feasible. Also, with resources being very limited, the only realistic way to achieve the goal was to partition the task into a sequence of well defined projects. The approach we took was to establish a plan to integrate existing systems based on previously performed data projects and to educate the users by promoting the sharing of data and highlighting the advantages of an information management tool.
The tasks to complete each project were identified as:

- Analysis and consolidation of data,
- Creation of data objects in the repository,
- Creation of databases based on repository definitions,
- Development of procedures for data transfer from existing databases,
- Identification of required application changes,
- Testing and implementation,
- Integration of applications into the repository.

Case Study: Integration of Student Information Databases and related applications into the Repository.

The first project chosen for repository integration dealt with the Student Information databases and related applications. We began with these databases and applications because they had institutionally specific data definitions, the system was developed in-house and had occurred recently using a relational implementation.

The project was started in June 1990. Because of other commitments, completion was scheduled for May 1991. Since only a rudimentary data dictionary had been used, we realized that the data definitions had to be consolidated.

The following inconsistencies were discovered in the process of data analysis.

- The same name was used to describe different data elements. For example, CITY was defined as 40 characters in one table and 25 in another.

- It became apparent, that in some instances one definition was used for a number of data elements. For example, the definition SUBJ was used to describe both High School course subject and University course subject. This was also observed for aggregate data types.

- Conversely, different names referenced the same data element. Names of address types were particularly redundant, for example, ADDRESS_TYPE and ADDR_TYPE_CORRESP.

While the first two types of inconsistencies required renaming and, consequently, substantial changes to database definitions and applications, the last one was easy to resolve by creating a unique definition relating to both. For instance all address type definitions were based on a single definition, ADDR_TYPE. Although we would have preferred to implement naming standards for data definitions at the same time, the effects on existing applications made this infeasible.

We identified data elements that were common to the institution and were to be defined in the institutional view. Keep in mind that our design involved using physically separate dictionaries and maintaining relationships between objects in each. Two days before implementation we discovered that this could not be done due to technical limitations of the software. Workarounds had to be rapidly developed. However, we were assured by the vendor, that these deficiencies will be addressed in future versions.

The data definitions were consolidated and defined by September 1990. In order to minimize risk, we selected the Archive database of Student Information data as the first candidate to be based on Repository definitions. The redefinition implied creating a new database and reloading all data. This was accomplished in December 1990. Related application changes were minimal.

Due to technical limitations in earlier versions of our DBMS, Student Information data were stored in physically separate databases. However, from a database integrity point of view, it was desirable to merge them. One of the prerequisites for the merge was the consolidation of the data definitions, which would be achieved by dictionary integration. Since merging the databases and integrating into the dictionary both require redefining and reloading the databases, we decided to combine the two tasks to minimize the effort.

Due to prior commitments and support tasks, it was the end of March 1991 until we were able to resume the project. With Early Registration starting in June, mid-May was the last feasible date for a spring implementation. If we missed this date, the next window would be in November. Summarizing the effort for all tasks outstanding, it became clear, that with the resources available it would be impossible to meet the May target. Since we were reluctant to postpone the implementation until November, we decided on a two phase implementation, jokingly referred to as a "two-phase commit".

The first phase was to be completed in May. It entailed modifying data definitions in existing databases and transferring relevant data, modifying applications to conform to the changed data definitions and integrating 3GL applications (primarily Cobol programs) into the repository.

The second phase, to be completed in November, consisted of defining the merged database to the repository, reloading all data, modifying applications to refer to the merged database and integrating the 4GL applications (Rally) into the repository.

The application changes required for phase one were extensive, almost five hundred procedures had to be modified. The irony was that without the repository being implemented, we had to rely on human recollection and directory searches to determine which applications might be affected. Contrary to what we had expected, modifying our 4GL applications was a real challenge and required substantially more time than estimated -- we almost missed the target date for the implementation of phase one.

The majority of application changes required for the second phase were accomplished by developing automated change procedures. We were fortunate to have our "toolsmith" working on the project at this time. Substantial effort was required, however, to completely redefine and load the databases (app. 2.5 million records).

The Future

Having concluded one Repository integration project, we are now planning the next: our Student Fee System (SFS). In addition to integrating its data and applications with the repository, this project's scope will cover the fusion of the SFS database with the Student Information database. This, of course, implies greater data standardization which will be reflected in the Repository. Following this project will be the integration of our General Receipting System, although no physical database fusion is planned.
We also plan to extend the use of the Repository beyond data and application storage; we intend to use it as a medium for true information engineering. Our analysis and design tool already stores its models in the Repository. Within a year the integrated programmers' tools we use will operate on Repository objects, also.

But the most interesting use of the Repository will be using it to store definitions of non-computerized data. As pointed out in the Information Engineering Management Guide, "A true Enterprise Repository perceives the Enterprise as 'The System', and facilitates the management of data whether automated or not[3]." Not surprisingly, The University Archives, with whom we work closely, is particularly interested in this notion. At that point we will have a true information repository.

[1] R.G. Sutherland, Chair, Report of the Steering Committee on Non-academic Reviews, April 1991

[2] This will, undoubtedly, have a major effect on our future ability to purchase applications and systems.

[3] Pacific Information Management, Inc, D.S. Coleman, Chief Methodologist, Information Engineering Management Guide (Santa Monica: Pacific Information Management, Inc , 1989) p. 5-12

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A Manager's Perspective on the Client/Server Model

Vinod Chachra
President
VTLS, Inc.

Abstract only

This presentation, focusing on Z39.50 and targeted for information systems managers and executives, will answer three types of questions.

First, the presenter will address the question of what Z39.50 is: What are its underlying assumptions? What is the present status of the implementation of the standard? How is the standard expected to change in the near future?

Secondly, the presenter will discuss (a) the resources implementors and users need to implement the standard, and (b) decisions that need to be made regarding the standard.

Finally, the presenter will discuss (a) the potential impact of the standard on the information systems industry, and (b) the penalties for not preparing now for the future that this standard envisions.

WORKSHOP ON DATA PRIVACY

Presented to
CAUSE-91

Anaheim, California
December, 1991

Abstract

About three years ago, Bentley College established a College-wide committee to oversee data standards and policies on campus. Among other tasks, one of the responsibilities of this committee is to establish policies and consider cases which involve privacy issues concerning the use of institutionally collected and maintained information. This workshop offers the opportunity to review several actual cases on this type which have come to the Data Standards and Policies Committee, and to discuss them in small working groups, bringing together the perspectives of different institutions represented by CAUSE members.

Presented by:

Peter T. Farago
Director of Administrative Systems
Bentley College

BENTLEY COLLEGE

POLICY REGARDING RELEASE OF STUDENT INFORMATION

(From Bentley College's 1991-92 Undergraduate Catalog)

Family Educational Rights and Privacy Act
According to the Family Education Rights and Privacy Act of 1974 (Buckley Amendment), individual students have the right to review all official records, files and data related to them and the right to challenge the accuracy of the contents of such records. Furthermore, the act prohibits colleges and universities from releasing personally identifiable information about students without their written consent. For detailed information regarding a student's rights under this law and the procedures involved in obtaining access to official records, please contact the dean of Undergraduate Admission.

Unless otherwise requested by the student, Bentley College may, at its discretion, release to the public student data considered "Directory Information." If a student desires that directory information not be released, it is his or her responsibility to notify the Registrar's Office in writing. Please note that students do not have the flexiblity of choosing to release or not release particular items within "Directory Information."

Bentley College will not sell or give directory information for commercial purposes to external vendors who are not affiliiated with the institution. The college may use all student data for its official operations or for the approved operations of any student organizations or other college-sponsored functions.

Directory information, as defined by the Family Education Rights and Privacy Act of 1974, includes the following information relating to a student: name, address, telephone number, date and place of birth, class, major field of study, participation in officially recognized activities and sports, weight and height of members of athletic teams, dates of attendance, degrees and awards received, and the most recent previous educational agency or institution attended.

BENTLEY COLLEGE
DATA STANDARDS AND POLICIES COMMITTEE
Sample of Data Requests Considered

CASE 1.

The senior class is busy planning activities for Senior Week. In order to be able to identify students of legal drinking age at these activities, they are requesting that a file containing students names, id numbers and dates of birth be downloaded into their PC. They would also like local mailing addresses and phone numbers if possible to help their communications concerning senior week activities? The request for all this come to you, the Registrar. How do you respond?

CASE 2.

A faculty member calls you at data administration and requests a list of all students' names and addresses. Asked for the reason for the request, he says that he wishes to be able to contact his students from last semester and the current semester to contact them about their course work. You could easily run such a report. Do you run the report? Refer the request to another office? Do something else?

CASE 3.

A student comes to you in Residence Life, and asks you for a set of address labels for all resident students. The labels are needed to conduct a market survey of students attitudes toward campus athletic events. The research is being done as a project conceived by the student to fulfill the requirements of a marketing research course she is taking. The proposed project has the approval of the professor in the course. How do you respond?

CASE 4.

A CIS faculty member is assigned a project by the Dean to establish a management information model for tracking students progress through certain academic programs. To do this, the faculty member has a CIS graduate student working with him/her to help in the design and development of this system. The faculty member requests on-line read only access to the complete student database with the authority (and intent) to download various data elements for a selected group of students to a PC, where the model is being developed. Assurances are given that the graduate student will only work on development using dummy data and that the faculty member will be the only one using the actual student data on the PC, once it is downloaded. The request comes to you as a member of the Data Standards and Policies Committee. How do you respond?

CAUSE91
December, 1991

CASE 5.

The local chapter of a national professional organization requests a list of the names and home addresses, and/or mailing labels, of all of our senior majors in that profession. The list is to be used to extend invitations to association events and membership to the graduating students. The association offers to reimburse the College for the expense of generating the requested materials. The request came to you, as registrar. How do you respond?

CASE 6.

A student organization runs a fundraising project. They wish to contact parents of resident students with impending birthdays, and offer, for a price, to prepare a birthday cake, balloons, etc., and deliver these to the student's room on his/her birthday. To do this they wish to have a listing of all resident students with their names, campus address, and birthdates. The organization is a recognized campus group, with a faculty or staff advisor. The request comes to you, the registrar. What do you do?

CASE 7.

The Director of Marketing requests that the names, addresses and telephone numbers of all current students be downloaded to a PC. The intent is to contact students in the course of conducting marketing surveys performed both in-house and by outside market research firms to be contracted by the College. Should the information be downloaded? What restrictions if any, should be placed on its use? Should it include all students or omit those who have filed a confidentiality request, asking that their "directory information" not be released by the College to the public?

BENTLEY COLLEGE
DATA STANDARDS AND POLICIES COMMITTEE
Resolution of Sample Data Request Cases

CASE 1.

It was decided that birth date was not actually needed, just a distinction whether the person had reached the legal drinking age as of the date of the event. The activity was deemed to be a part of "official College business", therefore the data were released, through the faculty advisor to the student organization, with explicit directions restricting its use for the designated purpose only. Instead of birth date, a yes or no flag was generated to indicate legal age status.

CASE 2.

The faculty member of course did not need "all students'" information. Instead, he was given the local address and phone number of his current students, and was informed that the addresses of former student would be available on an individual request basis. He was informed of the College's policies concerning protection of the confidentiality of such student information.

CASE 3.

This request was turned down. Surveys conducted by students for their own course requirements have to rely on other means of contacting their survey populations (such as direct distribution of materials).

CASE 4.

The Data Standards and Policies Committee agreed to give read only access to the student database to the faculty member, along with the ability to download information. He agreed to strip names and ID numbers (or rather to garble them) for the development data which would be used by the graduate assistant.

CASE 5.

This request was turned down. The association was given several options for methods of distributing materials to our students without gaining access to their names and addresses. (e.g. advertizing in the student newspaper, using bulletin boards, hiring students to distribute materials directly, etc.)

BENTLEY COLLEGE
DATA STANDARDS AND POLICIES COMMITTEE
Resolution of Sample Data Request Cases

CASE 6.

Mailing labels were generated, and the members of the student organization processed their mailings by placing the labels on the materials without removing them from the Student Activities Office. Thus, the issue of releasing the information was avoided without hindering the activity from taking place.

CASE 7.

Information is being relased for this purpose for those student only who have not chosen to restrict release of their "directory information". Further, when information is passed to an outside vendor, who is under contract with the College to perform the market studies, the contract is to specify that the information is to be used for that purpose exclusively, and that it should be destroyed after the contracted studies are completed.

ANAHEIM CALIFORNIA CAUSE91 DECEMBER 3-6

TRACK V

INTEGRATING TELECOMMUNICATIONS AND NETWORKING

Coordinator: Paul Shumaker

Telecommunications networks are becoming increasingly important as one of the most critical information processing resources in colleges and universities. The movement of information among various computer configurations provides extendability of and access to data which expands and enhances institutional effectiveness and efficiency. Papers in this track explore such potentials for telecommunications in colleges and universities.

INTEGRATING TELECOMMUNICATIONS AND NETWORKING

SACRED HEART UNIVERSITY
FAIRFIELD, CONNECTICUT

BY
MR. VINCENT P. MANGIACAPRA
DR. FRANCES GRODZINSKY
MR. DOMENICK PINTO

INTEGRATING TELECOMMUNICATIONS AND NETWORKING

The intent of integrating telecommunications into Sacred Heart University in Fairfied, CT is to provide the students, faculty and staff with a state-of-the-art network that will enhance the quality of education and research at the university.

The campus network will be implemented in three logical stages. Stage I will begin with the installation of a fiber optic Ethernet backbone among the main academic building, library, administration building and the campus center. The backbone will allow users in these buildings to communicate with the computer room. Within each of the buildings, there will be station cabling between a central hub and classrooms, labs and offices. During Stage I, it is our goal to gain access to the Internet via the JVNCnet which will provide a gateway to the outside world.

Stage II will provide an Ethernet segment to be connected to each of the three remote campuses. This will be a transparent link between the Lisbon, Stamford, and Ansonia campuses which will enable them to have access to all the computing facilities of the main campus.

The third stage will provide all residence halls and future buildings with the ability to access the campus network. Dormitories will have a "port for every pillow". Students will, therefore, have the option to work in their rooms or to go to a shared terminal room.

I. Introduction - Investing in newer technology
   A. Rationale for the shift from present technology to a communication and networking environment.
      1. VAX 750 outgrown in terms of size and capabilities
      2. Desire of disciplines other than computer science to integrate computer software into their courses for a state-of-the-art classroom for
         a. teleconferencing
         b. instruction of high school teachers on how to use a technical environment
         c. instruction in Basic Studies and English composition
      3. Desire of faculty to communicate with peers outside the university on research projects
         a. benefits include cooperative research and joint authorship on papers.
         b. possibility of consortium work without travel
            (1) desirable given limited budgets
      4. Desire for state-of-the-art library
         a. on-line services
         b. Criteria for determining an optimal network
   B. Conditions
      1. No existing network
      2. No limitations
         a. look towards maximum flexibility
         b. look towards growth
   C. Choice of Media
      1. Inter-building connections - Fiber optics
      2. Intra-building
         a. Fiber optic
         b. Coaxial cable
         c. Thin wire
   D. Topology
      1. Ethernet
      2. Token Ring
      3. FDDI

   E. Conclusions
      1. Practical implications
         a. closer faculty contact
         b. joint grants
         c. consortium work without travel
      2. Fiber-optic backbone for inter and intra- building
         a. Potential for growth
         b. Gateway to national networks
            (1) Internet
         c. Station cabling is twisted wire pair
            (1) Allow for Ethernet or Terminal connections

II. Design of the network
- A. Stage I
  - 1. Workstations and PC's
    - a. Faculty
      - (1) DEC workstations for CS faculty
      - (2) PC's for other faculty
        - (a) networked in a client/server model
    - b. Student
      - (1) General terminal lab
        - (a) DEC System 5500
      - (2) PC labs
        - (a) each lab will have 20 diskless color pc's
- B. Stage II
  - 1. Faculty offices
    - a. PC or workstation connections
    - b. Automated office
      - (1) E-mail
  - 2. Integrated Applications Software
  - 3. Networking of dormitories
    - a. Access to all campus computing facilities
      - (1) Linkage with remote campuses
    - b. Ethernet
    - c. Access to all computing facilities of main campus
- C. Stage III
  - 1. State of the art classroom
    - a. teleconferencing equipment
    - b. workstations
      - (a) for audio, video and data transmission
    - c. FAX

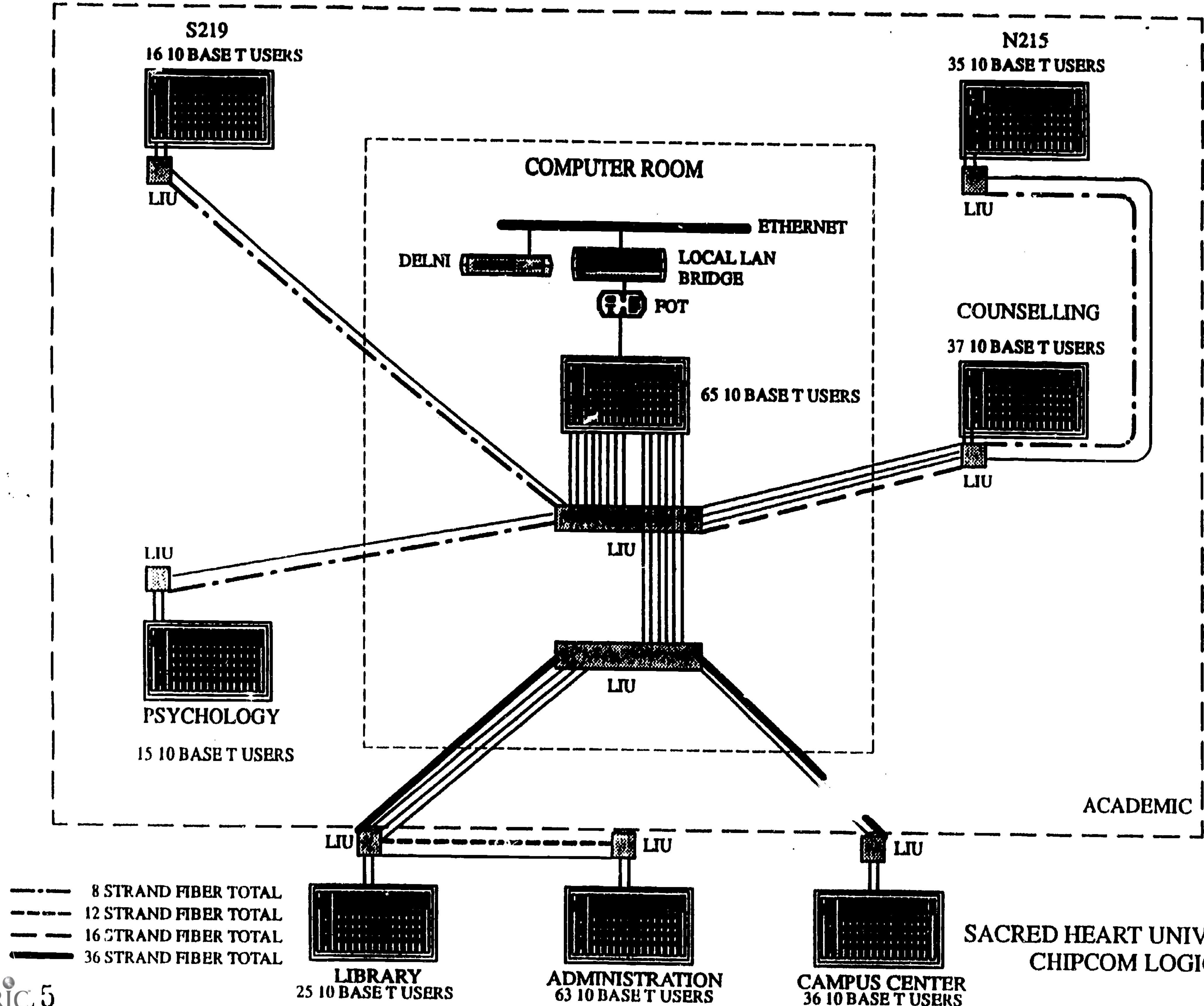
III. Management and Operation of the Network

A. Fiscal

1. Budgeting Increases: University Funding $750,000
2. Grants: JVNcNet $30,000
   Culpepper (3 year) $100,000 each year
   Others $450,000
3. Operating budget base must be established with 10% yearly increases

B. Physical and Human Resources

1. Manager of computer operations
   a. Technician - Hardware
      (1) minor wiring
      (2) repairs, moves, upgrades
   b. Software support through user services



SACRED HEART UNIVERSITY
CHIPCOM LOGICAL

PLANNING AND IMPLEMENTING AN INTEGRATED TELECOMMUNICATIONS ENVIRONMENT IN THE CALIFORNIA STATE UNIVERSITY

Patricia M. Cuocco & Chris Taylor
CSU Office of the Chancellor
Information Resources and Technology

ABSTRACT

The California State University is comprised of 20 individual comprehensive universities, ranging in size from less than 1000 to 36,000 students. The campuses are connected via CSUnet, which has recently been upgraded to an integrated telecommunications vehicle for data, video and voice communications.

This paper will detail the planning, implementation and obstacles associated with multi-function inter-campus networks. It will provide a history of CSUnet and discuss its evolving technologies and its multi-functional, multi-protocol nature. In addition, this paper will describe some of the library, academic and administrative applications which currently rely upon CSUNET and those which plan to use CSUNET as it is upgraded and enhanced. The developing relationships with K-12 and the community colleges as well as the linkages to regional and national networks will also be discusssed.

The California State University is composed of 20 individual comprehensive universities ranging in size from 1000 to 36,000 students. This paper will discuss first, the political and industrial factors that have made planning for an integrated telecommunications environment so important, then, the actual ways the CSU has implemented or is still in the process of implementing that environment and finally, some of the obstacles associated with this process. Much of this discussion is part of the <u>Plan for Telecommunications in the CSU</u> which the Information Resources and Technology (IRT) organization within the CSU Office of the Chancellor has recently produced.

I. PLANNING FOR AN INTEGRATED TELECOMMUNICATIONS ENVIRONMENT

Why is planning for an integrated telecommunications environment so important? For one thing, it's been said that the alternative to planning is chaos and, that has perhaps never been so true as in an area such as telecommunications where the changes in technology occur at such a rapid rate. One has only to look at the last dozen years to realize just how fast our technological environment changes.

If at the end of 1980, you were even thinking about what the next dozen years would bring, technologically speaking, you would have been a powerful seer indeed if you had imagined the products and services that have since been introduced and had foreseen their effect upon our lives and the way we conduct business. Just a short overview of what didn't exist, or wasn't commercially available in 1980 includes the Personal Computer (the IBM PC was introduced in 1981). Were you using a VCR in 1980? If you were, you were the first on your block; the VCR most likely supported BETA format and the device cost upwards of $1500. The Macintosh computer wasn't introduced until 1984. Some Executives had mobile phones, which were outrageously expensive, hard to operate, unreliable and certainly not available in all locations. In 1980, if you asked to use a phone in an airplane, the flight attendant would have assumed you had been served too much to drink. Did you, in 1980, want to start enjoying digital sound on a compact disc? Probably, but you had to wait a few more years!

One of the most significant differences between then and now in the arena of telecommunications was that in 1980 Ma Bell **was** the telepnone company. The divestiture of AT&T and the Bell Operating Companies occurred January 1, 1984, so in 1980 the full range of competition which we now enjoy had not yet come to the world of telecommunications. While competition in telecommunications has complicated the lives of those managers in that field, it is important to remember that it's been competitive pressure that has made increased bandwidth and the rise in network technology possible. After all, T-1 technology has existed and been used by the telephone companies since the mid 1960s. It's only been in the last few years that the price for this bandwidth has dropped enough to make its use for private businesses and educational institutions feasible.

On a university campus in 1980, to discuss "information resources" was to talk about computer mainframe and mini-computer access. Every campus had a centralized computer center, akin to the data processing department of private corporations, and a highly technical, professional staff to manage it. A local area network was a connection from a dumb, ascii, asynchronous terminal to the mainframe at the computer center. Access speeds ranged from 300 bps to 2400 bps and probably averaged 1200 bps if the copper cable plant on the campus could support the speed and could reach the terminal location. Some campuses used Computer-Aided Registration, but long lines at card pulling centers were still the norm. The term telecommunications usually referred **only** to the telephone on the desk, which was probably rotary dial, even though touch-tone® dialing was readily available. Enhanced productivity features such as call-forwarding and call-waiting were in use. Private line networks certainly existed and large corporations used them for everything from tie-lines between PBXs to batch data transmissions; airline reservations and credit verification were examples of the few on-line, real-time applications in use. Universities were doing little on-line processing. Electronic mail didn't became popular until the mid-1980s, and even then, the user interfaces were "unfriendly" to say the least.

The last few years have witnessed the exponential growth in the use of micro-computers. Many of these personal workstations are far more powerful in terms of processing ability and speed than the large mainframes of ten years ago. The proliferation of the personal computer/workstation has given rise to the need to share resources as well as information. This has lead to increasing emphasis on the importance of networks and a rise in user expectations. University faculty and staff, satisfied in the past by a local area network which, provided quick, reliable access to on-campus computer resources, now demand the ability to network with colleagues across the nation or in other parts of the world, through the "Internet". While computer labs were a perfectly acceptable way of providing computing access to students just a few years ago, the advent of the Integrated Services Digital Network (ISDN), is making it possible to provide this access (and access to many other university services) to students or faculty in dorm rooms or private housing within the vicinity of the campus. Students and faculty who were previously contented with research via card catalogues at the library, would today consider this an archaic method of locating resources. Today's colleges and universities make use of on-line catalog/circulation systems and the ideal is for faculty and students to access this information from anywhere on campus, and increasingly from off-campus locations. And, in addition to the resources of one's own campus library, students and faculty need to be able to view the holding of other major libraries and use databases such as "Uncover" in CARL (The Colorado Alliance of Research Libraries) which provides contents, and frequently abstracts, of journals and periodicals.

Telecommunications has pushed the boundaries of the university beyond it's physical perimeter by making it possible for members of one campus community to share the scarce or costly resources of another campus, such as access to a large database or a supercomputer.

Increasingly, universities, particularly public supported universities, will be asked to assist in enhancing and enriching K-12 and Community College education either through the direct delivery of instruction to remote locations over satellite, microwave or land-lines or by allowing K-14 to share the resources of the campus, such as library databases and computer or Internet access via these electronic media. As these geographic boundaries blur, we see more and more cooperative ventures among campuses and between the campus and its serving community.

II. HISTORY OF CSU EFFORTS IN INTER-CAMPUS (WIDE AREA) NETWORKING

We believe it goes without saying that the precursor to an effective inter-campus network is a robust telecommunications environment on each individual campus. Suffice it to say that not every CSU campus has the appropriate environment but that the acquisition of that environment is a very high priority from both the campus and systemwide perspective.

The CSU inter-campus integrated telecommunications network is called CSUnet. A history of CSUnet will provide a means of illustrating some of the key decisions made in the process of developing the network. In 1984, a feasibility study was undertaken with the intent of improving the existing network which was a proprietary network, based on a single manufacturer's mainframe equipment. It was determined that CSU needed a network that would a) be separate from any particular mainframe vendor and that b) would interconnect multiple vendor's equipment in such a way that if all of the hosts computers on the network should go down, the network would still stand. Consequently, CSU chose the CCITT international standard, "X.25", as its basic protocol.

In 1985, we conducted a four-site pilot to test the applicability of our decision. By the end of 1985 all 20 CSU sites were interconnected through an X.25 network. The proprietary network was abandoned. By 1988, the network was becoming more strategic to the mission of the CSU; usage increased and network bandwidth had to increase significantly. In 1989, we added additional support for protocols in addition to X.25. Then, during 1991, we again upgraded the bandwidth on the network significantly and changed the architecture so that we could support not only data, but also video and voice.

In a little more detail... In 1985, the initial implementation was a three node backbone: San Francisco, Sacramento, and Los Angeles. The network backbone was built from digital 56K circuits with each of the CSU campuses connecting to their nearest backbone node with 9.6K digital circuits. Our initial implementation was missing what we recognize today as a key component, in that it did not provide access to any outside resources external to the CSU.

A typical campus configuration in 1985 was an X.25 switch which was connected to the backbone. Attached to the switch were a number of X.25 async pads used to connect data PBX port selectors (which were very popular on our campuses at that time), dial-in modems, and host computers that did not support X.25 protocols directly. We also had some host computers that did support X.25 directly, namely our CDC Cyber computers, and, eventually, our Primes and some of our VAXes. In 1988 we enhanced the backbone. Additional backbone nodes were added at Fresno, Fullerton, San Luis Obispo, and San Diego. We also insured that each backbone node was triplely connected with other backbone nodes. These changes had two positive effects on the network: 1) it increased the effective bandwidth on the backbone to 112K bps and 2) it increased the reliability of the network. The X.25 switches that we were using were very robust when provided with routing alternatives. In the event of circuit failure, our major reliability issue at that time, the X.25 switches could, transparent to the user, automatically re-route traffic onto another backbone circuit. Network reliability was significantly increased with this enhancement.

In 1989, we made a key improvement in the network: CSUnet became a multi-protocol network. X.25 had met all of our initial design requirements but now faculty input indicated the need for additional protocol support. Chief among required protocols was the TCP/IP suite. Cisco routers were purchased for every campus, connected to the X.25 switches and encapsulated the TCP/IP traffic within X.25. In addition, we provided a connection from CSUnet to the National Science Foundation (NSF) Internet which provided access for our faculty to resources throughout the country. At a recent presentation by the NSF, it was mentioned that there are some 700,000 host computers on the Internet. Connecting CSUnet to the Internet provided some significant additional capabilities for our faculty.

In 1990, CSU continued the multi-protocol direction. DECNET became fully supported on CSUnet. It was not encapsulated in any form but was routed natively. We also began supporting, in a limited fashion, AppleTalk protocols across CSUnet -- again, routed natively. CSUnet addressed the need to interconnect IBM hosts by supporting SNA encapsulated within X.25. Finally, Group IV fax machines began showing up in our libraries and since they are very comfortable with the X.25 protocol, they were incorporated into CSUnet.

Supporting multiple protocols on CSUnet made it much more useful to faculty, students and staff. Consequently, by 1991, the traffic on the backbone increased significantly. Two main bottlenecks were identified: 1) the 56K bps circuits were too slow, and 2) the X.25 protocol, by virtue of its caused too much delay. Even though the X.25 switches were very efficient, the design of the protocol itself introduced delays that were becoming unacceptable to us. Earlier this year, the CSUnet backbone was re-engineered to use high speed T-1 switches thereby replacing the X.25 switches as the core technology on each campus with fast-packet cell-relay technology. As a result, CSUnet is not only a high-speed data network but can comfortably handle video and voice traffic. This new capability is very important to the CSU as we see video traffic and its associated distance learning applications as one of the highest growth areas on our network.

All CSU campuses today are connected via T-1 circuits to the backbone. Each campus has a StrataCom fast-packet switch into which we have connected the existing X.25 switches which are still providing the same functionality but, now, through the StrataCom switch. The Cisco router is no longer funnelled through the X.25 switch as it was previously. It now goes directly into the StrataCom switch and uses one of today's most sophisticated technologies -- frame-relay (a stripped down, very efficient X.25-like protocol). We also connect video codecs (coder-decoders) to the StrataCom packet switch with excellent results on a number of campuses. Finally, we have some interest, although we haven't capitalized on it yet, in supporting voice on CSUnet by connecting campus PBXs into the StrataCom switch.

From the campus point of view, access to CSUnet is multi-protocol which we feel is a very important aspect of our network. We support TCP/IP because that is the protocol one must use to connect to the national Internet. In addition, TCP/IP provides good interoperability between networks. DECNET is supported because it provides some unique capabilities for CSU campus VAX hosts. AppleTalk is a very popular and growing protocol on CSUnet because of its excellent functionality. It is very easy for AppleTalk networks to grow on campuses. Departments basically "plug and play" and before long a campus has a pretty substantial collection of AppleTalk networks. The next natural thing for campuses to want to do is extend that functionality between campuses across CSUnet. CSU needs to support SNA because we'll always have those big blue boxes on our campuses and the users of these systems naturally want to use SNA. However, the trend seems to be that most of our IBM hosts support the more robust TCP/IP protocols as well as SNA.

CSUnet continues to support X.25 because primarily because it enables us to support CSU's international projects. For example, we have some collaborative efforts with universities in South America, in the Middle East, and in Europe which utilize those countries' public data X.25 networks. These networks are internationally inter-connected and therefore they can easily reach CSUnet. Finally, as was mentioned previously, we need X.25 for Group IV facsimile.

There is also a large installed base of X.25 pads, some of which are used for community access via 9.6K bps modems located at every CSU campus. We encourage approved community outreach projects to use these dial-in modems to access CSUnet and the Internet. The network provides a user-friendly menu system and access control security on these dial-up ports. Users identify themselves and give their password. The network then provides a list of the resources which the user is authorized to access;. he/she selects one and is connected to the resource. This function is provided by the network, through software that IRT staff wrote for the X.25 programmable switches, and not through a host computer resident on the network. .

Regarding the technology on the backbone, as was mentioned earlier, CSUnet utilizes "fast-packet technology" which means that all of the traffic is broken down into small 24-bit packets. Each packet is routed at full T-1 speeds across the network resulting in improved performance. Packet bandwidth can be allocated in an isochronous manner for applications such as compressed video where a guaranteed bandwidth is required, or, on a "first-come first-served" basis which is very useful for bursty traffic such as LAN-to-LAN, a very fast growing area on CSUnet. Bandwidth can be automatically allocated by these priorities or by time of day (a capability that we use frequently for classes that are taught across the network via two-way video).

A very important aspect of CSUnet today is our high degree of interconnectivity with other networks. Although there are many valuable resources available on CSUnet for our faculty and students, access to still more resources available on other educational networks across the nation is essential. Consequently, CSUnet has two connections to the NSF backbone, one at Stanford and one at the San Diego Supercomputer Center as well as connections to other networks in California, such as BARRnet in northern California and CERFnet in southern California. As was mentioned earlier, a connection to the international public X.25 networks out of San Francisco has proved useful to the CSU. An area that CSU is particularly enthused about is CSUnet's connections to the Sprint Meeting Channel video network. There is presently a Meeting Channel connection at Sacramento, operated by Cal State Sacramento, and the CSU hopes to install a second connection next February at Los Alamitos. These connections allows the CSU to conduct two-way video conferencing not only between Cal State campuses but to more than 1100 locations nationally and internationally.

III. MANAGING CSUNET

One of the challenges associated with a multi-protocol network is its complexity which puts a definite strain on the staff responsible for operating the network. Within CSUnet (exclusive of management) there are four specialists in Network Engineering; three analysts, two operators and one equipment technician in Network Operations; and two consultants in Network User Services. User Services is an area that needs additional staff because network users are increasingly non-technical and require more assistance than past, more technically oriented, users. Finally, in Network Applications Support there are four consultants.

CSUnet is funded out through the State of California's General Fund via the Office of the Chancellor. which provides the network to CSU campuses at no charge. Other educational organizations, such as community colleges, pay their direct costs for connecting to CSUnet, such as the line charges for their circuit. Each non CSU institution also pays a small portion of the infrastructure of CSUnet (e.g. backbone circuits, the network operation center, etc.). There is no federal funding for this CSUnet; it's entirely a state funded network.

IV. CSUNET AND THE ACADEMIC AND ADMINISTRATIVE MISSION OF THE CSU.

We could have the most technologically sophisticated network on the face of the earth and it would still be useless if it didn't help students to learn, faculty to teach and do research and administrators to manage our business.

In an era of shrinking tax dollars and extreme budgetary constraints, the CSU does not have the luxury of duplicating all of its various resources twenty-times. Frequently, there are not enough users of an application on a single campus to justify the resource, or, the size of the application is such that it is best provided an a systemwide basis. There are also cases where it makes more sense for new technological capabilities and applications to be introduced and experimented with at one campus before being widely distributed. Some examples of CSU "specialty centers" include: ***Molecular Design Laboratory*** - at CSU, Fullerton which provides access to molecular design software for all chemistry departments in CSU. ***Business Database Specialty Center*** - at Cal Poly, San Luis Obispo. This service extends to the existing CSU-wide Academic Mainframe Specialty Center (AMSPEC) service provided through Cal Poly Computer Aided Productivity Center (CAPC) to include support for the large databases commonly used in CSU Schools of Business. ***Social Sciences Database*** - at CSU, Los Angeles, provides support for political and social sciences databases. ***Multiflow*** - at Sacramento provides computational chemistry faculty and students on more than eight CSU campuses with computing resources for both research and classroom instruction. ***CSU Census Information Center*** - at Sonoma State University, provides a platform for dissemination of census data. ***Geographic Information System Specialty Center (GIS)*** - at San Francisco State University provides the CSU with a facility where advanced geographic analysis techniques and sophisticated mapping capabilities which can be applied to real world problems. ***CSUPER-Net*** - at CSU, Fresno (managed by Academic Affairs, Educational Support). This system provides a comprehensive electronic library of information about admission to the California State University. It is used by high school guidance counselors and others to obtain current information on degree programs, financial aid programs, educational costs and admission procedures for each individual CSU. ***ATI -NET (Agricultural Technology Institute Network)*** - at CSU, Fresno. This system provides information about agricultural research conferences and publications of the California Agricultural Technology Institute at CSU, Fresno. It also gives general information on agriculturally related events and proposed legislation in California. It includes agricultural weather information, and daily agricultural market reports. ATI-NET has been recently expanded to include export trade databases: foreign trade leads, country and industry reports, trade shows and government programs. ***Engineering Specialty Centers*** - Sacramento and other Schools of Engineering in the CSU. ***Macromolecular Structural Analysis Center, CSUPERB*** - at San Diego State University provides a collection of biocomputing and structural (DNA protein) analysis, computer databases, programs and libraries.

In addition to specialty centers, CSUNET supports a myriad of activities such as:

Administrative Computing: Administrative Information Systems uses CSUnet in a variety of ways. Primarily, however, the network enhances the ability of the CSU to move information among campuses and the Chancellor's Office, and it provides appropriate remote access to resources. Common applications include the sharing of central control files maintained in the Chancellor's Office with each campus and the use of CSUnet is for remote access to the central computers at the Systemwide Computing Center located at CO/SWRL for actual processing.

BESTNET: BESTNET is acronym for the Binational English and Spanish Telecommunications Network which was established five years ago at San Diego State University. Since then, it has expanded to six additional CSU campuses, two University of California campuses (including

UCMEXUS - a university consortium dealing with U.C. and Mexico research projects), Arizona State University, University of New Mexico, Texas A&M University, the University of Colorado, and Metropolitan State College (Denver) plus a number of universities, university systems and research institutes in Mexico. This network involves collaborative work through teaching and research between member institutions. It includes programs in border studies, social and economic development, agronomy, biology, anthropology, sociology, telecommunications management and communications studies.

California Technology Project: The California Technology Project (CTP), as part of its mission to support K-12 educators interested in the uses of technology for instruction, offers a free computer-based telecommunications service on CSUNET known as the Technology Resources In Education (TRIE) electronic information service. TRIE offers K-12 educators access to electronic mail (with international capability via the Internet), computer conferencing on a variety of professional topics, information bulletin boards with updates from the California Department of Education and other educational organizations, and on-line databases including a resource database of staff developers and a database to help educators identify high quality software, videotape, and videodisc materials that have been screen for quality and "mapped" to the California curriculum frameworks. The CTP will offer the ERIC database through TRIE in the near future, as well as the CNN teachers' guides. TRIE is accessible to K-12 educators on CSUNET. To make use of TRIE, a K-12 educator needs to have a personal computer, modem, and telecommunications software. These are used to call the CSUNET access port (CAPS), at the nearest CSU campus.

Computer Conferencing: This is a popular application which allows participants to share data through a computer network by posting messages/information for others to read and access. an example of this is NetNews or Usenet on the Internet.

Cornell National Supercomputer Facility Program: Cal Poly San Luis Obispo, through its Computer-Aided Productivity Center (CAPC) has joined the SmartNode program at the Cornell National Supercomputing Facility (CNSF) on behalf of CSU. The SmartNode access allows any CSU faculty or staff member to obtain an account on the CNSF facility.

Distance Education/Video Conferencing: CSUnet evolved as a data network but, as we have indicated, we are now transmitting video signals over the network. Since CSUnet is comprised of land lines, the technology used compressed video Currently four classes are being taught between CSU Sacramento to CSU Bakersfield over CSUnet. The multiplexors that were installed as part of the CSUnet upgrade, allow us to set aside 384 Kbps of bandwidth for this activity at the specific times of day it as required and then reallocate the bandwidth to the rest of the network when class is over.

Demographics and fiscal constraints in California drive the need to find more cost effective ways to deliver instruction. Unlike many universities in other states, California will experience a significant growth in students eligible to enroll in college. Estimates are that the cost to provide new campuses and new buildings on existing campuses to accommodate this growth in the traditional manner will be upwards of $10 Billion. It is highly unlikely that these funds will be available. Televised inter-active instruction offers the CSU at least a part of the solution.

Electronic Mail: One of the most important applications using CSUNET is Electronic Mail. The CSUNET E-mail strategy is to enable CSUNET users to exchange mail with the widest number of their colleagues. Proprietary mail systems, even with attractive extensions, often yield "islands" of mail. But e-mail communications has become so important that it no longer be confined to a local area network, building or even a campus. Individual users must be able to reach much larger geographical areas such as the State, the nation and even the World.

Just as CSUnet is unique in the number of protocols it supports, so is it unique in that its E-mail strategy will allow for a variety of different systems. A campus can chose the system(s) which best meet(s) its individual needs and still be assured of inter-campus communications capability because of the CSUnet's incorporation of national standards.

V. CSUNET AND REGIONAL AND NATIONAL NETWORKING

As CSUnet grows and develops a very important part of our mission will be outreach to California K-12 and Community Colleges. Unlike many States in our country, growth projections for California are quite high. Funding for the bricks and mortar to build traditional campuses to serve the projected number of California college students in the year 2005 will be increasingly difficult to come by. Elementary and secondary educational will be equally if not more constrained. As part of the CSU mission we will have to assist in preparing K-14 students for admission into the CSU or other 4 year institutions. Certainly the answers to the budgetary shortfalls aren't to be found only in technology but CSUnet and networking in general can be a vehicle which alleviates much of the problem by allowing for effective resource sharing. Our local telephone operating company, Pacific Bell, has articulated this vision and referred to it as the "University Hub" with school districts and community colleges networked to the campus which is in turn networked to the world.

CSU continues to be active in planning for the National Research and Education Network through our affiliations with FARnet, CERFnet, BARRnet and the National Science Foundation and through our memberships in CAUSE, EDUCOM and activities with the Coalition for Networked Information. CSUnet users already have full connectivity to the Internet which functions as the interim NREN. We anticipate that CSUnet will play an important role in "wiring" California's education community to the National network and to the world.

VI. CONCLUSION

The era we live in has been called the Information Age. As we move into the next century we will become increasingly dependant upon easy access to more and varied information sources. As a publicly supported institution in an era of shrinking tax dollars and fiscal resources, the CSU will be called upon to provide this access to its students, faculty and staff in the most efficient and cost-effective manner possible. CSUnet has been designed to be the integrated telecommunications vehicle that can grow to meet the needs of the CSU and the community it is charged to serve

Network Growth and Evolution at CCC

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Over the last 13 years, Cuyahoga Community College's communications and data processing network has undergone significant growth and change. Starting with a small mainframe and six terminals, the network has expanded to seven mainframe and mini computers, 900 terminals/workstations, and 22 file servers distributed between five geographical locations. Future directions include the implementation of wiring standards for all network connections, expansion of existing networks, and the consolidation of network resources into a seamless user interface.

History of Network Growth

There were six significant milestones during the development of the present Cuyahoga Community College (CCC) network.

1978 - The first network was established at CCC. Primitive by today's standards, the network consisted of a Honeywell 2000 computer and six terminals distributed between two campuses and the district office.

1984 - By this date, three separate networks had been established to connect users at three campuses and the district offices. The primary network consisted of a Honeywell DPS/1 mainframe system with 50 proprietary "smart" terminals and 150 standard ASCII "dumb" terminals. This network was an expansion of the older Honeywell 2000 system and was used to support the academic and business needs of the institution.

The second network consisted of four WANG VS90 minicomputers and 200 proprietary WANG terminals. This network was established to provide office automation support to the administration and staff of the college.

The third network, consisting of an IBM 4331 mainframe and two Remote Job Entry (RJE) stations, was created to support the instructional needs in an IBM environment.

The end result of these separate networks was an overcrowding of desks in staff and administrative offices. Many desks had two terminals, several desks supported three terminals. Productivity suffered. Resources began to lie unused as the problems associated with multiple terminals and multiple operating systems mounted.

1985 - Because of the problems noted above, CCC's first network plan was formulated. The details of the plan included the concept of a universal workstation: a desktop device from one manufacturer which would provide access to all college computing resources. Resource to resource communications, mainframe to mini to PC, was a goal.

1988 - Network consolidation occurred during the 1985-1988 time period. By the end of 1988, the proprietary Honeywell network had been replaced by standard workstations. These standard workstations consisted of microcomputers running MS DOS along with V7800 software, a custom in-house terminal emulation package.

Communications between workstations and other computing resources was carried on the college's Wide Area Network (WAN). This network provided asynchronous communications throughout the institution at up to T1 speeds (1.54 Mbits/sec).

Local area networks increased in both number and size. Based on Ethernet protocols (802.3), departments within the college began to use E-mail on the LAN to communicate and to transfer files.

By the end of 1988, a Comprehensive Technology Master Plan (CTMP) was completed by Systems and Computer Technology, the college's facilities management supplier, and delivered to the college's executive management. The CTMP suggested directions for network growth and provided a framework to support the integration of newer technology into the day-to-day operation of the college.

1990 - By this date, LANs were installed in every campus and the district offices. Requests for connections to the WAN, LAN, IBM, and WANG networks were being received at an accelerated pace. Cable to complete these requests were being run in a most disorganized fashion, and, consequently, were being cut by outside contractors, crashing portions of the network. Wiring and cabling for the college was drifting into chaos. In 1990, the Cable Plant Management Group (CPMG) was formed to control the explosive growth of the college's network.

Following up on recommendations from a study completed by Robbins Communications, the CPMG created standards for the installation of all new cabling in the college. All requests for connection into the college network now must be approved by the CPMG. All projects which impact the growth of the college network are also presented to the CPMG for review and approval.

Current Status of the College Network

Computing hardware on the college's network consists of a dual processor Bull/HN DPS 8000/82, an IBM 4381 Model 2, four WANG VS/100 mini computers, a WANG VS 5000 minicomputer, over 900 PC workstations, 40 dial-in ports, and 22 file servers running Novell Netware.

Five different geographical locations are served by the network; the Metropolitan Campus located near downtown Cleveland, the Unified Technologies Center adjacent to the Metropolitan Campus, the District offices also near downtown Cleveland, the Western Campus located in Parma and the Eastern Campus located in Warrensville Heights.

Communications between locations is provided by copper T1 dedicated lines leased from Ohio Bell. Additional T1 dedicated lines provide for backup and are used as a secondary communications path to each campus.

Short distance communications (5,000 feet or less) between buildings is handled by privately owned optical fiber.

LAN/WAN traffic from each location is combined via Timeplex multiplexers into a single T1 connection. Video traffic is handled by broadband microwave and broadband coaxial cables

Where We are Going

Future plans focus on four areas: network expansion, improved network management and security, improved access to computing resources, and the workstation of the future.

Network Expansion

The college plans to continue expansion by upgrading existing, and adding additional new local area networks. Existing stand-alone student labs will be upgraded with newer, faster workstations. During the course of each lab upgrade, a new network segment will be installed and connected to the college-wide network.

Faculty offices in select areas will receive complete network segments. Each new segment will consist of workstations for all faculty offices in the campus department, a file server/print server if needed, and the necessary workgroup software to support the department.

Administrative offices will also be part of the planned college network expansion. Provost offices on all three campuses are targeted for network installation by FY93. District offices will be fully connected to the college network by FY93.

Student support is also provided by the growth of the Library Technical Access Centers (TAC). Each TAC has its own server, networked printer, seven to twenty workstations, and access to multiple CD-ROM units. Library information is available throughout the network, but is centralized in each TAC.

Improved Network Management

As the network grows both in size and importance, it becomes necessary to be able to detect problems in real time. Prompt response to and correction of network problems has always been a goal. In addition, real time monitoring becomes a necessity as network traffic increases.

An historical database will be implemented to allow for the generation of reports over a given period of time. This tool will prove invaluable in the tracking down of intermittent failures caused by older equipment.

Automated network management reports are becoming more important as the network grows. Current reports are generated manually. This process is time consuming and is not the most efficient use of scarce resources.

Automatic network configuration and tracking is also a must. Generating diagrams indicating the latest additions to the network is a time intensive task. The network changes on a weekly basis. Therefore, in order to conserve staff hours, it is important that an automated system be installed. Network security will also be addressed. With the advent of CCC's "smart" network as the first level computing access tool, it is only natural that system access and entry security reside on and be controlled by it. Because of CCC's open access policy, we see network software, based on LAN technology, as the access security process to all on-line computing resources, from on-line terminals to remote dial-in users.

Improved Access to Computing Resources

A unified user interface is an important goal. The college computing environment consists of a heterogenous mix of computing platforms. In order to maximize the use of these platforms, while reducing the learning curve for college users for each platform's command structure, a pull down, pop up menu system will be installed to shield users from the differences of each data processing system.

Standardized Wiring for all Connections

As new connections are installed in the college's network, a simplified, multipurpose cable will be used. This special cable will provide voice, video, and data communications capability within a single cable bundle. Economies of scale are invoked by only purchasing one type of cable. Full communications capability is delivered to each standard faceplate for each network connection.

Workstation of the Future

With the assistance of select faculty members, the specifications for the college's future workstation is now in the design stage. The new workstation must be capable of supporting multi-media presentations, for both the creation of instructional courseware as well as the presentation of instruction.

The workstation must be capable of multi tasking, so as to maximize the use of the hardware on the desktop. Peer to peer networking is a must. Workstations must be able to communicate with any resource on the college-wide network. Client/server applications must be supported. It is important to be able to use the computing power on the desktop in a timely and manageable way. With shrinking budgets, few institutions will be able to support large mainframes systems simply to get additional processing capability.

Conclusion

Our experience with the evolution and growth of the network at Cuyahoga Community College has brought forth three issues which must be answered in order to provide maximum usage for minimum effort.

- Structured wiring system - Cabling in the college can be a costly chore. Separate cable runs for voice, video, ethernet, asynchronous communications, and fiber are costly and inefficient. By structuring the wiring into a standard multi-function cable and creating a home run to a wiring closet for each user or lab, cost savings, manpower savings, and a general reduction in confusion are achieved.

- Client/server application systems - In order to maximize the available computing power from the user workstation and to minimize the necessity of acquiring a larger mainframe system, client/server systems need to be installed. UNIX style superservers can provide significant computer power increases when coupled with advanced client workstations on a users desk.

- Integrated voice, image, video, and data applications - Multimedia workstations capable of a wide variety of tasks will become more cost effective in the coming years. Multi media presentations are now in use in several departments of the college. This trend will continue to grow and will spill over into the faculty, staff, and administration usage of workstations.

CWRUnet - Case history of a campus-wide fiber-to-the-desktop network

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ABSTRACT

Case Western Reserve University is operating the first all fiber optic communications network on a university campus. When completely installed, this system of some seven thousand outlets will interconnect all faculty offices, student rooms, classrooms, libraries, and laboratories with computer data, telephone, audio, video, fax, and image information resources. We refer to the system as CWRUnet and pronounce it "crewnet."

CWRUnet features a standard premise, wire-once cabling architecture, independence of cabling and optoelectronics, and support for multimedia communications. Phase I of the network became operational in August 1989 for students in the University's sixteen residence halls. Phase II connecting faculty and staff offices and other locations is completed in twenty-two more buildings with the remainder under construction or scheduled for completion in 1991. CWRUnet accommodates a heterogeneous assortment of microcomputers, servers, mainframes, and gateways to other networks, telephones, television equipment, remotely operated surveillance devices, and energy management controls. It is planned to incorporate this campus-area network into a metropolitan area network following the proposed IEEE 802.6 standard. CWRUnet is steadily evolving into one of the earliest implementations of Broadband ISDN. A sophisticated network management system is used to monitor the operation of the entire network.

The CWRUnet project has been carefully documented, and precise costs are known for each element in the network. The data service is presently based on the familiar networking technologies of Ethernet and TCP/IP, and now offers a wide variety of network-based information services to the campus community. The network backbone presently uses 100 M bit-per-second FDDI token ring technology. CWRUnet has been planned to be the essential infrastructure for the University's new Library of the Future. At present, the University's libraries use CWRUnet's innovative CD-ROM jukebox to provide advanced applications of database technology to the campus community.

CWRUnet is an innovation because its existence as a model installation, as well as its successful operation, are changing the way other networks are being planned and implemented; it has established a new level in the "state of the art" and is now leading the way for both commercial and institutional networking facilities.

1. BACKGROUND

Case Western Reserve University is a research university with two residential undergraduate colleges, a graduate school, and six professional schools. It gives the Ph.D. degree in more than fifty disciplines and has a faculty of 1,685, a student body of 8,750, and an administrative staff of 2,300. It is best known for its medical and engineering schools and its polymer and materials science programs; its schools of nursing, law, social work, and management are among the best in the nation. With its extremely favorable faculty-to-student ratio, CWRU undergraduates get unusually fine experiences doing research with the faculty. During 1991-92, the operating budget of the university is $290 million, with over one third coming from sponsored research.

CWRU appointed a new university president in 1987, and accompanying this change were the appointments within a two-year period of several new vice presidents and deans, including a vice president for information services. Together the new management team has acted to develop a new role for information technology in the education, research, and service programs of the University. Central to this new mission is the campus-wide communications network. The University administration has developed planning, implementation, funding, and operating strategies and tactics for the network and has established the implementation project as one of the president's top priorities. Unusual among university CEO's, the CWRU president is championing his second network; the first was at Dartmouth College. The understanding of the implications of this project and the clarity of goals from the organization's top executive has made all the difference in the world in making CWRUnet a reality.

2. REQUIREMENTS FOR THE NETWORK

The new campus-wide network is designed to support a wide variety of academic and administrative applications in all departments of the university, both for today and for tomorrow. The academic applications cover both instruction and research, and for this university, we see these two domains substantially overlapping in many instances.

We believe that communications support to our 13,000 students, faculty, and staff, almost all of whom are "knowledge-based workers," requires the processing of all types of communications media, including voice, video, data, image, fax, and audio. Whereas we need to use these media generally in combination with one another, there are only a few "information appliances" (a.k.a. workstations) currently available that support any multimedia applications. In planning for the network, we needed to insure that the network would support combinations of media at each and every port serving a variety of new information appliances yet to be invented.

A high-speed backbone for a network of the size of CWRUnet seems to be implied. We envision that ordinary computer networking speeds to each desktop, such as ethernet (10 M bps) or token ring (16 M bps), will prove to be inadequate for multimedia communications. If we look at the power of the newest engineering workstations, we see networking capabilities and requirements far beyond ethernet and token ring speeds. Thus, the network for CWRU will have to be able to accommodate this and future generations of microcomputer-based equipment, where each generation is now about two years, and the power of a workstation in the next generation is approximately double that of the current one. As such, we made it a requirement that the network was never to be a bottleneck in the transmission of information from one location on campus to any other location. In practical terms, we understand this requirement to mean that we need an OC-3 speed (155 M bps) backbone now and quadruple that when the network is fully deployed in 1992. During the years 1992-94, the backbone speeds will need to increase again to two to four gigabits per second while the primary service rate delivered to each desktop increases to the OC-3 speed to support full multimedia applications. Applications at some desktops will need primary network service rates of OC-12 and OC-24 (622.5 and 1,245 M bps, respectively) for scientific visualization, and the backbone network will be required to handle such traffic without significant delays. With a backbone composed of four dozen strands of single and multimode fibers and expandable with the pulling of additional cable, CWRUnet will initially have an aggregate backbone transmission rate of over 200 gigabits per second.

A major application being developed at Case Western Reserve University in conjunction with CWRUnet is the electronic "library of the future." Although it will take many years for the University's largely paper-based collection to be transformed to a digital format, much information is presently available in digital form and otherwise available for transmission over our campus network. To make still more progress in this area, we are collaborating with the IBM Corporation to build an image collections server, which is now operational in a prototype form. The campus-wide network will be ready to receive the tremendous loading of information which the image system will provide to campus users. In addition, we have a project nearing completion which is developing an automated jukebox of CD-ROM platters as yet another networked information resource. The CWRU CD-ROM collection holds the equivalent of about 15,000 books; its holdings range from the complete Oxford English Dictionary and the Grolier's Encyclopedia to numerous reference data bases for chemical compounds and molecular structures. Over one hundred thousand book-equivalents in the digital format of CD-ROMs are being acquired by the University Library each year. The clear advantage of the CD-ROM is that in this format the data are capable of being searched by a computer, and with the networked CD-ROM server, the user may do the searching from his/her workspace without necessarily having to go to the library.

Electronic mail capabilities are important network services for this university community, especially as it connects students to each other and students to both faculty and staff. The CWRU electronic mail system must serve the entire 13,000 person campus community and must have linkages to networks beyond the campus, and there must exist the capability to send and receive fax's through the electronic mail system in an integrated manner. In addition, the network must have electronic bulletin boards, which will contain a variety of useful information for students, faculty, and staff, including course syllabi, course-specific homework assignments, and last semester's exams which students may use. The network will have to accommodate more than three hundred other moderated bulletin boards providing information about and for the greater Cleveland community.

The network must be a vehicle to offer other information services as well, including being able to provide software to our user community. Our vision here is that standard "commercial" software is made available without charge to students, faculty, and staff from the network-based software library, including a variety of word processors, spreadsheets, symbolic and numerical mathematics tools, graphics and statistics packages, and data base managers. "Courseware" is also distributed from the software library over the network.

Another fundamental requirement for the network is that it fit into a metropolitan area network grid to connect the campus to many off-campus locations, including the homes of our faculty, staff and graduate students (our undergraduates live mainly on-campus). In addition, the network will have to be connected to off-campus hospitals and other health-care facilities, to businesses that want to receive our continuing education offerings, and to other educational institutions in our region because our campus libraries share their holdings with the major regional academic and research libraries. Other network connections will reach beyond the campus to statewide (OARnet), national (NSFnet and NREN), and international (BITNET) networks. Thus, all of the citizens of the university will be able to maintain electronic relationships with their peers at other major centers of scholarship. The network must be able to provide connections to many off-campus systems, including specialized compute engines for computer-assisted design, for super-computing, which is a free resource for our students and faculty, for hosts of research software systems in artificial intelligence and expert systems, and for off-campus information services, such as Mead Data Central's Lexis and Nexis systems and the United Press International newswire, which is a constantly updated news wire service continually feeding its information products to the campus community via CWRUnet. Lastly, network users will need to have access to highly versatile laser printers in selected locations around the campus. These printers will be free for most uses.

Taken together, the requirements for the Case Western Reserve University network are demanding, but they are not substantially different from what we expect to see in general business use in the twenty-first century. Giving our students the experiences of learning with the "network of the future" on the campus of CWRU today will give them excellent preparation for careers in business and government and in other walks of life.

3. INNOVATION

Transmission of arbitrary collections of multimedia documents is a prerequisite to achieving our ultimate goals. A digital representation of all information formats makes it possible to use a common transmission facility, and fiber optic cabling with associated optoelectronics is the one medium that has the bandwidth for present and future applications. With this imperative, Case Western Reserve University has committed to implement a seven thousand port network in three phases. Phase I with 1,861 ports was implemented and made fully operational during 1989. Phase II used the identical design for 1,703 ports and was made completely operational just before the end of 1990. Phase III with 3,440 ports is being implemented during 1991.

CWRUnet was developed from a strategic planning process that considered a comprehensive array of potential uses for the network in the university and from a vision of what could be done with available, "off-the-shelf" technology. Although there are other "fiber-to-the desktop" systems in existence, CWRUnet is the first to use only fiber optic cabling for data transmission; this includes the use of fiber strands in all premise wiring and in all backbone cabling. In addition, all of the interfaces for a wide variety of brands of microcomputers use only fiber from the computer's backplane via optoelectronics and a fiber jumper cable to the network's wall outlet (faceplate). CWRUnet is an "open network" because it uses the industry standards of ethernet and of TCP/IP and presently accommodates on the basis of "plug-in and play" a heterogeneous mix of personal computers, workstations, servers, shared computers, and gateway devices of other networks.

CWRUnet is presently unique because it uses both single mode and multimode fiber in the premise cabling and in the backbone cables. With two pairs of single mode fibers in the premise wiring to every faceplate, the practical limit in information distribution with CWRUnet, using available optoelectronics, is presently over sixteen gigabits per second to each desktop! That speed is fast enough to transmit the entire Library of Congress to each user in less than one minute; it is also an order of magnitude faster than a pair of human eyes can take in information by way of the optic nerve. As it is designed and implemented, it is easily copied because it is made of only "off-the-shelf" components.

When designing CWRUnet, we built a high level of network management capability into the project. We set as a goal to be able to "see" each attached "information appliance" and all in-line optoelectronics from a central campus network operations center. If a device malfunctions, the unit can be disconnected from the network control center rather than from its specific location. The implications of this are economy of staffing, surveillance of the operating network, and operational segmentation of the troublesome unit from the rest of the network. Repairs may involve a "house call" but that can be a scheduled event. The network management system collects operational statistics which can be used by the system's managers to improve network performance.

CWRUnet is an innovation because its mere existence in a fully operational state is changing the way other network managers are thinking about implementing or upgrading their systems. Network planners will have to consider the use of fiber optic cabling in the premise wiring; they cannot dismiss this possibility because

CWRUnet is operational today. Most importantly, strategic thinking can work successfully in implementing a major communications facility for a company or an institution. The CWRUnet project is a successful case study of what can be done with careful planning and analysis; it is a model installation.

4. STRATEGIC PLANNING AND THE PROTOTYPE

Building a communications network of the size and scope of CWRUnet is a strategic project, and planning for the network was undertaken after a networking strategy for the University was developed. One of the important conclusions of the strategic plan was that the use of fiber optic cabling as premise wiring was inevitable. The question then became one of estimating when it would become the default choice for premise wiring, as it had already become for backbone cabling. We decided to ask the experts in the laboratories of the leading communications companies; their experiences were very enlightening and encouraging. We called vendors of fiber cabling to ask about costs, and they were also extremely helpful and provided the information we needed. We built a prototype of a 100% fiber optics network which taught us about connectors and other components that were part of a complete network installation.

Some of the University's key networking personnel had learned from other network projects at other universities that labor costs are a dominant component in the wiring of entire buildings. After consulting with various electrical contractors about the effort needed to wire (i.e., retrofit) older buildings, we became convinced that because of the cost and disruption involved, we could afford to wire the campus' buildings only one more time within the next thirty-to-fifty years, except for the situation where a building unit had to be extensively renovated. Labor costs can be expected to increase over time; thus, future wiring projects will have higher costs than present ones. Because we planned to use the fiber optic premise wiring immediately, we did not make a countervailing strategic funds management argument regarding the wisdom of allocating assets (the cost of the fiber) to only future use, and the loss of the use of the funds (and possible income generated by these funds) used to purchase the fiber.

The next immediate issue was considering how to make the premise cabling independent of the optoelectronics. We recognized that the fiber could be used for many years, certainly over twenty, but the optoelectronics was being improved significantly yearly. These improvements were a natural process in the technologies that build upon both integrated circuitry, where no plateau was going to be reached in any foreseeable time, and software, which was driving the operation, control, and management of networks. In the future, it is likely that software will provide networks the functionality that will be wanted, thus making upgrading easy relative to replacing the electronics hardware which requires more physical coordination and management and should be done only when it is needed. We concluded that we would want to institute a continual upgrading process for the optoelectronic components by changing them every five years on average or when a user needed the upgraded services. This strategy would work well only if these network components could be made independent of each other.

5. THE NETWORK CABLING ARCHITECTURE

CWRUnet has been built upon a cabling architecture that accommodates the University's strategic vision of the need for both single mode and multimode fiber optic cable in both the backbone and the premise wiring. It also recognizes the vision of a wiring plant that is comprehensive and flexible as to its uses. The architecture also fulfills the requirement for wiring buildings only once more, a so-called "wire-once cabling architecture." Because the wires are to be independent of the electronics, upgrades are made only to the electronics, and as often as user requirements dictate.

The cabling architecture used is hierarchical - in three levels. We adopted as a critical design principle that all types of premise wiring (level 3) were to be run together in common conduits and that the premise cabling would be deployed radially from "wire centers" in each building. Each wire center would be connected over the backbone cable (level 2) in a hierarchical fashion to an even larger concentration or "wiring hub" (level 1). A wiring hub typically serves a cluster of buildings. One of these hubs, physically near the center of campus, is currently viewed as the central control hub, but this relationship will change as an alternate site is established for continuity/recovery in the event of a local disaster. All of the hubs were to be interconnected to each other using redundant paths that would crisscross the campus in a suitable topology. We left it to our contractors to propose the exact arrangement of hubs and the particular physical network topology for our campus.

The "star wiring" and hierarchical premise wiring design adopted in CWRUnet makes each network port within a building wiring center independent of every other one, so it is possible to change the network services to an individual port without changing anything else. In this way, the "wire once" philosophy was justified. Independence of cabling and equipment was considered vital. Economics demanded the wire-once strategy for cabling, but CWRU recognized that equipment available to support its evolving needs would change with those needs. Other forces of change at work were the progress of technology to support new communications functionalities and to reduce equipment costs at the circuit level.

The Phase I implementation project built three hubs to serve the portions of the campus being wired at that time. Phase II added three more hub locations and put in the redundant conduits to connect each hub to at least three of its immediate neighbors. This backbone cabling consists of 24 strands each of multimode and single mode fiber and is routed through conduits which were installed mainly in existing steam tunnels; some new underground construction of dual four-inch diameter pipes was required. There is also one aerial span which crosses railroad tracks. With the hierarchical physical network topology it is possible to configure and reconfigure the logical network to support ring and point-to-point network topologies, in addition to discrete stars, by changing the equipment and the fiber patching in the hubs. Each of the hubs serves six to thirteen buildings, with star connections consisting of 18 multimode and six single mode fibers, capable of re-patching to support multiple logical network topologies. The network control center is housed in adjacent space to one of the network hubs; a redundant control center will be constructed and equipped for implementing a recovery from a physical network "disaster."

To provide the network services which were required immediately, data, voice, and video, at each and every faceplate, we assessed the practicality of using only fiber optic cabling in the premise wiring. If we had implemented such a plan, we would have found the cost of delivering telephone and television services to be very high because of the costs of connecting standard television and voice instruments directly to fiber cabling. Many networks are being built with fiber cabling used only in the backbone and with copper cabling, for example unshielded twisted pairs (UTP), as the premise wiring. At CWRU we inventoried our buildings and found little or no unused UTP; we had no other choice but to pull some new premise wiring. Clearly, we would probably have postponed the use of fiber cabling in the premise wiring if we had found such unused capacity available.

The primary user interface to CWRUnet is through a faceplate, an analog of the electrical wallplate. The premise wiring is terminated at each faceplate. Like electrical service connecting an appliance to the wallplate, there is a network "jumper" cable which is needed to connect each terminal device (phone, TV, computer, etc.) to the faceplate. Each faceplate is served by the CWRUnet "standard" premise cabling which is a composite of four strands of 8.3/125 micron single mode fiber, two strands of 62.5/125 micron multimode fiber, one RG-59 coaxial cable, and 4 unshielded twisted pair 24 AWG copper cable. The composite cable was constructed by Siecor as a custom product; the fiber products are made by Corning. As a aside, we note that the coaxial cable was pulled alongside the main cable so as to limit the size and complexity of the composite cable. Because of structural conditions in our buildings, horizontal surface raceway ("wiremold") or in-wall conduiting was used to protect the premise cabling from future wear and tear and from penetrations of the walls as a normal byproduct of customization of these living and working spaces. The vertical conduit paths were custom designed to fit the interior of each building. Premise cabling conduits were placed in existing "risers" where they had sufficient space; otherwise, new risers were built. The cable raceway uses common paths in the risers and as far as possible in the horizontals to minimize the amount of raceway, but each faceplate is served by separate cables in the raceway.

In a project of the scope, complexity, and strategic nature of this one, adherence to standards and emerging standards was considered to be of extreme importance. This dictated the choice of fiber size, specifications and connector type (ST), the decision to provide 8 conductors of UTP connected to an RJ-45 (which is fully compatible with ISDN services), and the termination arrangements for the cabling. Ease of administration added to the standards-based case for designing a single equipment room in each building, whether hub, premise, or both. The concept of "logical" buildings within a physical building was used in exceptional situations to reduce the quantity of costly premise cable and raceway. The structure supporting cable terminations, patching and equipment installation in each equipment room, consists of standard racks, patch panels, molding, foam padding, etc., designed entirely from off the shelf components, was engineered to accommodate CWRUnet's cabling architecture and provide space for both current and planned equipment.

Multimedia communications are central to the vision of CWRUnet services. Today's equipment does not support multimedia signaling integrated in a manner suitable for CWRUnet. It can be supported, however, by parallel cable paths of discrete media for voice, data, and video. CWRUnet was designed to follow this approach until emerging standards and equipment technology advance to the point that fully integrated signaling is practical and cost effective. When this happens, discrete signaling over separate media will be discontinued, and the unneeded media will be abandoned or used for some other communication which does not need to be integrated.

We considered building a formal cost model to justify our decision to use fiber cabling as the principal premise wiring as opposed to using unshielded twisted pairs. We abandoned this effort when we realized that the applications we wanted to develop and distribute using the network would likely require higher transmission speeds than we could safely say that copper cabling could support, and even if the copper cables would be usable, the cost of the electronics and the complex compression software that might be required could be very high. In the end, we could imagine enough cross currents in the trend lines over time to make the "conservative" decision to deploy fiber cabling at this time, which is what we did.

With our informal justification argument being somewhat neutral or ambivalent for or against the use of any one premise wiring cable in relation to the cost of the project, we realized that the University could market itself in a distinguishing manner by being the first university to implement a 100% fiber optic network. Clearly, one of the major telecommunications common carriers was using this difference to good advantage. In the end, the University administration was able to argue persuasively that the technical risks in the project were manageable, the short-term premium costs of fiber optics were tolerable, and the University's image could only be improved if the 100% fiber optic network actually was implemented on schedule.

6. NETWORK CONSTRUCTION

The University implemented the new network by contracting with TRW and JWP to design and construct the system. These firms were selected after a complete Request For Proposals (RFP) and competitive bid process was undertaken. The University developed the RFP internally; this document delineated a set of design principles that each proposer was to follow. Specifically mandated in the RFP was the appropriate use of fiber optic cabling to every wallplate (i.e., desktop).

The University received seven responsive proposals from the leading telecommunications vendors in the

United States. Each proposal was evaluated by at least three reviewers. A systematic rating score was developed for each proposal with the technical portion receiving about 70% of the weighting and the cost elements the remaining 30%. Two quite different proposals received nearly identical weighted scores. These two vendors were invited to update their proposals and a final evaluation was conducted. The winning proposal was submitted by TRW and JWP Information Systems - Network Services. The University negotiated and then entered into a contractual relationship with TRW as the prime contractor and systems integrator and JWP as the prime subcontractor, designer, and builder of the fiber optics network.

Before implementation of CWRUnet could begin, several issues were addressed in "engineering" how CWRUnet would be installed. These related to the fast-track schedule required to meet the completion deadline, and the need to provide for future expansion of CWRUnet services.

A number of electrical subcontractors were engaged by JWP to dig trenches and core drill the various buildings and to do many other construction tasks. Structures to support, protect, and conceal the premise cabling were built. Wiring centers to consolidate the cabling and to house the active optoelectronics were also constructed. For example, faceplate acquisition involved reconciling issues of cost, availability, and esthetics. The eventual faceplate selected was a standard part, re-engineered to our specifications, and "finished" with a high quality label for identification and protection from tampering.

Termination of the premise cables raised both technical and time issues. From a technical standpoint, the issue was how to terminate the fiber strands. The time issue was the large number (over 20,000) of terminations to be performed in a tight schedule, an elapsed time measured in only a few weeks. After careful consideration and cost analysis, we decided to have the premise cables prefabricated with connectors at the faceplate end, and pull the cables "backwards" from the faceplate to the equipment room. This overcame the technical problem of field termination of multimode and especially single mode fibers in numerous, rather awkward locations. Special practice was developed for equipment room termination of the multimode fibers, and storage of the as yet unterminated single mode fibers, and provision of hand-on training enabled us to handle the premise fibers in the equipment rooms within the time constraints. Significant time savings were achieved in the installation of faceplates by eliminating the time required for field termination at faceplates. Testing and rework time was also reduced because of the higher quality of the factory terminations.

Provision for the future of CWRUnet meant ensuring that cabling unused in the initial implementation could be placed in service easily and without cost penalty. For this reason, all of the premise and backbone multimode fiber strands were terminated and installed in termination bay patch panels, providing maximum protection for the unused fibers and taking advantage of the productivity value of terminating these fibers all at the same time.

Treatment of single mode fibers in the premise wiring differed because the in-service date for this fiber was indeterminate. Two of the fiber strands at the faceplate were terminated as part of the prefabrication process to avoid the future problem of terminating these at their separate locations. Two additional single mode strands were coiled and stored in the faceplate because they might never need to be used and the termination cost never incurred. All of the premise cable fiber ends in the equipment rooms and all of the backbone single mode fibers were prepared for future service by placement in splice trays within splice bays. When these are required for service, factory pigtails will be fusion spliced to fibers already prepared for this. Blank patch panels to accommodate these terminations are already installed. As a result of this engineering and installation practice, it is possible to place additional multimode strands into service within a matter of minutes and single mode strands within a few days.

Central to the physical architecture of the communications network is the building equipment room. All of the optoelectronics is housed in these rooms. The Phase I project designed, engineered, and constructed 25 rooms. Eventually, some 90-plus rooms will exist in the 85 buildings on the CWRU campus. CWRUnet depends on the faceplate for network service delivery to be an invariant entity; it is the equipment room where the network service is defined through hardware and software subsystems. A rack/cabinet and wall mounting system for cabling and equipment was developed and put into full operation, although some of it will not be used until the future as CWRUnet services are expanded. These racks and cabinets are all standard products and components. One of the biggest challenges in this domain was the development of overall building space requirements for now and the future, designing the most convenient layout for splice bays, patch panels, equipment, etc., and doing this within physical limitations of rooms that could be made available for this purpose. With our designs, we selected components, from racks and fiber storage cabinets, to molding for the routing of patch cables, foam rubber padding for the cable tray supporting the cable as it entered the room, clamps to secure the fiber entering the cabinets, and labels which would identify each cable, fiber strand, coax, and twisted pair. Building prototypes helped us to refine the design and engineering until we were satisfied that the cable and equipment mounting would satisfy the twin issues which we faced.

Underlying these implementation issues was the goal of making it easy to administer CWRUnet's cabling and change the equipment over time. For the fiber optic cabling, this was achieved through a combination of the use of fiber optic patch cables (jumpers) for all of the cross connections, patch panels which are easy to access when open but tightly secured when closed, and careful labeling of all cables and connectors. Connection to equipment is by the same jumpers, and all of this equipment is mounted in standard size racks and cabinets, with standard rack mount shelving available to accommodate any equipment of non-standard width.

Unanticipated problems were a part of the installation in this project. They ranged from asbestos contamination, blocked conduits, and supplier delays to slow adhesion of faceplate labels in the high summer heat and humidity and blocking of access to an installed but untested faceplate by a returning student's waterbed.

The entire Phase I project was carefully planned and managed, so that the active construction period for all 1,861 faceplates, the backbone, and all other network structures was only ninety-four working days. At peak periods, over one hundred people were working simultaneously in twenty-six campus buildings. Sounds emerging from the tired but triumphant installation team on August 25, 1989, when the first student successfully used CWRUnet and September 1, 1989, when the entire Phase I network went live, were a mixture of hearty cheers and sighs of relief. All of the design, engineering, and installation practices developed for Phase I are being followed in Phases II and III because they proved successful and cost-effective.

We have created a map for others to follow, through the previously uncharted territory of major, fiber to the desktop campus networks.

7. COSTS AND BENEFITS

Costs

For the Phase I project involving 1,861 network ports, the total cost was $4,427,616.76, an average of $2,379.16 per port. This figure is inclusive of all costs. Experience in Phase I has shown that for Phase II reductions were achievable. The average cost for the Phase II project is down to an average of $1,941.77 per port, based on 1,703 ports. A breakdown of the Phase II average cost in terms of its constituent elements is given in Table 1, together with percentage figures. In the Phase III project, further cost reductions have brought the average per port cost to less than $1,800.

The figures in this table are expressed in terms of each network port or faceplate, the outlet at each desk, which is the primary connection point of the network. These cost figures, however, include the photonics and electronics, PC adapter cards for ethernet or token ring, and "jumper cables" necessary to connect a standard microcomputer to the network faceplate, including IBM compatibles of almost all types and Apple Macintoshes from the SE to the IIci and a variety of UNIX workstations. Thus, these figures are all inclusive.

A second cost analysis was undertaken: whereas we had been told at the outset of our planning that the relative cost elements of the network would be very high for fiber optic cabling and optoelectronics, we suspected that the labor costs would turn out to be the dominant amount in the project. Table 1 shows the break down of costs for the elements of labor, materials, and optoelectronics as actually experienced in Phase II. Direct project labor was nearly 40%, with the other two components at 20% each. Thus, these data forecast that fiber optics networks built in the future will, in all likelihood, cost even more than CWRUnet because labor costs will continue to increase even if optoelectronics costs drop substantially, which they should do. Materials costs will probably remain at the level they are now because some components will go down in cost while others will increase.

Throughout the construction, the University kept track of all of the elements of the project with computer-based drawing packages (e.g., AutoCAD) and data bases for all faceplates, equipment racks, etc. A photo album of significant installation events has over three hundred pictures in it. These records of the construction will be maintained and used as part of the University's network management function. Changes to the network will be planned using this computer-based information. This time, the "shoemaker's children" are not going barefoot.

Benefits

CWRUnet has been operating continuously since August 25, 1989. It provides connections between end-user microcomputers and a variety of on-campus and off-campus information services, including electronic mail and bulletin boards, the library's on-line catalog system, several software library servers, the CD-ROM jukebox, a variety of shared computers - all on campus, and the Cray Y-MP/864 and Mead Data Central's Lexis and Nexis Information Services off-campus. Students and others are routinely checking both local and national news through the UPI newswire feed. CWRUnet also is connected to regional and national networks providing communications linkages to other universities and centers of scholarship and commerce. As supporting infrastructure, CWRUnet is proving each day that it helps users get to the information they want and need, that it is dependable and straightforward to use.

As more and more devices are attached to CWRUnet we are finding all the hardware and software components we need to provide this essential connectivity. We believe that these products exist and are available in the commercial marketplace because CWRUnet is built upon well known standards, such as IEEE 802.3 ethernet at ISO layer 2 and TCP/IP at layers 3 and 4.

Even at this early time as we are midway through the second year of operation, students, faculty, and staff are finding more and more uses for the network and requests to be connected are increasing since realizing the value of sharing information and developing new relationships across the network. This is why the University is investing so much in this infrastructure.

8. ASSESSMENT OF CURRENT OPERATION

Our contractors, TRW Information Networks Division and JWP Information Systems - Network Services, understood the goals and objectives of the project from the earliest stages. Their insights, creativity, and experience coupled with determination to succeed have made the construction and the operation of CWRUnet a "Case Study" in how to do a "fiber-to-the-desktop" project. All of the project goals have been achieved.

Time and cost budgets were met in Phase I. The Cabletron network management system with graphical "iconic" controls is fully functional.

9. PLANNED ENHANCEMENTS

CWRUnet is planned to have about eight thousand network ports in eighty-five buildings. During 1990, the University wired some thirty buildings with over seventeen hundred additional ports. During 1991, the remaining ports will be installed in the buildings not then wired.

The next network project is to extend CWRUnet off-campus following the standards delineated in IEEE 802.6 Metropolitan Area Network. Connecting CWRUnet to the university-affiliated hospitals and to the many businesses that participate in our Instructional Television Network will be a great step forward. Again, our vision for the network is that it connects people and that it provides a variety of information resources that support education, research, and service to our community, the region, the nation, and the world. Case Western Reserve University really believes that the CWRUnet network will made a substantial contribution to fulfilling its central purpose.

Another phase of the expansion of CWRUnet will bring it to the homes of our faculty and students who live off campus. The technologies to do this are still emerging from the development labs, but we know that ISDN telephone service will not be the vehicle for the expansion of CWRUnet. Our interests are more along the lines of the emerging technologies for Broadband-ISDN.

We see the future as having a basic service transmission rate of 155 M bps (OC-3) into each work space, but even that rate cannot provide all the services we would like to see develop. Is it too much to wonder when, not if, multigigabit per second service will be a standard utility in every home and office, each place of business and every institution? CWRUnet has established the fundamental wiring plant to support experiments and the development of prototypes for the telecommunications future. Thus, the University is planning to exploit this new capability. It will be reporting on the results of this work in the years ahead.

10. CONCLUSION

Case Western Reserve University has finished successfully two of three phases to build a major fiber optics-based communications network for its campus. The new network can handle a comprehensive offering of services, including voice, video, data, telemetry, and control signaling. Unlike other networks, CWRUnet takes both single mode and multimode fiber cabling all the way to the desktop. The network can accommodate a wide variety of end-user devices as "information appliances." The network wiring is independent of the operating optoelectronics, and thus, each can evolve independently of the other. The network is built of all off-the-shelf components, including an advanced network monitoring and management system. CWRUnet has been designed to become part of a larger Metropolitan Area Network following the IEEE 802.6 standard. As a high priority, strategic project of the University, it has consistently received the enthusiastic backing of the University community.

TABLE 1

Network Element	Cost	Percent
Premise wiring		
Structure construction	$254.76	13.1
Cabling	$454.60	23.4
Faceplate	$180.16	9.3
Satellite and hub equipment rooms		
Structure construction	$111.05	5.7
Data optoelectronics	$168.21	8.7
Backbone		
Structure construction	$140.80	7.3
Cabling	$72.22	3.7
Project management/engineering	$121.59	6.3
Data optoelectronics/software in each user's system	$438.38	22.6
Total	$1,941.77	100.0

Project Component		
Labor	$748.91	38.6
Materials	$586.27	30.2
Optoelectronics	$606.59	31.2
Total	$1,941.77	100.0

CENTREX or Switch?

Meeting Campus Communications Needs Through Business Partnerships with Service Providers

CAUSE 91

by

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Abstract

Partnerships with local Bell Operating Companies, AT&T and other vendors are a viable path for securing reliable and cost-effective communication services while positioning universities to take advantage of new technologies, such as ISDN and fiber optic. Cal Poly, San Luis Obispo and Appalachian State University have been instrumental in developing partnerships with external telecommunication providers. These partnerships have significantly improved voice and data communications capabilities on both campuses without incurring substantial cost increases. This strategy was initiated when cost-benefit analyses revealed it was more cost-effective to contract for services through off-campus vendors than to procure, install, operate and maintain a local, campus-based Private Branch Exchange (PBX) system. This paper will explore the rationale behind the decision to contract for services; describe the process used to form partnerships with vendors; and measure the progress of partnerships towards meeting university goals and objectives.

Introduction

In September 1987, California Polytechnic State University, San Luis Obispo replaced its 35-year-old CU-701 AT&T rotary analog telephone swi with digital CENTREX telephone service. Through a unique partnership with the local Bell Operating Company (BOC), Cal Poly was able to negotiate a solution that met campuswide needs within existing budgets. This was seen as a critical first step toward implementing an integrated communications environment. Following that initial venture, Cal Poly has held continuing negotiations with AT&T, Call America, IBM, MCI, Northern Telecom, Pacific Bell, Rolm, Ungermann-Bass, U.S. Sprint and other telecommunications vendors to secure the most reliable and cost-effective communication services while positioning the campus to take advantage of new technologies, such as ISDN and fiber optic.

Appalachian State University presentl, ::ases local exchange (ESSX) service from Southern Bell on an annual basis, including FCC access and local service. With the possible exception of intra-campus analog data transmission, the ESSX system has been generally satisfactory. Through a recently implemented partnership with Southern Bell and AT&T, Appalachian was able to upgrade its present telephone system, at the same time reducing line charges to student and administrative users.

Background

In 1984, U.S. District Court Judge Harold H. Greene settled the federal antitrust suit against AT&T that led to what is now called "divestiture." The result has been increased competition among vendors of telecommunications equipment and services. While users benefitted greatly from competitive prices and development of new technologies, divestiture also made planning and managing telephone services far more complex. Deregulation "opened a Pandora's Box of decisions for [universities] to make. Now the judgments in telecommunications are difficult."[1]

That same year, the California State University (CSU) published a strategic assessment of developments in telecommunications and initiated a systemwide project to replace telephone company services with campus-owned and operated digital voice/data systems. These would be key components in the gradual development of full service telecommunications "utilities" at each campus. The proposed infrastructure would provide sufficient capacity to handle projected growth and take advantage of new technologies while integrating available communications media and services. CSU also identified need for a high level telecommunications management position at each campus.

As part of the planning process, each campus would conduct a needs assessment to decide whether the move to a premises-based PBX would be cost beneficial. Three to five campuses would receive additional State funds each year to procure the necessary equipment. CSU replaced or upgraded digital switches on several campuses under this plan before budgetary constraints imposed by the State precluded additional State funding.

In 1986/87, facing budgetary constraints and a pending change of executive management within the information technology organization, Cal Poly indefinitely delayed its participation in the systemwide project. The campus already had a cable plant and had started to develop a campuswide data network encompassing broadband and SNA technologies. Following the recommendations of a campuswide task force, a new "Communications Services" department and manager were established.

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[1]Gene T. Sherron, An Information Technology Manager's Guide to Campus Phone Operations. Professional Paper Series, Number 3 (Boulder, Colorado: CAUSE The Association for the Management of Information Technology in Higher Education, 1990), p. 1

During that year, Cal Poly experienced significant problems with its AT&T electro-mechanical CU 701 CENTREX system. Some long-distance calls to and from the campus could not be completed because of inadequate and faulty trunking. Especially disturbing were reports of blocked calls during emergency situations. Simultaneously, a serious asbestos problem was discovered in the room that housed the existing switch. This problem was significant enough to preclude any AT&T repair people from working on, adding to or maintaining a 35-year-old system requiring almost constant attention. The asbestos had to be abated before removing the old equipment to make room for a new campus-based switch. There were no funds in the budget to cover this costly procedure.

Even if State funds had been available, it would have taken at least two years for the campus to procure a new switch. If the old switch failed before then, Cal Poly users would be without telephone service. Given the urgency of the situation, CSU approved an emergency measure that would enable Cal Poly to contract with the local Bell Operating Company for CENTREX telephone service under the same rate structure as the old switch.

In the intervening three years, no new funds have been allocated for switches at the remaining campuses. Given the current fiscal climate, additional funding seems unlikely in the near term. The asbestos remains in the building that is scheduled for abatement sometime in the next year or two. Anticipating this "worst case" scenario, Cal Poly took time to develop positive working relationships with telecommunication vendors. These efforts are now paying off in several projects designed to meet the university's telecommunications needs within existing budgets. Selecting vendor-supported CENTREX service over a campus-based switch was the first step in this ongoing process.

There is a no equivalent systemwide initiative to coordinate the installation of telephone switches in Appalachian's universities. Each university is responsible for deciding how to provide and fund telecommunications services. However, the state agency that operates the State Information Processing System (SIPS) is available for consultation to the universities. This same agency can assist the universities by taking a leadership role in aggregating demand for specific services and then taking the lead in contract negotiations with telecommunications' vendors to secure the best pricing for these services. One example of this is the reselling of long distance service to students.

The interior telephone wiring is owned by the university and is in good condition. The outside cable plant is owned by Southern Bell. The underground duct system is owned by the university. The outside cable plant is currently providing acceptable voice service, but the cable is an old air core cable which is not suitable for high speed data communications. The university currently uses approximately 40 "hard-wired" circuits for low-speed data processing and alarms. These circuits are leased from Southern Bell, even though both ends of the circuit often originate on campus.

Until mid-1991, voice switching was provided by Southern Bell through an ESSX special assembly rates stabilization plan. However, Appalachian recently entered into a 10-year contract to provide voice switching, data transmission and video through a full service ISDN switch at the central office.

CENTREX or Switch?

The freedom of choice resulting from deregulation gives a college or university one of the biggest dilemmas it will ever face: whether to (1) subscribe, or continue to subscribe, to CENTREX service or (2) acquire a private branch exchange (PBX), or switch, for the campus telecommunications services.[2]

[2]Sherron, p. 5

It is often thought that to own your own is always the best. But when it comes to large university telephone systems this may not be the case. Managing a campus telephone distribution system is much the same as supplying telephone service to a moderate sized community. It involves all aspects of supplying telephone services including procurement, installation, maintenance, replacement, training, adequate staffing, union interaction, and capitalization.

For planning purposes, it is important to consider all these factors. Too often an institution will address the cost and procurement of the actual equipment, while the ongoing staff and support needed to run and maintain the system are either not provided or underestimated.

Additionally, it is important to look at developing a strategy for the future. If there is going to be a partnership with companies in the telecommunications industry, then it might be appropriate to look at a CENTREX solution. During the partnership, CENTREX would be maintained by the company and kept technologically up-to-date with improvements as they became available. There would be opportunities to work together on other projects and programs. Becoming a beta test location for equipment and software would be possible.

<u>Needs Assessment</u>

Before deciding which system to choose, an analysis should be conducted to determine the level and type of services that are needed. Defining <u>basic</u> services separately from <u>optional</u> features makes evaluating results obtained from a Request for Information (RFI) process much easier and more definitive. At Cal Poly, standard features include touchtone service, transfer capability, and three-way calling. Additional features are available for 50 cents per line per month. When real needs are separated from the attractive but not necessarily critical features, the differences between systems are clearer.

<u>Strategic Planning</u>

This assessment should be part of the comprehensive, campuswide strategic plan for telecommunications encompassing voice, data and video needs. It is important to ensure that all connectivity issues have been addressed for all users and all applications. This is of course the most difficult part of the process, since many users do not really know what they need now let alone what they will need in the future. Often this phase of the development requires the services of an outside consultant.

Finally, the plan should be approved by executive management and other campus representatives, including academic deans, faculty senates, and computing advisory committees. The support of the President and other high-level executives as well as the faculty is also necessary to support commitment of the necessary resources to make the project successful.

<u>Cost-Benefit Analysis</u>

A cost-benefit analysis should also be performed for the various alternatives being considered. The CENTREX solution proved to be the most cost effective solution for telephone service at Cal Poly when cost of acquisition, installation, maintenance, amortization, and operational personnel were all considered. Cal Poly currently supports approximately 2,300 administrative and faculty offices and 1,500 student residences (about 3,000 students). The university is locked into a monthly service rate for 2,222 lines (initial September 1987 cut over figure) for 10 years at $12.60 per line. This is considerably below the normal monthly rates of $20 to $30 per line. Additional lines are charged at $15.64 per month. These rates are guaranteed for 10 years and can go down if this becomes a trend in the industry. Minimizing the cost of new lines was critical. In the next few years, Cal Poly would add several new buildings and move from two-person to single person faculty offices without a budget increase to cover the additional monthly line charges.

Table 1 summarizes the cost savings to Cal Poly using the 1987 rates over a 10 year period:

Table 1

	COST PER YEAR IN 1987	COST UNDER 10 YEAR AGREEMENT	SAVINGS PER YEAR
2,222 LINES	$651,668	$336,000	$315,668
200 ADD'L LINES	$58,656	$37,536	$21,120
TOTAL SAVINGS TO UNIVERSITY PER YEAR			$336,788
TEN YEAR SAVINGS			$3,367,880

Table 2 compares the cost savings of Cal Poly's contract service agreement against an average of five similarly sized campuses that own their own telephone/data switches:

Table 2

CAMPUS	PER MONTH	PER YEAR	10 YEAR
Average of five Campuses	$97,153	$1,165,836	$11,658,360
Contract Services (Proposed CENTREX)	$84,446	$1,013,361	$10,133,611
Savings	$12,707	$152,484	$1,524,840

At Appalachian, the CENTREX alternative was selected because it fit into the university's long-term strategy for distance learning and for developing a campus network. Factors investigated in the decision included: Administrative and operations personnel, training, maintenance, facilities, equipment costs, future equipment upgrades, and administrative expenses. Appalachian currently supports 2,356 administrative lines and 1,749 residence halls lines. When the CENTREX full-service ISDN switch with 2B1Q standards was installed in summer 1991, the university signed a 10-year contract with monthly line charges of $14.70 for each administrative line and $12.20 for each student line. The university can add lines at these rates as the demand increases. Should line charges decrease during that time, the reduction will be passed onto the university.

Other Factors to Consider

A campus-based PBX requires space, energy, air-conditioning, cable wiring plant, personnel, and a lot of capital for the initial implementation. All of these needs are normally in short supply on University campuses. Contracting for services eliminates many or minimizes some of these needs.

The fiscal constraints associated with a particular institution are critical. For public institutions, a PBX project costing $10 to $20 million may be very difficult to finance due to the uncertainty of available funds, especially given the current decline in tax revenues.

Not to be overlooked is the necessary capital to replace campus-owned switches in the future. Today, change is constant in the telecommunications industry; many digital switches acquired just a few short years ago are already obsolete. With an effective life span of three to five years, campus-based switches financed over several years probably will have to be replaced or upgraded before they are fully financed.

With CENTREX, expenses incurred in software upgrades, hardware upgrades, obsolete hardware and interconnection equipment are the responsibility of the service provider and are included in the monthly line service charge which may be subject to change, depending on the contractual agreement with the provider.

By developing partnerships with telecommunication vendors, colleges and universities can avoid large capital outlay expenditures while providing enhanced services to users. For example, many service providers are presently upgrading to ISDN and are planning for broadband services using ISDN standards. Since the cost for the services are based on a monthly service charge, large initial capitalization is not necessary. For campus-based switches, upgrades to new technologies may be priced so high for some equipment as to be financially inappropriate without another new switch being acquired. In contracting for services, you pay for what you get. It is not necessary to pay for equipment that is not being used or that is only used infrequently.

Another key factor in the decision to procure campus-based switches is staffing. Most universities greatly underestimate the number of personnel needed to operate what is essentially a small telephone company. Inadequate staffing can lead to reliability, connectivity, and operational problems in the future. It can also increase the cost of the service. Using estimates from other universities that have purchased switches, Cal Poly would have required up to 10 additional staff, increasing monthly line charges by about $12.

By contracting for CENTREX service, the local telephone company is responsible for maintenance from the telephone switch downtown to the actual jack on the wall. This service is included in the monthly line charge. When the campus owns the switch, it has to assume total responsibility for all campus wiring inside and outside of buildings. This is one of the most expensive aspects of any campus communications system.

Also, local service providers offer unlimited, 24-hour back-up support in case of major telephone service interruptions. For example, there were 17 trucks and 30 telephone company technicians to make sure the cut over of the Administration Building was done in a timely manner and without service interruption. This service provides an unlimited back-up capability that is not available from a small staff of in-house technicians.

The growth dynamics of any telephone utility requires the matching of customer lines to trunk lines for proper CCS contention ratios. This is constantly changing, difficult, costly and time consuming. The service provider guarantees the university that if contention ratios become a problem, they will be corrected by providing additional access within a short time frame. There is no extra cost for the necessary equipment upgrades, conversion and installation, and additional space is not required on campus to house the additional equipment.

It is also important to consider how a particular institution plans to handle other communication needs. For campuses without any communications infrastructure, there may be advantages to purchasing a campus-based switch to support multiple needs. By now, most universities have begun to implement data networks and video distribution systems. Vendor-provided CENTREX is a telephone service that can be easily and effectively integrated with existing communication systems. Finally, if physical space is a problem, the fact that the equipment for the vendor-based switch is located off-campus is beneficial. A campus-based switch requires appropriate space, security and environmental controls to ensure continuous operation.

Local exchange carriers are often overlooked because, based on past experience, they are perceived as expensive and inflexible. Yet, with proper needs assessment and evaluation, their services can play a vital role in the university's total communication needs.

The following checklist can help determine if your organization is a candidate for CENTREX service rather than a PBX:

> 1. Does your organization have two or more offices in one city (with over 100 phones in each office)?
>
> 2. Is it significantly easier to obtain an annual operating budget rather than a capital budget for the purchase of telecommunication equipment (i.e., does your company much prefer to "pay as you go")?
>
> 3. Is your senior management overly concerned about the cost of telecommunication personnel (analysts, technicians, or operators)?
>
> 4. Are you finding it especially difficult to recruit competent telecommunication personnel?
>
> 5. Do you wish to provide a centralized operator system to help your customers or employees?
>
> 6. Do your offices occupy especially expensive floor space?
>
> 7. Do you expect to move a major office within the next three years?
>
> 8. Is your company in a business where frequent changes in the number of personnel are expected?
>
> 9. Are you willing to pay the telephone operating company to configure the corporate telecommunications network and to administer all your moves, additions, and changes?
>
> 10. Is your organization's management concerned about making a commitment to a PBX vendor that may not be able to keep up with rapid technological change?
>
> Two or more Yes answers to the above questions indicate that your organization should at least consider CENTREX service. ... If you have five Yes answers then you should start a serious evaluation of CENTREX versus a PBX-based solution.[3]

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[3]John R. Abrahams, Manager's Guide to CENTREX (Norwood, MA: Artech House, Inc., 1988), p. 67-68

Industry Partnerships

The relationship between universities and industry is basic. Universities train students to enter the world of work upon graduation. However, to be productive employees, students must learn their advocation on state-of-the-art equipment used by those industries. This is even more critical since information technologies are now a fundamental part of nearly every aspect of modern life. Unfortunately, the nature of institutional funding cycles and procurement processes prohibit a rapid turnaround in technology acquisition. Therefore, it is to the advantage of industry to make such technology available to the university at lower cost or through special arrangements. This can minimize the time lag, speed up the educational process, and result in product innovations which directly benefit the industry sponsor.

Obviously, the primary benefit to institutions is direct industry funding or in-kind gifts to replace, upgrade and expand campus systems and facilities. But there are indirect benefits as well. By taking a proactive approach to developing partnerships with specific vendors, the university can effectively control its own destiny. At the same time, partnerships can bring the institution into the forefront of technology on a local, regional or national platform. This can generate interest from other vendors and increase the institution's visibility among its peers. This often results in further partnerships and projects which can aid the university in development, recruitment and other critical activities. Savings realized by the university can be reinvested in other projects designed to enhance the telecommunications infrastructure, including data communication networks.

When working with vendors, it is necessary to show them detailed cost/benefit data using competing technologies to explain how their particular product fits the overall scheme. Do not take it for granted that vendors understand this picture. After years of "tariff" training, they may not fully realize the benefits available to them under a business partnership arrangement. Secondly, it is important to demonstrate direct benefits to the business partner. For example, most long-distance calls by Cal Poly students occur in the evenings between the hours of 6:00 p.m. and 11:00 p.m. This happens to coincide with the time long-distance providers in San Luis Obispo had a great amount of excess capacity. Through negotiations with these vendors, Cal Poly was able to substantially reduce interstate long-distance charges. Other benefits for telecommunications vendors include guaranteed long-term revenue streams; additional revenues for extra features; revenues for services offered during non-peak demand hours; opportunity to test and develop new technologies, techniques, and products in an actual working environment before marketing these to other customers; and user identification and familiarity with their products.

Appalachian is currently working with the State Information Processing Services (SIPS) to develop an RFP to aggregate long distance service for students. The university can substantially reduce interstate long distance rates to students by aggregating the demand across the entire 16 campus university system. This service should be available on the Appalachian campus by fall 1992. This will be a mutually beneficial situation for both the long distance carrier as well as the university. Another example is distance learning. Distance learning is an area of increasing interest in higher education. AT&T, Southern Bell and BellSouth have a 10-year partnership with Appalachian to install an ISDN infrastructure for distance learning in a rural environment. The ISDN switch is the core equipment of the project. This is a cost-effective alternative to other current technologies over which distance learning is being conducted.

Developing partnerships with service providers requires a great degree of negotiation and public relations to be successful but the rewards can be great. All local exchange carriers or long-distance service providers are potential partners. Partnerships can take many forms. They can range from small-scale to large-scale projects. The extent of an institution's involvement in partnerships depends upon the resources and other elements which can be brought together by the institution and its industry partners. Former students employed by the vendor can be key. They can work within the company to generate interest and enthusiasm for the university and its project. An industry advisory council or board is also helpful in successfully building and sustaining industry contacts. Finally, the campus should identify alternative approaches in case the partnership option proves unsuccessful or short-lived. In general, however, if an institution can deliver, industry will continue to be supportive of that institution's goals and objectives. In other words, success will breed success.

What the Future Holds

Appalachian is pursuing a partnership with AT&T, BellSouth and Southern Bell utilizing full service ISDN capabilities. The project will address the educational needs of rural schools through distance learning and will be accomplished over the twisted copper pair telephone network. Interactive video, data and voice will give these rural mountain schools an opportunity to gain access to otherwise inaccessible educational tools and resources. It is an alternative to fiber optic, microwave, satellite, and cable technologies. The program has been labeled *Impact North Carolina: 21st Century Education*. It will initially start in six counties in northwest North Carolina which surround Appalachian State University. The test bed will be Appalachian's nationally award-winning public school partnership.

Through available and emerging ISDN technologies, pupils and teachers in participating schools will share resources and work together. They will have access to Appalachian's resources, work with university students and faculty, and tap into global communications networks. Teachers will find unprecedented access to continuing education, and student teachers will obtain immediate feedback from faculty supervisors on the Appalachian campus.

Cal Poly is actively pursuing partnerships with several vendors on a number of projects encompassing a wide range of technologies. The following are just two examples:

ISDN

Pacific Bell recently upgraded their San Luis Obispo CENTREX switch to provide ISDN voice-over-data service. Unlike a traditional modem, the ISDN telephone can support simultaneous voice and data transmissions. This digital connectivity is expected to greatly improve voice services and computer access for students, faculty and staff members.

Over the next three years, Cal Poly will test the new service in 200 faculty offices under a joint research and development project with AT&T and Pacific Bell. AT&T is donating the telephone instruments and other equipment necessary to link faculty to the campus network, mainframe, library and other computing resources. ISDN is an ideal solution for buildings that are difficult to wire using other network technologies because it uses existing telephone wires.

ISDN is expected to improve computer access for students living in campus residence halls. Like most campuses, Cal Poly has a limited number of on-campus microcomputer labs. ISDN will allow the campus to supplement these resources by enabling residence hall students to access computing resources and databases linked to local, national and international networks. While a campus-based switch could support ISDN in residence halls, only the local telephone company can extend this service into student residences, apartment complexes and individual homes in the community.

Cable Television

Cable television is another telecommunications media that is needed in the student residence halls. Cal Poly is currently reviewing proposals to provide students with standard cable television services as well as campus- and satellite-generated educational programs and informational services. As with ISDN, the goal is to eventually extend these services to homes in the local community. Also, low cost digital service will make distance-learning and teleconferencing between other campuses and institutions financially attractive. This could have cost savings implications for travel budgets in the future. Having the entire campus and community wired digitally and the switch located centrally will facilitate these efforts as well.

Other current projects involve voice response, imaging, voice mail, fiber optic, and other telecommunications systems. In each case, Cal Poly is working with the vendors to maximize services and minimize costs. By continuing to develop partnerships and enhance existing services, Cal Poly will eventually achieve the comprehensive and fully integrated telecommunications utility envisioned for California State University campuses after deregulation.

In five years, Cal Poly must terminate or renegotiate its current 10-year contract for CENTREX service through Pacific Bell. Demand for increased bandwidth to support campus data communications and a significant increase in telephone lines on campus will require the university to reevaluate the CENTREX solution. Over the next few years, Cal Poly expects to pursue various solutions to meet its needs, including CENTREX, switch alternatives and direct datalinks to vendors such as MCI and U.S. Sprint.

Conclusion

Choosing between CENTREX and a switch for any particular institution will depend on all of the factors discussed above. Timing with regard to the need for services also plays an important role in the decision making. In 1987, Cal Poly had to replace its telephone service and could not afford to wait until a campus-based switch was procured. Pacific Bell was able to meet the university's immediate needs within existing budgetary constraints while providing a platform for meeting future needs with ISDN, fiber optic and other emerging technologies. A few years later, Appalachian State University had to have its distance learning project on line within a few months and did not have the luxury of waiting to have its own switch installed. The university was able to negotiate with Southern Bell to upgrade its 5ESSX switch to include ISDN capability and reduce the cost of telephone lines to the university. In the end, the decision to choose CENTREX proved to be both mutually beneficial and cost-effective for the universities and their respective partners in industry.

Campus Networking: The Human Side

Cause91

Prepared by

James H. Porter

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Presentation Abstract:

The technical aspects of networking, while challenging, pale beside the challenge of successfully introducing networking, electronic-mail, resource sharing, etc., to diverse, frequently inadequately prepared, user organizations.

The paper will (1) review lessons learned at the University of Chicago as we studied, planned and implemented local area networks into academic, administrative and auxiliary organizations such as the Humanities Division, President's Office and Oriental Institute, covering 800 offices in 20 buildings; (2) outline our networking project organization which included telecommunication, academic computing and administrative computing personnel; and (3) share the networking methodology we developed and followed in these projects.

The presentation will emphasize building management awareness and support, coaching, training, and local support issues, and we will discuss the relationships between our voice, data and large-scale computer organization.

This paper builds upon the Cause90 presentation titled Desktop Power: Issues and Opportunities.

CAMPUS NETWORKING: THE HUMAN SIDE

Presented at Cause91 by James H. Porter

Introduction:

While the *Campus Networking: the Human Side* presentation at CAUSE91 followed the published abstract, this paper, which was written several weeks after the conference, presents the more important ideas covered in the presentation as four short articles:

I. So you want a network.

II. You expect me to do what?!

III. You can lead a horse to water...

IV. Electronic-mail for senior administrators.

I. So You Want A Network.

The calls came in at about the same time:

- Ken, an Associate Dean for Administration in one the University's professional schools called.

  Ken Jim, our network wiring was just installed. What do we do now?

  jhp What kind of wiring plant was installed?

  Ken I don't know.

  jhp Will you use AppleTalk or Ethernet?

  Ken I don't know.

  jhp Are you connected to the campus-wide network?

  Ken I don't know.

  jhp What are you going to use for e-mail?

  Ken I don't know.

- Sue, Associate Dean for one of the large divisions, had a similar problem:

  Sue Jim, we would like to investigate providing networking to our division. Where do we start?

  jhp That's great. What will you use the network for?

  Sue Electronic-mail. Printer sharing. Some of the departments may want to share some data. We are getting pressure to provide networking from several directions. E-mail has become important to us as we compete for faculty…

  jhp What do you know about network design and installation?

  Sue Nothing, other than it is expensive. How much will it cost?

jhp What kind of a network do you need?

Sue If I knew that, I might not be calling.

Ken and Sue were victims of our past successes in installing networks. At the University of Chicago we are very good at installing local area networks—either with in-house staff or through contractors; however, in the past we have been dealing with what I categorize as knowledgeable network users. They knew what LAN they wanted and could manage it once it was installed. You might say that we were installing networks as if they were telephones—where it assumed that the person calling for a new handset knows what he or she wants.

Since Ken, Sue and others at the University needed to understand how networks are analyzed, designed, installed and operated, we developed a *Network Planning Framework* which is represented by the diagram shown in Figure 1. (Astute readers may notice that the *Network Planning Framework* is similar in appearance to the classic "systems development life cycle.")

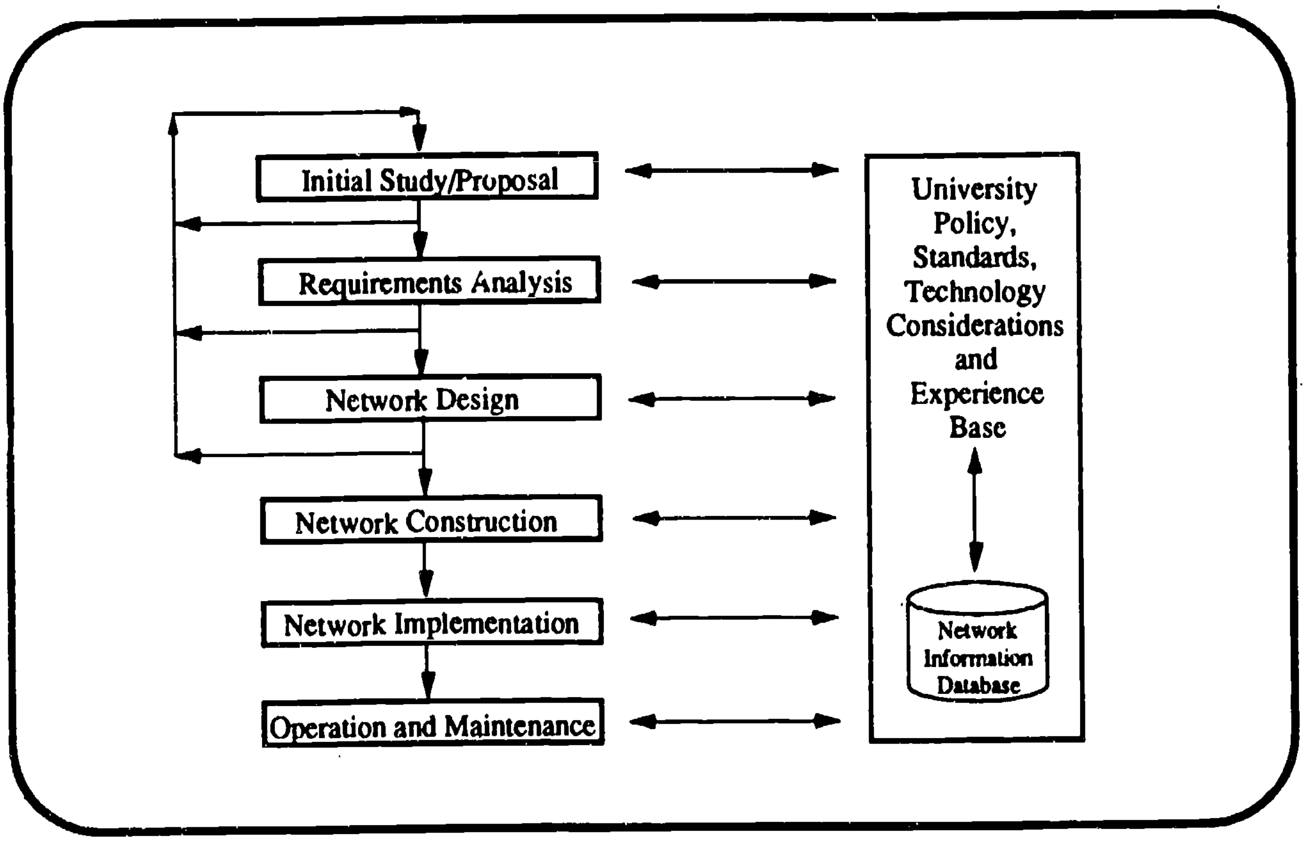

Figure 1. Network Planning Framework

	Network Acquisition (One time costs)	Network Operation (Annual Costs)
Personnel	Planning & Design Equip & S/W Installation Project Oversite Training	Administration Problem Correction Security (Training)
Software	Electronic Mail Network Management	Maintenance Upgrades
Equipment	Servers Network Boards	Maintenance Upgrades
Infrastructure	Cabling Closet Equipment Connections Site Improvements	Maintenance Upgrades

Figure 2. Network Cost Model

To compliment the *Network Planning Framework* diagram, we have developed documentation for each step in the framework which covers:

- Purpose. Why do the activities described in this step.
- Responsibility. Who is supposed to do the work.
- Deliverables. What is produced at the end of the step.
- Reference Documents and Standards
- Reviews What reviews are required for this step.

While the *Network Planning Framework* is not an official University document, it, along with other materials such as the *Network Cost Model* shown in Figure 2, are invaluable training and awareness building tools which we use in presentations to management personnel and non-technology aware users.

II. You expect me to do what?!

Setting expectations is, I propose, more important to information technology acceptance and usage than formal training. Three hypothetical cases based on my own observations and experience help illustrate this point:

- Networking and electronic-mail were introduced to Mary's department. Mary and her peers received formal training in e-mail. They found little use for e-mail, the network and other new technology. Departmental management had no experience with e-mail, networks and little experience with advanced computing other than using their microcomputers as typewriter replacements.

  Management shrugged their collective shoulders when Mary and her peers did not use e-mail. E-mail was not part of management's experience base and they were not prepared to set an example by using it themselves or to insist that the rest of the department use it.

- Later, Mary transfered to a new unit where electronic-mail was important to the department's operation. In her new job Mary was expected to use e-mail. Even though there was no formal training available, Mary learned and used e-mail.

- Mary had a co-worker, June, in her first department who very quickly mastered the network e-mail. While June's peers did not use the new technology, it did not keep her form moving forward.

In analyzing these three cases, please refer to Figure 3, *Expectations and Technology Acceptance*. Mary, in her first department, was in a situation of low external expectations. Management and peer expectations for e-mail were low or nonexistent. We can also assume that Mary had low internal expectations. Little wonder that e-mail was not used.

In her new department, Mary was in a situation of high external management and peer expectations. It was just expected that she would learn and use e-mail. Assuming that Mary still had low internal expectations, we can guess that she became an e-mail user with sufficient skill to meet management and peer expectations.

June was one of the special individuals we find occasionally. She had high internal expectations and was going to learn the new technology, whatever it may have been. Internal expectations, sometimes called motivation, is difficult to set. External expectations, however, can be changed.

External Expectations

Management literature tells us that it is important to get senior management support for major new projects. Our experience tells us that when management expects something, we do it. Somewhere, I remember reading that whatever gets measured gets done—which is a way of communicating expectations. This leads me to the conclusion that if management expects a system to be used, it will be used. If management itself uses the system, then the system is even more likely to be used.

If your peers all use e-mail, word processors, spread sheets, etc. in doing their work, they are setting expectations for you to do the same. If your peers have no experience with a particular technology and do not use it, it is unlikely that you will use it.

You can receive excellent, timely training in how to use an application but still not use the application if there are no existing management or peer expectations that you will use it. It has been my experience that management expectations can change peer expectations, peer expectations can influence management expectations and individual expectations/motivation, have little impact on peer and management expectations.

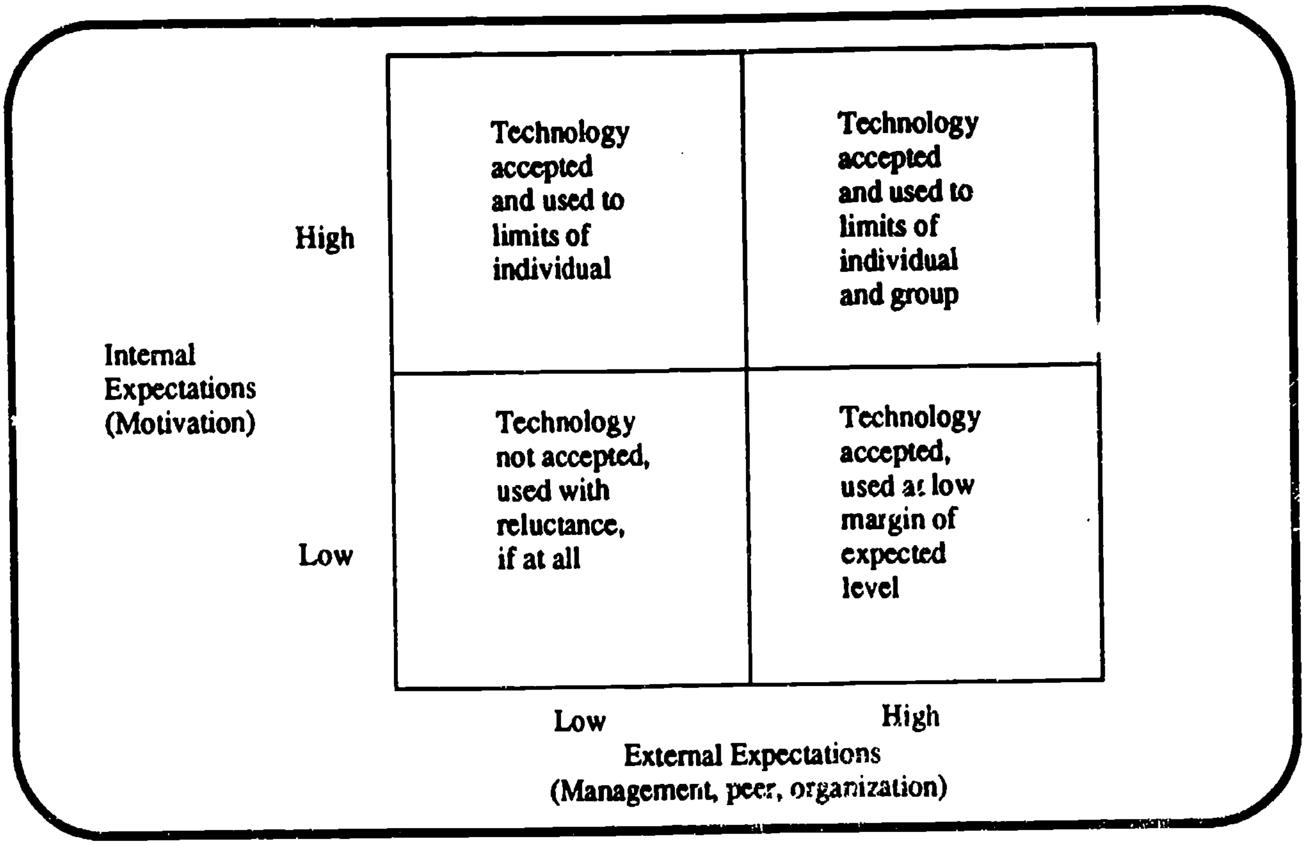

Figure 3. Expectations and Technology Acceptance.

I suggest that we, as information technology professionals, will do more to advance acceptance and use of new technology by focusing on helping management and peer groups set their expectations for the new technology than we will by only developing and offering comprehensive training programs. My hypothesis can be summarized as:

> Training without proper expectations is wasted.
>
> Expectations without formal training will lead to self learning and, when offered, successful formal training.

Setting expectations, which can not be adequately covered in this paper, includes visible senior management advocacy and use of the technology, training managers in what the technology can do, incorporating technology skill requirements in hiring and promotion criteria, etc.

III. You can Lead a Horse to Wat‹›r...

You can put a computer on an executive's desk but you can't make him or her use it.

Why? In my opinion, there are three requirements that must be met for managers/executives to use microcomputers, networking, video conferencing or other "new" technology:

The system must be easy to use.

I was recently discussing with one of out system analysts the problem she was having getting senior managers to use one of the University's "corporate" systems. It seems that she trained several managers in how to use the system. In her mind the training has been successful because, before she left their offices, the managers demonstrated that they could get to the monthly data they had requested access to.

She went on to explain that when, after two months, she looked back at system logs, these users had not accessed the system for the data that was so important to them. All that training, she bemoaned, and the system was not used.

How, we asked, did these managers access the system? Well, first, they invoked a terminal emulation program. Then they logged onto the mainframe system—which required a password. Then, she explained, they logged onto CICS session within the application—which required another password. Then they requested a CICS transaction which required a 9-digit account code, then......

Well, to make a long story short, these typical managers were comfortable using their minicomputer for simple word processing and limited electronic mail. Based upon my own experience with the same managers, anything more than "point and click" and they are lost.

In this case, the data was, according to the managers, important to them; however, they did access the data because the system was not easy to use.

The application must be meaningful.

Even without an example, it is "intuitively obvious" that managers are not going to waste time using an application that is not meaningful to the operation of their department, even if it is easy to use.

In my discussions with systems designers, in articles on executive information systems, and in other systems design references, there is always agreement that systems for managers must be easy to use. Sometimes, these sources state or imply that the application must meaningful; however, based upon my experience at the University and as a consultant, having an meaningful, easy to use system did not guarantee its use. Why?

There must ba a critical mass of functionality.

As a consultant, one of my clients had a similar problem with managers not using a system. The client had gone to go to great pains to make system access as simple as possible. The manager only had to enter one command which brought up the desired data. Several key strokes and the data was on the screen. Everyone agreed that the data was important. In this particular organization, electronic mail was not part of the culture and the managers did not routinely use word processing applications.

For this client, not only was the meaningful, "easy to use" application not used, the microcomputer on each manager's desk typically went days without being turned on. Why?

Required for Senior Management
to Use the Computer on their Desk

1. Easy to use applications
2. Meaningful applications
3. Critical mass of applications

Figure 4. Requirements for Senior Managers to use the Computer on their Desk

While easy to use, meaningful applications are necessary for manager acceptance and use of a microcomputer, these two attributes are not sufficient. The requirement usually not understood is that there must be a critical mass of functionality on the computer. The computer must become so important in the manger's/executive's life that the first thing they do every morning is turn on their computer, leave it on all day and, routinely use it during the day.

Figure 4, *Requirements for Senior Managers to use the Computer on their Desk*, summarizes these points.

IV. Electronic Mail for Senior Administrators

We have recently successfully introduced electronic-mail to the over forty of the University's senior administrators and their staffs including the:

President

Provost

Vice President for Business and Finance

Vice President for University News and community Affairs

Secretary of the Board of Trustees

Secretary of the Faculty

Director, Financial Planning and Budget

This was an important project since, once senior administrators began using e-mail in their routine communications with academic and administrative personnel, we would be changing University-wide expectations for technology use.

Under the sponsorship of the Vice-Provost for Information Technology, we followed the Network Planning Framework as discussed above. All of the senior administrators covered by the project were Macintosh users. Several were experienced e-mail users. At the beginning of the project, each administrator, his or her secretary and a LaserWriter were typically connected into a small, freestanding, three node local area network.

We addressed the ease of use and meaningful applications requirements discussed above by providing a "point and click" microcomputer-based electronic mail system. The critical mass requirement was addressed as follows:

- Every effort was made to connect all direct reports and their staffs to electronic mail. We helped these direct report organizations connect to the campus network by providing training, consulting support, demonstrations, supervising contractors, pulling network wiring, establishing a telephone bridge to link remote local area networks to the campus backbone, etc.

- We increased the skill level of support staff personnel by providing individual and formal training in computing fundamentals, word processing applications, and e-mail. Increased skills, we believed, would lead to increased usage.

- Electronic-mail was, in general, introduced to an administrator only when:

  (1) his or her secretary was ready to provide day-to-day technical support for the administrator; and

  (2) all of his or her direct reports were available via e-mail.

Timing was key. For each administrator, we designed the process to have in place a dynamic, active group of e-mail users, including all direct reports, before he or she was connected to the network. In several instances we used the administrator's anticipated e-mail use to co-opt non-users into the network (setting expectations) and then, once they were in, used the direct reports using e-mail as a way to set expectations for the administrator.

As mentioned above, the project has been very successful. All of the senior administrators and their staffs covered by the project use electronic-mail. For many, e-mail is important. For a few, e-mail is indispensable.

Copies of the presentation, the Planning Framework and supporting documentation can be obtained from the author. Contact him via the Internet: j-porter@uchicago.edu. His address is Jim Porter, University Computing Organizations, 1155 East 60th Street, Chicago IL 60637.

Track VI
Managing Information Technology for Academics

Co-coordinators: Marion Ball and Steven Gilbert

The traditional academic computing center is being transformed as it works to manage technology for academics. Scholars will benefit from scholarly workstations, with system-generated, individualized user-friendly tools. Access to academic programs will no longer be restricted by geography or availability of instructor, room or student. Texts now obsolescent because their printed format inhibits change will be supplemented with or supplanted by electronic textbooks. With data communications linkages making the workstation a window to the world, faculty and students can collaborate with peers worldwide in a shared learning laboratory.

Multi-media courseware is measurably affecting the redefined classroom, with innovations such as voice response systems in teaching foreign languages and laser technology in geography. Technology can make information available when, where, and how it is needed. The papers in this track address the profound changes academic computing is stimulating.

Technological Change: The Impact of Computers on the Teaching and Learning of Writing -- The Results of the National Project

Max Kirsch, Harvey Wiener, Michael Ribaudo, The City University of New York

Introduction

During the last five years, we at the City University of New York have experienced a tremendous growth in the use of computers in all disciplines, and particularly in the field of composition studies. We were and are aware that as this is happening, we are not alone. Composition studies over the country have generated considerable excitement for computers as teaching aids. Indeed, many campuses now consider regular computer use the foundation of college writing classes.

We, along with many other institutions of higher education, are also aware that as computers are actively integrated into the curriculum, too little attention is paid to the effect of their use or, for that matter, whether or not teachers, who are the backbone of the educational process, know how to use them. This has happened for two reasons: first, institutions generally find it easier to find funding for technology than hiring personnel, and second, the excitement over the possibilities of technology sometimes overshadows some basic concerns about cognition and learning. When we started to look at the literature on the use of technology in the writing classroom we found that reports on the benefits or dangers of word processing on the teaching of writing were highly generalized, based largely on impressionistic observations of classroom outcomes or driven by enthusiastic remarks made by converted instructors. These reports did little to calm the anxieties of composition teachers who were (and are) uncertain about how to use computers in the writing classroom, or the anxieties of less well-off institutions who, while noting the national trends, were not as confident about the results of such an investment.

And there was another concern. Those of us who have taught for enough years have witnessed the comings and goings of new technologies that never became integrated into instructional use. You need only to see the piles of overhead and opaque projectors, televisions, movie projectors and cassette recorders that are gathering dust on the shelves of the storerooms that administrators are trying to turn into offices to know that these technologies were never fully integrated into the classroom.

We did not want to see that happen to the computers that teachers were presented with when they returned from summer vacations and even more importantly, we did not want to make large investments in technology that no one knew what to do with. Our goal for the National Project on Computers and College Writing was to do a large scale assessment of the use of this technology, and if we found that it indeed worked, to effectively disseminate workable curricular solutions in the field of composition studies.

The National Project on Computers and College Writing

In 1987, recognizing the University's leading role both in skills assessment and the curricular integration of computer technology, the Fund for the Improvement of Post Secondary Education (FIPSE), part of the United States Department of Education, invited us to propose a wide reaching project to assess the use of microcomputers in the college composition class. In response, the City University's Office of Academic Computing and the Office of Academic Affair's Instructional Resource Center proposed the National Project on Computers and College Writing, which was funded for a three year period beginning in the fall of 1987. The initial goal of the project was to identify a number of representative institutions across the country that had already integrated computers into the writing curriculum, design a research methodology that could assess the effectiveness of this technology for instruction, and develop ways of disseminating the results to other institutions embarking on computer based approaches to writing instruction.

Word processing methodology varies widely from one college program to another. We set out to examine the nature of that methodology on diverse campuses. Then, we wanted to study the effects on student writing of particular uses of the computer in the composition classroom, thereby linking methodological strategies and assessment.

From the beginning it was clear that dissemination was as important as the empirical assessment. From the perspective of an English department or a writing program, the "how-to" must precede the investigation of programmatic outcomes. By looking at how various institutions have implemented computer-based approaches to writing instruction, and by providing information on daily activities in writing classes, we felt that we could be of significant help to the writing community as a whole.

In choosing the sites, we focused on schools with mature -- if any new program can be deemed mature --programs with well articulated goals ground in a clear theory of writing instruction. We were also conscious of providing geographical representation and of representing the diversity of higher education in the United States. Our immediate problem in the selection process was that almost 100 institutions responded to a call for participation, and we were only funded for six. The project's board and staff, meeting together in a hotel room over one weekend in 1987, was unable to pare the proposals submitted to that number. Realizing that the project needed to be larger than anticipated, we approached Apple Computer Inc. for additional funding to include 15 schools. They responded affirmatively, and the following institutions were chosen and agreed to participate:

BALL STATE UNIVERSITY/ INDIANA
BLUE MOUNTAIN COMMUNITY COLLEGE/ OREGON
BOWLING GREEN STATE UNIVERSITY/ OHIO
COLORADO STATE UNIVERSITY/ COLORADO
COLUMBIA COLLEGE/ ILLINOIS
UNIVERSITY OF CALIFORNIA, SANTA BARBARA/ CALIFORNIA
FAIRLEIGH DICKINSON UNIVERSITY/ NEW JERSEY
GREENFIELD COMMUNITY COLLEGE/ MASSACHUSETTS
INDIANA UNIVERSITY/PERDUE UNIVERSITY/ INDIANA
LAGUARDIA COMMUNITY COLLEGE,CUNY/ NEW YORK
MASSACHUSETTS INSTITUTE OF TECHNOLOGY/MASSACHUSETTS
MERCER UNIVERSITY/ GEORGIA
OHIO STATE UNIVERSITY/ OHIO
UNIVERSITY OF SOUTH CAROLINA/ SOUTH CAROLINA
UNIVERSITY OF SOUTHERN CALIFORNIA/ CALIFORNIA

Once we identified the sites, staff and advisory board members helped develop a research design that could be applied across the institutions involved. This design was oriented to ask some global questions about technology in the classroom. We also encouraged site specific research that focused on other questions that are now being addressed, such as, Can pencil and paper methods be combined with computer technology in the same classroom? Are there advantages of one over the other? Does fascination with the computer detract from the business of writing? How are the utilities of word processing -- spell checkers, formatting, style checks -- affecting the work of revision? Are students writing better? How does the word-processed paper influence the teacher's perception of good or bad writing? How do collaborative and process writing, enhanced by the computer, affect the notions of authorship and assessment? And how does the introduction of this technology change the role of instruction and curriculum in the classroom? What additional resources are needed?

DATA METHODOLOGY AND ANALYSIS

We put together a research plan that called for each site to identify six sections of Fall 1988 freshman writing classes for inclusion in the project. In theory at least, we wanted the six sections to be comprised of similar students, the major exception being that three of the six sections would be taught using computers and three would be taught using traditional teaching strategies without the use of computers. The sites were urged to use caution in assigning faculty to teach the six sections so as to not introduce additional potential bias -- the so called "teacher effect" -- and were asked to be sure that all sections, both computer-based and computer-free, followed as uniform a curriculum as possible.

We wanted very much to include multiple outcome measures in our study and chose or constructed a series of both attitudinal and performance criteria designed to measure change. We chose a one semester, pre-test, post-test design where all students would be tested during the first few days of the semester and then again at the end of the semester with the same set of instruments or with equivalent alternate forms of those instruments. Each site used the same essay prompts, the Descriptive Test of Language Skill's Sentence Structure subtest, writing anxiety and attitudinal questionnaires, and a background questionnaire. Faculty were asked for information on their teaching experience and philosophy, the experience with computers and their attitudes about their use in the classroom. We were sensitive to the problems inherent in trying to measure change over the course of one semester. We also realized that the classroom cannot be considered a true laboratory in which we could possibly control for all possible sources of variation or factors that might be contributing to differences between the groups; in our statistical analysis of the quantitative data, we attempted to isolate those factors that might have contributed to the observed differences.

Our final study sample consisted of almost 1,700 students - fairly equally distributed in both the control and experimental sections - 845 in the non-computer based sections, 850 in the computer sections.

We can say from an empirical base that computers do help student writers. Students in our study exposed to computer-based writing courses showed a significant decrease in writing apprehension and increase in writing ability (as measured by gain scores on analytically scored essay examinations) relative to their counterparts exposed to traditional writing classes not exposed to computers. Although we did not find a significant difference between the two groups when we looked at the essays scored holistically, we believe that this is a problem inherent in the holistic scoring protocol, which may actually be masking differences that do exist. Holistic scoring schema are generally not sensitive enough to measure the small differences that characteristically occur over a one semester period. When, for example, an MIT student scores 6 (on a 1 to 6 scale) on the pre-course essay and scores the same on the post-course essay, gain is not reflected. We were aware of this problem during the project's design (it is a common one in writing assessment) and built in the more costly and time consuming analytic scoring protocol for approximately 10 percent of the essays, providing for a more exacting analysis. The essays selected for analytic scoring were sampled at random from the four "blocks" of our research design (i.e. control group/pre-test, control group/post-test, experimental group/pre-test, experimental group/post test). We are presently scoring all of the essays analytically, and this will give us a larger data base, allowing for college by college comparisons of the analytic scores.

Significant gains in writing ability as measured by the holistic scores were found for certain subgroups within our population and we expect these differences to become much more pronounced when we have analytic scores available for every essay. At three of the project sites, students exposed to computers showed significant holistic improvement relative to their control counterparts. These three sites as well as some number of additional sites are almost certain to exhibit significant differences when the control vs. experimental gain in analytic scores are compared. In addition, within the experimental (i.e. computer exposed) group, basic skills students showed significantly greater holistic score gain than did their non-basic skills counterparts. This is an important finding and will most likely be also much more pronounced in the analytic comparison. This finding speaks strongly to the utility of computers in remediation, adult and continuing education, and at community colleges.

The analytically scored essays of students at both ends of the ability dimension (as measured by writing pre-test score) tell a very interesting tale. Students in the computer group differed markedly from students in the control group in post test performance with that difference most pronounced among the students who entered least prepared. The most well prepared students exposed to computers also significantly out performed their counterparts in the control group on the post test. No significant difference was found for students in the middle ability range.

Our biggest research challenge, after the analytic scoring is completed, is to integrate the qualitative data with the quantitative information. The quantitative data alone do not tell us *why* students improved or why improvement was more significant at some institutions than at others. We will be looking at faculty and student logs and at other ways at getting at these questions. As we indicated, the data are very complex. We mentioned only a few of the considerations that arise about the interpretations that the data suggest. Although we feel comfortable about the conclusion that computers are beneficial, we have much work to do on questions of why they are beneficial and how our findings can be applied to institutions that are now beginning to use this technology in their classrooms. We are operating with the assumption that while the technology does work, the real attention should be focused on the teaching of composition and the use of computers as tools in this process.

Future Directions

What has emerged from the National Project is a cohesive network concerned with the use computer technology in the writing classroom at the post secondary level. The National Project's monograph, *Computers and College Writing: Selected College Profiles* presents descriptions of forty-nine writing programs around the country that incorporate word processing in composition classes. It is clear from these descriptions that schools are eager to maintain a discussion of the use of technology in education, and the assessment that is thereby warranted and necessary.

What has also emerged is the need for educational leadership in developing computer uses. The fifteen colleges and universities involved as sites have met on a regular basis and have shared their experience of the assessment and demonstration process. The sites also noted the growing number of requests for assistance from both institutions of higher education and secondary schools in their area. Educational institutions need help in planning and implementing instructional efforts involving computer technology, and these needs point to the future of the Project.

The Next Phase

The next phase of the National Project will establish centers of excellence that foster and enhance the collaboration among institutions of secondary and post-secondary education. We think that this direction is necessary for a number of reasons. While colleges and Universities are engaged in integrating technology into the writing classroom, secondary schools have yet to jump on the bandwagon. And although it is widely acknowledged that writing is a critical skill for success in school and career, it is equally acknowledged that many students are coming to college with deficient writing skills. Many colleges and universities are now reassessing their ability to integrate students who enter without basic skills, particularly writing. The costs of remedial curricula have sky-rocketed during the last decade as institutions of higher education struggle to prepare students to handle content-based work. Attention has turned to the high schools: how can existing methods and curricula be improved to better prepare students for college?

We believe that it is time for secondary schools to reap the benefits of the educational advances made possible by the computer. Writing instruction with the computer has changed college students' lives as learners; a head start in high school with the use of this technology and pedagogy will go far toward strengthening the writing skills necessary for successful advancement.

We envision the National Project centers as catalysts for training, demonstration, research and assessment in their geographic areas. They will host workshops, sponsor competitions for the establishment of new computer based writing programs, establish credit-bearing courses with graduate institutions, assess program implementation and results, and host local, regional and national conferences. The Project is developing a monograph series for national distribution. For our part in New York, we presently have a proposal into the Federal government for a collaborative project that will redesign the writing curriculum of the New York City Public Schools, using the technology and the lessons learned so far.

Computers are here to stay in the English classrooms. Used well, the computer seems to engender more cooperation from students who like it more, write more, and revise more. The aim of the Project is to propagate a national discussion on these issues, and to further the kind of collaboration between colleges and universities and secondary schools that will produce the best methodologies and materials for this effort.

The Classroom as Virtual Community

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Providing access to vast information resources and the world's people, the network has brought a new vision to the classroom, one where people learning together no longer have to be in geographic proximity, where the emphasis is on communication and solving real problems to bring material to life. It is one in which students participate and work together as collaborators, and where valuable resources, both equipment and information, can be easily shared. This paper will examine how computer mediated communication can affect the classroom, provide some examples of how it is being used and some thoughts on the future.

Thousands of virtual communities now exist thanks in part to the ability of the Internet. These groups range from communities with only three people to ones with hundreds: their interests cover subjects as diverse as French literature to world policy. But what is a virtual community and how does it benefit education? A virtual community functions much like a community, but not. It differs in that people do not live in close proximity and communications is much more important to maintain relationships. When an instructor uses communications technology for any discipline, from K-12 to higher education, s/he makes possible the creation of a virtual community.

Such communities can have enormous impact on the dynamics of the classroom, affecting student motivation as well as relationships between teacher and student and among students. In this paper, I will examine how computer mediated communication can affect the classroom, and I will provide some examples of how it is now being used. Although use of the network for instruction is only in its infancy, it is important to try to envision what lies ahead.

In a virtual community, communication rather than proximity is the important force in maintaining relationships. The community shares a set of beliefs and through conversation negotiates meaning and forms a point of view according to Dr. John Seeley-Brown, Xerox Corporate Vice President and Director of the Palo Alto Research Center. In virtual communities, relationships often evolve into collaboration, the process of shared creation. Described by Michael Schrage as ["two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own. ....The thing that distinguishes collaborative communities from most other communities is this desire to construct new meanings about the world through interaction with others. The vision is never static, it's dynamic, always shifting as ...circumstances change. "] Michael Schrage author of *Shared Minds, The New Technologies of Collaboration* , Random House, Inc. New York, 1990, pp. 40, 48.

Analogy of the Telephone

One way of exploring the vision of where electronic networks might lead us in the future is to look at an analogy from the past. The telephone, invented over a 100 years ago, transformed the way we live and work. It led to new social communities because people could choose whom they wanted to talk to irrespective of geographic location and whenever they wanted to. People could converse across distances where before they could only talk to the neighbor down the road.

> "Of all the telephones effects, none is more dramatic than its impact on the ecology of the city and countryside. For 30 years beginning in the mid 1890's every few months someone wrote about how the telephone was rescuing farmers from rural loneliness. They could learn when the price was right for bringing crops to town, call the doctor when a child was sick or call for help when there was a fire. The telephone's direct effects on urban life are equally important. If the telephone has made it possible to form communities without contiguity, move to the suburbs without losing touch with those left behind, and operate business from outlying low-rent locations, then how can one doubt the phone's key role in urban sprawl." Ithiel de Sola Pool, Editor of *The Social Impact of the Telephone*, MIT Press, Cambridge, MA 1977, pp. 300 -301.

The telephone not only reached across town but it also facilitated upward communication. The telephone made possible the skyscraper. Before the telephone, a

> "hotel depended exclusively on the messenger to satisfy the requests of its guest and to deliver instructions and receive information from employees stationed on each floor. When a guest wanted service he could signal a messenger who would have to make two trips, one to learn what the guest wanted and one to provide it. Under these circumstances the elevators and stairways were crowded with bell hops, and hotels had to employ many messengers." [*de Sola Pool*, Sidney H. Aronson, "Bell's Electrical Toy," p. 30.

Writing as collaborative process - MIT's NEOS

Today electronic networks and computers take us beyond the boundaries of the telephone. The information age is hearlding the age of comunication and collaboration in one's own classroom or across continents. The network enables two new, paradigms for education. (Dr. John Seeley-Brown). One is called "collective memory" or collaboration in which each individual contributes expertise to the group, engendering diversity of thought. The other new paradigm called "transaction memory", which builds on experts linked to the group.

In the first class of an essay writing course a freshman at a well know eastern technology institute, is asked to write sentences beginning with the phrase "I like to." Whatever pops into your head, says the instructor. The student looks around the classroom. The other students are peering into their workstation arranged in a U around the perimeter of the room with a projection screen at the front. "Although I know how to use the workstation for computing fractuals, and I have been playing around with them for years, writing random thoughts down is something else." At this point, the writing instructor walks by and sees that she is having trouble. He suggests, "if you can't get started by writing what you like, write about what you don't like and don't worry about grammar or syntax." Immediately she types, "I don't like free associative writing." Slowly her list begins to grow on the screen.

This scenario is taken from an essay writing class at the Massachusetts Institute of Technology, where thirty undergraduates now use the Network Education On-line System (NEOS), an innovative approach to writing using on-line tools. The course requires students to do a good deal of writing both in and out of the classroom as part of weekly assignments. There are two goals underlying their work. One is to facilitate self expression, to overcome the reticence scientice majors often have about verbal expression, unleasing each students' creative energy through a free writing exercise. The other goal is to establish a social context for writing, to write for an audience (not just the teacher), who will review and discuss each other's work as collaborators.

Once student's have gotten some of their thoughts down on paper, the instructor asks them to deposit their electronic lists in the instructor's "turn in bin.", an electronic file folder. A few of these will be displayed on the screen at the front of the room. They begin to discuss the lists. One of the lists is terribly funny, and the ice is broken as the whole class begins to laugh. Comments begin to flow more freely, bonds begin to develop among the students which will be the foundation for a community that will work together over the semester. With network-based NEOS, "writing becomes a collaborative process," says Ed Barrett, Senior Lecturer in the Writing Program at MIT. "The students and I interact to create a shared understanding."

Like traditional writing courses, the NEOS students learn about prewriting, problem definition, outlining, drafting and style using a process of write, review, and revise. There are tools to support creating, exchanging text (student to student; teacher to student, and student to teacher) commenting and annotating, and displaying work in class. NEOS' set of annotation tools allows teachers and students to use writing to talk about writing. Comments appear as windows at the end of an article, or automatically open in front of the on-screen text, necessitating that students read the comments a .reviewer has spent so much time composing. Annotations can point directly to examples in the style guide, which is stored behind the text and can be called up as windows. "The annotation systems provided us with virtually infinite margins in which to write. Yet our comments became more specific and used a greater variety of examples and rewrites throughout the course of grading a paper." (E. Barrett, J. Paradis, "Teaching Writing in an On-Line Classroom", vol. 58 no.2, May 1988, p 166.)

"[NEOS] was in fact a 'virtual' classroom – an invisible 'ecology' of infinitely extensible systems that were on-line for use in any way an instructor saw fit." Barrett and Paradis, pg 164). Using NEOS tools, students write with and for the group, view one another's ideas, generate new ideas, and learn what comes across clearly and what needs revision. Since NEOS is networked, the community extends beyond the four walls of the classroom. A student can write, review, or revise, and then send text to someone anywhere there is a workstation on MIT's Athena network, even the student's bedroom if need be.

There are several components of NEOS that facilitate the development of community and collaboration.

- For one, the on-line environment forces reconstruction of the classroom process: the teacher no longer stands in the front, chalk in hand, lecturing, but sits at a workstation. S/he no longer serves as the mediator in the classroom or between student and textbook. Students generate the discussion with the teacher acting as facilitator.
- Along with on-line examples of style and construction that are part of the NEOS Style Guide, the messages and text exchanged by students become illustrations for the material, and students evaluate each other.
- Any student's writing can be displayed on the screen for others to review. Through open discussion, the students share perceptions about each other's work. Everyone is a full participant. Everyone has something to offer and everyone has something to gain. One student commented, "When you have this group of people who are criticizing or supporting your work, you get better. You take a different stance when you know everyone is going to be looking at it."

The on-line environment supports the sense of shared space. Just like the physical setting of a classroom, students can initiate points for discussion, listen and respond. The network serves as a vehicle for distributing materials that normally requires the instructor to cut off discussion and shift the focus to handing out paper copies. With NEOS everyone in the class looks at the same sample instantaneously whether at a workstation or on the large screen, allowing the discussion to continue.

Ed Barrett, Senior Lecturer in the Writing Program and one of a team responsible for creating NEOS, says that the on-line environment breaks down the barriers between teachers and students. When reading Barrett's comments, a student might send an immediate "Zephgram" of "Can you explain your comments!" or "Can I come by and talk?." something students sometimes are uncomfortable saying over the telephone. The anonimity of the screen gets students to volunteer more than they would do otherwise. This makes them less apprehensive about actually visiting the instructor. Barrett says that NEOS engenders greater contact than the more conventional way of teaching.

Although NEOS is currently available only on the MIT campus, it is anticipated that use will expand. In the future, students may be able to exchange texts and annotations at schools using the Andrew Distributed File System. This will mean the community for a particular essay course could expand beyond MIT. Ed Barrett looks forward to this expansion in which "other faculty would contribute materials and insight, expanding my own vision." He finds that the on-line community is sometimes more communicative than people in other departments on one's own campus.

<u>Self-motivated Students - French Language classes at Harvard and Stanford.</u>

Students initiate communication with class members and take charge with little or no intervention from the teacher. They are challenged to work independently, to discover the language on their own while creating their contributions, and to hone critical skills. Students appreciate the freedom and unstructured atmosphere of the computer/network classroom. In many cases the quality of student discussion and work is greatly enhanced through computer communications.

A French class at Harvard and one at Stanford teamed up to develop a French newspaper in the course of a semester. They used the Internet to initiate contact, exchange views, and write articles and stories. Beginning with the first class of the semester, students from one class communicated with the other, taking charge without the intervention of the teachers. After introductions and the establishment of working partnerships, locally and with the other class, the groups decided on the content and format of their project and committed to specific contributions. In this context, teacher-generated homework and assignments are no longer relevant, since students choose the topics they write about. Students prepare their comments and work more carefully knowing that they will be read by their peers. The classroom becomes a workshop, a relaxed environment where students can try out ideas and communicate in French with each other and with members of the other school. Because students are conversing and writing articles in French about contemporary events, they explore and use the idioms of the language. By the end of the semester, the students produced the *Le Pont Francais* (the French Bridge), a professional looking newspaper with articles on the environment and the presidential campaign of Michael Dukakis, as well as commentaries on life in Boston and San Francisco. Students said that working on the paper gave them a sense of accomplishment, and the final document was tangible proof of their collaboration.

A Broader Vision- ICONS

Networks offer an even broader world, one that allows the student contact with many others. No longer is the community just the local group, but is composed of a diverse population, of different cultures, concerns, economies, and perspectives. ICONS (International Communication and Negotiation Simulations), at the University of Maryland at College Park, links students in high schools and universities from all over the world using telecommunications networks to a host computer at the University of Maryland. Through ICONS, students participate in a dialogue about international issues, in a sense a simulated world summit conference. Teams of students assume the role of a national decision maker, deciding matters of foreign policy and negotiating positions on problems such as global warming, arms control, and the international debt crisis.

A typical ICONS exercise involves as many as twenty universities or high schools representing more than 20 country teams and as many as 700 participating students. Communication takes place in English, French, German, Spanish, Russian, and Japanese. Foreign language students participate as translators. The importance of language, especially for understanding the nuances of words in different cultures, becomes clear.

Scenarios are set six months to a year into the future so that students have the freedom to devise their own strategies. The project is divided into three components: preparation, simulation, and debriefing.

Preparation: Usually for the first six weeks of the semester, students research their own country's resources, goals, and instruments of foreign policy and develop a position paper outlining their teams posture and plans. A local teacher serves as facilitator, resource, and guide, encouraging dialogue and debate.

Simulation: During the second phase students use three forms of communication - prepared public policy statements sent as electronic mail, conferencing where all teams sign on at once from around the world, and the free exchanges of messages on what ever matter is under discussion. The simulation is less tidy than a debate because all aspects of the negotiation are constantly shifting. While country A is negotiating with country B, country B has behind the scenes dealings with countries C and D. [Betsy Kielman, Assistant Director, ICONS]

Debriefing: For the final 2-4 week debriefing, students reflect on the experience, the information and negotiating process. One student stated that ICONS taught him about the dynamics of international relations, particularly "how dependent smaller countries are on the superpowers for legitimacy." Another student in the role of OPEC representative from IRAN, discovered that decision makers of small, radical nations are "able to do crazy things you couldn't do as an American because it wouldn't be acceptable," and a member of the team in Argentina commented, " Through telecommunications we have felt a sensation of belonging to mankind and an increased belief that we all have to dialogue to solve problems. "

ICONS is exciting . Students actually work with real people from around the globe, communicating in different languages, arguing from different national perspectives. Through this process students gain an understanding that world problems are shared, interconnected, and complex. This is true collaboration as students construct new meaning about the world through their negotiations and interactions.

Network as Facilitator

Technology evolves rapidly, and its advances bring tools that are both complex and expensive. Few people know how to use these tools or have access to them, and even fewer can integrate them into the curriculum. For our nation to stay competitive and our schools to produce the innovators of the future, our students must develop the skills to use these advanced tools. Two recent reports, the *NSF Workshop on the role of High Performance Computing in Education* and *Grand Challenges: High Performance Computing and Communications, The FY 1992 U.S. Research and Development Program* by the Federal Coordinating Council for Science, Engineering, and Technology, tie the increased productivity of this nation to the skills of a workforce actively engaged in scientific and technical activities, and to the scientific, mathematical, technical and computational literacy of the general public. Both reports indicate that the nation's students need more education and training, as well as materials and curriculum development in the high performance computing science and engineering areas. High Performance computing expands the limits of scientific research, allowing for simulation and visualization of complex world problems such as weather and pollution flows.

There are two areas of technology, supercomputing and VLSI (Very Large Scale Integration) design, that are critical to the advancement of science yet many teachers perceive these subjects as too difficult to teach. The network can facilitate instruction and increase the number of students who can explore these technologies. A course in supercomputing at Arizona State University enables sharing of expensive equipment among several institutions by means of network links. An engineering course at Harvard is able to use resources at the Masschusetts Microelectronics Center to teach a VLSI design course.

Two courses are now being offered at Arizona State (ASU), and plans are to extend supercomputer instruction over the network to community colleges and high schools in Arizona. One course is an introduction to supercomputing programming, which uses the Cray machine at ASU and the Cray supercomputers at four national supercomputer centers (National Center for Supercomputer Applications, Pittsburgh, San Diego and at the National Center for Atmospheric Research). The other course allows students to carry out a research project of their own choosing related to software design and development on high performance computers.

In Harvard's VLSI design course, students learn how to handle complexity by analyzing chip design into its various components. They are taught first to understand the fabrication process, then to envision what they want to design, and then how to put it on to a silicon chip. This is all done with the ongoing support of the Massachusetts Microelectronic Center (M^2C), an organization that not only manufactures computer chips from electronically transmitted information, but provides equipment, training, and the VLSI design software it supports over the network. Students create electronic blueprints, which are sent over the network to M^2C. Seeing their design as a finished chip is essential to their understanding the complexity and issues related to integrated circuit design.

Real science in remote locations – a course in non-linear dynamics

Using the network to link up expert scientists with students in remote areas of the country seems an appropriate application. Making this happen, however, is not straightforward. For one, it requires a significant reorientation for teachers. Dr. George Johnston, a research scientist at MIT's Plasma Fusion Center, characterizes teaching over the network as very different: "For someone who is used to having everything planned and under control, my attempts at teaching over the network felt like standing up in front of the class naked." Working with David Hughes from Big Sky Telegraph in Montana, Johnston set out to make a course called "Chaos, An elementary Introduction to Non-linear Dynamics" available to junior and senior high school students there. (Big Sky Telegraph is a grass roots telecommunications system linking Montana's rural schools with resources and other rural teachers region-wide.) Johnston says that some of his students came from places that were so small they were not even on the map. Using text and character-based graphics, Dr. Johnston was able to teach students to derive simple mathematical models to explain phenomena in the biological, physical, and social sciences that have very complicated behavior; for example, growth and decline of populations with simple reproduction and resource limitations. The prerequisite for the course was a good mastery of high school algebra.

The course had some remarkable successes as well as some instructive failures. It was apparent from student solutions to problems that both junior and senior high school students understood the material. A junior high school teacher who supported two students taking the course as independent study said, "The investigation .... was one of the most valuable mathematical experiences that [my students] could have had. They were truly doing mathematics and tasted the excitement of research that I did not have until my senior year [in college]."

Clearly, if we want students to enter higher education with the motivation and the skills to guide their own learning, this kind of instruction has a place in junior and senior high schools. Recently Johnston received a letter from a young woman who had been one of the students. Her interest in mathematics and science had been so "emboldened by being able to understand a little of a course from MIT" that she applied to MIT and would enter next fall after a year in Germany.

Network-based instruction has increased the number of young people interested in pursuing a career in mathematics, a major concern of our nation. Network-based instruction has important potential to bring advanced material and courses to students who would otherwise be left out, students in rural areas like Montana as well students in inner city schools.

It is interesting to note the hurdles Johnston had to overcome in his pioneering use of the network. Because it took time to compose thoughtful answers to the students' questions and because of the lack of familiarity with the conferencing software, Johnston could not maintain a continuous exchange. Students viewed this as lack of interest and commitment. One of Johnston's solutions to this problem is to give immediate responses to all questions, with additional, more considered responses later, when necessary.

Gaining technical skills, building relationships with students and their teachers, and developing course content also took a while. Now that he has done it, Johnston will have a better understanding of the dynamics of network-based instruction. This course needs to be facilitated by the teacher at the local site, someone who understands the course content as well as having the technical skills to run the equipment.

Problems of implementation

With the capability to reach people around the globe, tap hundreds and thousands of resources, and bring life to the classroom, the network should be an ideal adjunct. Why isn't this the case? For one, there are a variety of practical problems, such as coordinating school calendars, allowing for different class schedules, matching up levels of expertise, and accommodating varying degress of interest. The instructor at Harvard whose class collaborated with Stanford found that she had to squeeze the project into the schedule of a core course where her group was one section out of many. Because there were only three class meetings a week, students had to do extra work ouatside of class for the project. Another problem is student access to the network. Without access from the student's dormitory room, it is not possible to take advantage of 24 hour mail service; special trips to the computer facilities are required.

Technical Problems

There are also very real technical problems. For almost any discipline, using evolving and sometimes erratic technology, is difficult and requires support. If the communications software or the mail package is too complex, the students spend a good deal of energy and time learning the essentials. Without user friendly software, a network project will flounder. The success of ICONS, which started in 1981, is due in no small part to software that is so easy to learn it does not require any special training.

Network reliability is of course critical. Imagine the anxiety of an instructor who has planned an international negotiating simulation for Tuesday, and finds a link to the national network down on Monday.

In general the more the technical infrastructure is in place, the easier it is to use technology in the curriculum. The Committee on Academic Computation at MIT has stated that "A consistent set of Basic Educational Services and Tools, distributed over a pervasive network, should enrich scholarly production and enhance intellectual community in research and education." Infrastructure includes network services like electronic mail and bulletin boards, along with support services. In the future, campus infrastructures may also include something like the Andrew File system, which would give faculty direct access to courseware and resources at other schools.

As we use the network more to transmit large files, data bases, and graphics, bandwidth may become crucial. For example, to receive a high resolution graphic image at a high performance workstation today over a T1 or 1.5 megabit connection takes 1.7 minutes. This is a noticeable delay which will disappear sometime in the next century when the gigabit network will be economically feasible for most participating large institutions. Then the same image will be transported in .1 seconds.

Political Issues

There are problems in less technical areas too. It will be harder to get funds in the 90s for instructional uses of technology in higher education. Those who made funds available in the 80's are now more hesitant because many of the promises have not been fulfilled. Even though we have made important progress in technology, the same political hurdles still exist. There is a lack of broad acceptance of technology in the curriculum, an inability to document concretely its value to education, a reluctance to allow time spent on use of technology as factors in awarding tenure, difficulties in changing traditional course requirements and in asking teachers to assume new roles and learn new skills, and finally competition among faculty members for scarce funding.

It takes a lot of time to develop instructional applications and at almost every school this is not rewarded. Faculty who are involved in instructional computing insure that they devote at least equal time to research and publications. A young faculty member , who spent a good deal of time developing wonderful new ways to teach, would not last long in higher education.

The K-12 world has many of the same problems (and more) as does higher education. For example, time is at a premium, and rarely is training offered; teachers involved in innovative projects are overloaded; schools often can not even afford a new telephone, let alone the cost of equipment; and teachers and administrators are still privately terrified of computers. There is, however, a strong grass roots efforts which must often struggle alone. Statements from K-12 teachers point to some of the reasons why:. "Practitioners are isolated from each other and from the corpus of practice (except for what is represented in the texts and curriculum guides) from the day they end practice teaching or administrative practicums." says John Clement, EDUCOM. "The value is in the empowering and catalytic effect that even a few short text-based messages between schools can have, regardless of how short they are." says Tony Scott, Laboratory of Comparative Human Cognition, University of Southern California at Davis. "We are all obviously desiring to create the best learning environments possible, be they regional, face-to-face., or global and online. Most of us who have used global networks with students agree that it is a tremendously powerful tool, and we are all inspired by its promise to help create a 'better world.' (part of the KIDS-91 Project Discussion.)

Future

Some factors, however, may expand the use of networked- based technology in instruction. Budget tightening at all levels in all institutions will force schools to leverage existing resources and find ways to keep up without major new investments. Many institutions have installed links to the Internet to provide access to the wealth of research resources accessible over the network and to support collaboration. These same links will provide access to course materials and instructional expertise.

The network has the potential to open up the world in which students interact and learn, to help students focus on expressing and communicating their ideas, and becoming sensitive to the impact their communication has on others. Shoshanna Zuboff describes network mediated communication in computer conferencing system, DIALOG as follows:

"In DIALOG the power lies in the ability to communicate and pass on knowledge. ..... It is strictly the quality of ideas, the way you put things in words, or your sensitivity to what others say that now determines your influence" (Zuboff *In the Age of the Smart Machine*, Basic Books, Inc. New York, 1988 p. 371)

A statement from the President's "National Education Goals reads "A strong education system is essential to maintaining a vigorous and responsible democracy and a prosperous and growing economy." The goals "are about excellence. ..They are about restructuring and revitalizing the education system of the United States." What better way to improve our educational system than to add network capabilities that enable students to work with scientists and communicate with experts or to have self-motivated communities of students working on tasks that are meaningful to themselves and have an impact on the world?

With the network, the classroom is confined no longer to the four walls. It can expand to the real world – to experts, to peers around the globe, to involvement in real problems. The network can bring a higher degree of educational support, to more motivated and self-directed students. Each one of us, whether student, faculty, or administrator, can take part in this growing global virtual community.

"The power of inventions is not necessarily the invention itself but "those who have the imagination and insight to see that the new invention has offered them new liberties of action, that old constraints have been removed......and they can act in new ways." Ithiel de Sola Pool, Collin Cherry, "The Telephone System", p 112.

These projects demonstrate how individuals have shaped use of the network into a virtual classroom. In NEOS, the free flow of ideas and communication with an audience engenders an exciting way to learn how to write. Writing a French newspaper with peers from another school over the network brings a new and more vibrant way to learn the use of the language. ICONS fulfills the dream of students collaborating and sharing information on a global scale. Reaching out to isolated students in a rural community, a scientist has overcome the problem of too few science instructors and increased the motivation of young students. These projects demonstrate that collaborative work over a network stimulates students to expand beyond what can be achieved in the traditional educational classroom.

CAUSE '91
Electronic Libraries in the '90s: Information Access on the Network

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Abstract

The Dartmouth College Information System project is both creating basic technology underlying electronic libraries and solving the new problems of integrating electronic resources into the College's collections and scholarship. This paper describes the Dartmouth "vision" of the library of the future, the problems we face, and the solutions we are developing.

The electronic library of the future will provide patrons with faster access to a wider range of materials than ever before. Patrons will be able to execute their own searches of the holdings of both local libraries and of libraries nationwide. Computerized searching will enable users to evaluate more materials, more effectively, on a more timely basis. Unlike paper books, electronic media can allow many people simultaneous access to the same materials. These resources are available continuously, from office or home. Accessed from a powerful workstation authoring environment, electronic data can be manipulated more effectively in support of research, teaching, and learning.

Electronic Libraries in the '90s: Information Access on the Network

Historically, the effectiveness of educational institutions has depended to a great extent on the quality and delivery of their information resources. In recent decades, the amount of information to be managed and made accessible has burgeoned. The pace of research and publication has made it essential to provide immediate access to the most recent information available. Higher education depends increasingly on electronic indexing of materials, electronic storage of text and data in local and national databases, and delivery of information via local and national networks. The greatly increased power and lower cost of all classes of computers coupled with widespread networking have changed scholarly information access. These advances in computing technologies are delivering advanced applications to a global audience.

The electronic library of the future will provide patrons with faster access to a wider range of materials than ever before. Patrons will be able to execute their own searches of the holdings of both local libraries and of libraries nationwide. Computerized searching will enable users to evaluate more materials, more effectively, on a more timely basis. Electronic texts and databases can quickly locate references that were tedious to find and answer questions that were too time consuming to even attempt with paper indexes and books.

Unlike paper books, electronic media can allow many people simultaneous access to the same materials. These resources can be available continuously, from office or home. Accessed from a powerful workstation authoring environment, electronic data can be manipulated more effectively in support of research, teaching, and learning. Electronic technology is also changing publishing. The number of commercially available titles in the CD-ROM format is growing at a rapid rate.

New services become both possible and desirable given these initial capabilities. As more library catalogs become accessible electronically, there is likely to be increased demand for interlibrary loan services. Electronic image transmission via Fax or electronic mail will replace photocopying and mail delivery. Access to complete works as full text or images is a natural extension of the bibliographic sources. Some patrons already expect that the books they have located in their search of the catalog should be similarly electronically available. Sound and video will become an integral part of topical collections. Electronic media will be used for the preservation of rare and fragile material while at the same time providing access to these works.

These electronic systems will have a major impact on the educational process. Access to such resources will add greatly to the value of the user's workstation. A student or faculty member's investment in a workstation will yield not only a terminal and word processor, but also a powerful gateway to a variety of network services geared toward scholarly tasks and campus life. Resources that were either not available or available only with substantial effort can become routinely integrated into classroom exercises and research. Scholarly impact will be gained through enhanced access to the review, retrieval, manipulation, and integration of information from diverse sources quickly and easily. Educational impact will come in part by allowing the faculty to guide students to the same types of information used by the faculty in their own scholarly pursuits.

Challenges

There are a number of obstacles to overcome in delivering this vision of ubiquitous electronic information access. Some are technical, some are logistical, and many are financial.

Initially there were problems in acquiring materials. A few years ago, few materials were even available in electronic form. Often a work was collected because it was the only one available. As computers became more prevalent in the publishing industry, many new works have become available by virtue of the fact they were manipulated electronically in production. Other popular works have been put into electronic form for use in scholarship. Now there are many 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.

The ownership of material is currently a primary concern in selecting projects for development. The simultaneous-usage aspect of electronic media has many publishers struggling with how to control and retain fair value for their property. Some publishers simply refuse to discuss the possibilities. Others have been more creative in working out mutually beneficial arrangements. Effective access control and accounting are crucial to continuing the availability of electronic forms. New models of use are being developed in these early experiments.

Meanwhile the high costs associated with some commercial services has required that access be foregone or rationed at many libraries. Libraries are being financially forced to specialize their collections. Collaborative projects will be needed to continue to provide the extensive collections needed by scholars.

Many libraries have invested enormous sums of money and effort in retrospectively converting their catalogs. The process of creating electronic versions of books is immensely larger. Though technically possible today, preparing an electronic text from a paper copy is time consuming and tedious. In addition, the sheer volume of material makes it currently necessary to be selective about what is available on line. Working closely with the faculty is crucial to choosing wisely.

Electronic publishing has created some secondary problems. For example, this year many government documents were exclusively distributed, for the first time, on CD-ROMs instead of paper. This approach saved significant publishing costs while creating access and distribution problems for libraries. To have full access, a patron either must be fairly computer literate or needs substantial staff assistance. In addition, publicly accessible computer equipment is needed to use the work that was formerly a paper copy.

Technically, the initial problem is widespread availability of personal computers, adequate server computers, and universal network access. This first step is a large undertaking, a continuous enterprise, and an ongoing expense. The diverse computer protocols are another technical obstacle. Simply interconnecting the various manufacturers' equipment is a challenge. Developing common software interfaces and conventions is an even more formidable task. There are always limited resources in terms of people who can develop new systems and maintain existing ones.

The majority of existing personal computing equipment is primitive. Computer displays need to catch up with the high quality and ease of operation of paper books. New machines of greater capability will be needed to deliver multimedia information.

Finally, there is the problem of learning and operating a collection of application software. The majority of end users are trying to use the computer as a tool in their work, not as an additional pursuit. Systems must be much easier to install, use, and understand. There is a great need for minimizing the variety of ways to access information.

Developing Solutions

The Dartmouth College Library and Dartmouth Computing Services, with the support of Apple Computer, Inc., are developing an integrated scholarly information retrieval system to address many of these needs. A combination of innovative yet practical software development and collaborative projects are achieving significant progress.

The project builds on the substantial base of a completely networked campus with extensive use of Macintosh personal computers. The broad-based team from the Library and Computing Services is providing access to an extensive collection of scholarly resources. The Dartmouth College Information System (DCIS) is designed to include data from a variety of sources: reference material, such as dictionaries and encyclopedias; indexes to library collections and the journal literature; scholarly resources; general information and news; numeric databases; image data; and administrative data, such as class lists, budgets, and schedules. Interlibrary connections with other institutions are also being developed. Networked server computers provide storage and retrieval for over 30 large full-text reference and catalog databases.

An innovative project has involved jointly acquiring the *Modern Language Bibliography* with Middlebury College. The database is mounted on the Dartmouth server computers. Middlebury patrons access the system over the Internet. Validation of users from both schools is provided by a distributed authentication server. Each campus is maintaining its own access list.

The Dartmouth computing environment is an ideal setting for such a system. A campuswide network extends to nearly every office, classroom, and student residence hall room. Over 80 percent of all students and nearly all faculty members own a workstation. A wide range of computing services are provided, from public laser printing to research use of mainframe computers. A large public file server provides an electronic application library containing both free and commercially licensed software. An electronic directory of all faculty, students, and staff controls access to appropriate resources. Through locally developed Macintosh applications, students and researchers have access to a sophisticated electronic mail system and the Usenet news, which provides worldwide connectivity to other scholars working on similar problems.

System Architecture

The DCIS project is developing applications that access database resources while leveraging our users' familiarity with the Macintosh interface. The Macintosh computer provides one of the most regular environments in this regard, based on published user interface conventions and an operating system that provides standardized interapplication communication and data exchange.

The architecture of the DCIS system integrates a collection of Macintosh applications that provide synergistic information-access services. This approach is based on the belief that it is impossible to have one interface for all the possible types of data, for example, text, numeric, image, sound, etc. In the opposite dimension, it is often the case that different sources of similar data have different interfaces. This problem complicates usage of the different sources tremendously and is one of the aspects we wish to change. Our design supports, and we have already implemented some instances of providing, the same interface to different servers of similar information. In the interim, it is possible to add terminal emulators as a means of reaching data sources not yet interfaced in a more sophisticated manner or those that use another existing application as an interface.

The DCIS applications used in conjunction with standard Macintosh productivity and authoring applications provides a rich research and authoring environment. DCIS relies on the Apple MultiFinder to provide simultaneous access to several applications. DCIS applications are designed to provide suitable interoperational links and features on this platform. Data transfer between separate applications can be very simple in this environment.

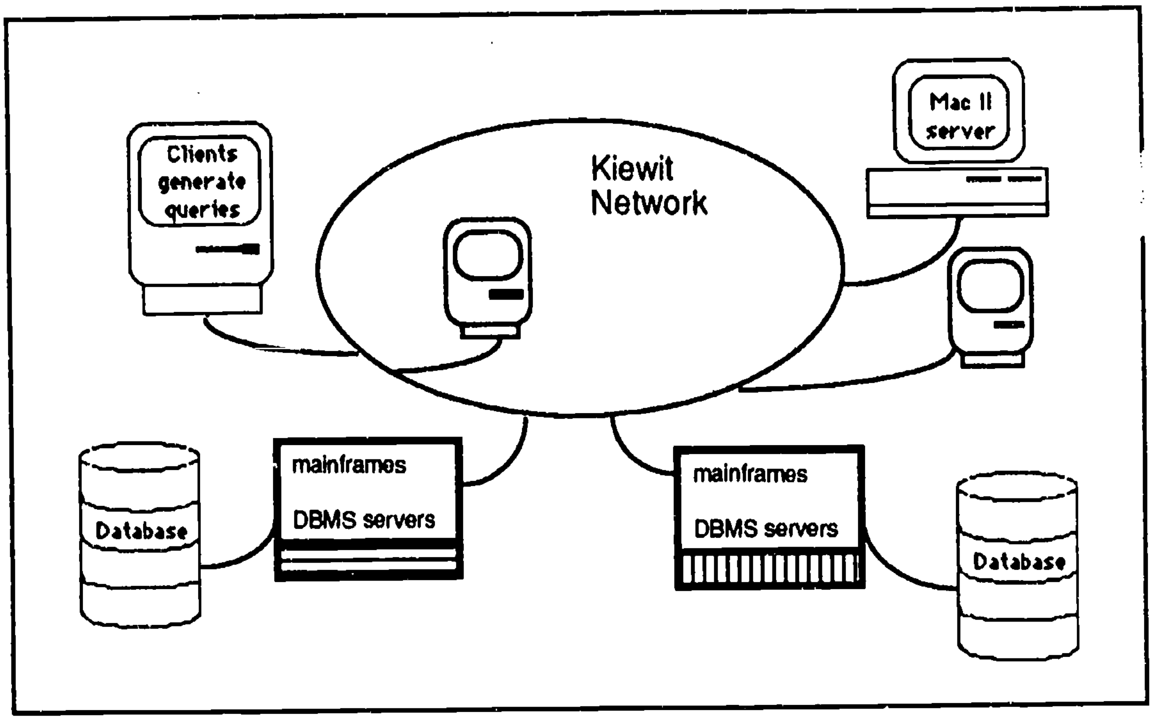

Figure 1. Client-server Computing

The system's architecture is one of distributed client-server computing, illustrated in Figure 1. Server programs often running on mainframe computers service search and retrieval requests generated by client programs running on user workstations. Institutional databases are distributed across a variety of mainframes and other database servers, which use a variety of operating systems and database management systems. The user interface software is resident on the users' workstations. Workstations and database servers communicate by means of the campuswide computer network. The DCIS programs allow the user to ignore the details of access and to concentrate on working with the data. These resources are also available at any time.

The DCIS system, from the point of view of the user at the workstation, consists of a "navigator" application that helps one to browse through the list of available databases. Having selected a database of interest, one can start a "viewer" of a database for the purpose of doing searches, displaying results, printing, etc. The viewer will locate and gain access to the database selected without the user being aware of its location or low-level log-on process. Figure 2 (see next page) illustrates the major components.

A generic protocol between viewer and database server ("InfoSpeak") has been developed. Host-server processes convert the InfoSpeak protocol into database operations and return results to the client workstation. Concentrating on a single protocol has reduced duplication of effort. InfoSpeak has been implemented for several different commercial database managers running on several different operating systems. The architecture accommodates other network protocols as well.

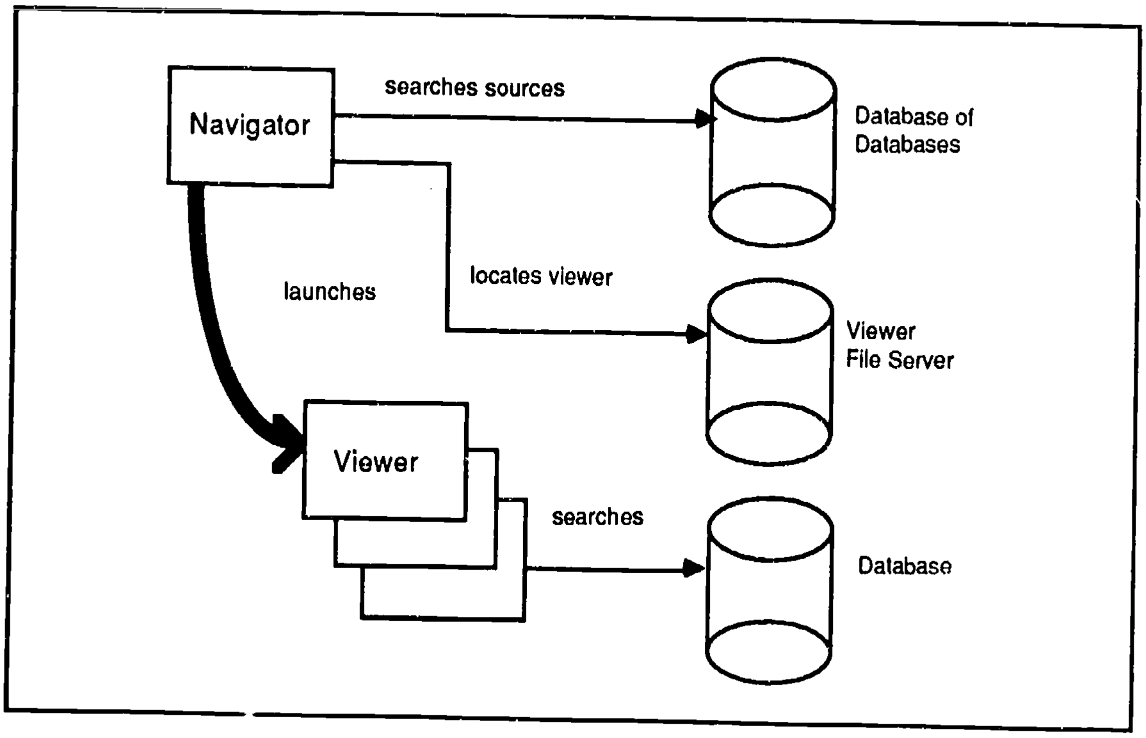

Figure 2. Application Architecture

Network Environment

DCIS currently works with both local Kiewit Stream Protocol (KSP) and Transmission Control Protocol (TCP) networks. All Dartmouth network ports provide KSP service over LocalTalk or Ethernet links. The TCP protocol provides access worldwide from workstations with Internet connections. Dial-in access to the Dartmouth network via a modem is also available.

Navigator Features

The navigator provides several methods for the user to peruse the list of databases. They are currently categorized by name, discipline, and topic. The capability to do keyword searches on the topics is also provided.

The navigator consults a network server that can list the currently available data sources. This "database of databases" provides the topic categorization and keyword searching mentioned above (in effect, the navigator is a viewer of the directory database). The directory server's name is a configuration parameter of the navigator application.

The navigator locates viewer code from an appropriate file server for the user. It downloads new or updated viewers, assisting the user in acquiring and maintaining the appropriate software.

Some of the data sources have access and use restrictions as part of their licensing agreements. User validation is required for these services. User validation is currently provided through the Dartmouth Name Directory, a network service listing all College faculty, staff nd students. In addition, a distributed validation service has been developed to permit other institutions to selectively share access to these resources.

Viewer Features

The viewers are the user interface to the individual databases. The viewers add value to the system by providing a common interface to the databases based on Macintosh user interface features and conventions.

The viewers are the client portion of the client-server computing partnership. They offload some processing from the host computers or provide additional functionality such as:

- Saved search strategies (for repeating the same searches)
- Saved search results
- Multiple sessions, same or different database
- Local reformatting of search results
- Form layout
- Printing (with typographical enhancements)
- Local scrolling
- Local text searching
- Local help
- Copy and paste to word processing, bibliography managers, etc.

Implementation Strategy

To maximize portability of the system, the components are designed and implemented in a modular style, anticipating interchangeable components in a number of places. The interchange of components adapts the system to differing network, computer, and database installations with a minimum of rework and duplication of effort.

The communication architecture is based on the widely used OSI model. The structure is often communicated using protocol stack diagrams as in Figure 3 (see next page). A software protocol stack is a part of both the client and server applications. Any layer in the stack can be replaced by an equivalent layer having the same interface, without affecting code in the higher layers. This allows for a wide variety of actual implementations by recombining different sets of components. For example, at the stream-protocol layer, the existing DCIS applications dynamically switch between KSP and TCP/IP protocols depending on the network attachment of the workstation.

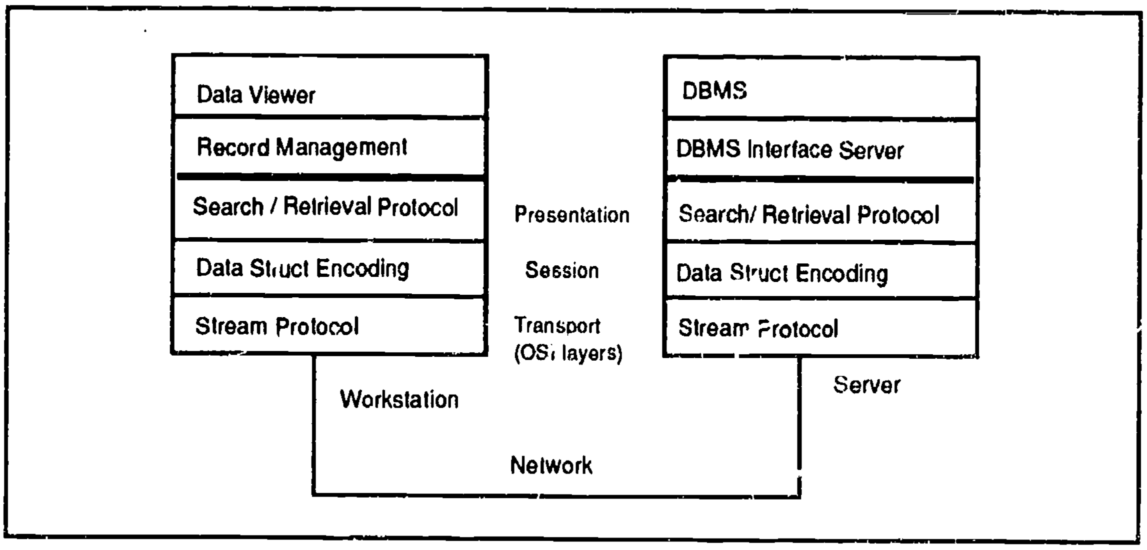

Figure 3. Communication Protocol Stack

The Presentation, Session, and Transport layers contain components of which the current applications are actually aware. Lower layers are completely transparent. Some components in the protocol stack have been implemented elsewhere, for example, XDR or TCP. The project development uses existing work where appropriate.

InfoSpeak Protocol

InfoSpeak is a transaction-oriented Presentation-level protocol (OSI level 6), designed to facilitate access to heterogeneous information resources. InfoSpeak was intended to standardize the local interface to data resources.

An InfoSpeak server is a network-visible entity that accepts InfoSpeak transactions on behalf of a database management system (DBMS). The server translates from the InfoSpeak protocol to the DBMS-specific form and invokes the DBMS for the primitive. The server converts the DBMS output to the operation into InfoSpeak and sends that output back to the client.

Interdomain Access Protocol

A distributed validation server has been constructed as part of the DCIS project. The server's development was motivated by the need to share access to computer databases while limiting access to the members of the participating institutions. The validation server distributes the name/password list and its maintenance to each participating institution. The design permits subgroups to be defined within an institution. The Internet is used to communicate between institutions. The data provider controls the list of groups granted access to each local database.

The validation server provides a common program interface for database servers or other network applications requiring validation services. It supports a number of validation procedures including clear text and secure one-way and two-way encryptions. The servers negotiate to find the most secure common method. The system design supports arbitrary name/password databases through a standard internal interface. At Dartmouth, the Dartmouth Name Directory is the name/password database used along with its partial name matching. Simpler flat-file databases are also currently implemented.

The server is portable and runs on most versions of UNIX. It is designed to be easily extended to other validation procedures and name databases. Versions of the program interface library exist for UNIX and VAX VMS.

Future Directions

The DCIS project has developed a strong framework on which to continue similar development. The architecture was designed for portability. Implementing the system on other campuses is an important goal. Another important goal is to enable all campus departments to create database resources that can be added to the system and to simplify the ongoing maintenance of the databases. The databases made available so far have been primarily text resources. The viewer applications are just starting to exploit the Macintosh's graphical interface for the display of typographically enhanced texts. Image and multimedia resources will be developed in the next phase of the project. Gateways to external databases are also under development.

College Access via Personal Computers:

Contributions of Technology and Telecommunications to Adult Higher Education

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ABSTRACT

Distance education and lifelong learning are educational goals of growing importance as higher education faces the challenge of serving an increasingly mature student body in an era of exploding information and technological advancements. Access to educational opportunities for the adult learner will be more appropriate when developed and provided in consideration of the adult learner's complex lifestyle. Telecommunications and computer technology provide the tools for building a platform that enhances education through time and location independent access. Improving access and services within a strategic plan for excellence can take the college and the classroom to the student; thus, a learner's educational experience involves a decrease in the amount of time and effort compromised in overcoming physical transport requirements, and an increase in the amount of time and effort available to spend in pedogogic pursuits. This paper outlines a case study of Thomas Edison State College's Computer Assisted Lifelong Learning (CALL) Network project. The project uses telecommunications and computer technology to enhance educational access.

College Access via Personal Computers:

Contributions of Technology and Telecommunications to Adult Higher Education

I. Introduction

The Computer Assisted Lifelong Learning (CALL) systems are technology mediated facilities created by Thomas Edison State College to provide access to the College via computer and telecommunications applications. Dial-up access to the College through these systems serves both students and prospective students providing an on-line college enrollment application, electronic communication with staff, view-access to academic records, browse/read utilities for a broad base of information, and assignment exchange with the faculty mentors of Guided Independent Study courses. Developed to aid the College's primarily adult constituency, the CALL systems play an important role in enhancing educational opportunity by using the advantages of emerging technologies.

Thomas Edison State College was created in 1972 in response to a national need for flexible and accessible high quality educational opportunities for adult students. Regarded as an underserved population, the adult student body is a large component of the work force which, in a fast growing and technological age, requires continuing education appropriate to the mature student's needs. The mission statement of the College contains several principles that define the educational role of the College, stating that the College seeks to provide flexible assessment tools for out-of-classroom learning, counseling and advising services to assist adults, high quality curricula, academically sound degrees, and the facilitation of ready access to other external academic programs and opportunities available.

The institution has been a pioneering force in the development of flexible assessment tools for the evaluation of college level learning, for example the portfolio assessment process, and has been recognized for its national leadership by the American Association of State Colleges and Universities and by the Council for Adult and Experiential Learning (CAEL). The College has implemented highly developed programs and services that have distinguished it as a premier institution for adult learners. The College is cognizant of its purpose and domain, and aggressively operates on behalf of its constituency as expressed in the principles of its mission statement.

In 1986, Thomas Edison State College submitted a proposal to the New Jersey Department of Higher Education for participation in the Governor's Challenge initiative. This grant program initiative, implemented by Thomas Kean, Governor of New Jersey at that time, issued a challenge to public higher education in New Jersey and urged each state college to follow its own path to excellence. The Kean Administration recommended that colleges strive for an excellence that reflects the institutional mission of the college. Thomas Edison State College responded with a broad strategic plan and a central project proposal which outlined plans for the assimilation of computer technology and telecommunications into the College's service delivery mode strategy. This project was conceived to be a continuation of the innovative approach that has been a hallmark of the College's efforts to fulfil its mission and a potential contributing force in its established national prominence and position of excellence.

II. The Vision: Using Technology to Enhance Distance Education and Lifelong Learning

Overcoming Location and Distance Barriers

The College's mission directs its specialization in serving the adult student population. Toward this end, the College makes several assumptions to drive appropriate development of many adult centered services. It is assumed that the adult learner has many concerns including family, home, and occupational priorities. Adults also possess a wealth of acquired learning and experience, and that acquired knowledge, if it is college level, should and can be recognized for credit award. In response to these needs, Thomas Edison State College developed programs such as Guided Independent Study, Portfolio Assessment, the Program on Non-Collegiate Sponsored Instruction, and the Statewide Testing and Assessment Center on behalf of its student body. All program developments were guided by the College's central assumptions about adult needs.

Unlike the traditional age student, adults are not as free to conform to the instructional and service delivery mode of a campus based institution. In consideration of the complexity and diversity of the adult learner's lifestyle, educational opportunities should be appropriate to their varied needs and must free the student, in as much as is possible, from the logistical barriers of time and location. The College had provided services and distance learning opportunities tha' relied heavily on the telephone and postal systems available to minimize in-person requirements. Emerging as potential tools of direct importance in reducing time and location barriers were telecommunications and computer technologies.

As early as 1982, staff at Thomas Edison State College were beginning to formulate plans for the assimilation of technology and education into a comprehensive dimension of service. With vision for the future and a commitment to innovation in mind, the College added another principle to its mission statement: " ...to create educational systems built around contemporary technology..." that would provide educational opportunities including information, modes of academic support, and access to instruction.

III. Strategic Plan and Funding: The Origin of the Project

The Strategic Plan

Seeking to implement its new ideas for educational technology on behalf of the adult learner and respond to the Governor of New Jersey's challenge for mission appropriate excellence, the College spent a considerable amount of time developing its submission to the Department of Higher Education. The strategic plan submitted may be viewed as a statement of the College's critical review of its operational plans in preparation for continued growth and the incorporation of the Computer Assisted Lifelong Learning Network project.

Thomas Edison State College's plan was formulated by reviewing the principles of its mission, the assumptions of its philosophy, the objectives of its operational plan, investigating strengths and weaknesses, and identifying characteristics of excellence in addition to a critical assessment of the degree to which those characteristics could enhance College programs and services. The resulting plan outlined a three pronged approach to maintaining excellence: Enhancement of Operational Strategy, including efficiencies in administrative and student records computing; Support through Special Projects Implementation, including improved services to corporate clients; and, Support for the Computer Assisted Lifelong Learning Network, a project to expand and enhance educational opportunity through the use of technology. While the operational strategy and support through special projects implementation summaries were by no means a comprehensive list of institutional concerns, they were sufficient within the strategic plan to demonstrate institutional health and strength of purpose, and are dealt with here only in so far as they relate directly to the central proposal for the Computer Assisted Lifelong Learning project.

Proposal and Funding for the Computer Assisted Lifelong Learning Network

Thomas Edison State College's proposal to the Department of Higher Education was approved and funded for $1.8 million. The proposal represented a two part submission containing the "Computer Assisted Lifelong Learning Network: A Project for Excellence", which spelled out the plans for the project, and the "Strategic Plan for Excellence", which outlined how this central project and the College's operational plan would serve the mission of the College to further demonstrate its vision and excellence. The Computer Assisted Lifelong Learning Network project, better known under the acronym of CALL, was thus launched on its initial development path.

The CALL proposal identified three major components to be developed: the infrastructure which would provide the technical backbone and various on-line services; Guided Study courses on CALL to provide on-line educational aids; and, Diagnostic examinations for on-line pre-tests for the College's for-credit testing program. The CALL systems would allow users equipped with a PC to dial-in to the CALL Network and take advantage of diagnostic testing, a "Simulated Classroom" of Guided Study courses, and other services stemming from the infrastructure development such as information data bases, on-line registration and payment of fees, correspondence with various College staff, and read-only access to student program plans and financial records.

The concept of CALL was intended to: reduce time and location barriers by using telecommunications and computer technologies to offer a fourth dimension of access virtually 24 hours a day from a student's home or workplace; enhance learning opportunity by providing aids, such as electronic class discussions, that were previously unavailable to distance learners; and, empower learners through access to CALL's consolidation of administrative and academic services.

Institutional Implementation of the Strategic Plan

Various institutional commitments were made to fulfil the strategic plan for excellence. In preparation for the College's CALL project, all student records were consolidated and transferred to an upgraded computer system. Three mini-computers were purchased and installed in a distributed system configuration to house these documents, and an automated transcript evaluation system was written in-house to accommodate the specific needs of the College. These additions reduced the amount of time that transcript evaluators and academic advisors spent in locating physical student record documents, aiding in the realization of the efficiencies in administrative and student records computing called for in the strategic plan. Those additions also prepared the administrative computing system for the generation of specific reports (program plans and billing records) that would be available to the student using CALL. All college staff were provided with a terminal, a log-on identification to provide access to computing resources relevant to their job function and to the new student records system, and training.

IV. Project Development: Building and Managing the Project

Project management plans were clearly articulated in the proposal. A Project Management Team was identified, and included three component directors and four other upper management college staff. The component directors would oversee development of the three project components: Infrastructure, Guided Study, and Diagnostic Testing. The College's Vice President for Academic Affairs was identified as the Project Director and Project Management Team Chair. An external panel of experts was selected and they convened on a regular basis to oversee progress, critique where appropriate, and evaluate the work of the Project Management Team in satisfaction of the proposal requirements.

The Infrastructure component, which essentially represented the technical base of the delivery system, was managed by the Director of Management Information Systems. This director was responsible for the hardware, software, telecommunications, and related administrative aspects of building the infrastructure. The Guided Study component would be developed by the Director of the Center for Directed Independent Adult Learning. This component director was responsible for the pedagogic and administrative aspects of the Guided Study courses offered through CALL. The Diagnostic Examinations component development was managed by the Director of Test Development and Research who was responsible for test content development and the concerns of its diagnostic capacity.

The project management team specified in the proposal was a workable and successful arrangement for the development phase. During the first year of public release, however, the consensus of the team was that a broader and more comprehensive organizational arrangement was indicated to address the added complexities of public release and future developmental directions. The College is currently in the process of studying this issue.

The Infrastructure

Preliminary feasibility studies for the CALL Network through an independent consultant had identified the major components of the infrastructure. New Jersey Educational Computing Network (NJECN), a timesharing organization originally created to furnish the State of New Jersey with reliable and affordable computing resources, would provide mainframe power and support the front end requirements for telecommunications. The software package CONTACT would reside on the mainframe and provide electronic mail and conferencing facilities for communications and course related purposes. NJECN would provide a staff consultant to draft the code necessary for a user to dial into the mainframe and access various services, and would assist in the establishment of software and hardware components necessary to build the Network. To reduce the cost of accessing the NJECN computing facility, where the bulk of CALL services would reside, an X.25 packet data network carrier would be utilized, thus reducing the connection from a potential long distance New Jersey call to one placed through the student's most local node.

A link between the College's administrative computing system and NJECN would be established to provide users with specific administrative functions. M.I.S. staff selected a relatively recently developed protocol that supports a level of communication between different types of computers: TCP/IP (transmission control protocol/internet protocol). As the CALL systems would rely on tasks requiring the interaction of separate computing facilities, TCP/IP would be the common protocol that would allow computers of three different manufacturers to communicate. In essence, then, the CALL systems comprise the CALL Network, which primarily serves enrolled students, and the CALL Public Bulletin Board, intended primarily for non-enrolled students.

Because of security concerns that restricted the use the CALL Network timeshared computing facilities, the College arranged that a public bulletin board system provide access to those CALL services that were primarily designed to assist prospective students or those who are interested in knowing more about Thomas Edison State College. Referred to as the CALL Public Bulletin Board, this system provides the general information and methods of earning credit sections, allows electronic mail communication between users and the College's Office of Admissions Services, has the on-line Application to the College and payment of fee service, allows for the downloading of select documents to the user's PC, provides a bulletin board of news items, and has a provision for providing the CPT's.

A decision was made very early in the development process to insulate the student as much as possible from the complexities of the technical platform, that is, CALL software would be developed in such a way as to relieve the user from the responsibility of operating or learning how to use CONTACT, the mainframe's operating system, file transfer utilities, modem protocol settings, etc. A user interface was developed so that from the user's point of view, the CALL systems were little more difficult to use than an automatic teller machine. Almost completely menu driven, with the exception of the text editors, the CALL systems require no more than the selection of an option with a single keypress, or the entering of a filename.

Guided Study Courses on CALL

The Guided Study program at Thomas Edison State College provides students with semester based independent learning courses. Students receive a course syllabus and various learning materials, usually a combination of basic texts, video material, and learning guides. Course mentors assess academic progress through written assignments, which are sent through the postal system, and examinations are proctored at various sites. The CALL Network provides Guided Study students and mentors with an alternate and speedier communication system through the use of electronic mail. Through this system, course assignments and messages of inquiry are exchanged. To draft messages and assignments, students may use their own ASCII format editor, or use the "Mail Writer" provided in the Network software.

To reduce the isolation often felt by the independent distance learner, the CALL Network also provides electronic class discussions. Supplementing the course learning materials, a class discussion topic is posed by the mentor. Students participate in the discussion by reading the topic and the discussion entries, and then submitting an entry of their own. Mentors monitor, guide, and participate in the discussion as necessary. Class discussion participation can be voluntary, or required and graded as an assignment.

Diagnostic Testing on CALL

Similar to CLEP examinations, Thomas Edison State College has its own testing program termed TECEP (Thomas Edison College Examination Program). To facilitate preparation for taking a TECEP test, the Office of Testing and Assessment has developed an hierarchically organized testing structure that serves as a diagnostic tool in preparation for taking the actual TECEP test. The diagnostic tests, termed CPT's (Computerized Predictor Tests) are short tests that sample a user's knowledge of a TECEP subject area. The CPT's are optional TECEP pre-tests that can be used to familiarize the user with the TECEP question format, and are predictive tools that report the user's score for comparison with a provided range of scores and their associated probability of success on the formal TECEP examination. The process of familiarization helps students to overcome some of the test anxiety that often accompanies those returning students who have become far removed from the testing process. Their predictive nature is important to those who would benefit from some objective feedback regarding their readiness for testing in the subject area.

Additional Services

In addition to the Guided Study on CALL courses and diagnostic testing, the CALL Network proposal included plans for the inclusion of a service that would provide general information about the College and its various methods of earning credit. Students would also be able to view their academic program plan, the preliminary spadework for which was provided by the computerization of students records. Another additional service would be an on-line application to the College with a provision for the payment of the application fee with a major credit card.

The technological infrastructure provides a vehicle for delivering all CALL services to students. Taking advantage of the electronic mail components that were drafted to allow communication between Guided Study on CALL students and their course mentors, the College broadened the service base by providing electronic communication between CALL users and a few of the involved College offices such as the Advisement, Registrar, and Bursar's Offices.

CALL Network development proceeded, for the most part, in accordance with the schedule provided in the proposal with the exception of a delay of one year, extending the original three year projection to a four year project. This extra year was realized through delays in the timesharing organization's implementation of equipment requirements, and the resignation and subsequent replacement of the consultant initially responsible for code generation.

The project's overall technical strategy was also largely intact at the close of the developmental period, with a few exceptions. Components such as the CPT's, and the general information and methods of earning credit sections, originally targeted for mainframe residence, were brought to the PC level to minimize expenses associated with on-line access and to take advantage of the PC's enhanced capability to provide an attractive display. Text editor facilities were incorporated into the array of CALL Network services as a "Mail Writer" to aid students in the preparation of messages and assignments.

V. Implementation: Releasing and Managing the Project

Preparing the Project for Release

Use of the CALL Network during the development period was restricted and it was essentially released in phases, ending in full public release in the fall of 1990. These general phases were: site bound release; controlled release: and public release. Each phase contained smaller sub-phases that would progressively test the reliability and efficacy of system components as they were developed. Testing at sub-phase levels provided a feedback loop that allowed the development team to solicit user's reactions and suggestions, and to incorporate modifications into the development process.

The College's Center for Corporate and Public Partnerships provided initial contact and liaison activities between outside professional establishments and the College to provide a testing "site" environment that would allow the College to test the first components while providing on-site equipment and a waiver of Guided Study course fees to the site's employees. This mutually beneficial relationship was crucial to early CALL Network development constituting the primordial soup, so to speak, from which refinements to the user interface, presentation organization, and supporting facilities (extra gadgets) emerged. Defined here only briefly, the user interface comprised: the conventions and rules that address how users see and operate the software system; the presentation organization that was imposed to govern how users understand the different options and how they work separately and together in the CALL systems; and supporting facilities that included items such as a directory listing, text editor templates (boiler plates, or blank forms), and a download/print facility so that students could read and study the contents of a class discussion off-line.

Initial components included an installation program, automated dial-in procedure, a text editor, Guided Study on CALL , and the information packages (General Information, and Methods of Earning Credit). These components were not all released at once; rather, they were provided and supported as development progressed.

The code for the CPT's was developed by NJECN's consultant in a preliminary form that did not allow the user to view any scoring or prediction. This allowed the College's Office of Testing and Development to use various normally scheduled TECEP testing sites to run the CPT's in conjunction with the TECEP test, thereby obtaining, from those who volunteered to take both tests, data for use in establishing the reliability of the CPT's as predictors of TECEP performance. The CPT code will be enhanced to report a prediction based on the user's score, and released for public use, when reliability testing is complete.

The second testing phase, a "controlled release" was a less restricted setting for testing of the Guided Study on CALL component. Specific student groups were selected and Guided Study on CALL was offered only to members of that group. The primary difference between the first and second phases involved the location of the PC and the type of support provided for the user. Whereas in the first phase all equipment was site bound and user support was provided through organized instruction provided by the developers, the second phase required that users have access to their own PC's and support was provided through a user manual and telephone support through the CALL Network Technical Support Center (CNTSC). This represented, to a large extent, a shift in the testing from the system's basic nuts and bolts to overall efficacy as a remotely supported product capable of its role in delivering distance educational aids and services.

The CNTSC was established to provide remote support for users of the CALL systems. Maintained by the College's Management Information Systems CALL Network staff, it provides telephone communication with staff during working hours and voice mail after business hours. Voice mail seems to lend more of an "electronic" flavor to the support of an electronic system and provides the very real benefit of providing on-call support after business hours as staff can collect and respond to messages from their homes in the event of a particularly busy period.

Project Support

All CALL project components were developed and tested in preparation for the last review of the Challenge Grant Review Team and subsequent public release of the CALL systems. As the final review heralded the end of the grant funded development, the CALL project was institutionalized, thus incorporating financial support for CALL into the College's budget. In addition, institutional preparations involved procedures to provide user and staff support, application procedures, printed information, and marketing. In general, support for the CALL systems followed the project management scheme with the project director responsible for global support, and component directors responsible for more local concerns. As the infrastructure represents the technical vehicle through which all components are accessed, support has tended to become centralized in the MIS Department. The Associate Director for MIS Educational Technology is the departmental project manager for infrastructure development. Most support has thus, by default, become the charge of the Associate Director for MIS Educational Technology. Specific MIS user support mechanisms involve a few areas: direct contact through telephone and e-mail communication; training; and user manuals for reference.

Telephone support is crucial and is often the only means open to a user during the time it takes to set CALL up on their PC. The CNTSC was created for such contingencies. Staffed by MIS CALL personnel, it has taken roughly 61 calls since public release in September 1991. All calls are reported on a "problem report" and reviewed periodically. Through this method we can assess areas that present difficulty to users and respond with enhancements if appropriate. Most calls to the Center are inquiries concerning installation and set-up of CALL on the user's PC. E-mail messaging to the Center is used much less frequently and will often contain suggestions about the system or reports of difficulties or questions that are somewhat incidental, for example, a question on how to format a document using the text editor. The word "users" has been used to refer to the College's student and prospective student constituency and does not include staff. However, support for staff is also a necessity; consequently, the Center answers staff inquiries also.

Formal training is provided for staff although it is not provided for users in general. Because the student body using CALL is geographically widely disbursed, on site training is not a feasible option. Training tapes or computer based training are possible but have not been opted for thus far as CALL is quite easy to use, and the user manual included in CALL's distributable package is comprehensive. The consensus of users seems to be that CALL is easier to use than it is to install and set-up. Installation and set up require that the user have a basic familiarity with their PC and its operating system, and any gaps in this familiarity show up quickly at this time.

A CALL overview and training session for all College staff was provided prior to public release, and attendance at the training was mandatory. This compulsory session was extremely important in fostering a wide reaching and consistent platform for launching CALL. Subsequent review/update sessions have been held periodically to support individual programs and departments according to their particular involvement with CALL. Printed handouts of each session's content are always prepared and circulated.

Training for Guided Study on CALL course mentors is provided by the Director of the Center for DIAL with assistance from the CNTSC staff. More intensive training is necessary for mentors as their role as instructors is much more active. Pedagogic issues are covered in this type of training with emphasis on the creation of electronic class discussions and the participation of students.

User manuals for the CALL Network were written in-house. The component modularity of the Network was mirrored in the manual, and each component is explained in detail. The manual's beginning sections covering "getting started" are meant to be read carefully, while the remaining component sections are primarily for reference. There is a Student and Mentor version of the manual for the CALL Network, and a user manual for the public bulletin board is currently in progress.

Applications and administrative procedures to support CALL were prepared as were explanatory materials such as graphic slide show and a CALL brochure. In addition, the College's Prospectus, Catalog, and other brochures were updated with CALL information.

The same process of constructing supporting mechanisms for the CALL systems is applied to the individual components so that departmental or programmatic specific concerns were handled by the program sponsoring the CALL component. For example, while applications for the CALL Network are processed by the CNTSC , registration for Guided Study on CALL courses is the responsibility of the Center for Directed Independent Adult Learning.

Public Release

The CALL Public Bulletin Board was released for public use in August of 1990 followed by the CALL Network release in September of 1990. Enrollment and use of the CALL systems has grown steadily with the release of college printed materials that reference CALL. The CALL Public Bulletin Board presently handles roughly 50 calls per month and has accommodated 176 new users as of this writing. Usage data has indicated that users are consistently most interested in reading bulletin board items and using the information packages.

There are presently 69 registered users of the CALL Network . The CNTSC receives and processes an average of about 6 CALL Network applications per month. CALL Network users have access to the information packages, Guided Study on CALL, and an Academic Services section. Within the Academic Services section, user activity for the first year included 76 e-mail messages to the Advisement Center, 21 e-mail messages to the Registrar's Office, 12 e-mail messages to the Bursar's Office, 224 requests for a copy of a program plan, and 57 requests for a copy of a billing record.

As was outlined above, very little direct marketing, recruiting, or training was done at the time of public release. Information about CALL was primarily disseminated as additional material written into the College's publications, and a CALL brochure is mailed to each new student along with the standard new student materials. This cautious marketing approach was primarily borne out of a desire to address personnel support needs before inviting potentially unmanageable enrollment. The College is presently conducting a study to determine, based on the first year's activity, its organizational and personnel needs.

Much of CALL's development to this point has been based on several assumptions. Access to a consolidation of services from a single point of entry is assumed to be convenient. Providing access from 7:00 am to 12:00 midnight as CALL does is also assumed to broaden service availability. The College's task from this point will be to enhance, refine, and add services that will further CALL's positive impact on its students.

VI. Cautions and Unexpected Expenses: Lessons Learned

Network Management Concerns

One of the most expensive aspects of supporting the CALL systems from a management information systems perspective is that of managing and maintaining the telecommunications and networking connections that comprise the "network" backbone through which services are delivered to the user.

For example, the public data network arrangement originally adopted to provide X.25 service was the most cost effective method available. This arrangement involves the central host computer's connection to a local area Bell X.25 service which takes care of all local calls and becomes the conduit to the computer host for all calls provided by another wide area X.25 service. While a wide area X.25 carrier could make a connection directly to the computer host and bypass the local Bell service, the cost of this type of connection is significantly greater than the formerly mentioned more circuitous route. However, it has been our experience that the circuitous arrangement has been a difficult one from which to provide reliable and timely service as there appears to be much finger pointing when problems arise. This situation was most certainly aggravated by two successive transfers of ownership involving the CALL Network's wide area X.25 carrier.

Public data network carriers also supply a list of telephone numbers that provide access to their network and one or more sign-on sequences that are used to access the host or target system, in this case the CALL Network. As the CALL Network software includes an automated dial-in piece, the code written for that piece must stay current with the carrier's sign-on sequences. It should also be mentioned that those sequences are sometimes essentially generic examples of the sign-on messages, so writing code that will wait to see a local "connect complete" message may be tricky if the connect message in another area of the country really appears as "now connected" or "hello". In addition, carriers periodically update their telephone lists, adding or deleting telephone numbers as necessary, and consequently any PC or user manual resident lists must also be updated. In short, it is prudent to budget time, personnel, and resources for routine updating.

The TCP/IP connections also proved to be another area of expense. As this protocol is rather cutting edge, and consequently somewhat new, the vendor supported software may not be as highly refined as would be a mature software product. Anomalies may be present and may add complexity to development. There is almost always a way around such difficulties, but work-arounds do have some added cost component.

Certain problems were encountered with the automated dial-in process. The CALL Network software operates with Hayes and compatible modems, and those modems in turn require voice-grade, analog telephone lines. It is apparently the case that some digital telephone systems (PBX's), as are encountered frequently in office buildings, do not behave at the technical level as analog lines do. Consequently, the CALL Network's automated dial-in process works wonderfully in residential homes yet frequently can not make a connection through office building phone systems.

A word of caution is worth mentioning here about the development of the technical platform under which a system like CALL would run, and it is in all probability no great revelation. In general, complicated applications require sophisticated equipment. Therefore, if the objective of a system is to deliver wide access to many users, make sure that the technical platform runs on equipment that many users have. In thinking about the many configurations of equipment, the task should be to find the lowest common denominator.

Cutting edge development usually carries the expenses and problems associated with forging new territory: there will be few established points of reference or comparison; extra time is needed to smooth and fix extraordinary concerns; creativity, patience, and persistence are essential; needed or desired tools have not been invented yet, etc.

CALL Usage Concerns

The CALL Network user manual was necessarily written based on the assumption that the users were responsible for and knowledgeable about their equipment. In practice, many users are not very knowledgeable. About half of the calls placed to the CNTSP are from users who do not understand their personal computer, modem, or operating system let alone any other technical complexities. This places the CNTSC in something of a quandary in offering technical support. As CALL is well automated, simple to use, and nonproblematic once installed, it has been to date considered reasonable to spend a few minutes helping inexperienced users get started.

On the other hand, although much less often, experienced users sometimes become frustrated with the boundaries imposed upon them by CALL's automation. The development of an "expert mode" is currently under consideration.

CALL is most useful and advantageous to users when they are actively directing the process, for example sending e-mail, browsing though information, creating an assignment, or requesting a billing record. The advantages are that CALL is fast and easy to use, it is available nearly all day, it allows users to easily save their written (thus documented) correspondence. CALL is not, however, as advantageous when the user is passive and waiting for e-mail messages. Users do not know if they have mail unless they turn on the computer and access CALL to find out. Unlike the telephone system which rings so users can hear a caller, or the postal system where users see their mail, CALL does not have a sensory cueing system that can easily alert the user that mail has been received. Although the system will display a "mail waiting" message, the user must first power up their PC and use CALL to dial-in to their mailbox, a process of at least a few minutes. If there is no new mail, that process can be frustrating.

VII. Project Future: New Initiatives

Strengthening the Infrastructure

Just prior to the completion of the Challenge grant funded portion of CALL development, the College was awarded a $400,000. grant from Digital Equipment Corporation. This award would provide for the acquisition of VAX equipment and the migration of the CALL systems to a VAX platform. Through this migration, computing facilities will become owned, housed, and maintained by the College as opposed to the present time-sharing operation. CALL thus becomes more directly controlled by the development staff.

The largest advantage to be realized will be a significant increase in the "strength" of the technical infrastructure. While maintaining systems in house will naturally incur some new costs, timesharing expenses will disappear, and without iterating each particular nuance of a cost and benefits analysis, the College will be enabled to accelerate the rate and quality of new development.

Broadening Services

The services currently available on CALL (version one) represent the initial development efforts to establish the College's CALL program. As such, the program is still in its infancy stages. Version two of CALL will contain enhancements that were conceived to be relatively easy to achieve in the process of the system migration from the time-shared facility to the in-house VAX platform. Services provided by electronic mail, file transfer, and conferencing components will be expanded to include more offices of the College.

The migration and development that will result in CALL version two will also include a major new feature termed the "portable classroom". This concept is designed to meet the needs of many of the College's corporate and public clients who differ from the individual student in their need to provide on-site training to groups of students. In this type of scenario, any interested outside agency would lease from the College the portable classroom system which provides on site computing resources, up to16 terminals, and a high-speed direct connection to the CALL Network. Thus a business establishment, for example, would be able to sponsor on-site CALL access to offer employees a Guided Study course on Business Management.

Another exciting addition planned for the Network is Internet access. The Internet is a global computer network designed for, and cooperatively managed by, research and education principles. Students will be able to use Internet resources for access to on-line library catalogs, data bases, scientific instrument usage, supercomputing facilities, and e-mail access to other Internet users. Eventually, the CALL Network itself will be accessible through the Internet as an Internet resource.

Version two of the CALL Network, with its enhancements as briefly described above, will further CALL's mission to empower users and to expand their access to educational opportunities.

AN EXPERIMENT IN THE REORGANIZATION OF LIBRARY AND INFORMATION TECHNOLOGY SERVICES AT A LIBERAL ARTS COLLEGE

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This paper describes a management experiment designed to knit the Kenyon College library to the academic program and information technology organization in a new operational structure. After years of library management problems, Kenyon is redesigning the future of the library as a collaborative project among the academic and information technology divisions. A five person oversight committee is managing the library while redefining its future role. The overall goals are to define the future role of the library, re-establish the library as central to the academic program, create an organizational structure which promotes cooperation between the academic and information technology divisions, and create a new institutional understanding about information as a strategic asset.

After years of management problems, Kenyon College by the spring of 1991 was faced with serious problems in and with its library. In addition to the challenges which all small college academic libraries are experiencing, the Kenyon College library had become disconnected from institutional budget and planning processes; library automation was virtually complete but few benefits of that implementation had been realized; the Library Director had resigned; and there had been negative external evaluations of the library. Disruptive or obstructive habits among the library staff were common. There was a communications chasm between the library and the faculty and other academic administrative personnel. The range and depth of these difficulties reduced the daily work of the library staff to merely coping, responding when possible to specific requests. Also, certain responsibilities of the library, particularly audio/visual and other departments responsible for non-print resources which rely on distributed technology and equipment, had been ascribed a second class citizenship, as the library staff understood both prestige and budget allocation. The environment in the library was felt and described as both hostile and lethargic.

What Kenyon College, long respected as a high quality liberal arts college with a distinguished reputation in the humanities, needed in its library was a sea change. The senior administration wanted to position the library at the center of the academic program, with the capacity to meet the challenge of rapid changes in libraries and information. We wanted to make sure that the library would not be left out of institutional strategic planning and the next capital campaign, a loss which might confound the library and the quality of the educational program at Kenyon permanently. After having spent over $500,000 on library automation, Kenyon needed to find the advantages which automation can and should afford the library and the academic program. We wanted to provide some influential and credible leadership for the library. We wanted to respond to the concerns raised by external evaluators in the most advantageous and constructive ways. We wanted the personnel in the library to revel in their tasks and glory in their accomplishments, making the library a place on campus where scholars, students and teachers alike, wanted to be. We wanted the extent to which technology has both assisted and altered the ways that libraries fill their role to be understood, as a function central to the academic mission of the college. We wanted the library's administrative structure to be in harmony with Kenyon's somewhat unique collegiate administrative organization. We recognized that the quality of the library, including its adaptability to the future, could be one of the hallmarks of quality or a serious flaw in a liberal arts college of the 21st century.

In order to intervene swiftly in problems which the library was experiencing, Kenyon's senior administration decided to design the future of the library as a collaborative project among the academic and information technology divisions. In March, 1991, following the resignation of the Library Director, Kenyon's President appointed a group of four people, three senior administrators and the chair of the faculty, to serve as an oversight committee for two years to manage the library and plan its future. Some background on Kenyon College and its organizational structure will help explain the rationale for this unique management arrangement.

Kenyon College is a distinctive, highly selective, undergraduate, liberal arts college in Gambier, Ohio. A splendid faculty of 127 FTE (full time equivalents) teaches 1500 students, all of whom are traditional college age students who live on campus. As the means to education in the liberal arts, Kenyon offers courses in traditional disciplines of the fine arts, the humanities, the natural sciences and the social sciences, and in interdisciplinary fields. Seminars, lectures, laboratory and studio courses, and collaborative and independent work are conducted in well equipped, comfortable settings. An annual operating budget of 35 million with an endowment of similar size plus gifts and grants to the college provide the financial parameters within which the library, the academic program, and information and computing services are managed.

For the past year, Kenyon's administrators, faculty, students, trustees, and alumni have been participating in a comprehensive strategic planning process. The resulting clarity about mission, goals, and objectives will provide a guide to priorities and achievable plans for the current decade.

Kenyon's basic administrative structure is a President-Cabinet model. The President has divided responsibility for management of the college into six administrative divisions, each headed by a person or persons who report directly to the President. The divisions, and their respective heads, are as follows:

Academic	Provost; Academic Dean
Admissions	Dean of Admissions
College Relations	Vice President for Development
Finance	Vice President for Finance
Information & Computing Services	Vice President for ICS
Student Affairs	Dean of Students

The Academic division of the college is led jointly by the Provost and the Academic Dean. The Provost is responsible for academic department budgets, faculty hiring, evaluation and development, and until recently, oversight of the library. The Academic Dean works with academic facilities and equipment, curriculum, planning, and oversees various academic support departments, including the Registrar's Office and the Off-Campus Studies Program. The Provost and the Academic Dean work closely together within the division, and cooperate and collaborate with the Vice President for Information and Computing Services on many issues of joint concern.

The Kenyon College library is housed in the Olin-Chalmers building, a spacious, well designed facility at the center of the historic, academic core of the campus. Approximately 5.1% of Kenyon's educational and general expenditures is budgeted annually for the library. The staff of the library is 20.75 FTE, excluding student employees. Library holdings include more than 285,000 volumes plus 300,000 other documents and audio-visual items. The services growing most rapidly in the library are interlibrary loan and on-line searching. Although the library has many strengths, recent evaluations by the North

Central accreditation group and a consulting team hired by the college expressed concern about management problems in the library.

In 1988, Kenyon combined the previously separate academic and administrative computing departments into a new division, Information & Computing Services (ICS). A new Vice Presidential position, reporting to the President, was created to develop and lead ICS. After three years of growth, ICS has a broad, collegiate mission which covers all aspects of information technology. ICS provides management, coordination and direct support for academic computing, administrative computing, on and off campus networking, library automation, office automation, information technology grant activities, technical services for equipment, microcomputer sales, and purchasing of all computing equipment and supplies. In addition, ICS staff members are involved in strategic and tactical planning for audio and video services, telecommunications, institutional research, college budgets, and college facilities. ICS has a staff of 20 FTE and a budget which is about 4.5% of the college's educational and general expenditures.

Since 1985, Kenyon has invested $3,200,000 to develop an information technology infrastructure. The college now has a full campus Ethernet and FDDI network which includes ample central computing resources, desk top computing for all faculty and nearly all staff, one computing access device for about every nine students (with the devices located in student residences, public clusters, the library, classrooms, laboratories, and studios), and access to the Internet for all members of the campus community. Network and telephone wiring is nearly completed to every student residence hall room. The library automation system (DRA) has been operational since 1990 and is accessible from any network access point. Nearly all faculty, staff and students use the college's computing and networking resources every week. The North Central accreditation group recently cited Kenyon as having outstanding information technology services and facilities.

Although the library historically has been part of the academic division, the Information & Computing Services division is responsible for supporting and developing the library automation program. The patterns of strong cooperation between the academic and ICS divisions, along with a general inclination to find the most efficient, effective way to organize information services at the college, led the President to create a high-level management team to oversee library operations and develop a long-range plan for the role and structure of the library rather than simply conduct a search for another permanent Director. In this key transition period, the President felt it was important to maximize cooperation between the divisions involved in information technology services and to take full advantage of the management skills of all academic leaders. For the past ten months, the oversight committee has been managing the library while redefining its future role.

The original library oversight committee was composed of four Senior Staff members (Provost, Academic Dean, Vice President for Information & Computing Services, and Chair of the Faculty). In July, the oversight committee expanded itself to a group of five -- called the Quintet, with intentional allusion to the possibilities of harmony in instrumental quintets -- with the appointment of two-year Interim Director. These five persons, three men and two women, include academic leaders who have worked at the college as long as a quarter of a century (Provost) and as short as three years (Academic Dean). The Chair of the Faculty, though not an administrator, is a full professor elected to that post. In that role he is present and involved at the highest levels of collegiate planning and decision making.

The members of the Quintet, none of whom have a formal background in library science, bring a wide variety of interesting academic perspectives to the library situation. The Provost is an historian (British and European history) who has just published a book on the history of baseball. The Vice President for Information & Computing Services is a statistician, whose work in the collection and analysis of data (and his ability to build structures such as decks and repair machines such as bicycles) has contributed to his expertise in the areas of computing and information technology. The Academic Dean is a PhD in English whose interests stray to film criticism and detective fiction and whose administrative experience includes work with strategic planning, Honors programs, and negotiation projects. The Chair of the Faculty is a classicist who also teaches in Women's and Gender Studies and is expert in analyzing human behavior and group dynamics. The Interim Director of the Libraries is an alum, one of the first women graduates of Kenyon (which became coeducational in 1969), who majored in history and, while a student employee of the library, measured available shelf space. What this disparate group has in common is that none among them has remained in the same field in which they began. The multiplicity of perspectives, the lively discourse, is part of the fun of what we do. It also is a central strength of this collaborative model. Of course, these differences can be a source of frustration as translation is sometimes necessary.

The work of the Quintet is heavily dependent on electronic communication, via E-mail and materials which are exchanged over the campus network. In addition, the Quintet meets biweekly, with intervening meetings of twos and threes of the team to work on specific projects. Each member of the Quintet, assigned as a match to talent and skill, has at least one sphere in which each represents the rest. For example, the Interim Director is responsible for day to day library business; the Vice President for Information & Computing Services works with the Interim Director on budget construction; the Academic Dean is outlining an organizational management structure for the consideration of the Quintet and the Library staff. There is no practiced hierarchy within the Quintet; responsibilities are shared.

More than one of us has mused that the work of the Quintet is a feminine rather than masculine model for working together. Our work is overtly collaborative and non competitive. Both successes and difficulties are talked through. Our first project, even before the Interim Director had been appointed, was to talk and listen to every person who works in the library, without regard to the level or character of their responsibility. All of us share responsibility for attending to our process, to the integrity of the Quintet. Our consultation and communication has been extensive and inclusive, blurring the more ordinary distinctions between brainstorming, planning, and rethinking. We have made celebrations and retreats a habit of our work -- eating together, placing flowers on the circulation staff desk the day we began to use on-line circulation system, talking over tea on the lawn at one of our homes, etc. What this coffee clutch has in common is that we are, at the best times, intelligent, articulate, good listeners. The Provost, initially skeptical about whether this management structure would work, agreed in large measure because he likes and has confidence in the persons involved. He also reports that in Quintet deliberations he finds that he is consulting his feelings as much as he consults his judgment. Similarly, Vice President Moberg and Academic Dean Ponder have some of our best ideas on weekly noon runs. Whether this describes a feminine model or not, we are more likely to value relationships over hierarchy and enabling the work of the team over individual achievement. We are attentive to the possibility that this structure is most ambiguous to the Interim Director, whose responsibilities are comparatively discrete and whose institutional position is not permanent. Each of us feels a sense of competence and accomplishment concerning this project and respects the talents of the others.

The first tasks of the Quintet were to intervene in personnel problems, reorganize budgets, involve the library in institutional planning, design a long-term management structure, and reinvigorate the staff. Longer range, the goals are to define the future role of the library at Kenyon College, to prepare the library staff to receive a leader, to promote cooperation between the academic and information technology divisions, to realize economies and advantages which technology affords traditional and future library work, and to create a more expansive institutional understanding about the role of the library in the academic program and of information as a strategic asset.

Difficulties and obstructions within the Library staff were apparent in the individual consultations from the initial stages of the project. The Quintet analyzed and characterized these habits, then met with the entire Library staff to describe the problems and explain that changes which would be required. We have labeled these negative behavioral patterns "Chicken Little", "Dysfunctional Family", "I am an Island", and "Accuracy means you never have to say you're sorry."

The "Chicken Little" story warns the populace that the sky is falling, a librarians' habit perhaps borrowed from the faculty. Attention to one's agenda was summoned by calling a few influential faculty members, alerting them to a disaster which was about to occur. The resulting rumor, however unfounded, took both time and emotional energy, but reliably focused attention, however unproductively, on a perceived problem. The example from this year which still amuses us was the campus "Chicken Little" story about how Kenyon would cease to be a repository for government documents. Several social scientists, department chairs, and academic administrators were engaged for a few days assuring everyone that such an action was not contemplated. This inciting to riot, we judge, was a result of the library staff feeling disconnected from the manner in which decisions were made on an institutional level. A similar example which exposed fears about change among the library staff took the form of a recurrent rumor that, "the computer center would take over the library." What precisely would be taken over--space, budgets, positions--was a variable feature introduced by each new teller of the tale, while each ignored the fact that Kenyon does not even have a "computer center." (As described above, computing and information resources at Kenyon are distributed and organized as a division). The Quintet politely required more direct communication or complaint about each real issue and ruled out of bounds the "Chicken Little" habit.

The "Dysfunctional Family" habit made interpersonal communication in the library difficult. Enemies could be made by choosing sides, by becoming an ally of some third party. Human relations depended on loyalty, rewarded inaction, and nourished grudges. Similarly, patterns of responsibility within the "Dysfunctional Family" supported a confusion between service and servitude, issues which were keenly felt by members of the professional staff who are women. Without ignoring the past, we asked that old loyalties and grudges be set aside in favor of making the library as a whole a comfortable, functioning entity. We asked that individuals minimize the emotional construct they placed on their own actions and the actions of others, trusting others to perform their duties professionally. Refusing to work with others was ruled out of bounds.

Closely related to the "Dysfunctional Family" is the "I am an Island" habit, which values separation rather than cooperation. When "I am an Island" is invoked, one can adhere rigidly to a formal work schedule, fill out time cards, take compensatory time for any minutes worked beyond the nominal schedule, and refuse to help or enable a colleague whose work is different. As a consequence, tasks that would simplify or improve the library but which were beyond the purview of one's own job were nobody's business. Bottlenecks to efficiency known to everyone but for which no one took responsibility abounded. Information and control, particularly authorization for budget lines, was jealously guarded. The Quintet intervened in this pattern and informed the library staff that cooperation would be valued and rewarded and that responsibility for the overall library was shared. It is now no longer acceptable to say, "It's not my job."

Procedures which delight the tidy hearts of some librarians are dear habits. Accuracy and efficiency are conflicting goals, even though virtual flawlessness may be the epitome of some librarians' desires. "Accuracy means never having to say your sorry" or variously, "When you ask me to be flexible you're really asking me to be sloppy," seemed to be fundamental to the training and habit of mind for many of the library staff. Each time a book was catalogued, the bibliographic record was double checked. Professional librarians were filling out pre-acquisition cards and spending an inordinate amount of time checking them manually against books in print, holdings, and shelf lists, in order not to duplicate a volume which the library already owned. Such procedures contributed to a cataloging backlog estimated at nine months, and convinced us that some of the procedures were more accurate than we could afford to be, particularly in the allocation of librarians' time. Even though the discovery and eradication of an esoteric error is a fundamentally appealing achievement, we have notified the library staff that rapid access to materials, reliable service, a diminishing backlog, and service to students and faculty who use the library are more important.

Although Kenyon is not yet halfway through with this experiment in re-thinking and re-engineering its library, a number of significant steps have been taken which have already improved the functioning of the library. Some of the actions and decisions which have been accomplished or are underway include the following:

(1) Each member of the Library staff has been interviewed. The staff interviews, analysis of behavioral patterns, and subsequent discussions with the staff have produced some positive changes, and at least, have made the staff more aware of how their habits have been affecting the overall library environment.

(2) An Interim Director was appointed to a two-year term to handle the day-to-day leadership and communication in the library.

(3) The process for converting the cataloging system from Dewey to Library of Congress has been funded, and should be essentially completed during the 1992-93 fiscal year.

(4) Some library acquisitions are being routed through the college bookstore, leading to significant savings in the materials budget.

(5) New patterns of consultation have been established with the faculty, via the Academic Policy Committee, and with the library staff, via regular communication and gatherings.

(6) The internal library organizational structure is being analyzed and modified.

(7) For the first time in years, the library operating budget has been carefully analyzed and redesigned to focus on new priorities and growth areas.

(8) The Quintet and other college staff members have been brainstorming about future opportunities, reexamining all procedures, and trying to ask potentially interesting questions about the role and future of the library (e.g., In what ways is a library like a bookstore and vice versa?).

(9) Some budget savings have been realized through required institutional budget cuts in library personnel.

(10) The college's special collections and archives, and their appropriate role in the future of the library, are being analyzed.

(11) The Quintet and interested faculty have begun considering the present and future role of audio/visual resources in the college's instructional program, along with various models for changing the management structure of audio/visual services.

In the course of this two year experiment, the Quintet expects to coordinate the formulation of a new mission statement and strategic plan for the library. We have deliberately deferred this task until we have had more time to deal with short term problems and study the situation in the library. However, the necessity to make a wide variety of short term decisions has continually required us to raise questions about long range goals and objectives for the library. While we haven't yet formalized our long range thinking in a planning document, we find that some basic trends in library usage and our own sense of important directions imply that a set of basic goals is emerging.

It seems clear that supporting and promoting excellent teaching and learning should be the primary aim of the library in this liberal arts environment. Support for student research will also be important, with support for faculty research a third priority. Librarians should be actively involved in the college curriculum, through collaboration on course design and participation in classroom instruction. A key question to be answered is "How are the differences between an undergraduate library at a liberal arts college and a research university library apparent in the Kenyon library?"

The library staff should be able to spend more time in service areas (bibliographic instruction, information literacy, support for the academic program) and less in administrative work. The library staff structure should facilitate greater efficiency in operations, which is likely to result in a smaller operational staff. The traditional technical services operation is likely to be the area most affected by a reorganization, particularly after the conversion to the Library of Congress classification system.

Kenyon is seeing a dramatic growth in the use of non-print media, interlibrary loans, and on-line searching, trends which demand recognition. The college will have to provide greater support and resources in these areas, particularly as they enhance or change pedagogical techniques and effectiveness. Provision of appropriate instructional spaces and equipment to facilitate teaching using electronic information resources will be required also. During the past decade, Kenyon (like most colleges) has spent about 60% of the library budget on personnel, 30% on materials, and 10% on operating expenses. In order to supply resources in the growth areas, we will probably have to shift some funding from personnel to materials (for both access to and acquisition of print and non-print media).

The dazzling rate of change in networking, electronic publishing, copyright law, database availability, inter-library cooperation, and library automation will present great challenges and offer great opportunities to the libraries of the future. It will be imperative to develop library administrative structures which are flexible and efficient, and to require and reward library staffs which are creative and adaptable. In the Kenyon context, it will also be highly desirable to establish an administrative structure for the library which will ensure cooperation between all departments involved in information technology services.

TRACK VII
NEW TECHNOLOGIES AND APPLICATIONS MANAGEMENT

Coordinator: James Scanlon

The pace of technological change is quickening. The information professional has a whole host of new tools available for new application development: fourth generation programming languages, distributed and relational databases, image processing, and CD-ROM available for new application development. Institutions of higher education are both users and drivers of new technologies. In developing new technologies it is important not only to choose the appropriate technology but to find the application which will best use a technology.

Proper matching of technology and application can be critical to the success of an information management organization and ultimately to the college or university it serves. The ingredients of successful applications development projects are of value to other information managers. Papers in this track should help IT professionals learn how to keep up with their rapidly changing field.

Executive/Decision Support System

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Assistant Vice President, Information Technology

Linsey Williams
Director, Management Information Systems

University of Missouri System
Columbia, Missouri

The University of Missouri acknowledges the value of information to support decision makers of the institution. With its multi-campus, decentralized environment and existing inventory of non-relational operational systems, the University is implementing a system for decision support and for executive information through a joint venture with the IBM corporation. The system utilizes data extracted from the operational system that is placed into a relational "data warehouse."

This presentation will include how the projects' idea was fostered. We will review the role of key University executives and the collaborative effort of the University staff and IBM. The information retrieval and presentation, particularly ad hoc requests, will also be discussed. The changes made possible with the application of appropriate tools, such as the Data Interpretation System (DIS) and Executive Decisions VM, will be highlighted. The role that the networked PS/2s, file servers and host components play in the delivery of charts, graphs and tables will be presented.

I. Background

The University of Missouri, established in 1839, was the first state university west of the Mississippi River. In 1862, the University of Missouri became a land-grant institution. Today, the University is comprised of four unique campuses - Kansas City, Rolla, St. Louis and Columbia, along with Extension and System Administration.

The total enrollment for Fall 1991 was 57,100, with roughly 75% undergraduates and 25% graduate and professional students. In addition, there are about 7,500 teaching and research staff along with about 12,000 service, support and administrative personnel.

The Chancellors are responsible for the operation of their respective campuses, and they report to the President who is responsible for the operation of the University. Information about the students, staff and financial data is collected by the campuses and aggregated by the System office. Campus specific reporting is the responsibility of the campuses, while reporting for the entire University is done at the System office.

The University uses common operational systems for all four campuses although four databases are used to facilitate campus operational differences. The major systems include the 1) student information system which was developed locally; 2) library system which was obtained from WLN and modified; 3) alumni/development system from BSR; 4) human resources system acquired from ISI; 5) financial accounting from IA; and 6) the purchasing system which is composed of software from APS and IA. These operational systems have been interfaced to allow for the exchange of data between them.

Even with these good operational systems, there has been a need to have more timely information to support the decision making process. The operational systems were designed to provide good operational support but are not adequate to support pla[illegible] For example, timely responses are needed in order to reply to ad hoc questions, an[illegible]e query tools to do this are not part of the operational systems. In addition, some of the data that was needed to respond to questions was in electronic form, but it did not reside in any of the operational systems. Also, there was additional University and external data that needed to be captured to respond to some of the ad hoc questions.

II. Early Effort to Provide Decision Support Tools

We started searching for a solution to our decision support needs in the mid 1980s. Our first attempt in 1986 centered around the use of Nomad to access the operational databases. Since the tool was not easy enough for the users and data administration functions were not supported, the effort was only slightly successful. Nomad became a programmer productivity tool and, even then, responses to requests still took days to provide.

In 1988, we entered into discussions with a Vice President from IBM regarding how we could address the information needs of the executives. The focus of this effort was how we could prepare charts, graphs and tables for the executives to facilitate their decision making process. After a prototype of the proposed system was presented to senior executives, the University's President and Vice Presidents embraced the concept and approved moving forward with an executive information system (EIS) project. At about the same time, a new Assistant Vice President for Budget and Analytical Services was hired, and he not only needed the EIS component, but also the decision support component that would enable his group to answer ad hoc questions in a timely fashion.

III. Project Background

In response to the need for timely information to support the decision making process at the senior administrative levels, we decided to extract data from the corporate systems and move it to a relational database in an information warehouse. This approach was chosen because we could leave the operational systems alone or change them over time and still meet the information needs of the executives. The position of the information warehouse within the University's information systems strategy is depicted in Figure 1. If we were to replace all the corporate systems and install a relational database as part of the project, the conversion would take five to ten years and would probably cost millions of dollars. Since we neither have the time nor money, we chose to create the relational information warehouse from our operational systems.

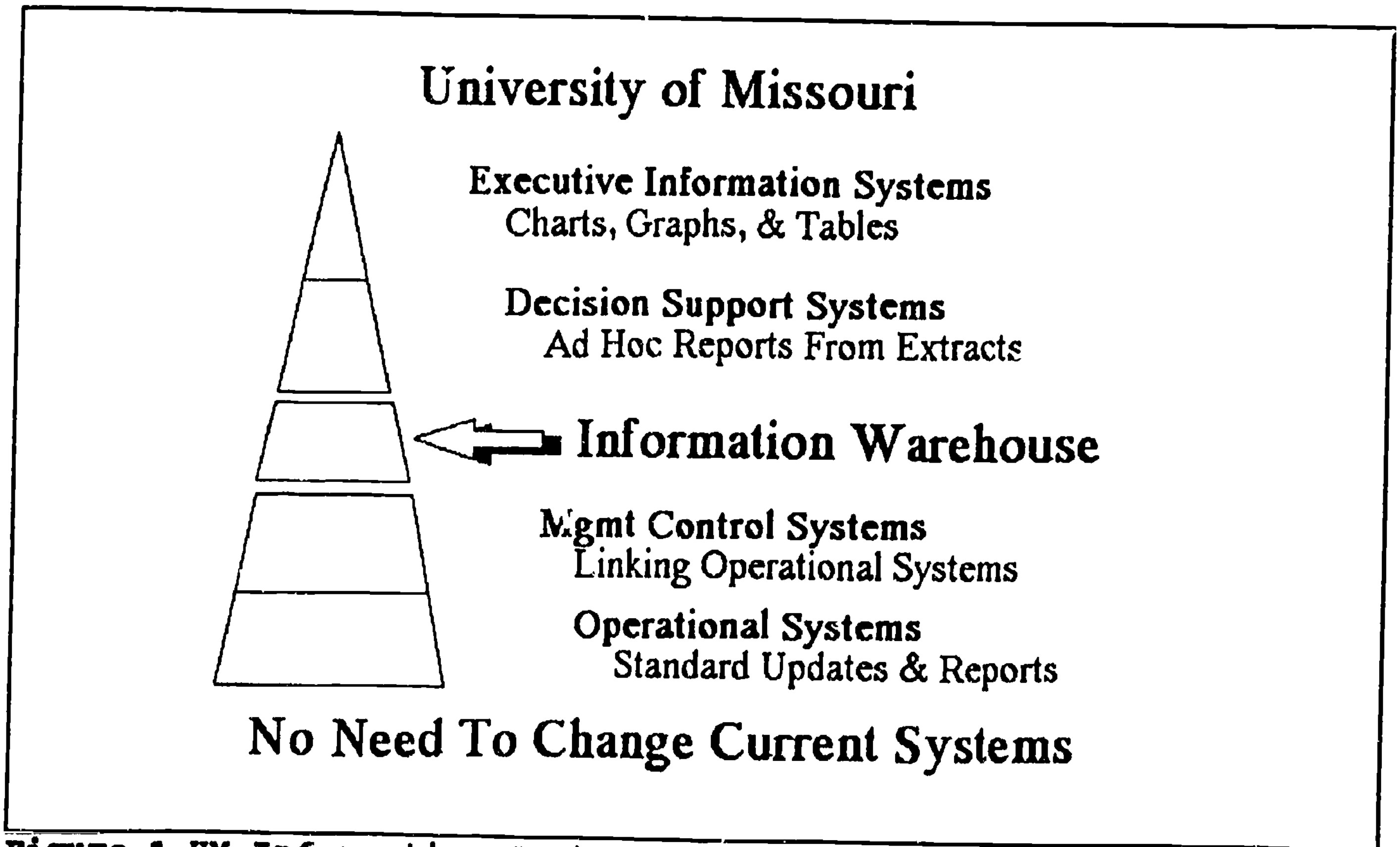


Figure 1 UM Information Systems Strategy

The concept of developing an integrated decision support and executive information was developed by the Budget and Analytical Services, Information Technology and IBM personnel. This idea was presented to the President and, after some discussion with the Vice Presidents and the Chancellors, he endorsed the project. In September of 1990, the President made a presentation to the Board of Curators indicating the proposed system was needed to better respond to questions and assist in the decision making process. This top level of commitment was critical to the success of the project.

IV. Project Organization

The management for the project was divided into four groups. Overall management of the project relating to policy issues is in the hands of the President, Vice Presidents and Chancellors. Management of the procedures relating to the project is done by the Assistant Vice Presidents for Budget and Analytical Services and Information Technology, the Directors of Management Information Systems and Institutional Research, and the IBM Project Manager.

The project team is composed of the Director of Institutional Research, Manager of MIS, two Programmer Analysts and an IBM System Engineer. The role of the project team is to 1) identify the data element to be included in the information warehouse; 2) design relational tables for the data warehouse; 3) develop a data element dictionary; and 4) develop applications in the decision support system we chose to use.

Next, there is an application advisory committee that is made up of the people who are responsible for the various corporate databases. The role of this group is to 1) review the data element selection of the project team; 2) provide interpretation of the definition of the data elements; and 3) identify data inconsistencies within or between the corporate operational systems. And finally, there is a faculty advisory committee which is comprised of two faculty members per campus and one academic administrator per campus. This group is responsible for reviewing the progress of the project and advising the President and Chancellors regarding the use of information from the system.

V. Data, Software, and Hardware Selected

During the initial phase of the project, data will be extracted from the financial accounting, human resources, student information, and student financial aid systems. So far, selected data has been collected from the most recent copies of the student system and the financial accounting system. Once the current information has been collected from all four systems the plan is to go back to the history files and collect additional longitudinal data to store in the information warehouse. The data elements are not always common across the four campuses, thus causing some verification problems. Generally, once the data has been loaded from the operational system into the warehouse, validation of the data is done by replicating reports that were produced from the operational systems.

The use of the various committees, data preparation and verification, and the creation of a warehouse is independent of the software chosen for the decision support and executive information components. We were looking for a hardware and software solution that would leave the current operational systems in place, work well for a large university and be a client/server application. With help from IBM's ACIS group and local IBM personnel, we decided to use the Data Interpretation System (DIS) from IBM, by way of Metaphor, to provide the decision support component. This system is a LAN based product that interacts transparently, from the user perspective, with the mainframe which contains the data warehouse. This system, as you will see later, is easy to use and is a true client/server application.

To provide the support for the executive information system component, we decided to use Executive Decisions VM from IBM. This is a mainframe system that will be used to transmit charts, graphs and reports to the senior executives. The data warehouse, DIS and ED/VM mainframe components are installed on a small 4381 running the VM operating system. Plans call for the passing of charts, graphs and tables generated in the DIS system to the ED/VM system for distribution. Members of the University will develop the interface between the two systems as well as DIS applications, referred to as capsules, in order to respond to ad hoc and the more standard information requests.

Figure 2 depicts a typical DIS hardware and software configuration. To start a DIS workstation, a "desktop" is requested from the DIS file server. From that DIS desktop, a user is then able to execute any of the functions available to that user. One of the functions that a user might want to perform is an ad hoc request for data. To accomplish this, the user would use the query tool from the DIS desktop to build the query, and that query then would travel to the data base gateway where DIS physically builds the SQL query. That SQL query is then forwarded to the data warehouse using the OS/2 communications server. At the data warehouse, the SQL query is executed against the data base tables specified, and the result is returned to the DIS desktop. Another tool available on the DIS desktop is the reporter tool, and the process to acquire the data is the same. Once the data has been returned to the DIS desktop, the user can put the data into a spreadsheet and/or chart.

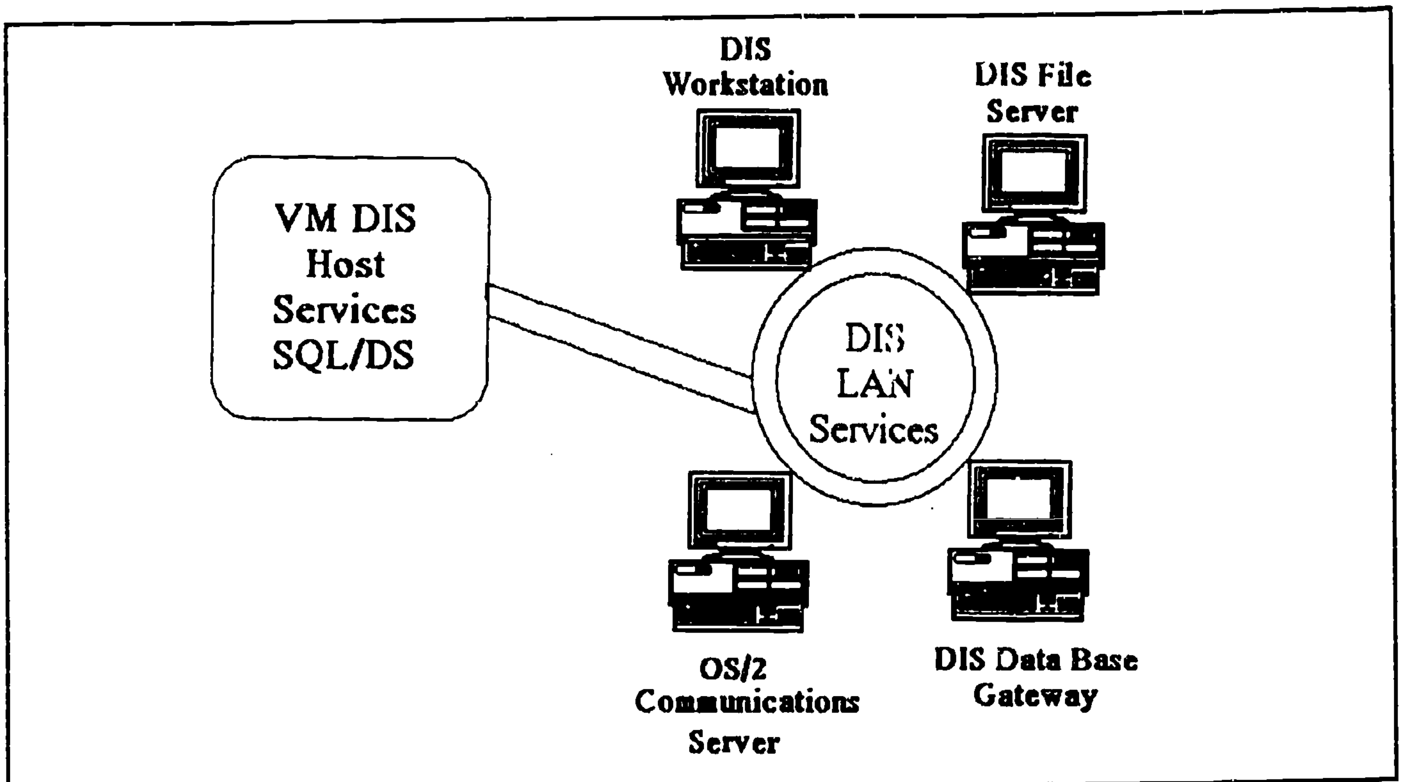


Figure 2 Representative DIS System

VI. The Decision Support and Executive Information System

The DIS system from Metaphor includes a complete set of traditional decision support tools. For example, spreadsheets and graphics are included as shown on Exhibit A on page 8. DIS also contains an E-mail component which automates the distribution of decision support information between users. Most impressive are two of the DIS components that generate and execute SQL statements for the user. One is known as the "query tool" and the other the "reporter tool." An example of the query tool showing the SQL is provided on Exhibit B on page 9. The query tool makes retrieval from a relational table simple while the reporter tool is used when executing multiple queries and for formatting formal or "pretty reports." The results from either tool can be incorporated into spreadsheets and documents and then stored in the specialized icon capsules. Another tool, called a "transformer," allows data from multiple queries to be manipulated and combined for presentation on the workstation.

Executive Decisions/VM consists of several IBM tools that assist with the distribution and presentation of reports, tables, graphs and correspondence to users. It is not dependent on DIS but can be used to store and/or transport information generated with the DIS tools. In a stand-alone environment it is used for storing and distributing "fact book" or "electronic briefing book" type information about the University. During subsequent phases of the joint study the University will be working with IBM to provide better integration between the DIS and ED/VM tools.

VII. Resources

The investment in this project over the first two years is about $500,000 which is split almost evenly between the University of Missouri and IBM. IBM's contribution includes two workstations being used by the two programmer analysts assigned to the project, and three PS/2s which are being used as the servers and gateways shown on Figure 2. The DIS LAN Services, DIS Host Client, and Executive Decisions/VM software was also provided by IBM.

There are two and one half FTEs dedicated to the project from IT. In addition, there is the equivalent of approximately another 1 FTE that is working on this phase of the project. We envision a continuing IT requirement of approximately 2.5 FTEs following the initial two years.

VIII. Conclusions and Future Opportunities

A question that should be addressed as we approach the mid point of the two year study is, to what extent does the technology deployed and the U/IDS system address the information needs of the institution?

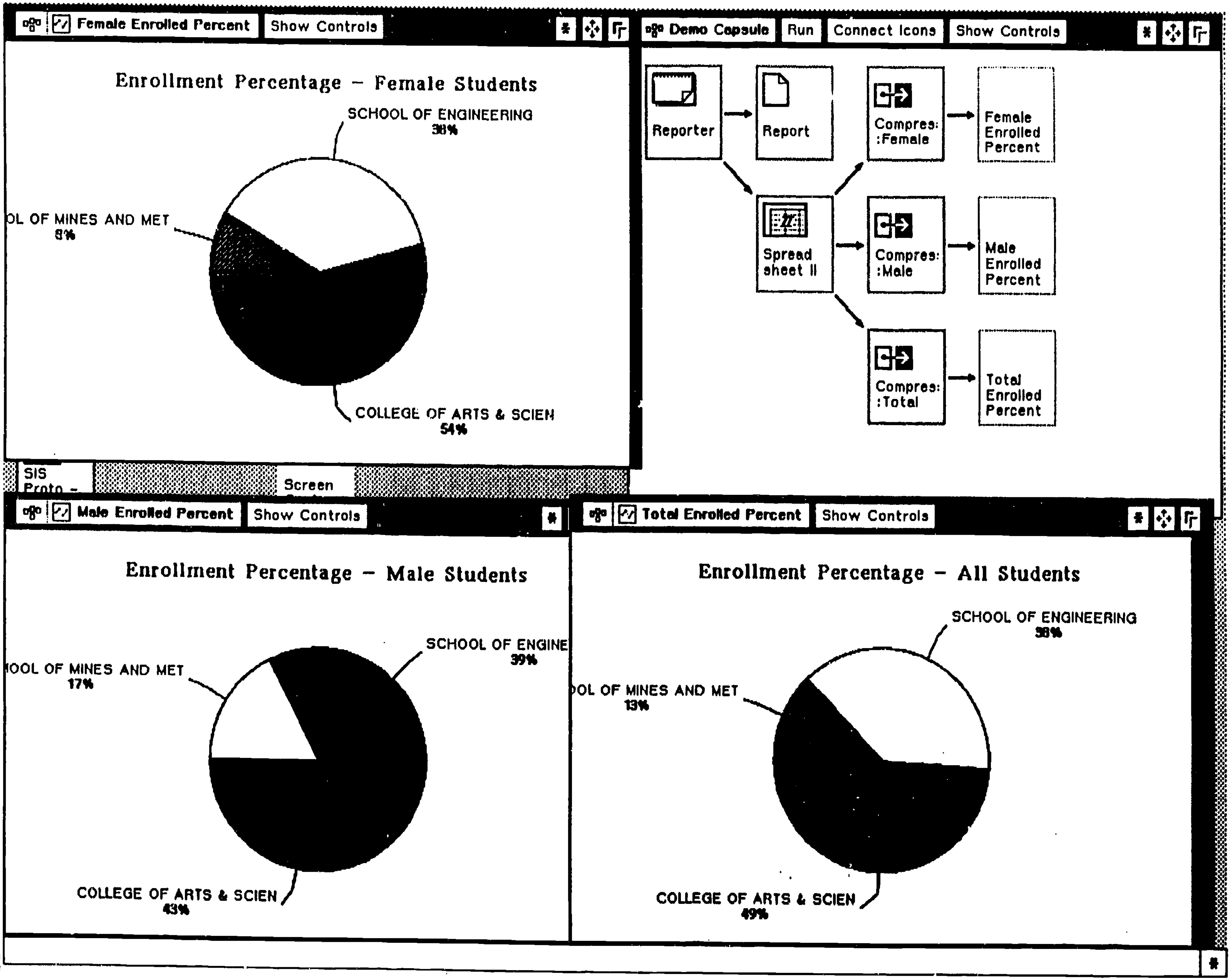
Neither the U/IDS System nor a single set of tools can meet all of the informational needs of the institution, however, the U/IDS project and joint study opportunity with IBM has afforded the University the opportunity to meet a critical need for consistent and more responsive reporting at the system level.

Additional uses of the tools are envisioned because of the success of the project and its visibility. The potential of the DIS technology is exciting to IT and is already generating considerable excitement elsewhere within the institution. It will be challenging for IT to support the warehousing and data design aspects as executives and managers in the operational areas learn more of the systems capabilities. The DIS tools set is easy to use and extremely powerful in the hands of users, but the actual design of underlying relational structure is a job for the IT professionals.

A challenge that the University has because of its multi-campus nature may be addressed by a product announced recently that permits remote access (via phone line) to a DIS system. The announced product, known as RemoteVision, from Token Technology, Inc., will eliminate the cost of multiple LAN configurations and make the distribution of DIS to the remote campuses much more economical.

Additional phases of the project will expand the capabilities of U/IDS as additional data about the University is added to the information warehouse and related to the initial data. University sources not yet tapped include data from research proposals and grants and information on private fund raising from the development system. Data from other institutions, as well as general economic information, is also being considered.

Exhibit A


Female Enrolled Percent
Show Controls
Enrollment Percentage – Female Students
SCHOOL OF ENGINEERING
38%
OL OF MINES AND MET
8%
COLLEGE OF ARTS & SCIEN
54%
Demo Capsule
Run
Connect Icons
Show Controls
Reporter
Report
Compres: :Female
Female Enrolled Percent
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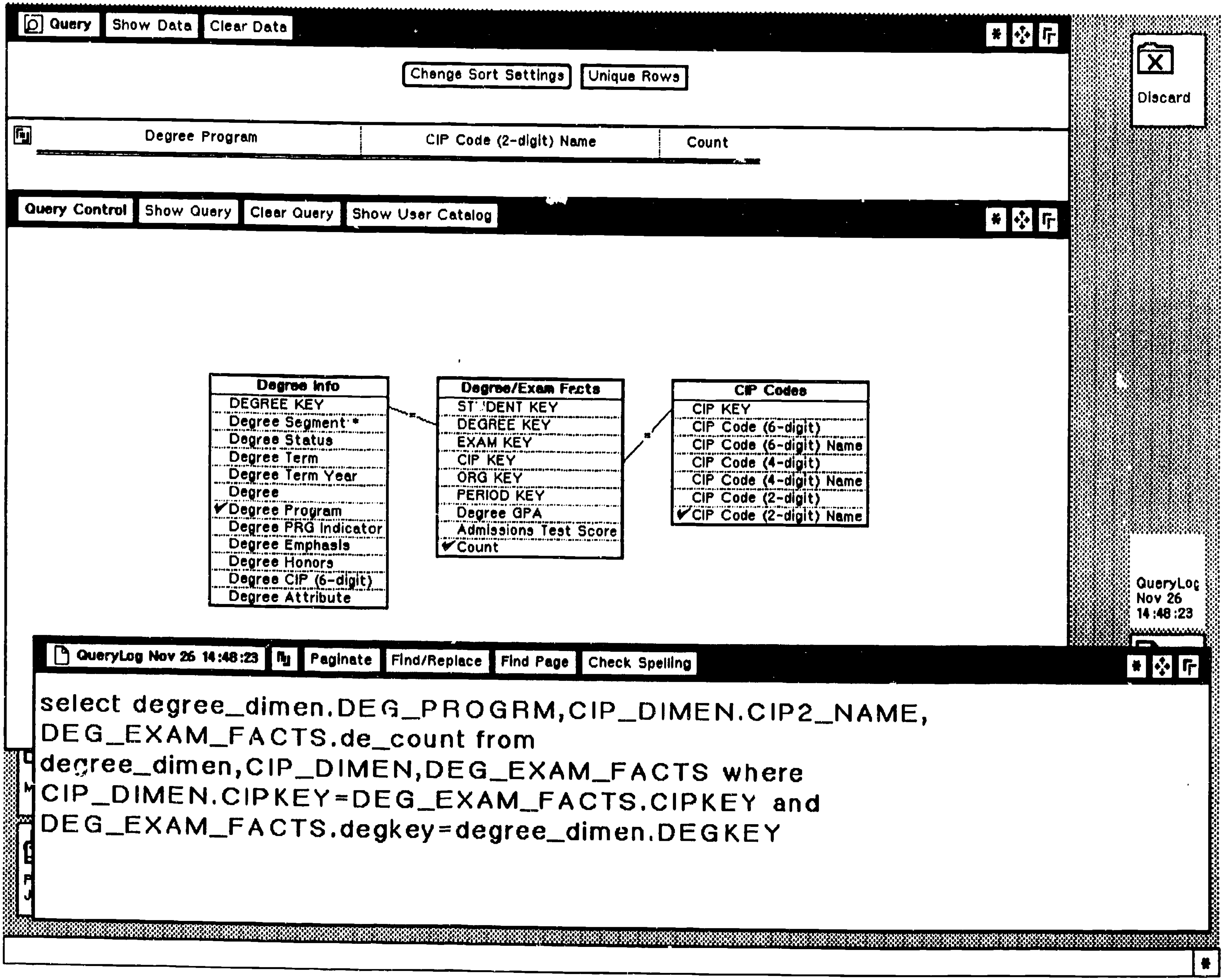
Compres: :Male
Male Enrolled Percent
Compres: :Total
Total Enrolled Percent
SIS Proto –
Screen
Male Enrolled Percent
Show Controls
Enrollment Percentage – Male Students
SCHOOL OF ENGINE
39%
IOOL OF MINES AND MET
17%
COLLEGE OF ARTS & SCIEN
43%
Total Enrolled Percent
Show Controls
Enrollment Percentage – All Students
SCHOOL OF ENGINEERING
38%
OL OF MINES AND MET
13%
COLLEGE OF ARTS & SCIEN
49%

8

Exhibit B


Query
Show Data
Clear Data
Change Sort Settings
Unique Rows
Discard
Degree Program
CIP Code (2-digit) Name
Count
Query Control
Show Query
Clear Query
Show User Catalog
Degree Info
DEGREE KEY
Degree Segment *
Degree Status
Degree Term
Degree Term Year
Degree
Degree Program
Degree PRG Indicator
Degree Emphasis
Degree Honors
Degree CIP (6-digit)
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Degree/Exam Facts
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EXAM KEY
CIP KEY
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Paginate
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Find Page
Check Spelling
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DEG_EXAM_FACTS.de_count from
degree_dimen,CIP_DIMEN,DEG_EXAM_FACTS where
CIP_DIMEN.CIPKEY=DEG_EXAM_FACTS.CIPKEY and
DEG_EXAM_FACTS.degkey=degree_dimen.DEGKEY

Beyond Electronic Forms: E-Mail as an Institution-Wide Information Server

Carl Jacobson
University of Delaware
Newark
Delaware

Delaware is applying existing electronic mail technology to effectively deliver information to faculty, staff and students. These "secondary users" of administrative systems require occasional access to small amounts of well-defined information from a diverse collection of institutional data.

Secondary users encounter many roadblocks in each quest for information. Users of "academic" machines have little desire to log-on to "administrative" machines and to navigate through applications, menus and display screens for occasional access of small amounts of data.

At Delaware, an intelligent mail server provides easy, inexpensive access to institutional information for users on any node, any machine or any operating system on the campus-wide network.

Administrative Systems

By tradition, convention and design, administrative systems at the University of Delaware satisfy the needs of the primary campus processing offices. In turn, these offices provide services to their campus "customers"; students, faculty and administrators. Today's business climate, however, calls for these offices to provide increased customer service during a time of fiscal restraint. Administrative systems aimed at the needs of these offices must be redeployed, targeting the needs of the "customer" more directly.

The registrar's office provides administrative services relative to student records. Students receive grades and transcripts, faculty expect course rosters and classroom assignments, administrators request classroom statistics and enrollment demographics. Automated systems were developed to enable the registrar's office to deliver these services.

With demands for increased customer service during a time of personnel cuts and shrinking budgets, expectations upon these systems have changed. Today, the registrar requests automated systems to serve the customers directly. We once heard; "Make systems to help us take care of the students when they come to the counter". But now, we are told; "Make systems to help the students without having them come to the counter!"

Of course these changing requirements are not limited to services provided to students. Faculty and administrators make similar demands on the registrar. And, in fact, it is not the registrar alone who is facing this challenge. It is shared by Financial Aid, Public Safety, Food Services, Billing, Housing and many other campus departments.

Segregation of Administrative Information

While this collection of administrative systems was carefully integrated, and network access was provided to all processing offices, and campus-standard terminals and workstations were installed, the computing needs of faculty, students and researchers were met on different platforms on various networks using a variety of terminals and workstations. Thus a large collection of valuable institutional information was segregated from "academic systems" and their users.

Faculty, students and researchers using "academic" systems have little desire to logon to "administrative" systems to navigate through unfamiliar applications, menus and display screens for occasional access to small amounts of data.

The vision of a seamless, integrated environment providing all members of the campus community with effortless access to a valuable storehouse of institutional information is clear. The effort necessary to realize this goal is substantial. During this time of fiscal restraint our need to move quickly toward this goal led to an examination of existing tools and technologies to identify solutions to satisfy some, if not all, of the requirements set forth by this vision.

As the first step toward this goal a charge was adopted to:

deploy existing information resources...
from all administrative systems...
to all users...
using a common user interface...
providing a single system image...
quickly and at a low cost!

Electronic Mail as an Integrator

At Delaware, word processing and electronic mail are the most commonly used applications and e-mail is the only application crossing all network boundaries. And while e-mail user interfaces differ from one platform to another, e-mail is the "most common" user interface.

While each e-mail system has a unique user interface, each is a familiar, well-used interface. These systems share common e-mail metaphors; inbasket, outbasket, file folders... While the details of the e-mail interfaces differ from system to system, every campus user is familiar with at least one e-mail system, and all campus users are routinely familiar with the e-mail metaphor and general e-mail concepts. This, in effect, provides a "common user interface". Can a useful level of apparent system integration be provided using electronic mail?

E-mail systems exist on every campus mainframe, mini or LAN. Various network gateways allow communication between all of these systems. Campus e-mail systems reach further into campus community than do administrative information systems. Can this "system penetration" help address issues of "information isolation".

Revisiting the original charge of our investigation we see that electronic mail might meet several of our objectives. Again, the charge was:

deploy existing information resources...
from all administrative systems...
to all users...
using a common user interface...
providing a single system image...
quickly and at a low cost!

Using existing e-mail tools might allow for rapid, inexpensive deployment. The collection of integrated campus e-mail systems might present the appearance of a single messaging system. And while the details of each interface to this system differ, the e-mail interfaces share many common functions while the users find them among the most common of computing interfaces. Campus e-mail is available on all systems and therefore has the ability to reach all users. Existing facilities meet four of our six objectives. Can these facilities be used to deploy existing information resources from all administrative systems?

Much as the LISTSERV software automates the management, access and distribution of electronic mail messages across the BITNET network, an electronic mail server can automate the access and distribution of institutional information across the campus network.

E-Mail Server

On one hand, electronic mail systems span the campus-wide network, providing basic messaging services to all campus computing users. On the other, administrative systems span the institutional databases providing access to a valuable information resource. A simple e-mail server can be implemented to merge these two existing resources to create an effective information system.

This type of e-mail server must be capable of

receiving e-mail requests,
determining what to do based on the content of requests,
providing necessary interfaces with institutional databases, and
preparing e-mail messages for subsequent delivery.

While LISTSERV message managers use a command syntax to enable users to communicate with the server, our institutional mail server uses position sensitive electronic forms, or templates, to provide this capability. For this reason the e-mail server is commonly called the "electronic forms agent".

At Delaware the electronic forms agent was developed on the "administrative" mainframe to provide the closest possible interfaces with administrative databases. As these applications migrate to network-capable databases and client-server platforms the physical location of the agent programs will be of lesser importance.

The e-mail package currently used on the administrative mainframe is the EMC2 mail system from Fischer International. Software AG's ADABAS database system manages the administrative databases, while the Software AG programming language, Natural, is used to develop administrative applications. A network gateway has been installed with the EMC2 e-mail system allowing mail to be exchanged with other campus e-mail systems.

The EMC2 product provides a forms feature allowing fill-in-the-blank forms to be designed for use by EMC2 users. Most other campus mail systems do not provide specifically for forms. In these cases "templates" may be manipulated using e-mail editors or forms "front ends" may be developed to provide for more control over the forms editing process.

While campus e-mail systems provide the user interface and transport mechanism for electronic forms, the forms agent was developed to control the distribution and routing of these forms and to provide interfaces between the forms and official institutional databases.

The agent was developed using the programming language Natural. A series of Natural modules serve as the generic agent providing an interface with the e-mail system. As the processing rules for each form are unique to that form, separate application interfaces are developed to meet the requirements of each form.

Techniques

-Inbox

An inbox was established within the administrative mail system to receive all electronic forms. Program code was developed to monitor this inbox and extract e-mail messages (forms) upon their arrival. Each extracted form is passed to the work flow agent for processing.

-Form Parser

The agent identifies the form and passes it through a parser to strip data from the form. Each form is defined in a dictionary containing rules for parsing and data validation. The data is placed in the agent's master database and control is passed to the proper application interface.

-Application Interfaces

Application interfaces may;

perform additional data validation,
return error or warning messages,
extract information from institutional databases,
pass data to update programs for eventual update of institutional databases,
determine distribution lists and routing paths for subsequent form routing.

-Form Builder

When the application interface determines the "next step" in the work flow process of a form, the form itself is rebuilt, moving the data from the agent's database onto a blank form. An audit trail, maintained by the agent, is appended to the form.

-Outbox

Once the agent has completed the rebuilding of a form, it is placed in an e-mail outbox for subsequent delivery.

Applications

Six classes of application have been classified. This somewhat arbitrary classification helps in understanding the capabilities of the e-mail server. Some applications are complex, while some are simple. In fact, some are so simple they can be accomplished without the use of an automating agent. However, an agent can bring additional functionality to such applications. The six classes include; form distribution, request for information, request for service, authorization required, data capture, and automated notification.

Application: Form Distribution

Counsellors in the Dean of Students Office complete an Academic Withdrawal Form when a student decides to leave the University before graduation. The form requires no further approval, that is to say, no one can deny the students intent to withdraw. However the form is distributed to notify eight departments of the withdrawal. This is an example of the simplest class of application, "Form Distribution".

While a full-function e-mail system can be used to implement most form distribution applications without the use of an electronic forms agent, an agent may add value to the form during distribution. "Form distribution" applications accept an electronic form and deliver copies of that form to members of a distribution list. The agent may append official institutional information to the original form during this distribution process. For example a student's outstanding liabilities might be added to an electronic withdrawal form as it is being distributed to administrative offices.

An electronic agent could go one step further and pass the withdrawal information directly to an institutional database to update an official university record.

Application: Request for Information

Applications classed "request for information" are quite common. An electronic form is submitted by a requestor calling for the agent to compile information from official institutional databases. The agent prepares and formats the information, places it in an "electronic envelop" and sends it across the network. In this manner a faculty member working on a Unix-based "academic" machine may request student transcripts from the MVS-based "administrative" machine. Class rosters and grant balances are examples served by this class of application.

Application: Request for Service

An electronic "request for service" is similar to the "request for information". However, instead of requesting information from university databases, these forms are used to request services from university departments. And while e-mail alone may satisfy these requests, a forms processing agent can provide interfaces with institutional databases.

Inter-library loan requests, textbook adoption forms, and workorder requests all fall into the category of "request for service".

Application: Authorization Required

Electronic forms requiring authorization are among the most complex applications. Routing rules must be established, stored and maintained to provide the agent step-by-step work flow instructions. Routes may be pre-specified and stored in tables or in the records of institutional databases. Routes may also be determined "on-the-fly" based on work flow rules processed by the agent. "A purchase requisition for hazardous materials must be routed to Occupational Health for approval" is an example of one such routing rule.

Three personnel forms exemplify different levels of routing complexity as they might be addressed by an e-mail agent. The Personal Information Form allows employees to change certain data fields in the institutional Payroll/Personnel system. Home address, phone number and emergency contact, are examples of information that can be changed at the discretion of each employee. The form requires no further approval and is routed directly to personnel system update programs.

The Personal Data Form, however, contains fields that can only be changed with the approval of departmental personnel representatives. This form may be submitted by any employee, but is routed for departmental approval before reaching the system for update.

The Personnel Action Form allows changes to payroll information and cannot be submitted by the employee. Rather the departmental representative submits this form, and the agent's routing rules send it on to the appropriate Dean or Director for subsequent approval and to the Personnel Office for final approval before entering the system.

Application: Data Capture

There are occasions when electronic forms are used to collect and format data to be posted in institution databases. If these applications don't require the complex routing rules of the "authorization required" class, they fall into the category of "data capture" forms.

An electronic form prompting department users to provide campus events information for a campus-wide electronic calendar exemplifies this class of application. The form prompts the user for formatted information, the electronic agent validates the completeness and correctness of the provided information, and may return the form for editing if the data has not been correctly submitted. A simple authorization step may also be added to "data capture" forms.

Automated Notification

While most electronic forms actions are initiated by individual users, one class of application is initiated by application software. These "automated notifications" allow applications to send e-mail notifications to members of the campus community. The simplicity of these applications make this good a good entry point for those wishing to leverage existing e-mail capabilities for the delivery of institutional information.

A summary report listing university donors of large gifts, automatically prepared and delivered to the university president is an example of an "automated notification".

Security

There are four general security concerns associated with electronic mail; authenticity, integrity, confidentiality, and non-repudiation.

- Authenticity provides proof that the apparent sender of a message is, in fact, the sender of the message.
- Message integrity guarantees that the message has not be changed since it left the sender.
- Confidentiality assures that the message cannot be intercepted on route from sender to receiver.
- Non-repudiation indicates that the sender cannot deny having sent the message.

Most electronic mail systems today do not address all four concerns and therefore information systems based on e-mail do not easily deliver the highest levels of security. However, until vendors of e-mail systems incorporate digital signature technology into their products to provide better authenticity assurances, effective e-mail agents may still be built based on the following assumptions.

- Many electronic forms applications do not require high levels of security.
- Many current information requests are made by telephone or paper form, methods which do not provide high levels of security.
- Electronic mail message sent TO the agent may be forged.
- Electronic messages sent BY the agent are correctly delivered to intended recipients.
- Those who can intercept campus e-mail messages in route, can also intercept information from other administrative applications using the network.

Application strategies can be developed based on these assumptions to deal with many security concerns. The "round-trip" nature of electronic forms transactions provides for several such strategies. If a student submits a forged "Request for Transcript" and the processing agent is fooled into thinking this is a valid request from the professor, the agent will send the transcript to the professor, not the probing student. The professor, while not making the request, does indeed have permission to access this information and the students attempted breach is unsuccessful.

The electronic form "round trip" can also be used to develop other authenticity strategies.

-Post-Event Audit

An electronic agent can deliver a "notification of change" providing the data owner with a record of changes made, and giving the data owner an opportunity to repudiate.

-Pre-Event Approval

The agent can return a submitted form to a data owner requesting confirmation prior to processing an update.

-Request To Make A Change

If necessary, the agent can require a data owner to request a "turn-around" form, populated with current field values, and delivered by the agent. Only upon receiving the returned form would the agent process an update.

The agent's master database provides a degree of security by storing all original electronic requests. Upon submission of an electronic request, the original form is assigned a certification number, timestamped and stored in the agent's master database. From this point on, all versions of the form are routed through the agent and built from this database. Any unexpected changes to a routed form are effectively "erased" as the agent rebuilds the form before the next delivery.

Additionally, if the certification and timestamp information has been altered on the returned form, the transaction is rejected. The certification and timestamp information is known only by the agent and each approver. Approvers must return to the agent an unaltered electronic form in order to complete the approval process.

Finally a complete audit trail is maintained logging each step taken by an electronic form as it makes its way through the work flow chain.

Exceptions

In addition to security concerns there are other limitations to e-mail based information managers. Alternative procedures must be used when handwritten signatures are required. Most e-mail systems today cannot respond when a collection of paperwork must accompany a form on an approval journey. Finally, when there are many members of the campus community who are not attached to the campus network, electronic mail looses its effectiveness.

Costs

Existing e-mail systems effectively bridge a growing, campus-wide network. Existing administrative systems span a diverse collection of institutional information. An electronic forms agent can merge these two valuable campus resources at a low cost.

An agent with basic functionality can be developed in a matter of weeks. Each application requires the development of an interface with the agent. The effort required for such interfaces differ according to the complexity of the application. Simple interfaces can be developed in a matter of hours. Complex applications could require several months of analysis and coding. As the application interfaces are primarily collections of institutional rules governing paperwork flow, analytical requirements usually outweigh the coding effort.

Conclusion: E-Mail To Play a Larger Role

Vendors of e-mail systems, graphics-based forms-processing packages, and database management systems are beginning to consider the potential of complete forms-automation systems. As work flow processing agents begin to be employed, electronic mail will play a more important role on our campuses.

An automated mail processing agent can provide a useful level of integration of campus information resources. Existing resources found in administrative systems, institutional databases, electronic mail systems and the campus network can be easily combined to provide more universal access to valuable institutional information.

QUALITY - - Just in *CASE*

by Linda M. Heika

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The Georgia Institute of Technology is currently involved in a project with ORACLE® Corporation to create an Administrative Information Management System using relational database design and the CASE Methodology. The University is also committed to following principles similar to Dr. W. Edwards Deming in Quality Management. This paper presentation will demonstrate how we are incorporating the tools for statistical quality measurement into the CASE Methodology.

QUALITY - - Just in *CASE*

1. Background

Established by the Legislature in 1885, The Georgia School of Technology, now Georgia Institute of Technology, is a unit of the University System of Georgia and operates under policies issued by the State Board of Regents. Located in the center of metropolitan Atlanta, Georgia Tech, site of the 1996 Olympic Village, is a constantly changing, ever growing institution of higher learning and research. With a combined graduate and undergraduate enrollment of more than 12,000 students and a research institute which conducts approximately two-thirds of the sponsored research performed at Georgia Tech, the administrative computing needs are as diverse as the various applications available on the market today.

The Administration had determined that Georgia Tech would switch to a UNIX-based environment using the ORACLE® Relational Data Base Management System (RDBMS) as the Institute's data repository and distributed processing platform. To aid in accommodating these expected changes, Georgia Tech began a search for Financial, Human Resource and Student Information Systems software using the ORACLE® RDBMS as it's foundation. In September of 1989 a Request For Information was issued to various vendors listing the requirements that would meet the current and future needs of the Institute. All responses were evaluated and on May 31, 1990 ORACLE® financials and human resources were selected, including a contract for joint development of certain applications unique to Georgia Tech's environment (primarily our Budgeting and Sponsored Program Tracking). Another contract for joint development of a Student Information System ensued, was finalized in August of 1990, and the project for building an Administrative Information Management System (AIMS) was launched.

2. The CASE Methodology

Many philosophies exist regarding methods for constructing new administrative systems for any large organization and we had been exposed to a number of them in the past. Georgia Tech's attempt at consolidating all administrative computing under one platform was a gigantic undertaking and would require an extremely structured approach (or development method) that could not only be supported by all levels of management, but most importantly include the functional areas or "end-users".

The success of any system can be hampered by a multitude of problems which usually fall into 3 categories. First, business problems within the institute as a whole; this includes a lack of clear direction, possibly as a direct result of conflicting requirements from the various functional areas, that create multiple solutions to the same problem. Secondly, add the technical problems caused by the proliferation of microcomputers, vast advancements in communications which only serve to raise the expectations of users, and the use of newly developed tools, such as CASE, which often times seem to only inhibit progress. The third category involves the problems of the individuals within the project and includes the most obvious: communication, communication, communication. Central to this problem is the entrenched view of all concerned about how things have always been done which only escalates their resistance to change. Therefore, assuring the success of the project is more about approaching the problem in the right way, with the right people, than the blind use of controlled procedures.

With the need for structure and end-user involvement apparent to all concerned, Georgia Tech and ORACLE® chose to use ORACLE's CASE*Method™, a top down, staged approach to developing systems that directly involves functional people at every stage. There are seven stages defined in this CASE*Method™; Strategy, Analysis, Design, Build, [illegible]ment, Transition and Production. Each of these stages has a number of tasks to be completed and although some activities within each task may appear to be redundant the information is not. Books have been written on the many details and tasks required in the seven stages yet space permits only a summarization of each. For further details you may wish to reference "CASE*METHOD™, Tasks and Deliverables" by Richard Barker.

Strategy

The purpose of the Strategy stage is to gain a clear understanding of the organizations needs by first defining "what is to be done". In short, this stage is used to determine the functions performed and how the current data relates to these functions. Accomplish this through the use of interviews and constant communication with the individuals involved in the day to day activities. The outcome or deliverables of these tasks will include a statement of business direction, an entity relationship diagram and a function hierarchy, among others. It is important to note that we are trying to document <u>what</u> is to be done not <u>how</u> it is to be done. This first stage represents a short, intensive period of gathering and filtering information in order to draw conclusions.

Analysis

Analysis involves breakdown of the functions to their lowest level of detail and elaboration of entities to include their attributes. It is a microscopic examination of the deliverables from strategy to verify that sufficient detail is included to ensure accuracy, feasibility and a strong foundation for the design stage. Once this clearer picture is in view, additional considerations can be brought forward allowing specifications to be defined regarding audit and control, security, a transition strategy and any viable issues that might block the success of the system. Again, this must be done with the total involvement of the functional representatives. This stage becomes a dissection process that allows us to see all the pieces in minute detail so that a new statement of future needs can be created from the component parts.

Design

The design stage will find the best way of fulfilling the detailed requirements from the analysis stage while meeting previously agreed upon performance levels. Deliverables will include a database from the entity relationship diagram, modules and manual procedures based on the functions, and the derivation of screens and reports. A great deal of consideration regarding the technical environment and the required levels of automation will be involved at this stage. The program specifications and a system test plan for transition are produced in accordance with these considerations. Basically an iterative process, design alternatives are created from the requirements and tried until an acceptable compromise solution can be found. Constant user and analyst involvement in determining "acceptable" will continue from the analysis stage and often the limitations of technology will force the designer to return to the user and analyst to see if requirements can be altered.

Build

The build stage involves the planning and coordination of program structure with an emphasis on common "look and feel" enabling the programmers to produce or construct maintainable code. Once actual programs are written much testing should be involved, often including the user and analyst to insure that they will get what they want out of this system. These programs and test results along with a tuned database are all deliverables that will help revise the transition strategy for the next stage.

Document

Documentation of the system, of operational procedures and of training requirements for the many types of users in this system (from data entry clerks to upper-level management) is the main deliverable in the user documentation stage. This stage has been conducted in parallel with the above build stage and is extremely important to a successful transition. The volumes produced here will guide the users and operations staff through the system for acceptance testing.

Transition

Implementation of the system is the goal of the transition stage and all tasks necessary to attain this goal must occur with a minimal disruption to the business as a whole. This is the most difficult stage since it realistically involves performing many activities twice. The problems may have to do with attitudes, resources, continuity, timing, deadlines and business pressures to name a few. It all leads to the fact that planning is most crucial to this stage. Training the user is followed by data conversion and hardware/software installation. The data is then loaded and the testing to determine readiness for production ensues. Although the user involvement escalates here, remember that cooperation of all those concerned, best represented by an initial support period, is a sure way to achieve the acceptability of the system.

Production

The production stage is the handing over of the entire systcm for continuous operation with minimal maintenance until the requirements of the business change or the need for software or hardware upgrades require the developers' intervention. This stage will include a great deal of statistical evaluation in the form of performance statistics and audit results to allow discovery of irritants or minor problems that may help correct larger issues.

With these seven stages of structured system development to follow, Georgia Tech and a number of ORACLE® consultants began the Administrative Information Management System (AIMS) project. Although the entire project includes Financial systems, Human Resources, and a Student Information System, I chose to elaborate on the Financials, particularly the Accounts Payable application, because the core of these applications have already been written by ORACLE® and some adjustments were necessary for our use of CASE methodology. We have completed the strategy stage and are currently involved in the Analysis Stage. The function hierarchy has been broken down to the lowest level of detail and the Entity Relationship diagram has had its attributes defined. ORACLE®'s Accounts Payable application has been installed on a UNIX machine and we have found that a necessary task in the analysis stage is to map the functions to the screens and the data to the tables or entities. One major result of this mapping task is a list of enhancements, a deliverable we find will be extremely helpful in creating the transition strategy. We have also found it useful, albeit somewhat time consuming, to create process flows to gain a complete understanding of the existing system. This process flow allows for an easy way to identify potential areas where measurement criteria can be established and incorporated to help determine acceptable levels of performance in the new system.

3. Total Quality Management

In the past year the Planning, Budget and Finance Office at Georgia Tech has also begun to learn about total quality management by adopting a customer orientation philosophy based on the works of Dr. W. Edwards Deming. A Quality Council was created and a mission statement and credo established. In summary, our mission is to work as a team providing services to our customers, not only satisfying them in their needs, but delighting them with our willingness to help in resourceful, innovative ways. We hope to remain keenly aware of our customers' needs by investigating opportunities for quality improvement in a university environment. One way to improve service is to build a stable and efficient Administrative System which will allow our customers to provide better services to the most important customer - the student. The question here becomes, "How do you know you have a stable and efficient system?" The 7 "tools of quality" represent quantitative ways of determining what data should be measured and how we can interpret the results of the measurement process to guide us in establishing standards for acceptance of this system. These tools can also help users understand their individual processes so they may better identify opportunities to improve their services. Quality improvement is an information intensive activity, yet unchecked collection of data will not ensure that a team will have useful information. Let's list the 7 tools of quality and then we will demonstrate how these measurement tools can be incorporated into system development.

Flowcharts

Basically this is drawing a picture of how things are done within each and every process in order to better understand that process. It is important to have the people doing the work involved in charting the flow of activity of this process. Questions are the most important aspect of flowcharting especially if they help the participants with some of their more detailed activities. Points of measurement can be determined with questions like: What tests are performed on products at each part of the process? Are there any tests on the process as a whole? What decisions are made in the event that the test results fall outside the tolerance levels? These flowcharts eventually allow the workers to control the process and more readily identify improvements, not to mention their value in training new employees.

Control Charts

Control charts are useful when dealing with variation. When a process exceeds previously determined control limits something has changed. A control chart is the most technical of the tools and can be created by collecting sample data and computing its mean and standard deviation. Upper and lower limits for the averages and ranges are then calculated, customarily at the mean ± 3 standard deviations. Once these limits have been established, all values used to calculate them must be plotted on their respective charts. If any points fall outside the control limits the distribution is not stable and reasons for this instability must be determined and resolved. Another sampling will then be made to get a new, more accurate set of control limits. With an accurate set of control limits periodic data can be collected and plotted. If an average falls out of the control limits the distribution has moved or expanded. If a newly plotted range falls outside the control limits the distribution has become wider. Either of these cases indicate a process that is not stable; it is said to be "out of control". These control charts can only warn us of a variation within the process, other tools will be used to determine the cause of the instability. As you may realize, many processes do not remain stable for very long, in fact process capability can change as often as several times a day.

Cause and Effect Diagrams

These diagrams are commonly referred to as Fishbone or Ishikawa diagrams and are a way of analyzing processes by relating causes and effects. The basic format shows an effect (or problem to be resolved) on the right side with major causes branching outwards like the skeleton of a fish. Sub-causes fan out from the branch they directly effect. To create a cause and effect diagram, first determine the problem, then with the people most familiar with the process conduct a brainstorming session. Each individual lists a possible cause for the problem until everyone involved has exhausted all the causes they can think of. It is important to allow each participant to say what is on his or her mind. Then group the similar causes under a few major cause categories such as methods, materials, manpower, machines or measurements and diagram them. Once the major causes are in place, the sub-causes can be added. The completed fishbone will help you identify areas where you can quantify the causes using additional tools and therefore determine solutions.

Histograms

A histogram is a graphic summary of variation in a set of data and is represented by a bar graph with permissible minimum and maximum values used as specification limits. An example would be to measure the number of pieces of candy in a 1-pound bag. Very few of these measurements will be the same. Values in a set of data almost always show variation and the frequently discernible patterns often reveal a great deal about the cause of a problem. Histograms are easier to decipher than tables of numbers and therefore make use of data that might have been misread.

Check Sheets

Check sheets, data sheets and checklists all represent a form for the collection of data in order to precisely answer a question that generates information. Use of a check sheet with a grid will not only provide a record of the data, but can also visually indicate trends. Because data collection is often the first step in establishing measurement criteria for any process, there should be a design stage to this activity. Questions about type of data needed to generate the necessary information, where to go to get this data, how to collect it with minimal interruption and chance for error must be asked. What you intend to do with the data is another important consideration, especially if you hope to get unbiased results. The form itself, with instructions for use, should be created with the aid of the individuals who will fill it out. The collected data can then be placed in the graph or diagram to help answer the question that started the check sheet in the first place. Note that every effort should be made to use data the application system may be recording, thus allowing the computer to automatically generate check sheets.

Pareto Charts

In simplistic terms the Pareto chart suggests that the majority of the effects come from a minority of the causes. A common example would be that 80% of the wealth is controlled by 20% of the people. This 20% is referred to as the "vital few" while the other 80 % are called the"useful many" (or "trivial many"). A bar chart is drawn with the most frequent or costly cause placed on the left and the other causes added in descending order. This chart is a natural by-product of the brainstorming used to produce the cause and effect diagram. By giving each person the opportunity to vote for each of the causes, usually having 10 total votes, a pareto chart can be drawn showing the causes along the horizontal axis and the number of votes on the vertical axis. With a pareto chart it is easy to see that two or three causes will become the "vital few" that should be concentrated on in order to improve the quality of the process.

Scatter diagrams

These diagrams are plots indicating relationships between two variables where the y-axis is reserved for the characteristic we would like to predict and the x-axis is for the variable we are using to make the prediction. For example, if we wanted to plot whether work backlog affects the error rate of computer data entry we would place the error rate (what we want to predict) on the y-axis and the work backlog (used in the prediction) on the x-axis. When the data collected is plotted in the scatter diagram a relationship will become apparent. Care must be taken to insure that a relationship exists between the two variables before using the predictions gained from this graph. Food price to housing price may seem like a viable relationship but in actuality they are more likely related to inflation and rising production costs.

4. A Practical Example

Now that we have a better understanding of the "tools of quality" how do we find practical ways of using them? We begin by asking questions that require information or data in order to get answers. In Accounts Payable, for example, the manager may want to know how many payments of invoices are delayed due to funds not available, account distribution error or a non-existing purchase order? How long is the delay? Another question, more related to all applications, is why does it take so much longer to process a transaction in the middle of the afternoon? By determining what data analysis tools we will use and the necessary data to construct this tool we have begun to gain insight into our questions. This insight will allow us to improve our process first by establishing standards and then by constantly checking the system to create better standards. A close look at the process flows we so diligently produced in our analysis stage will help us determine where in the process the data can be captured and who (whether individual or machine) can give us this data. We are performing the data collection task that will give us statistical information and allow us to measure the stability of our system.

A brainstorming session can help us determine possible causes to insure we are collecting the correct data. We state our question as a problem: Why are invoice payments late? A group of personnel involved in the processing of invoices, both internal to Accounts Payable and external to Accounts Payable, get together and begin to create a list. The machine was down, there were no funds available, the staff has been cut, slow response time, the invoice wasn't signed, the vendors had to be set up, the proper accounting information was missing, the person to contact about the error was not there. Each idea is written exactly as it is stated and the brainstorming is complete when all involved pass on a turn. Grouping the ideas into categories or major causes allows the fishbone diagram to take shape.

Next we will want to create a pareto chart by allowing each person in the group 10 votes for the ideas they feel most directly effect the problem. They can give as many votes to an idea as they wish. When all have finished there will be two or three obvious ideas with a large number of votes. Are these the causes for which we are collecting data? If not, they probably should be.

As the collected data is incorporated into the tools we get a clearer, more quantitative picture of the process of paying invoices. We begin to establish averages, standards and upper and lower control limits. Variations within the control limits and outside the control limits can be analyzed to determine if the unfavorable results come from a special cause or from a common cause of variation. Care must be taken to avoid the pitfall of totally changing the process to correct a common cause of variation perceived as a special cause. We start to recognize a point where the data indicates that the process is stable, in other words in a state of statistical control. These are the measurements we will use to determine the acceptability of the system being developed.

5. Conclusion

A critical success factor to the production stage of the project is a commitment to achieving high levels of service. With the foresight to include quality measurements in the early stages of system development, the necessary statistics for performance and system audit results are readily available and can easily be documented throughout the transition stage. The expected results as defined in the analysis and design stages by the users, developers and managers represents the "acceptance criteria". The charts and diagrams indicating acceptable results will demonstrate to management the capability and stability of the new Administrative Information Management System.

Imaging
An Overview for Managers

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This paper had as its origin the need to inform senior management about the new imaging technologies that are popping up on campuses across the country. And, hopefully offer a united front as to the technology a campus will/should adopt versus a piecemeal approach. Thus, it is written as an overview for managers.

The problem addressed by *document imaging systems* is the proliferation of paper, paper that can't be found, or is not at the right place at the right time, or that is otherwise clogging the administrative system.

As to format, the journalistic style of "who, what, when, where, why and how" is used as the structure. For example: *What* is imaging in terms of the process. By describing the new technology--from the optical disks, to image-display workstations, to the image management system, to the processor hardware--you'll see *why* it makes the difference. The *who* will provide an appreciation for the vendors in the business. The *where* allows us to see different educational institution's application of imaging. Then, a few thoughts relative to *when* the technology be mature. The paper closes with a few thoughts on *how* to be ready for imaging.

Imaging Systems: An Overview for Managers

The Problem

The problem addressed by document imaging systems is the proliferation of paper, paper that can't be found, or is not at the right place at the right time, or that is otherwise clogging the administrative system.

Paper means: (1) much wasted staff time filing and searching for a document; (2) ineffective use of the time value of money due to a slow "system;" (3) low staff morale because of a seemingly endless "paper chase;" and (4) an archaic workflow that reflects decades of "we've always done it this way!" Consider what *imaging systems* might do....

- Compress 20,000 pages of documents onto a disk the size of a CD.
- Reduce a room of filing cabinets to a single two-drawer file.
- Give all users, even remote ones, simultaneous access to the same document.
- Cut in half the time staff spend finding, reviewing, and acting on documents.
- Stomp out paper! Efficient electronic systems can actually improve morale.

What Is Imaging?

Document *image management systems* convert documents into digitized images, then compress and store them on optical disks. Once stored, images can be retrieved in a matter of seconds. These systems offer a number of advantages to organizations that have *large* quantities of active paper records that require certain processing steps and/or actions. The benefits from such systems include greatly reduced storage space, speed of retrieval, secure and organized storage of documents, multiple-user access to documents, and the ability to integrate imaging with existing computer systems and functions.[1]

Imaging, by definition, includes the use of such media as: microform, facsimile, and optical. Departments in which the long-term inactive storage of paper is the only filing requirement may find that *microform*, either microfilm or microfiche, i still the better and cheaper approach.

Facsimile (FAX) machines have become widely used image devices because of the CCITT Group 3 and Group 4 standard. FAX cards for a PC can now transform it into a remote scanner/printer and a digitized path into an image system. Because a FAX only talks image, performance is a major limiting factor in extending its usage further.

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[1]Amy D. Wohl, "Large-scale Optical-disk Systems Offer Big Benefits," Today's Office, January 1991, pp. 32-35.

The Process

The first step in the integration of new technology into an administrative function is to perform a *systems analysis* of the current processes. Through such analysis, one begins to see new ways of doing the old tasks, and users begin to recognize that the old process must change. The *change* is a reflection that the technology will allow some of the process to be accomplished by labor-saving electronics. Even jobs, and job descriptions, may change.

Now consider a generalized view of how document flow would be affected by the *implementation* of imaging technology.

- Incoming documents and forms are *scanned* in order of receipt. Documents can be *batched* and scanned through a *high-speed scanner*, or documents can be processed through a *low-speed scanner* as the mail is processed, at one or more locations. These scanners have a document resolution of from 200 to 400 dots per inch. The high-speed scanners operate at speeds of up to 100 pages per minute. Double-sided documents slow the process down to about 55 pages per minute. Scanning can be an expensive phase of an imaging project. For example, one of Florida's agencies is paying about 80 cents a page for document preparation, indexing, scanning, quality control, and archiving.[2]
- The type of application will dictate whether *graphic* imagery or *text* imagery is used. Graphic document imaging can be likened to taking a photo of the page. Such scanned bit-mapped graphics are very large compared to a text file--3+MB for a complex graphic page versus 5KB for an average text page.[3] Consequently, *magnetic* storage does not provide enough capacity and *optical* storage becomes the preferred alternative storage medium. One of the standard formats for graphic imaging is TIFF (Tagged Image File Format) which saves every aspect of a page, even white space. Users of graphic files must have relatively powerful workstations just to handle the load imposed by large files and graphics processing requirements. Text imagery is based on the premise that words are the most important part of the document. There are any number of choices in optical character recognition (OCR) software that provide for accurately interpreting a printed page of text with varied fonts, type styles, and layout formats.[4] Users have the option of performing the OCR process as each page is scanned or using TIFF images after they have been captured. Since text files created by OCR are basically word processing documents, most PCs can work with text

[2]Interview with Brenda Clotfelter, Department of Natural Resources, Tallahassee, FL, October 29, 1991.
[3]Daniel V. Arrington, "Small-scale Document Imaging," Proceedings of the 1990 CAUSE National Conference, November 27-30, 1990, p. 452.
[4]Lori Grunin, "OCR Software Moves into the Mainstream," PC Magazine, October 10, 1990, p 315.

imagery systems. Yet, accurate OCR scanning is far from perfected, so error detection and correction may be a time-consuming step.

- Image-based files (individual documents) are then *indexed*, as a step to integrate them into existing records or files that reside on the computer (host mainframe or standalone minicomputer). At this juncture, the image is in magnetic form being held in memory or rotating magnetic disk. Several indexes are entered on each document. Typically, the first is a sequential index number, others link the image to its "parent" file to provide retrieval through multiple paths. During the indexing process, the imaged document is given a quality check. The paper original then becomes extraneous and can be shredded and sold for recycling. This step frees up active filing space for office use and avoids dead file storage.[5]

Why New Technology Makes a Difference

Optical Disks. The first *optical disk* technology was 12-inch in diameter optical disks but later generation drives cut costs by moving to lower-capacity 5.25 inch media. Today, 650MB is the standard capacity, with Panasonic boasting of 1GB capacity. These single disk drive units sell for under $5,000.[6] The smaller disks are typically found in personal PC-based imaging systems. The larger disks still find popularity in large-scale imaging systems, although they can be used in combination.

Optical disks systems use *laser* technology to write information on an optical disk and read it from the disk. Once written on the disk, the information becomes *unalterable*. This is an important security and legal consideration. However, the information can be read back countless times and new images can be added to the surface, as long as there is space on the disk. Thus, the optical disks that are generally used in document image management systems are called Write-Once, Read-Many (WORM) disks. Information recorded on WORM disks is as safe as microfilmed information and more secure than that stored on magnetic disks. The down-side, however, is an ever-increasing library of WORM disks and associated increases in storage costs. There are two other optical disk technologies--CD-ROM and erasable optical disk. However, these are not typically used in imaging systems.

When digitized information is stored on optical disks, it is in *compressed* form--usually at a compression ratio of 20:1. At that ratio, 2 MB of imaged data can be compressed for storage on 100 KB of space--optically or magnetically. A 12-inch disk can hold about 2.5 GB of data or about 50,000 page images. The smaller 5.25 inch optical disk holds

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[5]Wang on Imaging (Lowell, MA: Wang Laboratories, Inc., August 1989), pp. 14-17.

[6]Dwight B. Davis, "Optical Drives' New Reading Habits," Datamation, September 15, 1991, pp. 71-73.

about 20,000 page images.[7] Another strategy to save storage space and reduce communications bandwidth is called *forms dropout.* Expert systems software allows the system to "learn" the form and simply drop it from the image, only to be introduced again for viewing and printing. This feature is part of American Management Systems' Image and Records Management (IRM) software. This approach often reduces forms documents down to 5 to 10KB per form.

In large image management systems, a number of optical disks can be combined in a single library unit called an *optical disk jukebox.* Jukeboxes range in size from desktop units to systems that contain around a hundred 12-inch disks.

Image-display Workstations. In the functional user's office, a staff person verifies the document images by means of an attached *image display workstation,* often an enhanced PC. The notoriously high memory requirement for processing scanned graphic images means that a single page of a scanned document may equal one megabyte of digitized data. And, a workstation may have a wide-display monitor for viewing two sides of a document at once. These PCs need enough processing speed and memory to handle such images, i.e., a PC with an Intel 80386 microprocessor, 2MB to 4MB of memory, a graphics controller card, and a high-resolution monitor. Once scanned, the document is then *indexed* by a variety of information fields, such as: name, account ID, receipt date, originator, and the like. The image is compressed and decompressed at the workstation. Retrieved images can be: *magnified* (another security protection against falsification); *condensed* (for comparing more than one document on the screen); *rotated* (to accommodate documents that are scanned sideways or upside down); *printed* (to get immediate hard copy); *FAXed* or *electronically transmitted* (for local or remote location use).

By the way, these workstations also typically handle word processing and spreadsheet applications and produce reports that are linked to the document images stored on the image system.

Printers. To match the quality of the document on the input side, a *laser printer* with a resolution of at least 300 dots per inch is typically used when a hard copy of an imaged document is needed.

Image Management System. In addition to optical disks, an *image management system,* including other hardware and software, is needed to integrate the technology into a functional system. These components are needed to enter, index, read, store, retrieve, and print documents.

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[7]Edwin D. McDonell & Brent M. Ehrman, "optical Laser Disks and Document Imaging," The Office, September 1991, pp. 32-34.

The *imaging software* that drives the system has two major components. First, there is the *workstation software* which provides for the scanning, indexing, and compressing of the documents.

The other major software component is the *database software* used for filing, retrieving, and managing the document system. It is this software that must be integrated into the functional software of the application being served, such as licensing, tax collecting, fingerprinting, etc. This software keeps track of the location or multiple locations of every document stored in the system, whether it is in magnetic form or on optical media.

The ability to *integrate* image-based document systems into other computer-based information systems is the major advantage of imaging systems. Integration supports on-line access from a workstation to other computer systems, such as databases stored on mainframes and minicomputers.

Computers--Mainframes and Servers. The database/imaging system software resides on a *computer.* This computer can be a *mainframe* located in a computer center, or a minicomputer referred to as a *server.* Servers are minicomputers or super-workstations that are typically located in the user's office. These computers receive retrieval requests from users and then route the document images to the appropriate workstations or printers. These computers may also have magnetic disks for the temporary storage of images before they are stored on the optical-disk drives. If the required optical disk is already loaded, the process takes four seconds or less. If the desired image is on another disk in the jukebox, the retrieval can take up to thirty seconds or longer. If the retrieval requires mounting another disk, it could take several minutes.

Costs. Document imaging systems come in a wide range of features, options, and prices. The cost of a system depends, to a great extent, on the hardware configuration and the number of user workstations. Datapro records almost 100 imaging system vendors with prices ranging from under $10,000 for a software-only system to over $1 million for a minimum mainframe-based system.[8]

A *small* system with a few users would usually include a scanner and PC for document entry, a central server, image workstations, an optical-disk drive, a laser printer, and software. As an example, FileNet's Series 1000 basic system with 16 port capacity but configured with just one workstation and two PCs can be installed for just under $100,000.[9] Another yardstick to approximate costs would be to say that these systems cost $20,000 to $30,000 per workstation.[10]

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[8]"Document Imaging Systems: Market Overview," Datapro Reports on Document Imaging Systems, February 1991, p.1.

[9]Dwight B. Davis, "Imaging Systems That Pay Off," Datamation, May 15, 1991, p. 77.

[10]Donna Tapellini, "How Imaging Can Change Your Business," Datamation, April 1, 1991, p. 72.

Referred to as departmental systems, these *medium*-sized systems typically use a mini-computer/client server approach and serve from 15 to 50 users. For example, Digital's DECimage EXpress features a VAX platform with supporting hardware and software from various third-party suppliers ranges from \$250,000 to \$500,000.[11] Again, when priced-out by workstation, the system cost would be in the \$30,000 to \$50,000 price range.[12]

Often called enterprise systems, a *large* system with scores of workstations, high-speed scanners, jukeboxes, and database management software running on a mainframe begins at the \$500,000 level. Costs are high because there is seldom an off-the-shelf design that suits the needs of most users. Typically, a user will need a hardware configuration that is custom-designed for the specific application needs of his organization. Extensive customization of software is usually required, not to mention the software modifications to interface the image system to the application.[13]

Bandwidth is another consideration because of the size of image files, the workstations, servers, and communications equipment must be capable of handling megabyte bursts of imaged data. This high-end equipment doesn't come cheap. However, the international standards organization, CCITT, is developing improvements in image compression techniques that promise compression ratios of 16 to 1, which will make image networking cheaper and faster.[14]

Legal and Security Concerns. Can the image, or a printed version of the image, be accepted in court? Yes, but clouding the answer, legal experts say, is a principle known as the *best evidence rule*. In essence, the "rule" is that the original (if it exists) must be brought into court. Thus, if the original no longer exists, the image becomes the "best evidence." Further, the "rule" also means that the courts look for three conditions to be satisfied: the evidence must be accurate, reliable, and trustworthy. So, there is an obligation to build *controls* into the system that assures those conditions are met.[15]

As to *security*, access to imaged records, as with other systems, should be limited to only authorized personnel through issued passwords and controlled logons. And, unlike paper files, image files can now be backed up and stored off-site on magnetic (disk or tape) or *optical disks* for added protection and disaster recovery.

Who are the vendors in the image business?

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[11] Ibid.

[12] Tapellini, loc. cit.

[13] Wohl, loc. cit., pp. 34-35.

[14] Salvatore Salamone, "Imaging Moves into Corporate Mainstream," Network World, February 18, 1991, p. 41.

[15] Ibid., p. 42.

As an industry trying to find itself in a time of recession, its structure gives a different appearance, almost annually. When it comes to an installed base of production imaging systems, no one can match FileNet which installed its first turnkey system in 1984 and now has over 400 in the market place.[16]

The companies that make up the document imaging systems industry can be categorized in several different ways. One method is to segment them by *hardware* and then pick up the remainder based on *function*.

Market Segmentation by HARDWARE. *Large* systems feature mainframes such as the IBM 3090 and VAX 9000. These multi-million dollar systems are for large, company-wide applications that often support over a thousand workstations. In addition to IBM's ImagePlus, system integrators like Andersen Consulting, EDS, Perot Systems, and TRW are major players in this segment.

FileNet, 3M, Kodak, IBM, and Wang are principal vendors in the *medium*-sized systems that feature Wang VS 5000, IBM AS/400, and DEC MicroVax hardware and their own proprietary software. These systems range in price from $100K to $900K and handle smaller, departmental-sized applications.

The *small* systems are micro-based which are either standalone or networked. The standalones are priced under $100K and intended for single-user applications. On the LAN side, the costs can run up into the $300K level. The principal vendors in this category include 3M, Bell & Howell, LaserData, and Micro Dynamics.

Market Segmentation by FUNCTION. The classic imaging application is that of replacing paper filing with optical disk technology. Many small systems integrators make up this *filings systems* segment of the market. Companies such as Sony, Maxtor, and Hitachi provide optical disk drives and jukeboxes under OEM (Other Equipment Manufacturer) agreements, work with these small systems integrators to service this market. Filing is *a first-generation application*, and full workgroup integration is already becoming more important.

Special software that emulates "manual" *on-line paper processing* by converting the work flow to digitized documents throughout the organization takes advantage of cost-savings, improved accuracy, and increased productivity offered through optical document filing. Wang Labs, long known for its office automation products, has installed over 400 Wang Integrated Image Systems (WIIS). Its proprietary WIIS software runs on Wang's VS 32-bit VS minicomputers. FileNet and Wang are well established in this segment, with IBM and Digital rapidly gaining ground.

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[16]Davis, loc. cit., p. 77.

The era of pure word processing is coming to a close. Replacing it is the concept of compound document processing--integrating text, graphics, images, data, and voice. Traditional *office automation system* vendors like Wang, IBM, and Digital understand the capture of document images as the logical extension of their business and product lines. ViewStar exemplifies the newcomers in the microcomputer LAN system market that blends workgroup-level image processing and office automation functions.

Where Is Imaging Being Used?

Imaging systems are found in the public and private sector. There are multi-million dollar, corporate-wide systems and small, PC-based systems for a departmental application. Brand-name vendors can account for an installed base of over a thousand systems. A few examples of document imaging systems are summarized below.

- The University of Central Florida has begun an imaging pilot project for its graduate admissions process in collaboration with ViewStar. This microcomputer (286, 386, or 486 processors), LAN-based system will run on the campuses' Novell network using Windows and standard VGAs (compression/decompression boards are not required for image display). This is a good example of the integration of workflow software, off-the-shelf optical jukeboxes and PC system hardware, which can all be tied to host-based applications to allow users to access distributed databases and use SQL technology.[17]
- The Florida Department of Education has installed a $1.5 million Wang Imaging System with *optical disk jukeboxes* to automate the *teacher certification system.* This system contains all imaged documents for 30,000 of Florida's public school teachers. Paper files are being converted to image files at a rate of 2,000 per month. Through an automatic call distributor (ACD) system, callers can learn the status of their application via a voice response unit or leave a message for next-day counselor response or talk to a counselor who has 20-second access to the file through the Wang system's interface with an IBM 3090/400 at the State University System's Northwest Regional Data Center.[18]
- The University of Southern California has installed a Wang Imaging System to handle its *admissions process.* Its annual paper chase of 50,000 applications plus associated essays, letters of recommendation, and transcripts with a 5 percent error rate has become an error-free, optical process. Using image-capable

[17]Interview with William H. Branch, Director of Computing Services, University of Central Florida, Orlando, FL, October 28, 1991.

[18]Interview with Larry T. Champion, Chief of Teacher Certification, Florida Department of Education, Tallahassee, FL, October 18, 1991.

workstations, admissions counselors can now view all the documents and have access to data residing on an existing Prime Computer system. Most have the electronic tablet to add handwritten annotations electronically on the applicant's transcripts. Once admissions decisions are made, the documents are permanently stored on optical disk. In terms of benefits, nine file clerks have been redeployed, paper files have been eliminated, and applicants get admissions decisions three weeks earlier, which provides a competitive edge in attracting qualified students.[19]

When Will the Technology Be Mature?

Not long ago, two of the most common components in many document image-processing systems were smoke and mirrors.[20]

Today, the picture has become brighter, as established products have become more refined and new systems are constantly materializing. There are still a limited number of options in the full-blown, production-type of systems. Yet, there are hundreds of vendors that supply parts of imaging systems. So, there is growing popularity with smaller, microcomputer-based LAN systems and systems integrators that will put the pieces together for systems from small to large.

Communications, File Formats, and Standards. Vendor strategies are changing to provide support for industry standards and open systems. For example, FileNet's system is built around a UNIX-based Ethernet LAN. Open standards such as Ethernet and *de facto* standards such as IBM's Token-Ring are very important to this market. Recently, Wang has made open system announcements such as OPEN/image-Windows and OPEN/image-CICS. Because facsimile reception is such a large part of document imaging systems, CCITT Group 4 and Group 3 are by far the most common file formats. Other file formats frequently supported are TIFF (a desktop publishing format for scanned images), DCA (IBM's word processing document format, and EPSF (encapsulated PostScript format). In addition to text and graphic formats, standard graphical user interfaces (GUIs) are being integrated into document imaging systems for ease of use at the workstation level.

A Dynamic Marketplace. This year, Datapro characterizes the marketplace as *dynamic*. Major trends include an increase in the prevalence of *system integrators* and *value-added resellers*. Standalone imaging systems have rapidly become obsolete, while integration with multiple platforms, components, and applications--and the adherence to industry standards that such integration requires--is in vogue. Image software has attained prominence as users seek appropriate

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[19]"The Paperless Chase," CIO, February 1991, p. 13.

[20]Davis, loc. cit., p. 77.

applications; vendors are responding with additional software options, often through joint development or joint marketing agreements. The increase in microcomputer-based systems and the heated competition in the imaging market are leading to lower prices. This trend looks like it will continue.[21]

How to Be Ready?

> *If you're putting in an imaging system, pay attention to the organizational impact rather than the technology. The technology will take care of itself; the organization will never take care of itself.*[22]

The implementation of imaging technologies can dramatically *change* the way organizations do business. These technologies can greatly affect the type of work, flow of information, and personnel *structure* of an organization.

> *If you're implementing an imaging system, get the users involved. They know best. They're the ones dealing with the paper every day, not the technical staff.*[23]

Because of the potential for these changes, the *objectives* of an organization considering the use of optical technologies should be clearly defined and the *requirements* for meeting the objectives should be specifically identified. Key items to consider when developing requirements are the volume of documents processed, retrieval response times, and information volatility. *Personnel* should be surveyed to determine their needs to receive, file, and retrieve documents. *Plans* for implementation should address how the optical technologies will fit into the flow of work within the organization. The automation of paperwork in an office environment is not unlike the disciplines required in computer-integrated manufacturing. In short, most offices will need workflow analysis *before* any technology is considered. FileNet has developed WorkFlo scripting software but it is not tied to image-processing systems. "Workflow is a service available to a lot of different applications, of which image processing is just one."[24]

Information systems utilizing imaging technologies usually cannot be grafted into existing computer application *software*. There are requirements for *workstations* which cannot be met by the typical

[21]"Document Imaging Systems: Market Overview," loc. cit.

[22]Ira Morrow (American Express Co.), as quoted by Caryn Gillooly, "Ups and Downs of LAN Imaging Systems," Network World, April 22, 1991, p. 17.

[23]Hal Petschke (Aetna Life and Casualty Co.), "Worth Noting," Network World, May 6, 1991, p. 17.

[24]Dwight B. Davis, "Software That Makes Your Work Flow," Datamation, April 15, 1991, p. 75.

installed base of PCs and terminals. Users may need large-screen, high-resolution monitors, large local jukebox storage, and increased processing capabilities. Although it is possible to incorporate image data into some existing database applications by writing *custom software* to maintain indexes of the images and cross check between systems, this can be a complex task and should normally be left to the system vendor.

Finally, most *networks* are not designed for the transmission of large image files. The network traffic from image data can be so large that it interferes with other users. Some organizations have installed separate parallel networks for image transmission to keep up with other workloads. The large size of optical images also means that the magnetic data storage demands are greater. Disk space requirements of several gigabytes are normal.[25]

Some Closing Thoughts

The success of any new system is more dependent on the work that goes on before the management "OK" than after. This suggests that there is much to be learned about imaging before deciding to do imaging. Users need to become as "learned" as the techies. Then, find a *small* place to test out this new found knowledge about imaging. A pilot keeps the cost down and your risk to a minimum.

And, . . .

All change is not progress. All motion may not be not forward.

[25]Steve Clark and Marc Tully, *Assessment of Optical Technologies*, an unpublished report of the Florida Information Resource Commission, 1990, pp. 10.

A Vision of the Future: It Starts on the Desktop

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This paper will describe why and how San Joaquin Delta Community College has created a graphic, electronic office environment called "The Virtual Desk" to operate on the desktops of its employees. Virtual Desk is a SuperCard front end to the network and includes such features as a desk with a calculator, spreadsheet, notepad, calendar, electronic mail, and word processor. There also are file drawers and bookshelves depicted in The Virtual Desk that contain institutional information such as policies and procedures, directories, and information from administrative systems. The paper will highlight the evolution of computing at Delta, its strategic plan, and its newest effort, a collaborative design project called **System 2000**. Delta is developing **System 2000** using CASE tools for the logical design and an object-oriented development environment. The paper will note that the partnerships with Digital Equipment Corporation ("DEC"), Apple, and The League for Innovation have advanced the development and use of technology at Delta, and the partnership with The Robinson Group, Ltd. ("TRG") will extend the innovation at Delta to other institutions of higher education.

Introduction

"We are shifting the ideal of the model employee from one who carries out orders correctly to one who takes responsibility and initiative, monitors his or her own work, and uses managers and supervisors in their new roles of facilitators, teachers, and consultants....computers are taking information out of the hands of middle managers and placing it into the hands of individuals."[1] This quote by John Naisbitt and Patricia Aburdene is extracted from the book, Re-Inventing the Corporation. The underlying assumption of the quote is that information is an organizational resource. In the past, access to information has been controlled and, therefore, potential employee growth and development has not been realized. In the future, however, information will be available to employees through their use of technology, and it will give them the necessary resource to expand their knowledge and become a "self-managed colleague."

A number of factors in the past, and even at present, have contributed to organizations under-utilizing their information resources: the political environment, the robustness of the knowledge base, the tools to access information easily, the ethics associated with that access, and the financial capacity to develop the information resources. This presentation addresses two of these important factors: developing the knowledge base and the tools to access that knowledge. The presentation will feature San Joaquin Delta College ("Delta"), an institution where the "self-managed colleague" is evolving.

The philosophy and goals of the Computer Services Department at Delta will be shared with the purpose of illustrating the values of the organization and how those values are translated into action. To understand the extent of change that has and will continue to take place at Delta, the evolution of the information technology environment at Delta will be highlighted. The role and benefit of strategic partnerships that have leveraged Delta's investment and expertise in management systems will be described. Finally, a glimpse of the development of System 2000, a new administrative system designed to make the vision of a desktop information support system a reality will be provided.

Background

Delta serves an area over 2,400 square miles in central California's agricultural San Joaquin valley. There are 265 staff and 230 faculty who work at Delta and 20,000 students who are enrolled in university transfer, occupational, and general interest courses. Founded in 1935, Delta is one of 105 California Community Colleges.

Philosophy, Goals, and Objectives

The philosophy of the Computer Services Department at Delta ("Computer Services") is that the student is the "ultimate customer" on campus. Lee Belarmino, Associate Dean for Information Services, has infused this philosophy throughout his organization. The goals that guide implementation of this philosophy are:

1. To optimize the resources available to serve students by extending the current investment in mainframe computing to a distributed environment where faculty, advisors, and counselors have easy access to information about students.

2. To give students and those who serve students convenient, consistent access to information, regardless of the source of information or location of the user.

3. To advance the use of technology in support of students by focusing on the technological environment, not the political environment.

Historical Context

Under Lee Belarmino's leadership, the Computer Services staff had to overcome several obstacles before achieving the above stated goals. First, the complex administrative systems, consisting of a student information system and a payroll system, were running on a UNISYS/Burroughs 6930, a very proprietary environment which limited access by users. In addition, just the maintenance of the student information system, which consists of over one million lines of undocumented code, is a major drain on programming resources. Users had difficulty accessing necessary information contained in these systems. A second obstacle, was the limited access to office automation. Users had only limited office automation capability from a System 36 accessed through 22 IBM terminals. Third, minimal support was being provided to the campus user community, and administrators could not access information for planning and decision making. The strategies employed to overcome these obstacles were to seek solutions that would decrease the workload on the mainframe by distributing computing to servers and the desktop, and to improve service to users by providing them with an easy to use interface and network navigation.

The first phase designed to implement the distributed strategy was initiated in 1987. The objective of this phase was to provide immediately those solutions which addressed pressing user needs. To do so, the Computer Services staff made available "deliverables" such as advanced office automation tools (a Macintosh) and a financial system, Digitronics™. An AppleTalk network with an EtherNet backbone was installed to provide the

Macintosh user with access to the student information system, payroll system, and new financial system. Electronic mail was installed and became the primary tool for communication and collaboration on campus.

The second phase was to position the department for the future by developing a strategic plan to guide development and implementation based upon user needs. Computer Services spent a year to create a five-year plan that outlined the future technology direction for Delta. Lee Belarmino, Matt Rosen, Assistant Director for Technical Services, and Ann Zinck completed the plan through extensive research and technical analysis. This strategic plan outlines the vision of a totally integrated information architecture for Delta.

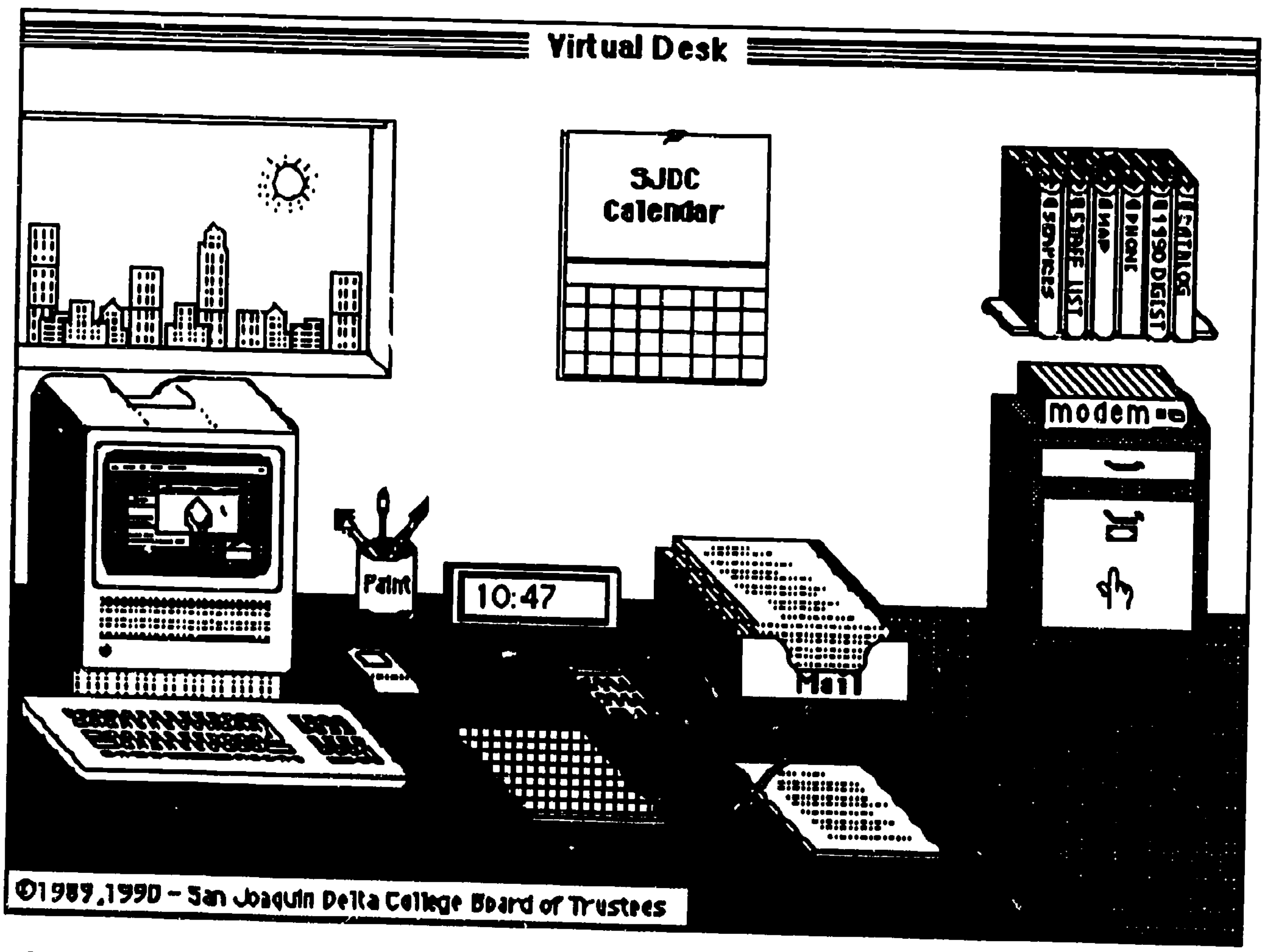
Current Status

Today, Delta has over 225 Macintosh computers running AppleTalk and DECnet protocols with LocalTalk and Ethernet cabling to eight buildings. There are nine AppleShare file servers; two dedicated Macintosh mail servers; an integrated touchtone registration system; a VAX 4000, VAX 8350, VAX 11/780 and the Unisys B6930. The VAX 8350 is the platform for Delta's financial system and serves as an interface to the Unisys B6930. The VAX interface to the B6930 enabled the Macintosh to become a desktop front-end for seamless access to both the Student Information System, the Digitronics™ Financial System (VAX 8350), as well as AppleShare™ servers. In early 1990, ten Macintosh campus servers were installed to enable a variety of functions ranging from serving collaborative work folders to software, planning data, and budget information. At approximately the same time, a new in-house Matriculation System for counselors was designed. This system was designed to function as an appointment system and total educational planning/counseling tool. The Matriculation System runs on a VAX 4000 and accesses a subset of data from the student information system on the Burroughs 6930. Out of this complex enterprise of equipment has grown a network that provides instant, seamless access to information in any administrative office on campus. With a touch of a key or click of a mouse a user may pass from Macintosh to VAX to Burroughs without knowing it.

One of the most distinguishing aspects of Delta's computing technology today, however, is The Virtual Desk, shown in Figure One. This innovative, Macintosh, front-end depicts an office setting which is both familiar and logical in design. The interface is kept constant for all users on campus with variations in the type of tools, files, and services the user can access through the Virtual Desk. Each object on the Virtual Desk is a stand-alone tool, thus users can create, add, and delete tools appropriate to their job responsibilities. Clicking on the desktop note pad accesses a favorite word processor. Clicking on the wall calendar accesses the college events calendar. The file drawer and bookshelf are object based so that updates to its contents can be easily sent across the network for the users to update their "Desks." The bookshelf and file cabinet provide users with centralized access to campus-wide planning tools, budget building tools, financial summaries, the "Dean's Grade Viewer," policies and procedures, staff directory, and organization chart.

The following scenario illustrates the user friendly nature of The Virtual Desk. The Dean clicks on the file cabinet icon on her Macintosh screen; when the cabinet opens, a series of folders appear. She then clicks on the folder titled "The Budget Worksheet" and views her budget that shows how much was requested, allotted, and expended. She recalls how she used this function during the budget preparation process. The Dean then clicks on the "Business Summary" folder and views the data in summarized form. She knows that the summary sheet takes the equivalent of a financial summary report and puts it into a series of eight HyperCard stacks, each of which represents a different account type and sort order. She knows that the data are current and consistent since both of these applications are HyperCard stacks that are created from data downloaded from the VAX each evening.

Figure 1: The Virtual Desk



Delta now has a network that provides instant, seamless access to information from any administrative office on campus. Although The Virtual Desk provides a wealth of services to the faculty and administration, full implementation of the concept with students depends upon the completion and implementation of the new administrative system, System 2000, described in a later section.

Partnerships

To advance innovation at an accelerated pace, Delta formed several key partnerships. The first was with Digital Equipment Corporation ("DEC"), which engaged Delta as a regional training center for its customers. The second partner was Apple Computers Inc. ("Apple"). Apple awarded a grant to Delta to assist in the development the Virtual Desk and the Macintosh administrative network. With the implementation of The Virtual Desk, came the third partnership, the Apple Community College Alliance ("Alliance") which was a collaborative development with the League for Innovation. Delta is now one of ten community colleges in the country that participates in this progressive partnership. The mission of this national consortium of community colleges is to enrich the quality of teaching and learning and improve the effectiveness of institutional management through the careful planning for and integration of information technologies. The Alliance is accomplishing this mission by developing specialized areas of expertise with Macintosh technology and by sharing information and innovation models with other community colleges as a network of regional resource centers.[2] The Alliance has been of great benefit in implementing the vision of desktop information access at Delta. The fourth partnership is with TRG, which is now marketing the Virtual Desk to other institutions of higher education. For example, Monroe Community College, Houston Community College System, and the University of California at Irvine Student Services staff have acquired the Virtual Desk and are planning to implement this innovative desk-top front end in their environments.

The Challenge

Delta's commitment to Macintosh and DEC technology has provided a strong, flexible platform on which to build a new enterprise. However, there still are remnants of the former environment that Delta must update. To illustrate, the mainframe is running at maximum capacity. Only through the considerable talents of the operations staff and programmers/analysts does the mainframe continue to provide the critical data necessary to keep the campus operational. Thus, Delta faces the "burning platform" issue.

Another challenge at Delta is the outdated administrative systems. To address this issue, Delta conducted an exhaustive search and evaluation during 1989-90 of all currently available administrative packages. Based upon the evaluation, Delta's staff concluded that only after extensive modification would an "off-the-shelf" system comply with technical, user, and State requirements. Delta staff realized that if they were to choose this option, once these modifications were made, the vendor could no longer support the system with maintenance or upgrades, thus eliminating one of the primary advantages of a third party system.

The primary technical specification for an administrative system at Delta was that it be designed as a true relational database system, preferably using object based code. The evaluation yielded no systems that met these standards. The Computer Services staff concluded that the only option was to write a new system.

The Future

System 2000, a new administrative system, is the next technological advancement for Delta College. It was conceived based upon the philosophy and goals of Computer Services. The primary focus of ***System 2000*** is the curriculum and courses, the true products of education. Inherent in the curriculum-based design of ***System 2000*** is the concept of shared governance and shared information. Students, staff, faculty, and administrators will have access to all appropriate functions in the system necessary for them to make decisions about their roles in the educational environment. To leverage resources and accelerate the pace of design and development of ***System 2000***, Delta established a collaborative project involving Saddleback and Santa Barbara Community Colleges, both of whom share Delta's philosophy and technical design approach.

The designers are taking a fresh approach to the way traditional administrative systems currently operate. Instead of merely updating or translating code from an existing system to a more current platform, the designers are completely re-engineering the administrative processes and procedures. As noted above, the curriculum and courses are the driving the administrative processes. For example, the approval of a course means that an instructor must be assigned, a schedule made, room assigned, finances allocated, etc.

System 2000 is based on innovative, even "break through," technology in both its design and system requirements. The designers are using a CASE tool Deft™ to develop the logical design. By using this software on the Macintosh, Delta streamlines development time and communicates more easily with non-technical audiences about the design. The architecture of ***System 2000*** is a client/server-based model with the majority of computing done on the desktop. Computing is distributed over several powerful servers with a minicomputer providing necessary data to the system.
Delta will develop ***System 2000*** using objected oriented tools which will allow parsing out of the system components so that the components can operate on one or many Macintoshes. The object oriented design principle of "inheritance," will make ***System 2000*** easily portable to other institutions. When another institution needs a modification, for example, the institution can accomplish the modification by describing only an entity's "new" properties or characteristics.

Delta plans to implement the basic modules of ***System 2000*** by April, 1993. ***System 2000*** will be the final link in providing major campus information services to all students, faculty, and staff. Delta will integrate distributed applications of ***System 2000*** with the academic network, which will entail a migration from 3COM to DEC PathWORKS™. Delta also is preparing for the inevitable application of ISDN or similar technologies. All of the basic technology necessary for ISDN is either in place, or will be within three years, throughout the campus. Delta will continue its commitment to develop the ultimate communication network and work environment for the campus community using the Macintosh computer.

With **System 2000** students will be the "ultimate customers," and will be able to access easily the information that they need to be successful in the college environment. **System 2000** will permit students to request and receive transcripts, select courses, evaluate educational plans, receive grade reports, and communicate electronically with faculty. Administrators, faculty, and staff will be able to obtain information that is current and immediately accessible from their desktop Macintoshes for use in planning and decision making. Delta will accomplish all this access to information using a collaborative effort, advanced design and development tools, and a client/server architecture.

Observations

Upon visiting Delta College and seeing this vision evolve, one recalls the writings of Stan Davis and Bill Davidson, who describe in their book, 2020 Vision, those organizations that are positioning for the future by "informationalizing" their organizations. The Virtual Desk has been an important tool in the informationalizing process at Delta. The authors observe that there are bottlenecks in the process of informationalizing. They cite such factors as the partially met need for compatible computer architecture, and the dilemma of choice. Delta has overcome the dilemmas of compatible computer architecture and choice by providing a seamless link to existing proprietary platforms from the desktop standard, a Macintosh. Like other organizations, howerver, Delta has experienced some of this resistance, although to a lesser degree than most institutions. A few specific examples of resistance at Delta illustrate the type of issues that an organization may enounter in achieving a fully informationalized institution.

The first example of resistance pertains to database ownership and responsibility. While much of the data that is accessed using The Virtual Desk comes directly from administrative databases, some sources of information, particularly text files, are in "end user" departments. Other competing priorities can impact the ability of these end users to update their information frequently. Consequently, some of the textual information that users access from the Virtual Desk can be out of date. The Computer Services staff are aware of areas that are difficult to maintain, and work with their end users to stay abreast of the changes.

The second example relates to user expectations. While Delta has deliberately selected the most user friendly tools, it is still difficult for some users to adapt to a technology-based workstyle. These users become impatient with the tools, because the tools are more difficult to learn than these users anticipated. To respond positively to these unfilled expectations, Delta continues to provide education about and training in the use of technological tools.

The third example of resistance is a subtle but important one. This form of resistance pertains to the "aura of accountability" that is present in an organization when information is easily accessible. To illustrate this resistance, a number of questions are posed. Should administrators make their calendars accessible? Should budget status information be shared beyond just the person responsible for a program area? Should employees be able to communicate electronically directly to the president? Should progress reports for achieving division and departmental goals and objectives be shared widely? These questions represent just a sample of those questions that an institution that is "informationalizing" its organization could raise. The Delta Computer Services leadership and staff deliberately try to stay above "the politics of information," but are aware that these and other important questions will continue to emerge and must be addressed.

The fourth example pertains to technology itself. While new hardware is providing dramatic increases in performance at lower costs, institutions are faced with the financial reality of continuous upgrades to stay abreast of the hardware, operating systems, and communications technology. Furthermore, as the technology becomes available to users, their appetites for more technology grow. In response to this demand and the technology changes, Delta formulated and continuously updates its five-year information resources plan. Information Technologies staff are noted for their ability to evaluate applications and tools, identifying those that have a high price/performance return while at the same time selecting those that best advance Delta technologically.

How does Delta continue to move ahead given these expressions of restraint? Three characteristics emerge. First, Delta has a well articulated vision that evolved from an effective planning process that serves as a guide to the future. Second, Delta Computer Services staff have an action orientation, and use the best productivity tools as part of their day-to-day work style. Third, Delta Computer Services staff adhere to the orientation of a "no politics here" environment. While some institutions use a laborious committee process to identify a need and develop a design, Lee Belarmino and his staff take the first step in defining a new application; then they go to the users. Vision, tools, and no politics appear to be just the right ingredients to keep Delta rapidly moving toward the "informationalized organization."

Davis and Davidson, referred to above, hypothesize that "the maturity of the infrastructure (infostructure) may be measured, in part, by the degree to which it (the organization) adopts standards, develops compatibility among its parts, and connects incompatible pieces into a seamless whole." They continue with, "This process is occurring now and will continue to be the major focus during the next decade." Based upon the plans that have been developed and executed at Delta, one concludes that Delta is an institution that is maturing into an effective organizational model for the information era.

Delta has received much recognition for the way in which it is maturing. As part of the Apple Alliance, Delta is featured at many conferences and in publications. For example, the Spring, 1991 edition of Query, Apple's information source on administrative computing, featured Delta in their "In Depth" feature. Digital Equipment Corporation recently featured Delta in its Fall, 1991, issue of EDU focusing on "Creating an Open Environment: Two-year Colleges in Forefront." The Robinson Group Ltd., distributor for The Virtual Desk, regularly demonstrates the Delta-developed application at major conferences and notes the positive reaction of observers who first see what "starting on the desktop" means at Delta College.

Conclusion

In starting on the desktop, the vision of self-managed colleagues and empowered students, all networked into the institutions knowledge base as well as external networks, is beginning to emerge at Delta. Delta began with a well articulated vision developed through an effectively executed planning process. Delta progressed by implementing a hardware and software architecture designed explicitly for its ultimate customers - its students and employees. The institution is reaching toward the future by designing an enterprise-wide model for an information architecture that focuses on the student and curriculum. The vision of the future: it begins on the desktop - - at Delta it does!

References

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2 Apple Computer, Inc. and the League for Innovation in the Community College, Apple Community College Alliance brochure.

Information Access, Technology and the Academic Library
Making Information Accessible: What Academic Libraries Do With Technology And How Fast It All Changes

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Abstract

The proliferation of information products has forced academic libraries to examine how to best coordinate the multitude of products and make them as compatible as possible. One way to do this has been to create networks that can interact with one another and allow users to seek, retrieve, transfer and save information via various methods. With libraries traditionally being one of the biggest users of computing resources on campus, the competition for new applications on any given network is keen and the setup can be costly, complex and difficult. This paper examines what kinds of networks academic libraries need in order to offer access to a variety of databases and CD-ROMs, online public access catalogs (OPACs), local area networks (LANs), microcomputing, interactive telecommunications packages and specific functions of library operations. Networks are created on an inhouse, campuswide and remote scale requiring enormous planning and familiarity with technology, communications and end-user needs and this application in the academic library as the major player on a campus will be explored fully in this paper.

Introduction

Until recently, academic librarians selected books with the intention of retaining them forever in one facility, with branches or satellites responding to individual subject breakdowns or faculty interests. With a ready supply of money, it was best to err on the side of inclusion rather than exclusion, and hence collection sizes steadily increased. The "research library" emerged as one with significant holdings of books, journal titles, and eventually microforms, and other types of mixed media. Today, things have changed dramatically; with tight budgets, dramatic increases in subscription costs, and a realization that one library cannot possibly collect everything, nor be everything to all people, library management is putting a strong emphasis on coordinated and cooperative collection development with other libraries, while shifting the paradigm from ownership to access of information. To meet this challenge of accessing information, computer technology is playing a large role; the academic library, once a storehouse of bound volumes is evolving into a multi-resource center with links to databases in nearly every part of the world.

Library Computing

With the introduction of the computer a generation ago, units such as Offices of Central Computing (OCC) began springing up on university campuses to provide access to computing. The OCC offered highly centralized computing where departments, typically Computer Science and Electrical Engineering, could run batch jobs on the campus mainframe, with students and faculty doing much of the programming. In the beginning, the library had little use for computers, but slowly the library began to develop an association with OCC. First it was only for access to primitive text editors, but later the library leased machine time to run the online public access catalog (OPAC), the automated circulation system, and more recently, to use OCC's machines for such things as electronic mail. Within this milieu, there were many administrative headaches- different campus departments often had different needs, which could not be fully met on one central mainframe. As campus departments required more and more computing for an endless list of academic and administrative functions, political and territorial turf wars became common.

Finally, about ten years ago, with the introduction of the microcomputer, computer access became much more prevalent on campus. For the library, this was a blessing. Previously, with computers costing in the hundreds of thousands of dollars, the library had to rely on the centralized OCC for computer access. Now, as the power of the computer increases relative to price, libraries are finding it more cost effective to purchase their own machines rather than lease them from OCC, eliminating the "middleman" and essentially making the library an autonomous computing unit on campus. This also frees the library from having to abide by the constraints of OCC, which often times did not have the same priorities as the library. With this autonomy, the library is able to tailor the computer requirements with the needs of library users and staff, and able to do the following:

- Set up desktop computing for staff to run word processing, do internal document preparation, spread sheets, and data management;
- Purchase a machine to run the library's OPAC;
- Link to other databases via dial up access;
- Access library holdings on campus as well as access other libraries locally, regionally, nationally, and internationally, via existing international networks;
- Integrate access to all systems linking multiple library functions such as circulation, acquisitions, serials, public access on a single system;
- Access locally held databases in CD-ROM format

With this autonomy, the library can then begin to create its own inhouse networks, for administrative PCs or CD-ROM networks for patron usage. Since the library is now running its own machines, library administration must handle the responsibilities of having appropriate personnel to install, fix and repair machines or hardware, others to develop and install software, train staff and users and still others to oversee the extensive computing operation.

Cooperation Among Library Systems

Parallel to the development of library computing on campus, another facet of library computing has been unfolding: cooperation. In the 1970s, responding to the enormous and specialized manpower demands for the cataloging and processing of materials, the first wave of cooperation in libraries was introduced with coordinated bibliographic control of materials. This national movement began with the Library of Congress and a commercial vendor, OCLC near Columbus, Ohio in the 1970s, working together to offer libraries systematic processing for their materials for a fee. Instead of a book being cataloged a thousand times by a thousand different libraries, one member library would catalog the book, and make the computer tapes available to other participant libraries. This system promised a reduction in backlogs, and faster delivery of books to the shelves and thus greater user satisfaction. Conversion efforts were made to bring together old records with new access points and standards such as the Anglo American Cataloging Rules (AACRII) were introduced to promote standardization and allow for centralization to take place.

We do not have to look only to the past for collaborative ventures between libraries; in the future, cooperation will play an even greater role than it has in the past. Entering the 1990s we have and will continue to see profound changes in computing within libraries. No longer will each library be an independent island of information; the days of decentralized computing is nearly past to be replaced by cooperation. Administrative applications, such as word processors and spread sheets will continue to be autonomous of any outside control and stand alone or become part of an established LAN. However, distributed computing between library systems will become much more common as libraries move toward the common goal of providing access for patrons. Such interdependence between library systems will be a result of several factors:

- More powerful/cheaper computers;
- High costs of databases in digital form;
- Tighter budgets competing for greater demands

These factors are intertwined, but the paramount reasons are the technological advancements: prices will continue to drop for hardware in relation to its memory size and speed, and software will become more standardized and easier to install, leading to microcomputers that will be able to store and retrieve data at rates far faster than today.

The second reason will be tied to the costs of commercial databases. More and more, what libraries are finding is that while it is great to have access to indexes and abstracts in machine readable form, these databases come with a steep price tag, sometimes exceeding their print counterparts by over 500%.[1] In this day of belt tightening, libraries are casting about ways in which they can have resource sharing among libraries. One of the means is for cooperative access to commercial indexes via high speed networks, such as through the existing Internet or the future NREN. In such a scheme, tapes loaded on a central mainframe take the place of local databases. Then, instead of each library having to buy and maintain individual indexes/databases, there is one subscription, avoiding resource replication, but providing access to all participating libraries.

Unlike the centralized computing relationship between a campus OCC and the library, where there was friction because of differing needs, the current model is more apt to succeed. Instead of having many units with disparate needs, as was the case with the OCC-library model, all of the libraries in the system will have the common goal of gaining access to journal indexes as cheaply and quickly as possible.

Today, libraries are already banding together to buy/lease databases cooperatively. One local example is the University of California system; this past September, on UC's MELVYL OPAC, three databases became available for all nine campuses to access and use. All of the tapes are centrally housed and maintained on the Division of Library Automation's IBM 3090 mainframe in Oakland. By having the indexes on MELVYL, the libraries share access and share costs. Another example also with access via MELVYL is the MEDLINE database mounted by the National Library of Medicine offering indexing and abstracting to the major clinical medicine journals. Searching via keyword, descriptor, author, title and journal source allows far greater access, far faster than the print equivalent of the Index Medicus and is more current.[2]

These consortia are not limited to large, wealthy university systems, such as the University of California. For smaller independent schools, networking offers the libraries greater access to much more information than their own institutions can justify or afford. One such network, is CARL, formed in 1974 as the Colorado Alliance of Research Libraries. This group originally consisted of six member institutions in close proximity to one another who were interested in exploring interlibrary cooperation. Later, they created a single OPAC which was expanded to offer an integrated system for circulation, acquisitions, and bibliographic maintenance. Today, CARL is involved in the development of full text transmission of journal articles for a fee, via their networked database access.[3]

New Challenges

From a conceptual standpoint, these networks are challenging some basic tenets held by librarians. With these databases, the whole concept of "free access," once held sacrosanct by many, is being rewritten to read "fee for service." Since these databases are so costly, especially as libraries pay the licensing fees to give more and more users access to the information, libraries are finding it necessary to charge patrons for material, which in the past they would have gotten for free. Another change is the shift from ownership of the physical volume to access to the information contained in that volume. Until recently, libraries were judged by the number of books and journals they owned. While number of volumes is still important, today people are offering new definitions of collection "greatness" based upon access to information, not ownership of volumes.

From a practical point of view, for the local librarian, these consortia mean giving up flexibility when deciding what indexes to buy and acquire. Instead of having to reach agreement with only the people at one campus and evaluating user needs, people from many different campuses have to be in accord. Because there is so much necessary agreement or consensus and decisions can be costly, there are limitations to the number and types of databases that will be available on these general networks. These consortia are only going to have databases that are of interest to the majority of the campuses. If only one school has an interest in acquiring a database for the network, it is unlikely that the group will fund the request. Seeking balance between anticipated heavy use for general materials and specialized materials with expected low use can cause discord and force decisions about alternative answers.

Distributed Computing

As specific institutions acquire more and more powerful machines, and as libraries become dissatisfied with the limitations of these general information networks, "micro-networks" will spring up to fill the subject specific niches of individual institutions and their users. It is in this stage that we will really see distributed computing take off, with various databases, located in different locations, providing access to a full spectrum of users. No longer will a library have allegiance to only one library computer network, instead they will form consortia for only databases in their area of specialized interest. As an example, the University of California, Riverside, with its strong emphasis on agriculture, might become partners with UC Davis to mount agricultural databases on their machine, offer access to both schools, share the costs and interact directly with the National Library of Agriculture in Beltsville, Maryland. Or on a larger scale, both institutions could form agreements with universities outside their region to share access of machine readable data. Nor will there be a limit to the number of networks to which a university belongs. A major institution may identify scores of research emphases in all disciplines they want to have access to by distributing the cost on a per use basis, or as contributors to the holdings of the network, without assuming the full costs.

Full Text and Transparent Networks

To this point, we have only concerned ourselves with indexes/abstracts as they are available in machine readable form. Computerized indexes are a boon to the researcher, sparing the person countless hours of having to leaf through year after year of the same index in search of finding useful citations, but these indexes are only pointers to the real information; they only tell you where to go to find the end product. To reach the stage of acquiring information at the push of a button will require more than just converting indexes to machine readable format. It will require full text with graphics being available online, via transparent networks.

The key to these networks will be the establishment of "data superhighways" such as the National Research and Education Network (NREN), which will allow for very fast transmission of large data/graphics files from coast to coast.[4] Once such a data infrastructure is in place, neither physical distance nor file size/type will be an issue. Beyond the technological hurdles, there will still be the question of standardization, and the pressing issues of copyright and intellectual property. Although venture capital is currently being sought to develop handheld versions of encyclopedias and collections of other major reference tools, until the legal debates are settled, it will be some time before we see best sellers available at the drop of a hat.

This does not mean that a "library without walls" cannot exist in the near future. The first major move to full text available via national networks will be and has been scholarly publishing, primarily in academic journals. For commercial publishers, who are driven by the profit motive, their rationale in charging thousands of dollars per title for a subscription is that their investment is great and the potential market is small. Assuming the reasons are solid for pricing subscriptions very high, this does not negate the fact that journal prices are spiraling forever upwards. As an example, one large science publisher took out a two page ad in a library magazine to trumpet the decrease in prices of their journals, one title, Biochimica et Biophysica Acta, was down 7% to $5385.00 per year[5].

If the publisher is only serving as a vehicle for dissemination of the information and all the potential readership has access to the Internet or some other network, why not bypass the publishers entirely? It has been asked, why should academics conduct research, write up their findings and respond to their hypotheses, submit them for peer review in refereed journals which have an abundance of submissions to choose from and whose subscriptions cost an inordinate sum and which take months and perhaps years to be published?[6] Today, through "online journals," the scenario can be different, where academics can achieve the same product faster, more efficiently and cheaper, and still serve the same purpose of promotion and tenure requirements.

Technology, Access and the Library of the Future

It is nearly 1992 and we in academic librarianship find ourselves at a crossroads. While no one knows the exact direction of the library, its relationship to technological advancements suggests several possible scenarios:

- Comply with the traditional role of the library as a repository for printed publications.

- Serve as a gateway to electronic information and marry that to print and mixed media holdings creating a mixed configuration of information.

- Become part publisher, part supplier, part storehouse and serves information seekers in providing access and retrieving full text documents.

- Engage in a combination of all aforementioned activities and constantly be aware of changes and new demands.

Clearly there will not be one model for the library of the future. Some academic libraries will be repositories of musty tomes, while on the other extreme, some will neither own nor lend books, instead only providing links to computers interconnecting the world. Conversion of all printed books to machine readable format is unlikely and traditional publishing will continue as the economic incentives for conversion just are not there. Instead new products and releases will have online equivalents, information will be shared more efficiently, cheaply and quickly. Libraries will be networked into complex organizations, however all that will be transparent to the user who can still ask for information and be amazed from where it comes. Organizations will change, skills will become more technically focused, the ergonomic climate will be different, and technology will dictate the direction. FAX, high speed computing and greater capacity for storage and manipulation will make sharing resources and scholarly communication more feasible.

Problems exist for those in the global climate who can not afford the technology or do not have the expertise. The automation revolution is not a fair game for all and the fact that it is not stagnant but always developing causes enormous frustration. The "data superhighways" may one day be clogged by networks and competing structure, but we today know that NREN needs support, academic publishing has changed and will continue to and the economics of information poses many challenges.

Endnotes

1. As an example, the index PAIS International costs the University of California, Irvine's library $495.00 for the paper copy and $2335.00 for the CD-ROM version. This does not include the price of the hardware.

2. For a good article on MELVYL, see:

Clifford A. Lynch, "From Telecommunications to Networking: The MELVYL Online Union Catalog and the Development of Intercampus Networks at the University of California," Library Hi Tech, 1989, pp. 61-82.

3. Rebecca T. Lenzini and Ward Shaw, "Creating A New Definition of Library Cooperation: Past, Present and Future Models," Library Administration and Management, Winter 1991, pp. 38-41.

4. For a good article on the NREN, see:

Roberta A. Corbin, "The Development of the National Research and Education Network," Information Technology and Libraries, September 1991, pp. 212-220

5. See Elsevier Science Publisher's ad in Against the Grain, September 1991, 24-25.

6. Brian Nielsen, "The Coalition for Networked Information: Realizing the Virtual Library," Online, September 1991, 97.

Track VIII
Management Challenges for Distributed Services

Coordinator: Terry Bratton

The issue of distributed services is one of the most prominent in information technology. The trade press contains articles with growing reports of great success and significant savings. Other articles report a more negative story stating the problems of control and reporting. One story indicated that branch offices and remote facilities love the autonomy while headquarters complains that they no longer get the information they need to operate the whole organization. Papers in this track look at many of the facets of distributed services management.

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ABSTRACT

"IS CLIENT/SERVER THE FUTURE OF INFORMATION PROCESSING?"

In the progressively changing world of communications networking, a need for proper exchanging of information in a viable and cost effective solution has been recognized. To satisfy this need the industry has chosen to apply and develop the concept of distributed network systems or client/server networks.

The criteria considered in defining the client/server network includes radically different architectural design parameters such as location transparency, consistency and effectiveness. Other factors to evaluate are: interconnectivity to permit interaction and the cooperation and sharing of facilities by maintaining real time secured servers.

The users have found the "glue" linking together the growing "islands of information." "Clients" usually workstations, high-end PCs or hosts will reach out to information on "servers" using the proper architecture in order to form a cooperative collection of computing components which, together combine to achieve some common goal.

This presentation discusses the architecture defining cooperative information processing and the client/server's major components from the client/server perspective.

"IS CLIENT/SERVER THE FUTURE OF INFORMATION PROCESSING?"

INTRODUCTION

Client/Server computing is becoming an increasingly important topic to many of us who are viewing client/server computing as a way to meet the challenges of the 1990's.

The idea of integrating the varied resources within our institutions is extremely inviting. For instance, MIS departments with large and/or mid-range host systems can play an important role in client/server computing as servers and as managers of the client/server environment.

Several business and technology factors are becoming increasingly important in how institutions are choosing to solve business requirements. Each factor brings with it unique requirements that must be addressed. In most institutions today, we are seeing the need to rapidly respond to change in order to attract and retain faculty, researchers and students. Another element in an institution's ability to succeed is its use of information and information technology for competitive advantage. Information is now viewed as a strategic institutional asset. In today's corporate America, there is a trend toward streamlined organizational structures characterized by reduced layers of management. In order to make this strategy successful in higher education, there is the growing need to empower all levels of employees in information analysis and decision making.

Five years ago, the University of Miami embarked on a five year Long Range Information Systems Plan. One member of each applications development team was an empowered employee from the user area performing the function of information analyst. However, this information analyst viewed the new design functionality only from the principal user department perspective. Today, the applications development staff is incorporating departmental needs and requirements from all levels in the institution. This new approach provides departmental autonomy -- allowing for faster adaptation to change. This proactive process will give us an edge in the competitive global market.

Rapid change is also taking place in information technology -- providing institutions with new ways to respond to the trends taking place in the business environment. For instance, the power and capacity of workstations has dramatically increased -- allowing a much wider variety of instructional and research solutions by using an available platform that is easy to implement at a relatively low cost.

One needs to be aware of the potential problems of "islands of information" when employees are divided into workgroups. When a group of employees has formed into workgroups in order to share expertise and resources, it is the responsibility of the MIS department to be the catalyst to prevent the isolation process. Our responsibility in the client/server environment is to effectively share resources and expertise by using information technology.

CLIENT/SERVER AND DISTRIBUTED SYSTEMS

The client/server model of computing, as discussed in this paper, is relatively new. It traces its development from the original centralized computer architecture and the later development of tiered architecture.

The International Standards Organization has not established a standard definition for client/server computing. Client/server computing means different things to different people. It is very important to understand what people mean when discussing the client/server model. Information technology professionals are planning tomorrow's distributed computer networks based on their perceptions of this concept.

There is not very much consistency in the computer environment today regarding a definition of client/server. From a conceptual level, client/server computing is fairly straightforward. It is a distributed processing technology that defines:

- A client as a requester of service.
- A server as the provider of services requested by clients.

According to IBM's Art Olbert, Director of Client/Server Computing Client/Server is defined as the physical separation of applications and data between or among programmable systems. The Business Research Group has defined client/server computing as "a system in which application processing is shared between a desktop "client" and one or more network-attached "servers."[1] However, there are three critical elements to the function provided by a client/server system: cooperative applications; a support infrastructure; and seamless, transparent access to the applications and resources within the infrastructure.

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[1] "The Best in Client/Server Computing!," Datamation, 1 October 1991, p. 7.

The variable with the most influence on computing architectures will not be related to computer hardware or software, but to the experience of the end users. The dominant computing architecture, therefore, will be oriented toward maximizing the productivity and effectiveness of the end user. That evolving technology is the client/server.

The information technology professionals are obliged to examine elements thrusting the institutions solution toward the client/server technology. These elements are:

> "Technological: The power of today's desktop systems-coupled with advances in networking, relational database software and graphical user interfaces are enabling organizations to use personal computers and workstations for true corporate information processing.
>
> Economic: Information Systems managers are under pressure to lower costs even as they improve and increase the enterprise's information processing capability.
>
> Organizational: IS managers are charged with creating flexible systems that boost the productivity of revenue-generating and cost-saving employees. What do these organizations get for their efforts? Significant improvements in both end user and IS productivity. Information system consolidation. Better access to information technology, eventual decreases in operating costs. Improved control of corporate products and services."[2]

Advances in computer technology that lowered hardware prices allowed departures from the centralized architecture model to tiered architecture. The tiered architecture model utilizes departmental computers that shared central processor unit time and allows fewer users to share the resources than the central mainframe environment. Then came the personal computer--allowing a move away from the shared approach to computing. Personal computers did not, however, replace centralized and stand alone departmental computers.

Cooperative applications are the driving force behind any client/server implementation. A cooperative application involves distributing function and/or data across multiple systems. It can be viewed as a subset of distributed computing. The users have the opportunity to choose from a wide spectrum of applications designed to best exploit a particular business environment. Cooperative applications provide the key advantage of allowing customers to exploit the strengths of both programmable workstations and servers.

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2 "The Best in Client/Server Computing," p. 2.

The traditional distributed computing systems were tightly coupled to a departmental minicomputer, supporting local discrete functions. Connectivity among these different computer types was minimal. However, all types of computers can coexist within an organization, although they may be isolated and operate independently. For the most part, the communications network was not on a "realtime" availability. One of the prevalent connectivity techniques was polling the appropriate queued files overnight. Local sovereignty over data and processing can make the system more responsive to local needs. It may also result in increased motivation and involvement of local personnel. However, this deprives the enterprise of the realtime data availability resources and expertise.

The term "distributed computing systems" described above should not be mistakenly confused with "distributed processing." "Distributed processing" is a general term that involves dispersing functions across two or more interconnected systems.

Client/Server Infrastructure

Users have many diverse computing requirements and these functions are sometimes best satisfied by a variety of different platforms. The client/server model utilizes existing resources in the enterprise such as the client, the network and the server.

Clients using workstations or high-end PCs will reach out to information on servers -- some of which is based on traditional minicomputers and mainframes. Users need workstation clients that provide access to a wide variety of applications critical to their business needs.

To maximize the user's efficiency, there must be a consistent, easy-to-use interface that allows the user to access applications and services with minimal training. Workstation clients must also be capable of being upgraded as system use and business requirements change -- thus protecting the investment that has been made in that system. The client must also be able to access services that are located on other systems in the institution.

As the use of intelligent workstations becomes even more widespread, our users are recognizing the need to integrate these workstations with all the other computing resources available in the institution or department. This integration has required two capabilities: an extensive network that reaches all of the resources in the enterprise and support of a multi-vendor environment.

To facilitate distributed computer network systems between dissimilar clients and servers, we need a strong communications system that supports multiple protocols and multiple vendor products. We also need to bridge between Local Area Networks (LAN) segments, Campus Area Networks (CAN), Metropolitan Area Networks

(MAN) and Wide Area Networks (WAN) whether they are on private loops or remote public networks. Client requests demand high speed communications capabilities to the workgroup or institution server. The networking capability of the workstation has also become very powerful. Ten years ago, communication and networking speeds were so slow that it was not productive to rely on remote systems for services such as file, database, and print sharing. The speed of data between devices directly attached to a networked server is faster with the implementation of fiber optic technology. Fiber and high speed T3 communications lines have allowed efficient networking between remote systems. Lastly, there must be a robust network technology in place to provide the function, availability, and management needed in such communications-intensive environments.

The selection of servers depends on the system size, geographical deployment, and type of application running on the distributed systems. The server investment needs to support the organization evolution in order to get full utility of the client/server components. The servers can be placed in two categories: the generalist and the specialist. The generalist server supports various workgroup sizes and can simultaneously act as a LAN server for installed personal computers and high-end workstations. The specialist server is dedicated to support specific functions such as peripheral sharing, applications software, gateway functions, file sharing, storage and retrieval, network and document management, batch processing, database systems, remote management and bulletin boards, just to mention a few.

The selection of mass storage for the server used to be easy. Traditionally, the preferred storage has been magnetic hard disk. In many ways, things are not much tougher today. One would probably still want a magnetic disk because optical disks remain slower and more expensive. The primary issue to consider is the controller interface, which defines how the controller and hard disk communicate. This interface is a significant factor in the performance of a single drive. If the network is small and the application requirements demand low volume of queries, then the interface issue is not as important. However, if one designs a large network with a high frequency of reads and writes, then the interface performance is critical on a single drive. Recent development in the server's drive addresses fault tolerance configurations in the form of disk mirroring and disk duplexing, as well as disk arrays.[3]

Earlier, we mentioned the consistent, easy-to-use interfaces that allow access to the institution's resources. This area lacks standardization. However, vendors use at least four methods to

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[3]Michael Hurwicz, "Selecting Server Storage," Lan Technology, August 1991, p. 45.

link network applications: Application Programming Interfaces (APIs), database servers, remote windows, and Remote Procedure Call (RPC) software.

A network transport API is a vendor provided tool allowing applications programmers to access a proprietary client/server environment. Without an API, a programmer must be an expert in the LAN environment he or she wishes to access. A disadvantage is that a universal API model or definition does not exist. Consequently, APIs are not easily portable among different operating environments. The database server concept has erroneously become synonymous with client/server computing. In a database server network, an application server is dedicated to providing clients with distributed access to a database management system, usually employing the Structure Query Language (SQL) relational database model to communicate between client and server. Remote window systems are extensions of the "window" concept popular on PCs and workstations. The concept uses the Universal Terminal standard, ensuring multivendor connectivity. Remote processing calls are perhaps the most promising new technology supported under client/server computing. RPCs are based on Computer Automated Software Engineering (CASE) programming tools -- allowing conventional procedure calls to be extended across a network. An RPC allows application programmers to develop applications for single or multiple environments without understanding the underlying network operating systems and communications protocols, which are handled by the RPC.

CLIENT/SERVER DESIGN CONSIDERATIONS

In order to share resources, the client/server systems fall under the category of "loosely coupled systems." Loosely coupled systems give the impression that they are using a single, integrated computing facility, although the facility is actually provided by more than one computer and the computers may be in different locations. The shared resources needed are made available by some of the computers in the network and the access is supported by system software that runs in all of the computers using the network to coordinate their work and to transfer data between them.[4]

One goal of client/server computing is interoperability by mixing, matching, and linking applications with different components across networked environments. Linking people with applications requires more than simply connecting hardware (connectivity). Today's users search for ways to connect applications from different vendors (multivendor interoperability).

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[4]George F. Coulouris and Jean Dollimore, An Introduction to Distributed Systems: Concepts and Designs (New York: Addison-Wesley (1988), pp. 1-20.

The main design goal is to create the effect of distribution transparent to the user. Users should have a view of the system as whole and normally need not even be aware of the locations of hardware and software components from which the system is constructed. In addition, the system should execute tasks for its users consistently and effectively. Location transparency refers to several aspects of design of a client/server system. In this discussion, we are concerned with location transparency because it is the form of transparency that is most strongly affected by architecture of the system. There are three levels of location transparency.

Level 0. At this level the user sees separate computer systems that are able to communicate in specific ways. Usually there are facilities for remote login, file transfer and remote execution of programs. More specific protocols are defined in the application programs for the above facilities; these protocols are widely used and are either actual international standards[5] or regarded as de facto standards.

Level 1. At this level there are some application programs that conceal the multicomputer environment. When using these applications, users are not aware that more than one computer may be cooperating to provide the service they use. The applications are constructed as fully distributed systems with server processes providing location-independent access to specific shared data and client processes interacting with users and accessing the shared data on their behalf.

Level 2. At this level the servers provide general-purpose, network-wide services to share data and hardware resources -- concealing the multicomputer environment from application programs. Application programs can be constructed without any need to take into account the location of the shared data resources.

WHY CLIENT/SERVER COMPUTING?

Client/Server computing will help organizations to better match technology to their institutional goals. The challenges of a global economy require that information systems be redeployed quickly. The sharing efforts between researchers, co-authors, administrative academic support units, and long distance education require realignment of MIS resources to support and integrate new data processing operations with those of the institution. The more

[5]CCCITT 1981. Character Terminal Access To Public Packet Switched Data Networks-X.3, X.28, X.29, International Telecommunications Union, Place des Nations, 1211 Geneva, Switzerland.

fluid design of client/server computing, which isolates the application from the information it processes, will enable institutions to restructure and access information on new servers with only minor programming changes.

Let's analyze some of the issues currently facing our organizations:

Accessing information residing on standalone PCs and distributed departmental computer outside the central facility.	Client/Server solution - Applications on PCs will be able to access data at multiple locations using high speed networks and servers.
Corralling "maverick" end-users who are introducing new technologies outside University guidelines.	Client/Server solution - Client/Server will allow for more flexible guidelines. It will also make it easier for emerging technologies to be linked to old programs.
Enticing employees to use computers and minimize training costs as users switch systems.	Client/Server solution - Institutions will be able to standardize on one interface at the client. This will eliminate retraining.
Securing data outside the host.	Client/Server solution - With Client/Server, programs can be distributed to the desktop while data can be put on an MIS-secured server for audit and control purposes.
Protecting the investment in personal computers.	Client/Server solution - PCs are now the platform for all applications. As the usage becomes even more widespread, our users will recognize the need to integrate these PCs with all the other computer resources.

At the other end of the spectrum, there is the fully transparent distributed form where many processors are either executing specific parts of application code or supplying data. A fully transparent cooperative application allows this interaction to take place without any special considerations or actions on the part of the end user. This design provides the advantages of being able to implement business-critical applications that may rely on many different computer systems across an organization. Data and application codes can be placed on the processor that makes the most business sense and, at the same time, can be exploited in the implementation of other business solutions. All of these technological advancements have allowed the client/server to take on new roles. As a client, the Client/Server has become a flexible platform for business applications. As a server, its strong networking capabilities allow it to provide resources sharing within the workgroup and the organization.

CONCLUSION

Client/Server will require the close coordination of several technologies -- from the network level to the applications level. The critical question dealing with limitations inherent in industry standards needs immediate attention. What standards are in store for the future? To become widely accepted, client/server systems require a standard RPC, a standard network protocol stack, and standards for the way applications communicate.

There is a new message-passing technique offering more efficient use of distributed resources than RPC technology. Although not yet popular as client/server, the peer-to-peer model may be the future of distributed networke systems.

For many of us the mission is critical. Users are looking for three things from the client/server. Aggressive price/performance in the PCs, servers and workstations; the ability to deploy more functionality; speedy applications development cycles. Client/Server will facilitate the users with local processing power enabling them to perform interactive tasks more effectively than in a timesharing system. This technology provides great responsiveness to users, extensibility, the ability to share information and resources and continued availability. The main drawbacks are related to lack of industry standards and the potential failure of a single component within a system that is still running; these can produce new sorts of error modes. Barring any new tremors, the computer industry is ready to support a transition of this magnitude by having architecture that can handle processing large blocks of data and move them through the network.

The client/server model attempts to address the desire for freedom and ease-of-use of a single user system -- combined with the performance and control of traditional host-based, multi-user computing. Early adopters are discovering that it is complex to implement, but when you do it's cheaper. In some cases users are finding that it's half as expensive as a minicomputer and a third the expense of a mainframe computing. The growth in the network will put additional strain on the users ability to manage the network resources. This is an opportunity to introduce a new unit of measurement called "number of input/outputs per sec" (NIPS). This term is described as the ability to move large blocks of information quickly through a network, as opposed to "millions of instructions per second" (MIPS), which essentially measures the power of an individual machine. Client/Server has the ability, when implemented correctly, to utilize embedded telecommunications infrastructures cost effectively. This is clearly an evolutionary step. The ability to provide interoperability between and among systems often is complex because the integration calls for different and incompatible hardware and software. This technology will allow us to develop and deploy business and instructional critical applications which may have data and resource requirements from across the institution.

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Distributed Computing, Centralized Support
The Best of Both Worlds

by

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Brigham Young University, like most institutions, has experienced rapid growth in the use of distributed computing systems. However, the maintenance and support of distributed computing has not kept pace with its growth. Several methods of support have been tried, ranging from departmental autonomy to a central hot-line for total campus support. Each method has met with varying degrees of success, as well as some major problems. Recently, a method of computing support known as the "Computing Support Representative" (CSR) Program has been implemented that provides the coordination and economies of scale of a centralized support organization, but the autonomy and responsiveness of a decentralized support team. The CSR Program was patterned after a national business franchise, which provides the support and training of a centralized administration, but allows each unit to operate much like an independent small business.

Introduction

At Brigham Young University, we have observed an interesting evolution in computing support. In the late 1970's and early 1980's campus computing revolved around one or more central computers. Computing support mirrored our highly centralized computing technology with computing personnel concentrated in a centralized support organization. The advent of the personal computer as a serious research and administrative tool and the evolution of departmental information systems has brought a migration of computing facilities into the various colleges and departments. Likewise, computing support of the mid 1980's mirrored the decentralization of computing technology. However, a small centralized group was left to tend the remaining systems that continued on the campus mainframe.

In most cases, these departmental support groups were autonomous. They made their own purchasing decisions and supported their users with little if any University coordination. When sharing of databases or other resources was necessary, these groups interacted directly with each other and invented arbitrary interfaces to deal with the interchange.

In 1987, the University began to install a computer network to support some of these resource sharing applications. This network evolved into a campus-wide network which we call Y-net, or Brigham Young University's Internet[1]. In the early days of this network the support structure was very much decentralized in that Y-Net simply interconnected these diverse and autonomous departments. However, as the network became more and more useful, the computing environment that the average faculty or staff member dealt with became more complex. The answers to questions could no longer be found in word-processing or spreadsheet manuals because the interaction with network resources complicated their environment. We saw the support problem growing more complex.

In 1990, we realized that more and more of the critical University business was being conducted via the campus network. We needed to solidify and "productionize" the support that was given to the networked computing environment. One alternative was to re-centralize the computing support personnel to provide coordination and economy of scale necessary to accomplish the task. However, many support organizations had become quite autonomous and supported many users and stable applications within their colleges. Such a radical re-centralization would be quite disruptive to University business and would probably cause more problems than it solved.

Because of these decentralized support groups on campus, we chose to model our computer support structure after the computing technology that we were dealing with. Thus we developed a "networked" computing support team that mirrors the computing environment that is rapidly growing at BYU. Networked organizations are prevalent in the service industry. An example is a national franchise, where advertising and distribution are supported nationally, but the local business is independent and autonomous. We have also used these networked organizations as a model for our computing support.

The Computing Support Team

Brigham Young University has chosen the client/server computing model to create its networked computing environment[2]. This means that each computing user utilizes a client computer (such as a personal computer) attached to the campus network to access resources provided by server computers that are also attached to the campus network.

Using this same client / server model for the support structure implies that each computing user utilizes a specific support person (Computing Support Representative or CSR) who has access to the Computer Su, . ort Network and through it, access to all the other CSRs who may be serving other clients. The CSR is responsible to solve computing problems that cannot be solved by the faculty or staff user. The key concept is that the CSR has "ownership" of these problems and uses his access to the support network to resolve them.

Historically, many departments already have individuals on their staff that provide computing support but do not have formal access to a support network. Others have utilized the Computer Consultation Center (the BYU provided computer support center) as their CSR but do not develop continuity with any individual consultant and thereby spend much time rehashing problem information. Finally, University Computing Services (our central computing support organization) provides contractual support to other computing entities who do not want to hire individuals, but would rather contract their CSR service.

The client / server model ties all these CSRs together, whether they are employed by the client or the network, into a formalized service organization which provides first level support, as shown in Figure 1, with a "one call does all" philosophy. It emphasizes the concept of problem ownership by the CSR in order to dispel the unhappy aura which surrounds users who do not know what is wrong or who to call. And finally, it creates a knowledge network which makes the "whole" greater than the "sum of the parts".

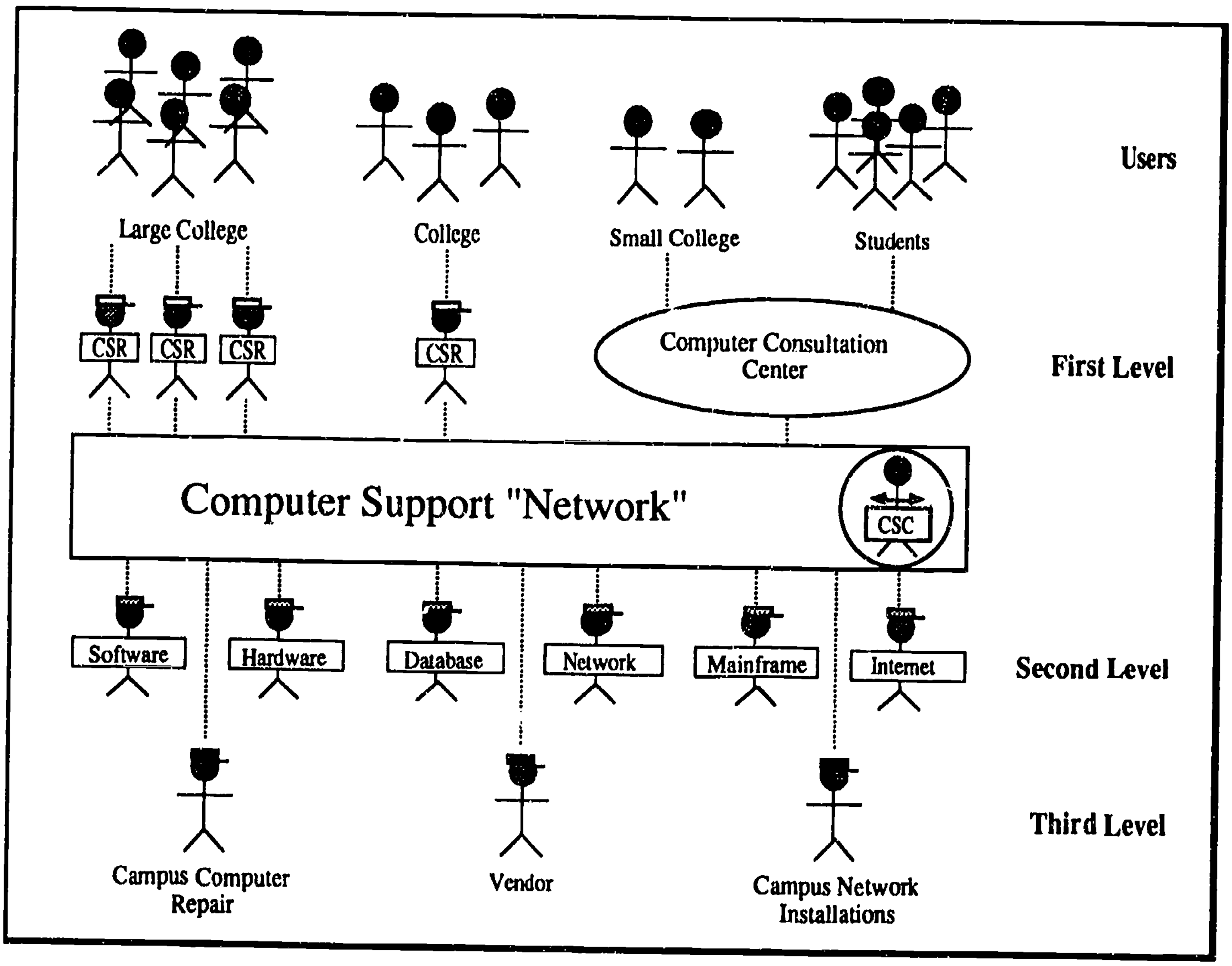

Figure 1

The Second Level in the support team consists of expert problem solvers in specific areas of computing. These are individuals that can find solutions to problems that the First Level CSRs are not able to solve. They also have the skills necessary to deal with the technical support staff of vendors, to completely resolve problems that may involve that vendor's equipment. The major advantage of this three leveled support team is to reduce the burden of the technical support people and give them more time to resolve problems. This keeps them from having to field so many trivial questions. The clients of the Second Level problem solvers are the CSRs at the First Level. This effectively reduces the support burden of the Second Level experts from several thousand faculty and staff to less than 100 CSRs. An informal and unofficial structure of this nature has actually existed on our campus for many years. Support staff in various departments have had an unofficial list of who they might call to obtain answers to technical questions. However, coordination has been haphazard, and isolation has still been prevalent. Therefore, another important concept of the Computing Support Team is the addition of a "Computing Support Coordinator".

The Computing Support Coordinator

The Computing Support Coordinator is a person who insures that effective communication and problem management occurs between all support levels. The duties of the Computing Support Coordinator are to:

1. act as a problem manager to track problems that get escalated from the First Level to the Second Level. This would insure that no problems get "lost" and that solutions are properly cataloged for future reference by First Level CSRs. This is accomplished by utilizing a problem tracking system that keeps track of work accomplished on a problem. It also sends status information to all interested parties via electronic mail.

2. coordinate communication between the CSRs and the technical support staff. This does not mean that all problem calls from CSRs must funnel through the Computing Support Coordinator. Rather, the Computing Support Coordinator acts as a "hub" in the network of CSRs when the CSRs don't know who to call with a given problem. This communication is accomplished through electronic mailing lists and bulletin boards, as well as telephone contact. This provides First Level CSRs with two way communication and solutions to problems or other contact to give them the feeling of membership on the Computing Support Team.

3. train CSRs in how to interact with the computing support structure of the University. This is done through monthly CSR meetings that focus on a topic of general interest. Additional specialized training is provided through other sessions that focus on more specific topics. These meetings not only help train the CSRs but also bring them together so they can learn more about the various skills of other CSRs. This helps to foster a more networked support environment.

4. publish periodic newsletters. This helps to keep the CSRs informed of new methods of support and appropriate use of computing technology for their clients. The newsletter also provides a forum so that CSRs with particular specialties can contribute to the computing support network by publishing articles about their own expertise.

5. follow-up on problem resolution. The Computing Support Coordinator contacts CSRs, as well as end-users, to get feedback on how computing support is being perceived on campus. This acts as a quality control indicator to keep the computing support structure service-oriented.

6. focus the technical staff on problem solutions. Individuals with in-depth knowledge of particular computing technology sometimes become so distracted with investigating

solutions that they tend to lose perspective as to what the end result should be. The Computing Support Coordinator helps to channel this energy in productive ways.

The CSR

The computer users have two basic needs, to have their computer problems solved, and to gather information about their computing environment. To satisfy the end user's need for solutions and information, it is important to appoint a Computing Support Representative (CSR) to act as a channel to network the user to campus computer support (see Figure 1). The CSR is appointed by the college dean or organizational head to fulfill the users needs for solutions and information. The CSR needs to be someone that the users can trust for reliable information. This can be anyone from the "local computer guru" to a skilled secretary. We have found that it is important that the CSR be a full time employee.

No two colleges do things in exactly the same way. In order for the CSR program to be effective in each college, it must be specifically designed to integrate into the way the college operates and include any existing support structure that may already be in place. If either the users or administration feel awkward about using the CSR program, they won't use it and the program will fail.

There are many considerations when attempting to integrate the CSR program into a college, but the most important is to listen to the needs of the college and ask "What is it that these people really need." If a college has computers, then they will have already created some method for supporting them, even if it is inefficient and undocumented. Support may range from a faculty member who knows a particular program to a team of network administrators. By understanding what the college has in place, the CSR will be better able to determine their future needs, and how the CSR program can benefit a particular college.

The CSR as a channel for solutions

The CSRs are the computer users resource for resolving computer problems. The CSRs do not have to be highly trained computer problem solvers. The main requirement is that they are someone who can handle responsibility in a way that the users trust.

The CSRs should at least be able to understand the users computing environment. This means that they should know what applications the college uses, what sort of network configuration the users are connected to, and what kind of computers are being used. The CSRs will be given strong support from the second level support team to help them find solutions to computing problems, and should never be in the awkward position of being responsible for solving a problem, but having no way to find a solution.

The CSR as a channel for information

In addition to being a channel for problems and solutions, the CSRs need to be a channel for transmitting information to the users in their college. This information can be anything that will help the user be more effective in using their computer. We let our CSRs know about changes in the campus network, site licensing of software, computer vendor presentations, known software bugs, vendor recalls of defective hardware components, common problems and solutions, campus computing standards, and any other information that will help keep the end user informed as well as compatible with the rest of the campus. This information can be distributed in a number of ways. We especially encourage the use of electronic mail because of the relative ease and speed that the information can be distributed. We require that every CSR have a mailbox for electronic mail, and strongly encourage the CSR to use electronic mail to distribute pertinent information within the college. We have also found that regular newsletters are a good way of distributing information both to the CSRs and within a college.

It is important to note that using the CSR as an information channel works both ways. Since the CSRs are located in the college, they have a good idea of the needs of their faculty and staff. This information is very important to the campus administrators who make decisions that affect the direction of campus computing. As an example, we sent out a survey to the CSRs asking what software their college planned to purchase. We found that the University could save a great deal of money by purchasing a site license and distributing the software to everyone who needed it.

Network CSRs to each other

Each CSR has a particular specialty that they know better than other CSRs. By networking their collective knowledge, we are able to solve problems much more quickly. We have set up a Listserv[3] electronic mail group and a Usenet news group[4] to help facilitate this process. In addition we encourage our CSRs to interact at the monthly CSR meetings.

Network CSRs to third level support and vendors

In order for the CSRs to find answers to tough problems, they will need to work with third level support and off campus vendors. At BYU, we have a number of third level support organizations. Examples of third level support include Data Communication Systems (Responsible for network wiring), Electronic Media Department (Hardware service contracts and repair), and University Computing Services (Mainframe, database, Unix, etc.). When the CSR needs specific help from a third level support organization or an off campus vendor, and doesn't know who to call, they can contact the Computing Support Coordinator who can refer them to others for additional help. Also, when the third level support organizations need to give information to the campus faculty and staff, they can work through the Computing Support Coordinator.

Sample CSR setups in a college

Now that the basic ideas of how the CSR program works have been presented, we will review how this program may be set up in a college. We stress that these are suggested models, and that in order for this program to be effective in a particular college, it must be tailored to fit with what the college feels most comfortable.

Research has shown that in order to have a successful computer support program, it is necessary to dedicate one support person for every 30 users. We have found this to be a good guideline to follow, however through successful networking we can usually extend this ratio to support more users with fewer support personnel.

In a relatively small college where there are 30 to 60 computer users, a single CSR can coordinate the functions of resolving problems and distributing information (see figure 2).

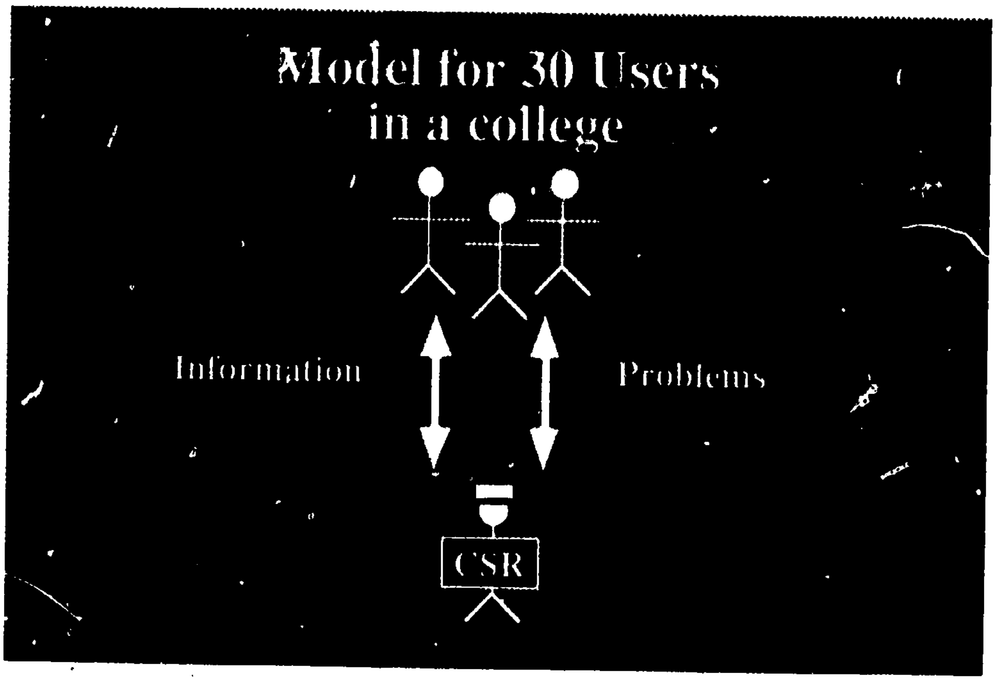

Figure 2

For a medium sized college where there are a number of computer users in a department, we have seen two main models. One has a single college CSR appointed with separate "department CSRs" working under him (see figure 3). The Computing Support Coordinator can transfer information to the college CSR who transfers it to the department CSRs. When the users have problems, they can contact the department CSR for solutions. If the department CSR cannot provide a satisfactory solution, he can work with the college CSR who in turn can work with the campus CSR network.

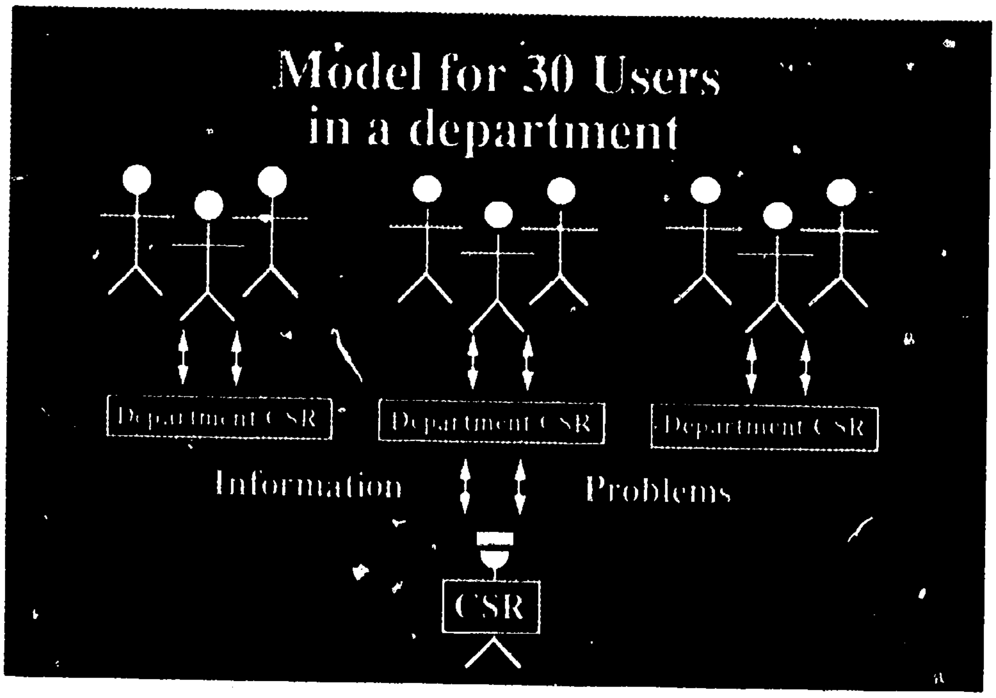

Figure 3

Another way of organizing support is to appoint a separate CSR for each department (see figure 4). Each of the CSRs acts as a college CSR that directly interfaces with the Computing Support Coordinator and the Second Level support, rather than funnelling through a single college CSR. We have seen both models work well.

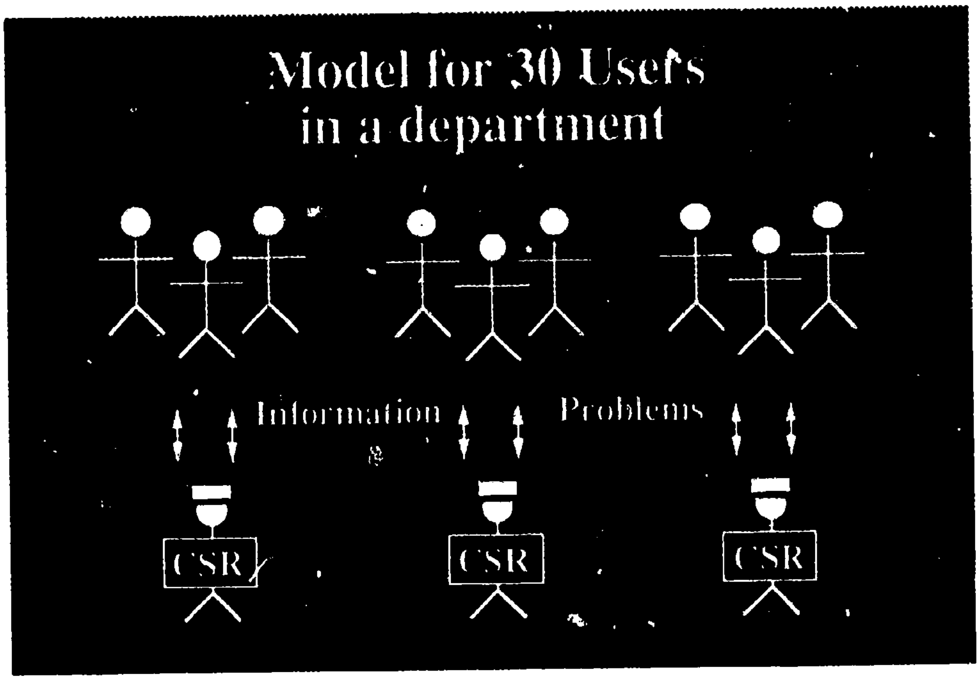

Figure 4

At BYU we have a few "Mega-Networks" where a college has 200 or more computer users. For this type of situation, the basic CSR model can be modified to have the college CSR responsible for channeling information while a college support hot-line can be used to resolve problems (see figure 5).

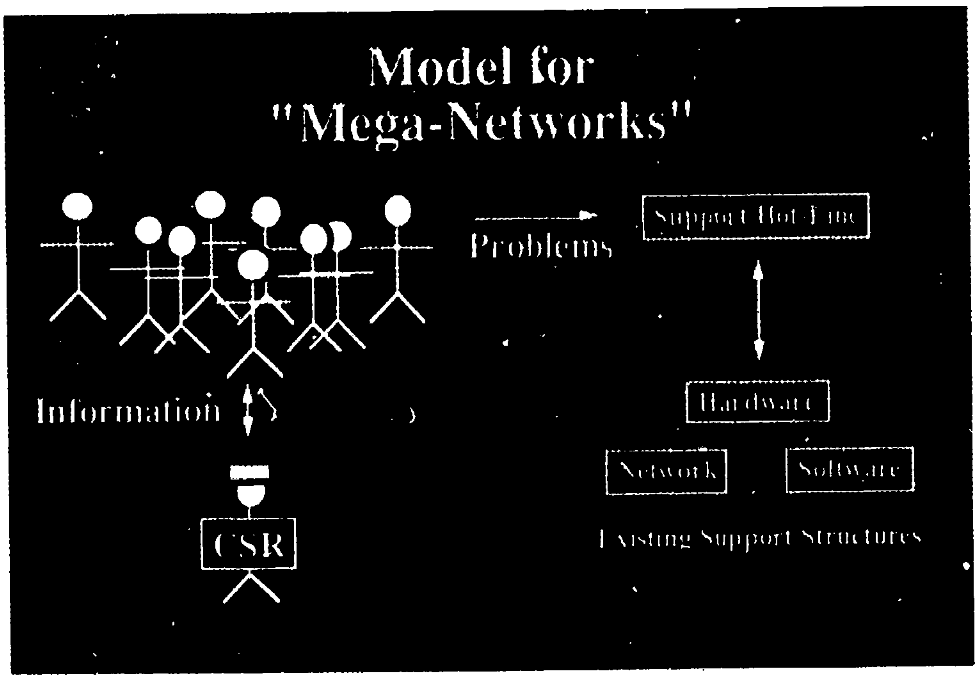

Figure 5

In a college of this size, the CSR has to use efficient means of distributing information, and we strongly recommend the use of both electronic mail, and a regular college computing newsletter to the faculty and staff. Since the CSR is the person channeling the information to and from the faculty, they will view the CSR as a friend from within the college, and feel secure with their computer support. When users have a routine computing problem, they can call the college support hot-line which needs to be tied in with the rest of the campus computing support network. This will avoid taking valuable time away from the CSR who has other important responsibilities.

If the support hot-line does not give the user enough satisfaction, the user can contact the CSR to have the support hot-line problem resolved. We tried a model like this for three months and found we could support over 160 users with one full time CSR and a hot-line that was staffed with a trained student from 8:00 am to 5:00 pm.

Advantages of the CSR program

Most of the advantages of the CSR program come from understanding the needs of the end user. By having the CSR in the college, the users feel more comfortable about asking for help. We have found that some faculty members feel uncomfortable about calling a student-staffed university wide"computer hot-line", but feel fine about talking to a peer in their own college. In addition, CSRs understand the faculty's scholarly interests. For example, a biology professor wants to use a database program to process information sorted by genus and species. A support person outside the college might not be able to give as good advice as someone inside the college who understands basic biology concepts. The CSRs are also aware of hardware or software that may be unique to the equipment a specific college uses. Finally, the CSR program eliminates the problem of who to call for help by providing one computing support telephone number to the user. The user knows that they can call one number and that the person on the other end will help them find a solution to their problem.

Conclusion and Future Efforts

Computing support at Brigham Young University has evolved, just as computing technology has evolved. Computing technology is moving toward a more networked environment and an appropriate support organization for this technology is a network of computing support personnel.

The key individuals in a networked support organization are the Computing Support Representatives, who insure to the end-user that computing problems are solved, and the Computing Support Coordinator, who insures that the CSRs receive the technical support that they need. Case studies have shown that the number of computing users that a CSR can effectively support can be increased when the CSRs can rely on a networked support organization. The quality of computing support can also be increased by focusing the efforts of the support team with a Computing Support Coordinator.

Although we have seen a lot of initial success with this program, there is still some improvement to be accomplished. The CSRs are the heart of this program. The more knowledgeable and experienced they are, the better the system works. Over the next year we are going to focus on ways to better train the CSRs. We plan to do this is by combining the monthly CSR meeting, and the training meetings, and hold them more frequently. At the CSR meetings, we will have the second level support personnel teach a workshop in his or her speciality. The CSRs can sign up for a subject, an when that workshop ends they can sign up for the next most important workshop for them. In addition to the workshops taught by the second level support, we will be having some of our most knowledgeable CSRs teach workshops to other CSRs. This will help to foster the "networking" concept and get the CSRs working with each other. The Computing Support Coordinator will be teaching a workshop for newly appointed CSRs that will cover the basics of all the subjects, and familiarize them with how the program works.

It is also important to help the faculty members feel more comfortable in dealing with their CSR. The first step to achieving this is for the faculty member to know who their CSR is. In several colleges we tried putting stickers on the front of the faculty's computers that told them who their CSR was, the support phone number, and some information that would help the CSR solve the problem, such as the University Inventory Control Number and the type of network the computer was connected to. This helped the faculty members become familiar with the CSR, and encouraged contact when help was needed. We plan to extend this project to the entire campus, so every faculty member knov s who to contact when they need help.

When the CSR program was first started, the colleges were happy to have some way of organizing computer support both within the college and campus wide. Deans were happy to assign the duties of the CSR to someone in the college, and the CSR was willing to take on the extra burden of support knowing that now there was campus level help. This initial euphoria has worn off as networked computing support has become more common, and CSRs are now looking for an additional incentive to take on the extra responsibility. One of our goals over the next year will be to write a det- 1 job description of the CSRs responsibilities and use it to approve a salary increase for those who hold the position of CSR.

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Moving to the Client/Server Model

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Decreasing financial resources and higher expectations for information systems support on our campuses are forcing us to rethink our delivery systems. In the early 1980's, larger mainframes were purchased with many terminals, then came the microcomputer systems, followed by networks to tie everything together. Now with multi-million dollar facilities we find the replacement of systems, added functionality and support of present systems too costly. The networks and intelligent desk-top workstations have given us the vision of what client/server computing will offer. The RISC hot-boxes have the potential to replace the mainframes as servers in this environment and at a fraction of the cost. The combining of intelligent workstations, networks, and SQL/RDBMS servers now offers the functionality and flexibility we need in order to satisfy the increasing expectations of our clients. The results of our development efforts will be presented along with the considerations we are giving to moving to RISC based systems.

Moving to the Client/Server Model

Several years ago we started to develop some systems that would allow on-line access to information that traditionally required a special run of a batch program and normally produced paper output. As we began to develop these types of systems the idea of developing an Executive Information System and of providing academic departments with administrative information[1] also evolved. These initial goals had nothing to do with the client/server model, but as developments have taken place we have ended up with client/server systems and have realized their value. It is this evolutionary development and the things that we have discovered along the way that we want to discuss.

The first project came about because of a need to provide simple campus directory information for students and employees. Our paper directory based on twelfth class day information is not available until about half way through the fall term and is out of date the day it is distributed. We developed a file based directory system on a VAX with terminal access. As this was being developed we realized that it would be easy to add things like home directory information and student majors and employee departments so users could produce mailing lists. At that time much of the word processing was done on the VAX using Mass 11 word and list processing. Having a directory system that would produce files for input to this system would be helpful.

As this system became operational we received some requests from academic departments for listings of those prospective students who had had their ACT/SAT scores forwarded to Baylor. A number of departments use these for recruitment purposes. Rather than provide paper output through a batch report we decided that the student directory could be modified to allow a department to look up prospective students using the interest fields in the ACT/SAT information.

One of the programmer/analysts assigned to this project had a Macintosh and the potential of HyperCard had been discovered. The LaserWriter had become available which made the Macintosh an acceptable office system and a campus network was being installed to connect all microcomputers, printers and mainframes. In order to provide the user with easier access, it was decided to develop a HyperCard front-end for the Macintosh. The resulting Macintosh Graphical User Interface (GUI) changed the way we think about user interfaces for systems. We had gone from a terminal interface to MacTerminal, which allowed cut and paste, to a more functional HyperCard interface that allowed the Macintosh easier access and more control.

Next we developed an interface to the Information Associates' Student Information System (SIS) that had been installed on an IBM 4381. A new tool had become available from Apple called MacWorkStation. We used it since it gave some good development tools. It is basicly an X-Windows for the Mac and is a step beyond HyperCard. We also developed a MacWorkStation front-end to our new AMS College and University Financial System (CUFS) written in DB2.

During this development phase, some of the ideas in Tom Peters book, **Thriving on Chaos**[2], became important to us, including: invest in application-oriented small starts, encourage pilots of everything, support committed champions, support fast failures and create a corporate capacity for innovation. It takes special people with special talents to break new ground and they must have considerable freedom to do their thing once they see the vision. It should be noted that not every one in CCIS was or is sold on this new approach to providing end-user information.

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[1] "Baylor University: Equipping academics with administrative tools," Query, Summer 1991, p.8.

[2] Tom Peters, Thriving on Chaos (New York: Alfred A. Knopf, 1987) p.ix.

We came to a cross roads. Our experience with a relational data base management system (RDBMS), DB2, sold us on the use of a RDBMS for the storage and retrieval of data. We began to look for a project to test its use and were presented with the opportunity to test a new product from Apple, Data Access Language (DAL), which provides an SQL interface to an SQL/RDBMS on the host. We obtained a version that would that would access Rdb, a RDBMS on the VAX. Now we needed a project. One of our needs for some time has been on-line access to student transcripts. We do have access through SIS, but security does not allow the control needed and it is one of most CPU intensive programs since it builds the transcript with each run. We decided to produce a copy of each student's transcript, move these to the VAX into Rdb and access them using DAL from the Macintosh. This system convinced us that we were on the right track with RDBMS and we have now rewritten the Student and Faculty/Staff Directories in Rdb and DAL.

At this point we realized that we were in the client/server environment. We had the SQL/RDBMS data on a server with DAL/SQL access from a client where tools like Word, FileMaker Pro, Excel and PageMaker were available for the user to customize and refine data into information. We developed a HyperCard front-end, the desk-top that we named the **Baylor Macintosh Workstation (BMW)**, that provided direct access to applications, desk accessories and the **Baylor Information System (BIS)**. The attached chart shows our Baylor Information System Architecture. Now, what does client/server now mean to us?

I. Client/Server Computing

The first thing that we have to determine is what we mean by client/server. It implies a complementary relationship like customer/supplier. One is not complete without the other. Several years ago we decided that we needed a better name to call the individuals on campus to whom we provide services. The common name we computer techies call them is "users." After much discussion we selected the name "client" to use in referring to those we serve, thus making us a "server." In some sense this people client/server relation is very similar to the technical client/server relation that we want to discuss.

In both cases, the server has resources available for the clients to use that will assist them in fulfilling their responsibilities. The server supports a number of offices, while the client office is the place where the final product is made. Together they make a complete system. It is a dynamic relationship where the boundaries are often not well defined.

We found that there are five important areas that must be dealt with to have success: **clients, technology, technical personnel, economics** and **vision.**

The Client

Our systems must have a (people) client-centered and focused design. The client part of the client/server relationship involves the **desk-top, training/support** and **change.**

Desk-top: The microcomputer is the technology part of the client side of the relationship. At any stage in developing our systems, one of the main limiting factors is what is available on the desk-top, hardware and software. In our case, we use mostly Macintosh microcomputers as the hardware platform and have found that there are a few core software packages, including Word, QuickMail, FileMaker Pro and Excel. The clients must have a rich variety of tools like these that allow them to customize their information processing.

The graphical user interface design of the Macintosh has allowed us to move considerably beyond what was being done using either DOS or mainframe menu type systems, and the flexibility of the desk-top tools has given the clients considerable control over their work. The power of the microcomputer is one of the driving forces pushing us to client/server computing.

The installation of the client BMW/BIS can be complicated, especially in the situation where different system versions are being used as it involves two main components: the application software and the networking software. The different levels of client access to information also requires customization. The installation procedure we presently use requires a minimum of 20 minutes for each of 1100 Macs. Automatic updating by the client must be developed for the future.

Training: One of the major successes that we have had is in setting up an Office Systems staff whose purpose is to train and support the clients (faculty and staff). They provide hands-on training, telephone hot-line support, in-office support and software installation. They develop training materials and review new products being considered for on-campus use.

Once the BMW/BIS installation is completed, some basic training is required. The client must first have a basic knowledge of the Macintosh desk-top that includes a working knowledge on the use of windows, menu selections and opening, closing and saving files. The BIS menu offers the choices of access to the Faculty/Staff and Student directory information, Library Services (BayLIS) and access to terminal based University and personal calendar systems on the VAX. The Chairman BIS version provides additional access to CUFS, SIS and Student Advisement.

It is important to make the client aware that the data they need is now available and can be down-loaded based on any format that they choose. The "How To" is made apparent as the client views the menu choices as they move from screen to screen. It is not necessary to burden the client with pages of documentation and the balloon helps available in System 7 will be used to further enhance on-screen instructions.

The next stage of training involves the manipulation of data once it has been down-loaded from the workstation to the Macintosh desk-top and the possibilities are numerous with approximately 46 different packages being supported. These include systems for word processing, page layout, file processing, data base, statistical, spreadsheet, communications and graphical presentations.

Change: This topic could be a paper in itself. There are always a few individuals who are willing and ready for change. Most, however, do not want change, and they must to go through the stages of change: self-pity (why me?), denial (not me!), anger (I'll get even!), bargaining (I'll cooperate if...) and acceptance (what change?). Change brings about conflict, and conflict is solved by either persuasion or power: the carrot or the stick. The CCIS staff has slowly gained credibility among many of the client base. Providing the clients with resources, training and support to help them fulfill their responsibilities has minimized the resistance to change.

Technology

The enabling technologies, in addition to the **microcomputer** on the desk-top, includes the **network** and the **relational database management system.**

Network: The network is the glue that holds the system together. It allows everything to connect to everything else. Peripherals can be shared, files can be transferred, and under the new Mac System 7, a client Mac can become a server to other Macs.

We have 1,100 Macintosh microcomputers and 150 LaserWriter printers all networked together. In addition to sharing printers (the initial reason for the network), it has the capability of providing information access, file sharing, electronic mail, document management, video, mainframe access and connectivity to wide area networks.

Relational data base management system: This has been called the key to the kingdom. This is true for many reasons. The RDBMS simplifies both the design process and programming.

Data is stored only in the columns of tables, not hidden in the structure of the database. The clients (people) can understand their application systems developed as normalized tables where network/hierarchical systems are confusing to them. A myriad of tools are available which allow these clients easy mainframe or workstation access to their relational data. Programming (in 3- and 4GLs) with relational sets of data decreases program complexity.

The flexibility/adaptability required to deal with our changing environment is much better supplied by relational systems than other flavors of databases. RDBMS DBAs can get a better handle on security with database access control at the table level and with column and "value-level" restrictions through the creation of views. And the performance concerns raised in the past as an objection to RDBMS, if still an issue at all, is less and less one, with each new release from database vendors. We believe that relational database systems ultimately provide the basis for more effective exploitation of an institution's information resources. Several years ago we committed to the SQL/RDBMS as the basis for our information system development. This commitment has carried over to the server-based information systems.

Technical Personnel

At a recent MacIS meeting, one of the speakers was asked how many Macintosh programmers they had working on their projects. He replied, "Fifty," and was immediately asked where they got fifty Macintosh programmers. He stated that they converted COBOL programmers to Macintosh programmers and someone in the audience quipped, "But that's genetic engineering!" Program development in this environment requires more that just the knowledge of a language and JCL.

The server development requires individuals with expertise in RDBMS, and in the future will require knowledge of new tools like object-oriented development tools and databases. We are using DB2, Oracle and Rdb to develop various server data base systems. UNIX is becoming the standard operating system. Development on the client end requires knowledge of tools such as HyperCard, MacWorkStation, Pascal, C++, MacApp, TCP/IP and DAL. Our initial developments used MacTerminal, then we went to HyperCard, followed by MacWorkStation. We are now using MPW Pascal, MacApp and DAL as our development tools.

The initial developments of our client/server systems have required individuals with considerable talent, knowledge, initiative and creativity. They were oftentimes using beta software versions with bugs that required considerable work arounds. There were no seasoned professionals to provide support and no guarantees that there would be success. The only guarantees were challenge and obstacles. This has been no place for the faint-hearted. Pain should be anticipated. Transforming our COBOL programmers still remains one of our greatest challenges.

Economics

Since 1984-85, we have averaged purchasing 225 Macintosh and PC microcomputers each year, with a total investment of about $4,000,000. We could have purchased a lot of mainframe power for this amount, but it would not have provided the desk-top functionality. With the desk-top now forcing the direction, we have had to rethink our server strategy. The mainframe can be a server; however, it retains a high cost for both hardware and software. The new RISC hot boxes from companies like IBM, DEC, SUN and HP offer considerable power for a fraction of the cost of the mainframe and also offer the network connectivity required of a client/server system.

We have found that to replace one of our administrative information systems would require the upgrade of a mainframe at a cost of over $2,500,000. We have instead purchased an IBM RS6000 RISC computer for less that ten percent of this amount and purchased the SCT Banner Alumni/Development System written in Oracle. For the first time we have paid less for the hardware than we paid for the application software system. As each of our systems is replaced, we expect to find similar savings with RISC servers.

With economic pressures to cut costs and operational pressures to provide more services, we have chosen to keep personnel and decrease hardware costs. Downsizing can now be accomplished without cutting services.

Vision

To move into the client/server arena to date has required individuals with vision. In addition, the risks have been high. There are many potential points of failure including hardware, software, network, technical personnel and clients. A failure at any point will result in a failure of the system.

Most systems are designed with considerable client involvement from the beginning. We have chosen to develop a working prototype of a system before even mentioning it as a possibility to anyone. Once it is operational, we start showing it to key clients who are open to new ideas and get a few to using it. If it catches on, the system sells itself. So far they have all caught on and been accepted. Few, if any, would have even gotten off of the ground if we had used the traditional project management development process and first taken the idea to the clients for approval. Knowing client needs and which clients are receptive to new ideas is essential.

II. One Person's Journey

The following comments represents the feelings and opinions developed by one of us (BK) during this past year as a change was made from doing and directing traditional administrative programming projects to the development and supervision of Macintosh client projects.

Production Data Centralized on the Mainframe: Our definition of client/server at Baylor has developed as centralized management and storage of the University's mission-critical data resources on a mainframe with down-loading of subsets of that data to workstations where users manipulate and present the information as required/desired using various tools. These tools generally provide more flexibility in presentation than those on the mainframe.

From my perspective, any successful client/server application must have the same foundation as any non-client/server application - a good RDBMS and a well-designed application database utilizing this RDBMS. In the future, object-oriented databases will become major players in the DBMS market also. But for now, only a relational database provides the reliability, flexibility and simplicity necessary to give users the functionality to expand the questions they need to ask to get their job done as that job changes and data required changes.

Keeping the production data on a mainframe gives centralized control over availability, security and backup/recovery. Also, it is usually not desirable to have redundant production data all over the place. For example, if several offices maintained separate application data files that required student address, who would know what the current official student address was? Students would find it a nuisance to have to update their address several places to continue to receive all necessary correspondence.

There will always be some processes that require the compute power of the mainframe. And there will always be very large print jobs that require enormous amounts of work/sort/print spool space. Many OLTP applications are unsuitable for the workstation due to response time requirements, although some applications now do limited editing of transaction input at the workstation to off-load processing from an overloaded mainframe.

Thoughts on Downsizing: Downsizing can be a driving force to move to the client/server model or I suppose it could be the result of a decision to move to this model. At any rate, downsizing does NOT imply a reduction of services or support.

I am completely in awe of the cost differences between the RISC boxes and traditional mainframes. And these RISC machines are out there running administrative applications in production at many institutions. After my discussions with other schools in this environment, I am completely confident that our alumni/development project on the RS6000 will be a great success and a tremendous move forward for Baylor. It seems ridiculous that more third party software suppliers are not yet in the UNIX/RISC arena.

Advantages of Workstation Applications: After working on development of our new Housing System in which we will be writing files out to the Mac to be imported into FileMaker Pro, I have begun to see the power of the client/server model. Once the data is there on the workstation, the user has complete control and can develop most reports he might require. I feel we will benefit more from the programmer time saved than from the mainframe computing resources saved. When a slightly different version of a report is needed, or one in dorm/room order rather than alpha order is needed, the user can easily accomplish it in minutes. Not only does this save programmer time, but also the clerical overhead of writing, entering and tracking Requests for Programming Support. I realize that for many systems, the number of records necessary to produce a required report will prohibit use of a workstation. And I have some concerns about how we will draw that line, but I know many of our current reports printed from the mainframe could move to the workstation easily.

Creation of reports in the user office provides added data security. Programmers do not need to run tests of reports against "live" data and the output does not lay around the computer center waiting to be processed and delivered. This would especially be helpful in the Human Resources System. That system will be our first major opportunity for some real off-loading of processing to the client end. The volume of data is small enough that all straightforward reports could be done on the workstation. I think this will relieve us from converting somewhere between 60 and 80 current batch programs.

I am particularly excited about workstation front ends to mainframe data when it comes to the graphical presentation of that data. Graphical user interfaces to traditional data will be a great extension of administrative systems. And common user interfaces properly done should reduce support costs once development is completed.

If production data resides on different server platforms - for example, HRS on the RS6000 under Oracle and CUFS on the IBM 4381 under DB2 - the workstation may be the most efficient and economical place to produce output that requires data from more than one of the platforms. It can be expensive to acquire the tools necessary to accomplish this at the mainframe level today when open systems are not yet a reality.

Considerations in Moving to the Client/Server Model: The client/server environment implies that different skills are necessary for the IS staff. They are no longer just application programmers turning out COBOL code in a secluded office. They have to have better interpersonal skills and be able to analyze the problems/opportunities while consulting within the client offices. They will be more concerned about database design and connectivity/integration issues and less about output design. I see us becoming facilitators within the University. This requires that we know more about what goes on outside of CCIS. Also, application development on multiple platforms using assorted development tools will be more difficult (challenging?) than our current situation. Development methodologies will have to be refined to include an awareness of the client and its capabilities and to exploit them.

A recent editorial stated "Users must be provided with adequate technical support and training. If users are to run their own computing systems, they must have experts available to assist them when problems occur. Devoting inadequate resources to technical support and training is perhaps the leading cause of failure in IS downsizing."[3] The column went on to suggest a fully staffed hotline of experts on users' hardware, software and application systems. This also implies that there is some sort of standardization of client tools.

From my own staff's point of view, we will certainly have an adjustment period. We are accustomed to being fully knowledgeable about Baylor's administrative systems. We are able to answer all of the users' questions about SIS or any other application. As we move to the client/server model, we will be asked functional questions on workstation products by these same users. Most likely the users themselves will know more about using these products than we do. We will have to maintain some knowledge of how departments are using the provided server data in their individual information systems.

An interesting quote from an article we have circulated in the Center: "Research continues to demonstrate the importance of the work itself and the opportunities for achievement and advancement as key factors that motivate the IS employee."[4] This implies to me that the client/server environment may improve the motivation of our staff. Certainly the arena is more challenging and less static than traditional COBOL mainframe programming. Our staff is absolutely capable of adding Macintosh programming skills - the critical problem is with a lean staff, finding the time to come up to speed while continuing support of existing systems.

The University will have to understand that the users will now have added responsibility. As these staff members across campus take time to develop their own reports, other of their traditional tasks may take longer to get completed. On the other hand, they will hopefully have the information they need in the fonnat they want much sooner than before. Also, computer literacy should become an important criteria in filling many campus staff positions. IS staff will hopefully be more quickly able to get to the things that always get pushed to the bottom of the stack like tuning databases, investigating new products, documenting and re-engineering old systems as well as more critical items such as management reporting/EIS applications.

Some major decisions are yet to be made about the best way to provide users access to the data they need. Much of the data selection can be "canned" using MacWorkStation or MacApp/DAL. But what about adhoc requests or a new requirement that means two new data columns need to be added to the file of student data down-loaded to a particular department's workstation? We will have to have tools available to allow fairly rapid response to these situations. It seems to me that there must be some provision for allowing users to code their own database queries (SQL) that will create a down-load file of the columns they need. The down-load process itself should also be transparent or very easily accomplished. This would be similar to the new Excel access into Rdb.

Another consideration is something that we have faced for quite a while with our Mac systems. New products are constantly becoming available which may make those currently being used for development obsolete. Just keeping applications up-to-date with new releases of the products currently being used is a horrific task. We already have such an investment in certain Mac products (HyperCard, MacWorkStation) used in the BIS that we will not be able to convert those applications to a different development base (i.e. MacApp) anytime soon. I am not optimistic about our ability to keep workstation systems developed in the Center updated to use the best/most

[3]Editor, "Downsizing: Is it for MIS?," Database Programming and Design, August 1991, p. 6.

[4]Stewart L. Stokes, Jr., "The New IS Manager for the 1990's," Information Systems Management, Winter 1991, p.48.

efficient product available. This is similar to the problems we have keeping mainframe applications current with maintenance releases and new versions (SIS to SIS Plus/DB2).

A concern about moving to this environment is the lack of control with what is done with University data resources. For example, all mailing labels from SIS and URS are produced with a control number for tracking purposes. In the future, more and more correspondence will go out without this security measure in place. We can educate but we cannot police the users.

Other Observations: I have to admit to being resistant to the client/server and open systems ideas at first. I think my primary concern was involved with UNIX and my perception of it as an unfriendly operating system as well as our lack of a RDBMS for use with UNIX. I have become quite fond of DB2 and was looking forward to putting all administrative data into that format. Relational databases are much easier to design and administer than network ones or indexed files. With our acquisition of Oracle and the inevitable future improvements in database connectivity and integration, this obstacle has been removed in my mind. And as I said above, the price differential between RISC and other platforms is impossible to overlook.

After working on the new Housing application and seeing for myself how easy it is to write out data to the Mac from CICS and then to import the data into FileMaker and use it to create various layouts, I am sold on this methodology for providing report data to users. I think some IS people have a hard time adjusting to the fact that clients are much more computer literate now and that they usually know what they want and can be trained to produce their desired output from workstation products. In the Housing System, only the large batch roommate matching program will be done in COBOL on the IBM due to the computing resources needed. Other reports, including special forms, will be driven from FileMaker on the Mac using data files down-loaded from DB2. Data entry will be done in a CICS terminal mode application but inquiry will be provided in both terminal mode and Macintosh mode.

I think that we may be further along than other schools contemplating moving to client/server computing because we have operated for several years under a form of the concept of "networked computing"[5] due to our variety of platforms - IBM, VAX, Honeywell, Apple, IBM-PC, Zenith, Rainbow - and the communications peculiarities that go along with each as well as the diverse software.

III. Summary

Within the Center for Computing and Information Systems at Baylor there are those who like an environment which involves more traditional planning and organizational management and those who like a less formal structure and planning process, for which each day is a new venture into the unknown. To have successful production systems you must have the former and to develop in new areas, such as client/server computing, you must have the latter. One challenge is to balance these two opposing styles. A goal of our development efforts must be to liberate not constrain our clients. Some of us view IS as a journey which each day offers new challenges and opportunities. Today we have set our sails toward the client/server model knowing full well that tomorrow we must test the direction of the wind and be ready to change to some new direction that new technologies, new insight or new needs beckon. This is the greater challenge.

[5]Grey Freeman and Jerry York, "Client/Server Architecture Promises Radical Changes," Cause/Effect, Spring, 1991, p.21.

Baylor Information System Client/Server Architecture

Macintosh Client

Administrative Functions

Faculty/Staff Directory (Client-DAL)
Student Directory (Client-DAL)
Student Advisement (Client-DAL)
Recruitment Directory (Client-MWS)
Library (CRT Emulation)
University Calender (CRT Emulation)
Student Information (Client-MWS)
Financial Information (Client-MWS)
Student Housing (Client-MWS)
E-Mail
Administrative Productivity Tools

Macintosh Software

Data Access Language (DAL)
HyperCard
MacWorkStation (Client-MWS)
Telnet
MPW Pascal, MacApp, C++
LocalTalk, EtherTalk
TCP/IP

Network Services/Protocols

AppleTalk for VMS 3.0
Data Access Language
Terminal Emulation

DEC VAX

VAX 8700, VAX 6510
VAXStation 3100 (3)

Administrative Functions

Faculty/Staff Directory Server (Rdb)
Student Directory Server (Rdb)
Student Advisement Server (Rdb)
Recruitment Directory Server (RMS)
Library System
University Calendar System
E-Mail

VAX Software

Rdb (Relational)
RMS (Indexed)
MacWorkStation (Server)
Custom IBM/VAX Navigation Program

Network Services/Protocols

File Transfer
Terminal Emulation

IBM Mainframe

IBM 4381-MVS/XA

Administrative Functions

Student Information System (VSAM)
Financial Information System (DB2)
Student Housing System (DB2)

IBM Software

DB2 (Relational)
VSAM (Indexed)
CICS
QMF

Information Transfer

File Transfer by Tape

Honeywell Mainframe

HIS DPS 8/49

Administrative Functions

Human Resources System (IDS-II)
Alumni/Development System (IDS-II)

Honeywell Software

IDS-II (CODASYL)
DMIV-TP
PDQ

DISTRIBUTING ONLINE ACCESS - FAST

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ABSTRACT:
The distribution of online access to administrative systems for an ever increasing campus audience has presented significant security and procedural challenges. The routing of requests for online access resulted in bottlenecks for clients. An electronic process was put in place to relieve this. This paper focuses on the development and evaluation of an electronic authorization process for online access, Forms Approval System Tracking, which has been in place at Syracuse University for the past three years. The success of this system, its acceptance by the audit staff and its effect on the user areas will be discussed as well as the pitfalls encountered during the implementation. There are still significant challenges to be met. This system is currently in the process of being upgraded to meet future security needs of the University.

Fifteen years ago, a small number of users of online administrative services at Syracuse University were able to view biographic and academic information through the new Student Records Information System. Aside from the programming staff, there were about 175 individuals on the campus who had been assigned a LogonID which enabled them to use one or more of the 30 or 40 functions which made this information available to them.

Twelve years ago, the Alumni Development Information System added another 50 online users and another 30 functions. Information control areas were created to help handle requests for large client areas and to act as liaisons between the online users and Administrative Information Systems (AIS).

In rapid succession, additional administrative systems, supporting a wide variety of areas within the University were developed within AIS or purchased from vendors. Each new system required AIS to add some online users, while the number of new functions available to all users grew dramatically.

The introduction of the General Ledger System in 1986 doubled the number of online users as at least one individual in each administrative department was given online access. Many of these new users quickly realized that other types of information could be made available to them, including the capability to receive their montl reports in data file format, ready for downloading to their person computers.

By 1987, AIS was supporting over 60 online systems, with 1600 active users who were requesting access to over 800 functions. In addition, as more end-user services became available, requests for access to data files and extract files became difficult to monitor and control. Electronic mail had arrived, and the once definitive line between Administrative and Academic Computing users began to fade as requests increased for access to services supported throughout the University.

We, like many other institutions, set policies regarding access to information stored in the university's administrative computer systems. These policies included guidelines for

- the ownership and control of information

- confidentiality and user responsibility in the use of that information
- procedures for access and for distribution of information
- adherence to auditing standards and government regulations

As the retrieval and distribution of information began to change from printed materials to computer terminals to electronic media, the University recognized the need to strengthen some of these policies. A structure was defined which addressed the responsibilities associated with information access.

Data Custodians became the owners of information and were ultimately responsible for granting access to either the files in which that information was stored, or to the system or function which allowed the information to be viewed.

Since a Data Custodian might not be directly involved in the day-to-day processing of requests for information, areas often designated a *Delegated Approver* to assume those duties. At Syracuse University information control areas servicing major client areas often functioned as approvers for areas with related information.

To assist both the Data Custodians and Delegated Approvers, a department might designate an individual to handle the paper request, and to monitor the access requirements of the employees in their area--a *Department Security Coordinator.*

Administrative Information Systems as the technician, processed requests for online functions, handled associated security issues, assigned electronic mail IDs, forwarded and monitored the progress of access requests outside of its direct control.

Data file security, access security for programming staff and for some end-user services was addressed in 1985 with the purchase of the ACF2 security package. Access to the CICS online systems was controlled through a process developed in-house, which handled individual user access, from logonID to password validation to function access and ultimately to the information. AIS found itself in the position of not only handling the assignment of access to a variety of sessions, but monitoring the security associated with each of these sessions. To address this situation and to minimize administrative overhead, AIS issued a stated direction to use ACF2 to provide security control and audit access for administrative computing resources and data wherever possible.

Until the *FAST* system became available, requests were initiated either by a Security Coordinator or through an information control area or directly to AIS; but no matter which access avenue was chosen, the vehicle was always the same . . . . *A PAPER FORM.*

An employee heard about an online function which could provide useful job-related information, or new responsibilities required additional access. If the department had a security coordinator, he/she could provide direction on how the form should be completed; however, these coordinators were not an organized group. Distribution and consistency of information regarding access procedures and security policies was often less than adequate.

If a coordinator was not available, AIS would mail forms to the requestor, through our campus-wide mail service, with instructions for completing and routing the form, or we would contact one of the information control areas to get the request started. If the employee needed access to information in a variety of systems, student records information, alumni development information, financial aid, athletic systems, etc., the form would go to the first data custodial area for review and action, and be forwarded to a second custodian where the process was repeated. Some forms required as many as five or six signatures. If the first custodian had granted access, AIS could not act upon that approval until the signed form was received. In cases where access was of some urgency, phone calls followed by supporting memos were used to get an employee 'up and running', while the original request snaked its way across the campus.

Once the form reached AIS, all approved requests were processed. If all or part of the request had been denied, a copy of the form was mailed back to the initiator. It was then quietly filed away so that the auditors could look at all the *real* signatures should there ever be a question regarding security procedures.

By 1987, AIS and some of its clients were discussing alternatives to the entire request process. Terms like *'processing'*, *'authorization'*, *'routing'*, and *'notification'* all were being prefaced by the word *'ELECTRONIC'*. While the problems and criticism surrounding the delays and paperwork associated with requesting online access increased, proposals to the larger University community who initiated and handled online access requests were not being met with enthusiasm, and in many cases, generated negative feedback.

When the *FAST* system was conceived, our staff had no expertise in electronic approval systems. We realized, however, with the dramatic growth in demand for access to online functions, we needed to devise a better, faster way to get the job done. We also needed to accept the reality that this change would have to be initiated by AIS. Our computing direction had been to get information into the hands of the people who need it in a timely fashion. We needed to reinforce and support this direction. Enter *FAST*, an 'administrator's tool', focused on reducing the paperwork and time delays involved in granting access to the University's administrative information. Aside from AIS, two of its data control areas and the internal auditors, its function as an electronic signature and approval process was not generally publicized.

In evaluating the existing process we felt that there were basic elements which should be maintained. The policies behind the existing paper system fit our needs and the institutional culture. It was important that the control of access be maintained at the data custodian level. As stated in our policy manual, they have the right to approve or deny requests to access the data within their domain. Because the paperwork had to come to Administrative Information Systems to be processed, many of our clients viewed us as the authorizers. We felt that we needed to reinforce the role and responsibilities of the data custodians with the end users.

The most significant problem that we had with paper authorization was simply the time that it took to process. Many of our clients did not realize that if they were requesting access to General Ledger, Alumni, and Student Records systems, that the form had to be routed to three separate custodian areas before it reached us for processing. With more and more work in campus offices requiring the use of online systems, we could not afford the luxury of allowing access requests to take days or weeks to be completed. A second area of concern was our inability to identify the current status of people who had access to administrative data. With no direct tie-in to the payroll system, it was difficult to track a person's current status in a timely fashion. This was especially important for student employees whose access to student records functions must be limited.

Being able to electronically distribute access requests to data custodians simultaneously rather than mailing paper forms, seemed the way to go. We began to sort out the issues which would be encountered with this kind of change. The issues raised by internal auditors centered around the backup and audit trails, electronic and paper, and restriction of function. There were a maximum of three separate forms involved in the access authorization process for a new user:

- Employee Security Acknowledgement form stating agreement with the University data access and security policies
- Request for Online Access form detailing functions to be accessed
- Student Employee form for students accessing production administrative data.

These forms had always been maintained in AIS for audit purposes. If the requests were being made electronically where would they be maintained? We determined that the new system would be used only by the data custodian areas. Campus offices would submit the same paperwork to one of these offices, who would in turn ensure that the proper signatures were in place and then retain the forms in their offices for backup. The question of electronic audit trail was answered with the design of the system including a history of all access requests, with action taken, and identity of the requestor and the approver. This information would be made available online and in the form of hard copy reports where necessary. In automating the process, it was possible to provide much more information to custodians and auditors in a timely fashion. Lastly, it was necessary that the custodians as the approvers of access requests be restricted to approving only those requests which fell within their domain of responsibility. We felt that *FAST* could easily address all of these issues.

The *FAST* System provided an online facility for the request and authorization of online access. It allowed departments throughout the University to electronically request access to administrative online systems, and to distribute these requests to the appropriate custodians through a data custodial system maintained by the *FAST* administrator. Unlike the paper system, the online system applied access as soon as approval was given.

An audit trail of activity on the system was provided, and was also used for statistical analysis.

FAST covers three basic areas:

- *REQUESTOR*
- *APPROVER*
- *ADMINISTRATOR*

A *REQUESTOR* is an individual who initiates a request to the system. This request could be to add a new user and assign menus; to update the menus available to a current user; or to delete a user from the system.

An *APPROVER* is a Data Custodian or Delegated Approver who has been designated within the FAST approval distribution system as the individual(s) responsible for granting access to specific functions.

The *ADMINSTRATOR* is the AIS Security Coordinator who has the ability to define and maintain the Authorized Approver tables, to create and maintain menus and to handle any special requirements which might be associated with the assignment of access.

We have been very successful in distributing the use of the *FAST* system to our data custodian offices and information control areas, and establishing them as the primary contact for campus offices. This helps our clients to understand the role of the data custodian. There is widespread acceptance of the system and its use is second nature. Our clients expect to be able to gain access to functions in a timely manner and they do. The initial fear of electronic authorization no longer exists because our clients see the advantages and *FAST* has proven itself as a basic electronic approval process.

The data custodians would like to distribute the requesting authority out to the campus offices. This is not feasible with the current system for two reasons. First, distribution of the requesting authority again raises the question of where the paperwork backup would be. It would need to be in the campus offices. To ensure that it is done properly, additional training for campus staff needs to be established and additional information needs to be maintained within the system. Secondly, there are technical and system design issues. The whole system needs to be "friendlier" and more intuitive to address an audience whose primary function does not involve security.

With a larger client base, we need to be more integrated with our Human Resources system. Although we are able to track when people leave the University, and whether they are a student employee, the issues of people changing positions and job functions within the University are not addressed well. Two scenarios can occur. If a person changes jobs and does not notify a custodial area, he retains the old access whether it is appropriate to his new position or not. The onus is on the person or his supervisor to notify someone. If the custodial area is notified, it is treated the same as a termination, all of his access is deleted and he is put back on the system with a new logon id in his new job.

Since *FAST* was implemented, our clients' desktops and toolsets have changed dramatically. Where, ten years ago there were primarily dumb terminals available with limited online functions, our clients now work with an array of electronic tools. Electronic mail was introduced to administrative offices in 1987, about the same time that *FAST* was developed. The use of microcomputers, with their spreadsheet and word processing software has made downloads of administrative information a standard and everyday occurrence. Each of these tools, requires some security and access authorization. AIS is now administering several security systems with no easy way to monitor a person's overall security profile. For instance when a person leaves the University, *FAST* can take care of cleaning up the online access, but the electronic mail and download access are entirely separate operations done only in AIS. We have to look at all the other systems to see where cleaning needs to be done. This even extends across CPUs. Many clients have accounts on both the academic and administrative mainframes but we do not have an effective way to know who has the access and who should be notified of changes.

Finally, we are seeing that as new systems are developed, requests for distribution of update functions to campus offices is a priority. From a security perspective, we feel that the extra data value authorization required to implement this should be integrated with our online security system rather than proliferating small independent security systems. Again we feel that we could handle this within the scope of the *FAST* system.

FAST is currently in rewrite, to expand its capabilities and to address the security and access environment which the University will face during the 90s. Some of the changes driving this expansion are:

During the past three years Syracuse University has made a commitment to ACF2 and to cutting administrative overhead while improving administrative services. Changes in software now make the links between *FAST* and ACF2 possible.

A high-priority on the University's agenda is providing students with online access to selected information. Current plans are to use

FAST to monitor system access and usage for this large population, based on ID card and PIN (personal identification number).

New system development at Syracuse is being written with distribution of update functions to campus offices. *FAST* will be used to handle the authorization of these functions, and to monitor changes in personnel or responsibilities which could effect access.

The rewrite will provide both AIS and its clients with several additional features and flexibility:

It will include a repository of information on all system access for an individual, sessions which can currently be assigned through *FAST*, as well as those which require additional processing.

Access profiles linked to position numbers within University departments will be stored by the system. The profile will be created at the department level, by an Information Coordinator, and will include the functions and services required to complete the duties related to that position. Our analysis has shown that while different individuals occupy a position over time, the access requirements of the position usually remains static. Use of profiles is expected to dramatically reduce the overhead involved in assigning user access.

The new system will monitor status through links to the Payroll and Student Records systems, and provide electronic notification for:

- adjustments to access based on position or department changes for an individual;
- termination or leave of absence;
- EMPLOYEE/STUDENT status changes. Individuals whose major status is not employee have restricted access and require special authorization.
- validation of 'continuing employee' for individuals whose sessions IDs have not been used for extended periods of time.

Request status reports, information on current requests as well as historical data, will be available online to requestors, approvers and administrators. A comment 'note pad' has been included so that information can be available online to all levels within the process, to eliminate 'phone tag' inquiries. When a request is denied, the custodian must provide an explanation which can then be reviewed by the requestor.

Date parameters can be used to activate and suspend access, allowing IDs which are used during heavy processing periods or for special events to be set up at any time and then controlled by the system.

While *FAST* was originally intended for use by areas which would be considered 'computer literate', knowledgeable about online systems and comfortable with their use, our intent is to put the new system into every department which currently takes advantage of administrative systems. Extensive user input during the design process have resulted in a 'user friendly' online environment, as has the addition of an online HELP feature to provide explanation and direction.

It became apparent as we developed the plan for the rewrite that some of the surrounding issues would be easier solved if we enlisted the support of high level administrative managers at the the University. These are the people that make up our steering committee, the Administrative Computing Advisory Group. Proposals were sent to this committee for the universal signing of an Employee Security Acknowledgement form when a person is hired, and for the creation of a network of Information Coordinators to support distribution of online access.

The Employee Security Acknowledgement form was revised to address non-computerized as well as computerized information. This document sets guidelines for handling information in all formats and begins the education process for each employee on University data security policies. Although the ACAG agreed with our proposal, other areas within the University did not. We will continue to use this document only for those people requesting access to our online systems.

The Information Coordinator Network will change the terminal user's contact from the data custodian areas to an AIS sponsored and supported network of individuals at departmental levels who will handle a variety of security and access related functions. Our goal is to provide the opportunity for departments to become more aware of and to handle data access and security issues, while maintaining a centralized system to monitor and support the University's information security policies. This will be done in two phases. Currently, we are identifying potential information coordinators in all departments of the University. This person will be responsible for

- processing requests for access to administrative systems
- educating their online users on the guidelines and policies to be followed to insure compliance with the University's information security policies
- monitoring the status of their users
- some minimal instruction on the use of administrative systems

We are holding training sessions during the fall semester for these coordinators to provide them with the necessary knowledge and toolset to do their job. Our current estimate is that this network will involve about 150 people. In maintaining a group at this level, we feel that the load on any one person will not be so heavy as to interfere with their normal job.

In the spring, we will begin the implementation of the new *FAST* system and these information coordinators will be able to process their requests electronically. We will begin a second round of training and give them additional facilities for tracking the status of requests and satisfying audit requirements for paper backup.

On an ongoing basis, AIS will be providing the network with support in the form of training sessions, help sheets and information on who to call and what resources are available to the network. It is our feeling that we cannot progress in distributing security access without this network. Distribution of security functions needs support and a centralized point of control. AIS will provide these for the Information Coordinators. The response from offices has been very positive. The remote physical location of our office has made us and our policies an enigma to much of the University staff. We feel that education is the way to change this.

Our experiences with *FAST* have taught us the value of developing a prototype system. The organizational and political changes involved in implementing this system seemed insurmountable until we decided to just get started. We have leveraged the current system to be more proactive with our clients; to show them "real time" how electronic approval works. The planned enhancements for this system are viewed with enthusiasm by our user community. We are proud that we will deliver a product which is as useful to our institution's administrative support areas as it is to their clients.

Centralized Budget Preparation in a Distributed Environment

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Abstract

The University of Miami is a private research university with four campuses. Budget management is a centralized function of the Coral Gables budget office, while the individual schools and departments carry the responsibility of preparing their own budget. Although this budget preparation responsibility lies at the department level, higher levels have the task of summarizing the data into manageable information. In response to this environment, a mainframe-based decentralized Budget Preparation System was developed and implemented.

This system provides an interactive, on-line budget preparation tool to departments and provides on-line consolidated information to the schools, divisions, and the central budget office in a standard format. As data is updated by departmental users, instant totalling is accomplished for all associated organizational levels. This effort provides departmental users with "ownership" of their budget, while providing both a high level and detailed view to the central offices.

Introduction

At the University of Miami, budget control and management is a centralized function of the Budget Office at the Coral Gables campus, but the workload of budget preparation sits in the hands of over two hundred departmental units. These departments must get approval not only by the department chairman, but must also be approved at the divisional and school/dean levels. At each of these levels, the budgets of the lower units must be consolidated for management review and approval. Some of these departments are so large that they are budgeted at a sub-department level. At the Medical campus, budget management responsibilities lie with the central Medical Budget Office.

The Applications Systems Development group of Information Resources has recently completed its initial long range information systems plan that encompassed the development of systems for all central administrative functions. Currently, the focus is to reengineer these central processes to provide tighter integration between systems and to decentralize the functions to the departmental units. One of these decentralized systems is the Budget Preparation System.

Background

The idea for a budget preparation system originated due to difficulties the Medical campus was having compiling the budget efficiently and on a timely basis. Departments on the other campuses are much less complex and deal with a smaller number of accounts and employees. Also, these departments are so small that most of the budgeting is done at the dean/school level. The accounts of the medical school come from a variety of fund sources including: grants, contracts, gifts, and medical professional services. On the other hand, the other campuses primarily budget expenses based on an allocation. Since the departments at the other campuses are less complex, they had little problem completing their budgets using PC spreadsheet software.

Another problem that all campuses faced was the difficulty in obtaining the initial information required to complete a budget such as personnel and financial records. At the time, the Human Resources System and the Financial Records System were strictly centralized systems and the departmental administrators were forced to rely on reports that were usually a month old by the time they received them. The Department of Medicine had so much information to compile that the process of preparing the budget brought their administrative office to a standstill for five months.

The medical school departments were limited in their ability to prepare their budgets due to outdated computer equipment and lack of technical guidance. As a result, several departments began hiring programmers and tried to develop specialized systems on their own. A major shortcoming of these systems was the inability to share data with other university systems. Each of these systems produced different reports and did not follow the same methods. Therefore it was very difficult for the central Medical Budget office to consolidate the departmental budgets into a campus-wide budget. The central Medical Budget office would have spreadsheets not only piled up on their desks, but covering the floors and hallways. Even with newer hardware and a programming staff, some departments found the PC solution to be to slow and cumbersome. One department using a spreadsheet program was forced to wait several hours for one recalculation.

The central medical budget office prepared a budget "bible" that was intended to provide the rules for budget preparation on that campus. It was hard for them to verify if the departments were really following the policies since reports were generated in many different formats. These policies include limitations on salary increases and use of fringe benefit rates. The large number of departments and the lack of a central communication mechanism made if difficult to communicate updates in budget policies.

To further complicate the consolidation process, there was no integration of data or communication between the medical school departments. It was very common to have budgetary transfers from an account in one department to an account in another. There was no method to verify that all transfers were accounted for by both departments or that both departments agreed that this transfer should take place. A similar problem was when an employee was budgeted from an account outside of their department. This required an archaic process of gathering signatures that no one had time to verify.

With strong support from the Assistant Vice President for Medical Finance and Budget,, an appeal from the Assistant Chairman of the Department of Medicine to the Sr. Vice President for Business and Finance lead to recognition of the need for a standard computerized solution to the budget preparation problems. The University had the choice of developing a system or continue to have individual departments find their own solution by hiring individual programmers and purchasing additional computer hardware. The decision was for Information Resources to analyze the problem and develop a computerized solution.

System Development

Information Resources began the project towards the end of August 1990 with the goal of implementing a standard budget preparation tool by January 1, 1991. This date was critical since this was when the budgeting process began for the next fiscal year. Among others, the Department of Medicine needed to be assured that there would be a system to use or they would begin obtaining equipment and developing a system on their own.

User interviews were conducted on all campuses with over thirty departments. The medical campus was very interested in the development of a standard solution, whereas the other campuses were adamant they maintain the status quo. It was decided that in this time frame a system would be developed exclusively for the medical campus. Despite this decision, functionality issues for all campuses were maintained throughout the design and development phases of the project.

The interviews at the medical campus identified several problems. At that time, the reports they needed to begin their budget were routed through the central offices. From there they were distributed to the appropriate campuses, and finally to the departments. This process led to the reports becoming outdated before ever arriving at the department. Therefore, the system would require all of the initial information on-line from the beginning to eliminate the need for these reports.

After analyzing the problems with the current process and the needs identified by the users, three alternatives were identified. The first alternative of maintaining the status quo was quickly dismissed. A standardized PC system was deemed unacceptable due to the hardware limitation of many departments, speed of recalculations, security issues, and consolidation of the budget by the central offices. The last alternative was to develop a mainframe system that would provide the functionality required at both the departmental and all other organizational levels. The mainframe system was chosen since it offered the departmental users the data and processing they required as well as a mechanism for centralized control and consolidation.

Administrators from the Department of Medicine and the Medical Budget Office were identified as key users and participated in the functional design of the system. The Department of Medicine represented the most complex department in the University and could speak on behalf of the other departments. The Medical Budget Office could aid in defining the policies, maintaining the appropriate controls, and set criteria for the consolidation of information into management views.

The management views included such information as viewing an account with all of its associated detail, viewing account balances by organizational level and by fund, as well as an overall plan of operations by organizational level. Managerial views of employee data included percentage increases of salaries by employee, salary pool percentages by organizational level, and the ability to view employee salaries by account and fund.

After several discussions with the key users, it was determined that the system requirements be broken into five categories for more detailed analysis. These five areas were: 1) the initial information requirements for budget preparation, 2) the processing requirements at the various organizational levels, 3) specific requirements at the departmental level, 4) the security, approval, and consolidation requirements of the central office, and 5) the data flow to other systems after completion of the budget.

The initial information requirements were determined to lie in three places. The chart of accounts and financial data were required from the financial records system. Also, prior year budget amounts were needed from the budget file. Finally and of prime importance, was the need for personnel/payroll information from the Human Resources System. This data would save countless hours by eliminating the need to verify salaries, and automating the work involved in consolidating the information for salary pool calculations. Since all of this information resided on the mainframe, it could be easily ported to the budget preparation system. Standard budget policy was to use information as of calendar year end. Since point-in-time data was required it was decided to extract the information from these systems instead of directly integrating with them.

Processing requirements at the various organizational levels was basically the same. At the division and dean/school levels, users require immediate consolidation of the lower level budgets. Since immediate updating at all levels is required, all updates must roll up to higher levels in real time. Efficiency in database design and program specifications were of utmost importance due to this multi-level on-line recalculation process.

The needs for processing at the departmental level were simple. They wanted to update personnel budget information as well as operating and capital budget amounts. Recalculation time and ease of data entry were of prime importance. They needed the ability to update their chart of accounts with TBA accounts, and also create TBA positions for future employees. They also required automatic calculation of employee fringe benefits and a method to manage salary pool requirements. Finally, they desired several different on-line management views of the budget as well as supporting reports.

The central medical budget office was primarily concerned with the security, approval, and consolidation of the information. It was very important that the departmental users could only access data from their department. They needed the ability to use other department's accounts and to transfer funds between departments, but should not be permitted to view the account detail or employee salaries from another department. The central office also wanted the ability to "shut off" a department from further updating of their budgets once they were approved to insure that unauthorized changes did not enter the budget. Finally, they needed to have a real-time consolidated view of the information. The same managerial views provided to the departments were required at the school/dean level, as well as the division level. Therefore updates to a department's budget had to be reflected at all levels instantaneously. This would eliminate any need to manually consolidate the budget for any level.

Both the departmental and the central budget office administrators were interested in having the data flow directly into the Budget File, the Financial Records System, and the Human Resources System for the next fiscal year. Upon final approval at all levels, the information would be extracted from the budget preparation system and loaded into the appropriate systems. This would eliminate the need to fill out forms based on reports at the departmental and central levels.

Database design was completed by the end of October, leaving only two months for data conversion, programming, testing, and documentation. Several problems were encountered in data conversion since the data in the other systems was not as easily extracted as expected. Although the required fields existed in the other system's databases, fields not important to the central offices were often overlooked or entered incorrectly. Therefore, significant time was spent in researching specific problems associated with the conversion.

Implementation

The implementation phase of the system began January 1, 1991 and training started immediately. A few of the larger departments were chosen to use the system for the first year so that the bugs could be worked out. Once these departments were trained and began using the system, word spread throughout the medical campus that there was a system available to complete budget preparation at no expense. Soon the majority of the medical school departments asked to use the system. Another series of training sessions were started as more users were recruited.

Some problems were encountered with departments who did not already have a connection to the mainframe. Due to the time framr, these departments had to rely on modem connections to gain access to the system. Another problem was the report distribution process. There was no printing facility at the medical campus, so a high-speed line printer was purchased and installed at the Medical Budget Office. Reports were submitted on-line upon user request and were printed in this facility. Since most of the information they needed was available on-line, printouts were needed primarily for final budget review.

A review of the system shows that an annual cost savings of approximately $102,000 in personnel costs will be realized by the medical campus as well as intangible cost savings of $44,000. Efficiency in the departmental units will allow other tasks to be performed during the budget preparation period. Also, all time previously spent on consolidation of budgets at higher levels will result in substantial time savings.

Future Plans

With the overwhelming success at the Medical campus, there was an impetus to expand the system to be used on all campuses as "the" budget preparation tool for the University. This eliminates the need for any uploads into the old flat file system and provides a strong foundation for the development of a year-round budget management tool, the Budget Management System.

The Budget Management System will maintain the permanent budget base for all university accounts and employees. The user interface will be virtually identical to the Budget Preparation System thereby avoiding a retraining effort. Also, this will provide an on-line view of the permanent budget to the central budget office and the various departments.

Downloads of the data can easily be provided to facilitate various needs. The central budget office can use the information to aid in forecasting future budgeting needs, employee salary pools, fringe benefit rates, etc. The departmental users can use the downloaded information to upload the data into their PC based expenditure control and financial management systems.

Furthermore, the budget management system will provide for on-line interfaces with other financial systems. This system will be just a piece in the puzzle of an overall decentralized view of all University financial data. This "Departmental View" will encompass functions from Budget Preparation/Management, Human Resources/Personnel, Financial Records, Purchasing, and Document Processing/Approvals.

The Document Processing feature of the system will provide for direct entry of "documents" by departments into the various systems. The approval feature of Document Processing will electronically send the document to all individuals requiring an approval of the document. Once all of the electronic signatures are gathered, the document will be immediately processed in the appropriate system.

For example, a mid-year budget revision would be entered by a departmental user as an electronic document. This "form" will be sent to the Account Signatory, the Departmental Financial Supervisor, the Controller's Office, and ultimately the Budget Office. Once approved by all of these areas, the revision would update the general ledger and the budget management system. The ultimate goal of this facility is to convert all University forms into electronic documents.

The Budget Preparation System has provided a strong foundation for the development and acceptance of the decentralized concept. The distribution of data entry from the central office to the departmental offices has reduced errors, reduced lag time, and better educated the departmental users on central office policies and standards.

Providing Distributed Services With Centralized Resources:

A Case Study

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Abstract

This paper provides a case study of the experiences of Bucknell University in installing network services in support of the administrative offices on campus. In some respects, Bucknell was a late-comer to networking. This facilitated an integrated approach to campus-wide networking. Wherever possible, needs of diverse departments were accommodated within the framework of centralized hardware and network administration. The presentation includes an evaluation of the project to date, along with plans for growth.

For the past year, Bucknell has engaged in a project to provide network services to the microcomputer users in administrative offices. The primary goal of the project is to provide services to diverse departments using centralized hardware, software, and personnel resources. This paper presents an overview of that project to date.

Introduction To Bucknell University and Bucknell Computer Services

Bucknell University is a small comprehensive University, located in rural central Pennsylvania. Bucknell has a strong liberal arts program, complemented by professional programs in engineering, management, and education. Bucknell has approximately thirty-four hundred students, who are mostly full-time, undergraduate, and resident.

Bucknell Computer Services is headed by a Director and Associate Director. It is divided into four departments: Administrative Systems, Academic Services, Systems, and Telecommunications. Each of these departments is headed by an Assistant Director. The organization reports to the Vice President for Academic Affairs.

The division of labor between Administrative Systems and Academic Services is based on constituents. Administrative Systems provides computer services to the administration of Bucknell. Academic Services provides computer services to faculty and students. As a result, the two departments provide some similar services to different constituent groups. During the past year, both departments have established network services for their respective constituency. This paper focus on the efforts of Administrative Services to provide network services to the administrative offices at Bucknell.

Administrative Computing

A Bull (Honeywell) DPS 8000 mainframe computer running the CP6 operating system supports most administrative data processing applications at Bucknell. Access to that computer is through terminals or microcomputers running terminal emulation software. Each device has an RS232 connection to a data switch. This provides access to the mainframe. The Bull computer does not participate in the campus network. The Bull computer regularly supports eighty to one hundred simultaneous on-line users.

The Bull computer is shared with Academic Services for some of their applications. However, academic use has gradually migrated to other computer platforms. The academic community now counts for very little activity on the mainframe.

Data processing applications are mostly written in COBOL. A CODASYL database, keyed files, and sequential files are used for data storage. Since administrative data resides on the Bull mainframe, it is necessary to logon to that computer to access the data.

Bull is no longer providing enhancements to the CP6 operating system. In addition, they have migrated support for CP6 to a service organization. As a result, Bucknell is actively searching for a replacement platform for the Bull computer. It is anticipated that the next administrative platform will be a full participant in the campus network.

Networking Prior to 1991

Some local area networking was in place at Bucknell prior to 1991. These networks all provided small, isolated departments with limited service. There was no campus-wide network or network services available to administrative departments before 1991.

Several network operating systems were in use on these networks. Several offices used EasyLAN. EasyLAN is a zero-slot LAN for MS-DOS computers. EasyLAN works over standard RS232 wiring. Other departments used TOPS, and its companion product NETPRINT. These departments had a mix of MS-DOS and Macintosh computers, and required a network operating system that would support both those platforms. Network connections within these departments were made with LocalTalk and PhoneNET (twisted-pair) wiring. Finally, several departments were networked solely for access to AppleTalk printers. These departments were not using any network operating system.

Network Services

These networks provided few services. Primarily, these modest networks were aimed at providing shared access to a laser printer. In some isolated cases, file sharing capabilities were also available.

Before 1991, a total of twenty-four computers were involved in seven separate departmental networks. (This only includes network activity in administrative offices.) Besides a network connection, most of these twenty-four computers had an RS232 connection for access to the administrative mainframe.

Request for Network Services

Most of these departmental networks were actually in place before 1990. The year 1990 was characterized as a year of delayed requests. During this time, plans were made to systematically network the administrative offices. As a result, requests for networking were put off with the promise of something better in the future.

Networking Now

That something better is an integrated, campus-wide network instead of isolated, single-function networks. Networking is now viewed as a campus-wide resource, not a departmental resource. As a result, any plans for networking that do not fit that view are not implemented. A description of Bucknell's requirements for a campus-wide network follows.

Network Requirements

The campus network is evolving as an Ethernet network. While there are some current installations that do not meet this standard, everything will be migrated to Ethernet within a few years. Twisted-pair (10Base-T) wiring is used within buildings. Fiber-optic cabling is used between buildings. The campus network is currently available in selected buildings.

The following were considered goals of the project. At a minimum, the network should provide access to the following services: file sharing, printer sharing, application sharing, and access to hosts. The network should be constructed in a way that will allow for addition of new services. The network should support MS-DOS and Macintosh computers.

Currently, network services are available through Administrative Systems for MS-DOS computers only. There are a few Macintosh computers in administrative offices. These will be discussed in the section on future directions.

Hardware Resources

The central hardware to support networking of administrative offices at Bucknell is a single server. This is an IBM PS/2 Model 80, configured with 10MB memory, a 320MB hard disk, and a 150MB tape backup device. A second server will be brought on-line soon. It also will be a PS/2 Model 80. The additional server is being installed in anticipation of future needs. It is not a response to current performance or other problems.

All client devices are connected to the network with a standard Ethernet card. For MS-DOS machines, a 10Base-T 3COM card is used. For Macintoshes that are connected directly to the Ethernet, an Asante 10Base-T card is used. Several AppleTalk networks are connected to the campus-wide network with Shiva FastPaths.

Network Operating System

All network services are currently provided using a single network operating system. This is Microsoft LAN Manager, version 2.0. LAN Manager comes in a variety of flavors. The version that is available from Microsoft runs under the OS/2 operating system. Other versions are available for the UNIX environment and the VAX VMS environment. All versions of LAN Manager are based on a core product originally developed by Microsoft.

The decision to use Microsoft LAN Manager involved a few different considerations. First, OS/2 was a factor. The Administrative Systems' staff was already familiar with the MS-DOS environment. OS/2 shares many features with MS-DOS. As a result, it would require little training for personnel to become familiar with the OS/2 environment. This was not true for other environments. For instance, there is no UNIX experience within the Administrative Systems' staff.

Second, a wide range of file access controls should be available with the network operating system. A provision to define 'groups' of users is important. In the multi-department environment, both of these features are essential to maintain some level of file security. The network operating system should include facilities to control the number of simultaneous users of a particular program. This is necessary to insure compliance with various software licenses. Support of client printing is considered important.

Microsoft LAN Manager meets all these requirements. In addition, when Microsoft LAN Manager was purchased, there was a promise of support for Macintosh computers and TCP/IP services in the next product release.

Bucknell is a heavy user of Microsoft applications software. In both the MS-DOS and Macintosh environments, Microsoft Word is the word processing program of choice, while Microsoft Excel is the predominate spreadsheet program. The integration of Microsoft LAN Manager with other Microsoft products was considered an important feature.

Finally, two other flavors of LAN Manager were under evaluation on campus. Academic Services was looking at the AT&T version of LAN Manager running on a UNIX platform. The Library has also looked at Pathworks, which is a derivative of LAN Manager running in the DEC VMS environment.

There are other networking operating systems that would meet most of these requirements. (It's hard to ignore Novell Netware.) In the end, Microsoft LAN Manager was chosen as the network operating system for administrative offices at Bucknell.

Implementation

The networking project has been underway for about a year. There are a few implementation issues that are worth discussing. These include a timetable for the project, the costs associated with the project, and the training necessary for the project.

Timetable

Planning and discussion about networking administrative offices was an ongoing process during most of 1990. Microsoft LAN Manager was introduced in the fall of 1990. Bucknell was introduced to LAN Manager at a Microsoft product rollout in Washington DC, in early November of 1990.

A single copy of LAN Manager was purchased in December of 1990. This was installed on a single server during December. At this time, there were four computers in the Administrative Systems' complex that were connected to the campus network. These four computers all had access to Microsoft LAN Manager services.

January and February, 1991 were used for testing. Basic services such as print, file, and application sharing were initiated during this period. Administrative issues were resolved and the network underwent a limited shakedown period.

The first actual users were added to the network in March. The first department to be connected was the Financial Aid office, where there were five MS-DOS computers. This office also had three printers, including one laser printer. All three printers needed to be shared.

Other departments were added to the network in rapid succession. By mid-April, a total of thirty-five computers in six different departments were connected to the campus network. All were using Microsoft LAN Manager services.

The summer of 1991 was a period of evaluation. A survey was sent to all users of the network. The survey was designed to measure satisfaction with existing network services. During the summer, some benchmark testing with AT&T StarLAN was also conducted.

Which brings us to the present (late November, 1991). There are currently forty-seven MS-DOS computers in twelve different departments that are using LAN Manager services. The smallest of these offices has only two computers. The largest office has six. A total of twelve laser printers are shared over the network. The total number of computers would be higher, except that one of the original departments switched from MS-DOS computers to Macintoshes during the fall. As a result, six of the original thirty-five computers are not included in the current counts.

Costs

There were some costs associated with the network project. These start with the cost of the server and backup. As previously stated, both are IBM PS/2 Model 80s. These were purchased with matching gift funds, so it is hard to place a representative dollar cost on them. Similar computers are available in the $3,000 to $6,000 range.

Next are costs for Microsoft LAN Manager. To use LAN Manager, an initial five user license is required. Additional (concurrent) users can be added ten at a time, or an unlimited user pack can be purchased. The normal list price for the five user license is $995. However, since we had attended the product rollout in November, we were able to purchase that license for only $295. The normal list price for the unlimited license is $5495. We were able to purchase that at a substantial discount as well.

Unlike most other Microsoft products, there is no educational pricing for the LAN Manager five user license or the unlimited license. Consequently, it is not possible for educational institutions to save much over the current list prices. LAN Manager is purchased through a reseller, so it may be possible to obtain some discount, but it is likely to be small. To complete the network software environment, printer sharing software is also used. This software cost approximately $500.

Shared applications placed on the server are an additional expense. This was not a major part of the initial phase of the Bucknell network. Consequently, only limited funds were available in the initial year of the project. Additional funds were available after July of 1991. Bucknell has spent approximately $2000 for applications software to date.

Costs associated with network adapters and particularly, the Ethernet wiring, are not included here. These costs were absorbed by another department. As a rule, we estimate that it costs in the $500 - $1000 range for a network connection. This cost can vary greatly depending on the complexity of the wiring that is involved.

Another cost of any project is the cost associated with the personnel to implement the project. This networking project required one person, almost full time, for the period of December through April, or five months. Personnel costs to provide ongoing administration of the network are small. At most, this requires a few hours each week. Additional time is required when new users are added to the network and when new applications software is installed on the server.

There are additional costs for training and support, which [illegible]ussed below. These added several thousand dollars to the total cost of the networ[illegible].

Training and Support

During January 1991, one person attended a week of LAN Manager classes that were conducted by Microsoft. These classes are designed for people who are to set up or administer LAN Manager networks. The classes were invaluable in getting off to a running start with the software.

Microsoft provided thirty days of free technical support with a LAN Manager purchase. This is not like other Microsoft products, where unlimited free support is available. In addition, support for installation and startup was provided by the vendor that sold us LAN Manager. An additional ten hours of telephone support were purchased from this vendor.

Another person within Administrative Systems has been trained in most of the administrative functions of LAN Manager. Several other people within the department are familiar with some basic administrative functions like canceling print jobs (and of course - Ctrl Alt-Del to reboot the server).

Training for network users has been minimal, and all conducted in-house. Ideally, the network environment should be transparent, and require little training for new users. However, this was one area that the users asked for more help in our survey. There was an expressed interest for more help in using the network strategically. There was also a desire for more training in the applications software that resides on the network.

Problems

The problems associated with the network installation were limited, and within the bounds of reasonable expectations. OS/2, like any operating system, crashes occasionally. These crashes were frequent at first, averaging once every other day. After a new version of the printer sharing software was installed, the frequency of crashes diminished to about one per month.

A system update, from OS/2 version 1.2 to OS/2 version 1.3 caused a total loss of the server hard disk. This was the major installation problem, and knocked the entire network down for two days. Some services remained out for a week. This was complicated by the lack of a backup of the server hard disk. Since the initial phase of the network implementation dealt primarily with printer sharing, there was no provision made for tape backup, since it was not a necessity. However, since the available services grew well beyond just printer sharing, a method of backup became essential. This problem has been corrected.

There was also a failure of the disk controller for the server hard disk. This did not cause any loss of data, but the network was down for almost two days until parts could be delivered and installed.

The most troublesome problem has been printer sharing. Printer sharing is more difficult than you would like it to be. Postscript printers, and printers that do multiple emulations complicate this process further. Most problems associated with printer sharing have been worked out. But there are still occasional glitches.

Successes

There were many successes with the network project. A major success was the connection of thirty-five computers in six departments in about six weeks. While that timetable is more ambitious than may be prudent, the installation was successful. That speaks for the viability of the project and the product.

The benefits of file sharing have also been one of the successes of the project. Some departments are using shared access to files to great advantage. Workflow between individuals within these departments has been streamlined.

Exposure to new software has also been well received. When applications software is installed on each individual computer, it is just not cost effective to give users access to a full suite of applications. However, when the software is installed centrally on a network server, everyone can have access to a variety of software.

Another significant success of the project was the adaptability of our current MS-DOS environment to the network. Existing MS-DOS installations were using a menu program to provide access to the software that was installed on individual computers. This environment was easily transported to the network. As a result, the user sees the network as an extension of the environment they were already using.

Finally, while we had some problems, the network experienced little downtime during its first year. Except about seven days, the network was available constantly and consistently during the first year of operation.

Distributed Services

The primary purpose of the network is to provide services to the user community, in this case the administrative offices at Bucknell. With the Bucknell network, those same services are available to a variety of departments. A discussion of the available services follows.

Printer Sharing

The first network service that was requested and provided was shared access to laser printers. Taken by itself, this service does not provide justification for the expense of a full campus network. However, given that a campus network is inevitable, printer sharing is a good place to start.

In the traditional model for printer sharing, shared printers are connected directly to a network server. We chose a model for printer sharing that is a little different from this. In our chosen model, printers are connected directly to a client computer. The client computer is used as a normal workstation. The software used to implement client printing on our network is Spool+ from Ultinet Development.

There are several major advantages to implementing printer sharing in this manner. First, it requires one less wire - the one going from server to printer. The connection to the printer is usually made with a normal parallel cable. The primary advantage of this model is that the client workstation and printer are still functional when the network or server is experiencing problems. In the traditional model, when the network is down, no one can print. In the client model, the departments are a little less dependent on the network to continue functioning.

There are several disadvantages to the client printing model. First, it increases network traffic. Each print job travels on the network wires twice, instead of once. The extra layer of software to support client printing adds another layer of complication to an already complicated process.

From our standpoint, the advantages of client printing outweigh the disadvantages. In particular, the individual departments have a little more autonomy than they would otherwise.

File Sharing

File sharing consists of the ability for multiple people to access the same files. This access may or may not occur simultaneous, depending on the application. File sharing on our network is implemented based on user logons. A user's network ID determines what files that person can access.

At Bucknell, we instituted four layers of shared files. At the bottom layer, each user has a space on the server hard disk where they can store personal files. These files are accessible only to that single user. Each user sees this disk space as their U: drive. No matter where a user logs on to the network, these personal files are available.

At the next level, a portion of disk is allocated to each department. Everyone within the department can access the same files. All users see this disk as their X: drive. In larger departments, a third level of shared files is also provided. Workgroups within these departments have access to a portion of shared disk that is only accessible to members of the workgroup. This is viewed as the Y: drive.

Finally, a portion of disk is set aside for public access. Anyone with a valid logon to the network can view, add, or update files in the public area. This area is viewed as the P: drive.

These various levels of file sharing support many diverse departments. Where appropriate, file sharing between specific departments can be accommodated. The primary aim is to provide the services needed to accommodate the individual needs of each department.

Application Sharing

The next major service that is provided over the network is shared access to applications. Various programs are installed on the network server, and are accessible to all users of the network. There are two primary benefits to application sharing. The first is a significant cost savings. When software licenses allow, it is only necessary to install enough copies of a program to support the maximum number of simultaneous users. In some cases, this may mean that it is possible to install just a single copy of a program. That one program is accessible to every network user. In other cases, two or three copies of an application may support the entire network. This can result in a dramatic savings.

A second less obvious advantage is that network users can be exposed to a much broader range of applications. It may not be cost-effective to install a particular application on a particular computer. By installing the software on the network server, it can be used by everyone.

A third advantage of shared applications is the ease of maintenance. For example, when a new version o a program becomes available, it only needs to be upgraded in one place. This results in a considerable time savings for support personnel.

Most of the applications software that is installed on the network server is accessible to all users of the network. In some limited cases, programs are only available to specific departments. Examples would include some utilities that are only available to Administrative Systems or specialty programs that serve the needs of a specific department. The menu environment in use at Bucknell provides customized menus for each user, displaying just the software and services that they can access.

Automated Access to Hosts

The network environment through the normal menu structure, provides automated access to various hosts and services. Specifically, the on-line card catalog on the Library system is available with a single keystroke. A program that displays campus events, running on the Bull mainframe, is also a single keystroke away. These services provide a rudimentary beginning for a campus-wide information system. In addition, some network-related functions like logging on, displaying messages, and viewing printer queues are available through the standard menu interface.

Centralized Resources

A major tenant of this project is that while the services may be distributed in nature, the resources to provide those services should be provided under the Administrative Systems' umbrella. As implemented, these resources have all been centralized.

The single server and the backup server are both located in the Computer Services' building, in the same room as the administrative mainframe. There are NO network servers located within administrative departments. It follows that the software to run the network, and the applications software available over the network are centralized as well. Finally, the personnel needed to administer and support the network are all located in Computer Services.

Disadvantages of Centralized Resources

There are two disadvantages often cited for any centralized computer resources. First, there is a perception of loss of control over the departments own computing. Second, each department is forced to compete with other departments for computing resources.

The response to these comments is that the computer service organization must be responsive to the needs of each department. At Bucknell at least, the individual departments do not want to be their own computer experts. If they feel like they are getting a fair allocation of computer resources, they are generally content to have their needs supported by the centralized organization.

Advantages of Centralized Resources

There are many advantages derived from a campus-wide network supported by centralized resources. First, access to the network is universal. There are no "haves" and "have nots." Second, there is a consistency across campus. Each network user has access to essentially the same resources. Both points help to eliminate the "keeping up with the Jones'" syndrome. Consistency is also an aid to support personnel. They know what each user should view when they are accessing the network. That consistency can be an aid in training. A user should be able to move from one department to another without extensive retraining.

The most significant benefit to centralizing network resources is the reduction in costs. The most consequential of these is the reduction in costs for applications software. This has already been discussed. Support costs are reduced, as there are fewer people to be trained in network installation and administration. Training costs are also reduced, as training is minimized. Combined, these costs should offset most, if not all of the cost of network installation.

There are other advantages to a consolidated network. Accounting for network use is centralized. All usage statistics are available in a single place. In these days of tight budgets, this kind of accounting may be needed to justify continued network expansion. Finally, available resources are used to their fullest potential. When the effort is made to provide a new network service, that service is available to everyone on campus, not just a single department.

Future Directions

Administrative Systems and Bucknell Computer Services have some goals for continued network expansion. The computer services organization has undergone a year of evaluation, with several possible outcomes.

First, a reorganization of Bucknell Computer Services is possible. The current constituent-based organization may be replaced with a functional-based organization. If that happens, a single department may be responsible for network services to both academic and administrative constituents. The impact of that possible reorganization on the current administrative network is not known. However, implementation of the administrative network is still proceeding normally.

Second, a plan for campus-wide networking has been developed by a broad-based committee. One major recommendation of that committee is that the entire campus be wired for

Ethernet in a short period of time. With a tentative commitment from the University trustees, the wiring project will begin during the summer of 1992, and should be completed within two years. That will make the network available to all administrative offices on campus.

Growth

We anticipate network growth in several areas. First, we know that the number of users of the network will grow. Second, we expect that most users will use existing network services more frequently. And most important, we expect that the available services will continue to grow.

Microsoft LAN Manager Update

A significant short term objective will be the installation of a new version of Microsoft LAN Manager. This version (2.1) is to be available commercially in mid December, 1991. This update will bring several significant new capabilities to the administrative network.

First, the new version of LAN Manager will support the TCP/IP protocol. This will open a wide range of possibilities for connectivity with other platforms. It will bring Microsoft LAN Manager in line with proposed standards for networking at Bucknell. Telnet and FTP support will be available. This will make it possible to access Internet resources through Microsoft LAN Manager. While the need for this service has been small to date, the use is expected to increase with time.

The most significant change that will come with LAN Manager, version 2.1 will be support for Macintosh computers. There are currently forty-six Macintosh computers in ten different administrative departments connected to the campus-wide network. When the new version of LAN Manager is brought on-line, various services will be available to these Macintoshes through LAN Manager.

In Summary

This paper has outlined a project undertaken by Administrative Systems at Bucknell University to provide network services to the administrative departments at Bucknell. The major focus of the project is to provide services to a diverse group of departments in various locations on campus. Networking resources are to be centralized at Bucknell Computer Services. The benefits of a consolidated approach are many. Primary among these is a significant reduction in costs. The reduction in costs for applications software alone may justify the expense of the network.

A successful project of this nature requires that the network be viewed as a campus-wide resource and not a collection of loosely connected departmental networks. It may be necessary to postpone projects that are inconsistent with these overall goals. Short term fixes to some problems may become long term complications for a fully integrated network.

It also requires cooperation from the user departments. This will follow easily if the computer services organization has the respect of the user departments. A successful project also requires that the computer services organization be mindful of the needs of the individual departments and responsive to their problems.

In the end, an integrated, campus-wide network, providing a full range of services to all administrative departments, can be implemented and maintained centrally. The benefits of this approach far outweigh any disadvantages.

Implementing Distributed Financial Information Systems at Indiana University

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Introduction

The Financial Information System is one of the cornerstones of administrative information systems in the university. Access to financial data in a timely way is crucial to departments being able to manage their individual units in a Responsibility Center Management environment. The ability to capture data at the source, to manage local data locally, while being able to transparently interact with non-local data are all requirements for this environment. Vendors today are offering new tools and technologies to meet these needs in a distributed environment.

This paper discusses the various components of the new Financial Information Systems and how these neatly integrate with the strategic directions of the University Computing Services organization. Access to financial data by all eight campuses of Indiana University, as well as a robust on-line transaction processing environment for data capture at the source of collection are a baseline requirement for this system. Covered is an implementation schedule for the system and its associated technologies.

Indiana University...a time of transition

Indiana University is moving towards a radically different method for planning and operating the various entities within the institution. The concept, called Responsibility Center Management (RCM), places the responsibility for funding and expenditure with each Responsibility Center. The Richmond Campus of the institution, the School of Business and the University Physical Facilities Unit are examples of RCs. For instance, in the case of the School of Business, it is expected to fund itself from student fees, research grants, gifts and other fund raising methods. An RC may carry surpluses from year to year but must carry deficits forward as well, balancing its budget in the current period by "borrowing" from the institution at the going cost of capital rates. With the advent of this RCM philosophy and the realization that the institution is operating in an era of critical resource constraints, Indiana University faces a significant challenge in facilitating the way in which it needs to manage its financial activities.

A New Financial Information System for IU

As the unit responsible for financial information processing at IU, the Financial Management Support (FMS) department has embarked on an initiative to address these needs. Utilizing powerful but cost-effective new technologies, such as the high-speed network being deployed around the state, the workstation devices being attached to it, and emerging relational database tools, Indiana University feels it can develop effective financial information systems to address what many agree are these shortcomings of the current environment:

- Financial data are scattered among many different files, resulting in limited and difficult access; dictionary information about the data is not always available.

- Computer programs that link these data are aging, complicated and inflexible, and therefore difficult and expensive to change and maintain.

- The impact of a transaction on a unit's financial position is not immediately available to an account manager.

- Responsibility Center Management has created new needs not easily met by current systems or data structures.

- Paper is still the norm for the creation of financial data.

- Planning and forecasting activities are difficult to perform, at best.

Mindful of the above and of the resource constraints under which it operates, FMS has developed a model, shown on the next page, of how the Financial Information Systems (**FIS**) of the nineties will look at Indiana University. Please note that this is not a flow diagram. It is intended only to depict the major components of the system and how they are related.

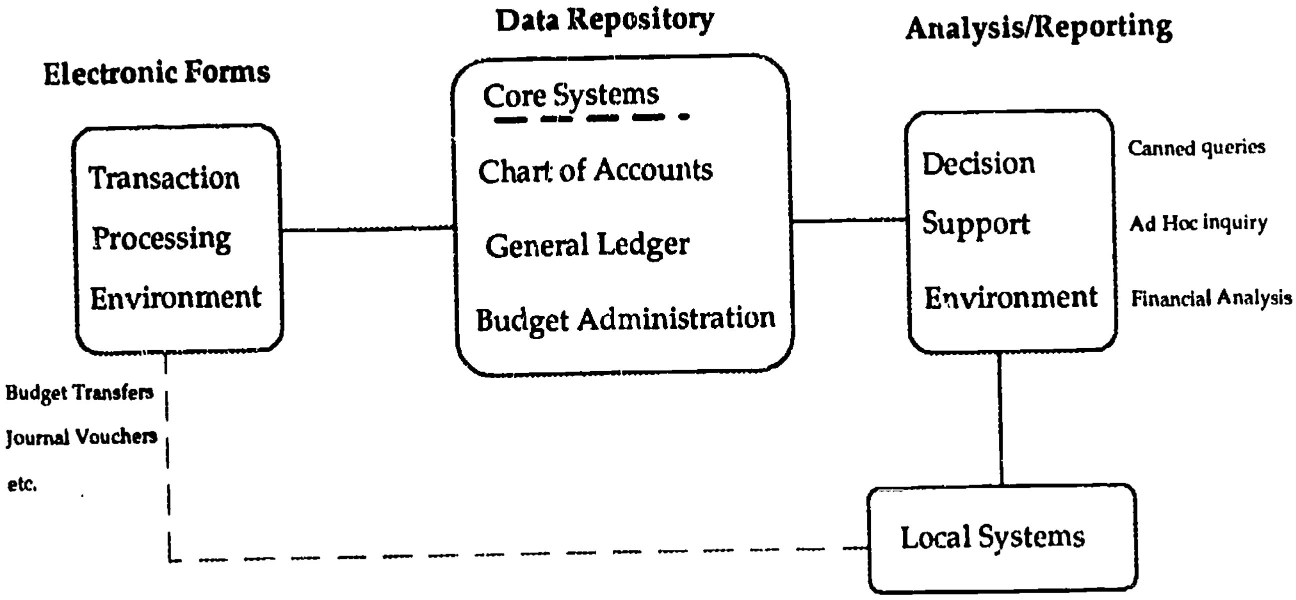
The model breaks the financial process into three separate but interdependent functions:

- **Transaction Processing** ---- those services which enable the processing of individual (or multiple) "transactions." Examples would include such things as: performing a budget transfer; paying a faculty or staff member; approving an invoice; appointing an employee, etc.

- **Core System Functions** -- the internal (to FMS and UBO) process of managing the general ledger and budgeting functions via the initial recording of financial transactions and the transfer of data created during the Transaction Processing procedures to the Financial Analysis databases.

- **Decision Support (Analysis, Reporting and Planning)**---those services that facilitate the management of a department's or Responsibility Center's account(s). This would include such things as: the development, administration and presentation of a set of integrated financial databases; decision support tools and services; the production of required internal and external financial reports, etc.

Financial Information Conceptual model



Graphical user Interface (GUI) based system

Local (workstation or LAN based systems) will be integrated into the system as the user desires. The Graphical User Interfaces (GUI) used, (MAC and Windows 3.x) provide the standards by which this will be enabled. It is only by using these standards based environments that we can offer true integration for many users. It will, of course require they users of these tools, but the FIS is in part premised on the fact that departments at the institution are voting for Windows and MAC with their hardware and software budgetary resources. We are, in essence, guided by their choices here. Our intent is that the FIS look and feel like any other 'shrink wrapped' graphical application they may have purchased for their own desktop workstation. In this way, we minimize the learning curve and in fact restrict it to the functional arena for those who are already users of the GUI.

The development of this system involves a partnership among FMS, its service recipients and the technology organizations (University Computing Services (UCS), IUPUI Computing Services and the Campus Computing Centers at the regional campuses). An **FIS Steering Committee** consisting of senior administrators from all eight campuses is providing the needed guidance throughout the development and implementation of the entire system.

The guiding principle at work here is that FMS will distribute much of the management of financial information to the operating units (RCs). Its role will be that of data stewardship, overall coordination, consulting, and the delivery of official institutional reports, both internal and external.

The design objectives of the FIS can be summarized thus:

- deliver user-friendly, timely and effective financial transaction processing services to faculty and staff;
- provide financial decision support tools to account managers and others to facilitate effective financial management, planning and forecasting;
- reduce the paper flow and lengthy approval cycle associated with many of the current financial processes;
- leverage the technology architecture being advocated by University Computing Services;
- where appropriate, utilize the Graphical User Interface and multimedia capabilities of the desktop computer to deliver an easy to use suite of services.

Technologies being implemented

The technological infrastructure being implemented by UCS provides an excellent foundation for the FIS. Before we discuss this infrastructure, a brief background will help to put things into perspective. University Computing Services was formed in early 1989 with the merger of the Bloomington Academic Computing Services (BACS) organization and Information Services, the administrative computing organization. This merged organization is responsible for academic computing support on the Bloomington campus and university wide support for administrative computing.

The former Information Services organization used the SNA network protocol while the BACS organization employed DECNET and Sytec primarily. The new UCS organization developed a policy and plan to move towards an open network architecture, employing TCP/IP as the backbone transport protocol. With the diverse hardware and systems at IU, this network held the promise of access for all users. Faculty and students who were previously unable to access records on the traditional administrative IBM mainframe would now be able to do so.

We have come a long way towards the implementation of this dream. The Bloomington campus has been completely wired with FIBER cable over which is running Ethernet using TCP/IP. On the main campus of Indiana University we are in the final year of a two year project to connect most academic and administrative units to the TCP/IP network. At the completion of the project in September of 1992, we expect to have over 6000 faculty and staff connected.

On all campuses of the IU system, projects are underway to provide connections to the network. Some campuses are ahead of Bloomington, others are a bit behind. Through state legislative funding assistance, we hope to have all faculty and staff, system-wide, connected to the network by 7/1/93.

Many administrative systems, including the purchasing system, statement of accounts, student advising, student scheduling, the entire information center as well as libraries, are now available over this open network. Traditional administrative users are also migrating to the TCP/IP network in order to access more services than are available via SNA. We are addressing questions of security, 3270 emulation, user-friendly appearance of the transactions, and access authorization. The new financial information system will rely exclusively on this open network.

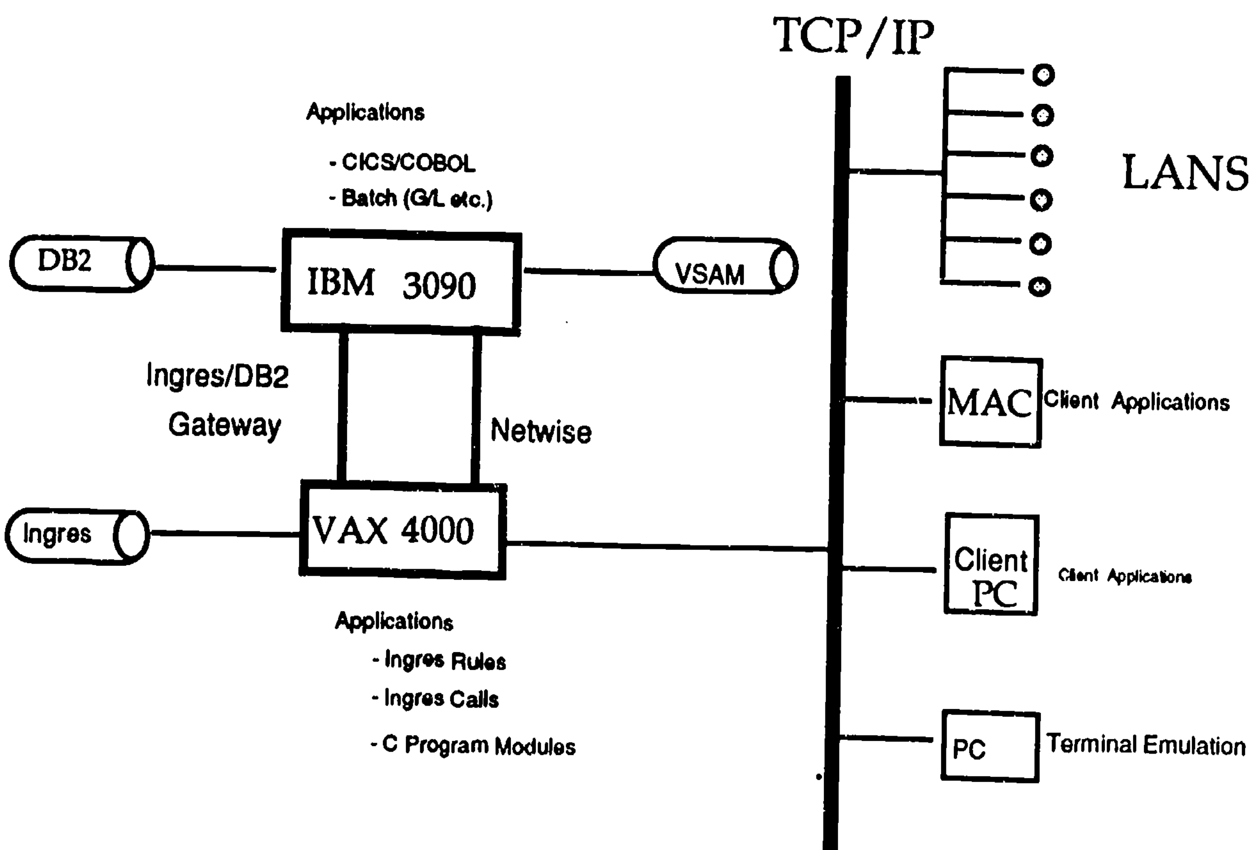
University Computing Services committed to a relational database structure in December of 1990 and has since then implemented DB2 for the IBM mainframe. We currently have nineteen tables and three production applications using DB2. We are in the final stages of converting our largest information center VSAM file, the employee database, to DB2 to facilitate access to those data. We see the use of DB2 as a file server for institutional data for all campuses of IU.

In addition, we have investigated, evaluated and declared Ingres as our RDBMS for distributed applications. We have acquired a VMS central server (referred to as the scalable alternate platform) on which Ingres will reside. Our current "information center" customers are using FOCUS to access VSAM files on the mainframe and the FOCUS/DB2 interface to access DB2 files on the mainframe. We plan to architect a new environment on the new VMS/Ingres machine whereby users can access institutional data and where Online Transaction Processing (OLTP) systems can reside.

The toolset that will be available on the VMS machine will include tools for development of the server application and the client application for both windows and non-windows environments. The ideal application development tool would satisfy our "develop anywhere--deploy anywhere" goal. Deployment modes being considered include terminal emulation, character-based GUI, Windows 3.0 GUI and Macintosh. Query tools will facilitate access to the data for the end-user.

Gateways from this platform to the IBM3270 mainframe will allow both ad hoc access to DB2 and predefined access to any CICS application. We are acquiring the Ingres gateway to allow access to DB2 files on the mainframe as well as a product to allow access to VSAM files on the mainframe. Acquisition of these gateways will help us to leverage our investment in existing applications and data files and move to the new client/server technologies without migrating applications or files. The figure below shows the application architecture being deployed.

Financial Information System Architecture



The business functions and applications that are required by the new Financial Information System leverage this technology being rolled out by University Computing Services. The question of whether the business requirements should be driving the technology or whether technology can now give opportunity for delivery of business applications more efficiently and effectively is an interesting one. University Computing Services and Financial Management Support perceive this as a mutual occurrence. We look upon this as a unique opportunity to make this architecture available for mission-critical production applications such as the FIS.

Timeline of services--Technology

University Computing Services has constructed a timeline for the types of tasks in which we are engaged in order to move this environment into production. UCS and FMS are working to align schedules for the roll-out of these applications in a timely fashion.

Already in place are a data administration guidelines document, a data access policy and a data architecture document. After the announcement of the distributed database standard, Ingres, UCS has been working on configuring the hardware platform, which is currently being installed. This month software is being tested on that platform, and plans are to have both gateway products installed in January. The toolset will then be finalized. Change management standards and production implementation standards for this new environment as well as system administration standards and support, are being developed. This will be followed by application development standards and Ingres DBA standards and support procedures. Pilot applications will be done in a March - May 1992 time frame. UCS will then size the hardware for the next several years' anticipated needs and install the required security products. UCS intends to announce the alternate production application environment in the summer of 1992.

Timeline of services--Applications

As the various technology components are put in place, the FIS application will be implemented. FMS and UCS have already completed a conceptual data model for the system using a CASE tool. In addition, specific pilot applications have been designed to calibrate the environment. We have put in place a dedicated project team, made up of FMS, UBO and UCS staff, which will be responsible for the implementation of the projects and the coordination of the various advisory committees. This also includes a learning curve for staff who will be developing and supporting the major parts of the FIS. These pilots will be completed in March-May of 1992.

Transaction Processing

Initial deployment of the Budget Adjustments, Distribution of Income/Expense, Error Corrections, Internal Billings, Hourly Pay Advice, Accrual Entries and Cash Transfers transactions is planned for December 1992.

General Ledger/Budgeting System

Plans call for purchasing a G/L package and the decision date for selecting the specific product is June 1992. Deployment of the G/L will take place in June 1993.

Decision Support

The decision support tools will be introduced as soon as the RDBMS toolset has been selected and will be used in the Tool kit project. As databases are developed for the FIS, these tools will be deployed out to users around the network.

Conclusion

The emphasis in this initiative is to put control of financial information into the hands of the operating unit executives. The financial information system being developed differs from the standard financial information system utilized by many institutions in that it presents two distinct "views" of the system: 1) Transaction Processing where specific sets of financial transactions are performed and 2) Decision Support, where desktop tools are used to facilitate data analysis and reporting. The core part of the system, the standard General Ledger, is unlikely to be of much interest to anyone except the central accounting and budgeting staffs who manage the "books" of the institution.

Implementation of a distributed system of this size is challenging and we are proceeding with caution. We plan to roll out these first few applications by implementing those which are not mission critical and learn from our experiences. The technologies we are using are not yet mature enough to allow total distributed database implementation, but we will use those components of the technology that are ready and position ourselves to evolve with the technology.

CORPORATE PARTICIPATION

Coordinator: Martin B. Solomon

Participating in CAUSE91 were 46 corporations which 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 CAUSE91 ranged from corporate presentations, workshops, and exhibits, to sponsorship of special conference activities and suite hospitality.

PARTICIPATING CORPORATIONS

CAUSE appreciates the participation of the following corporations in CAUSE91:

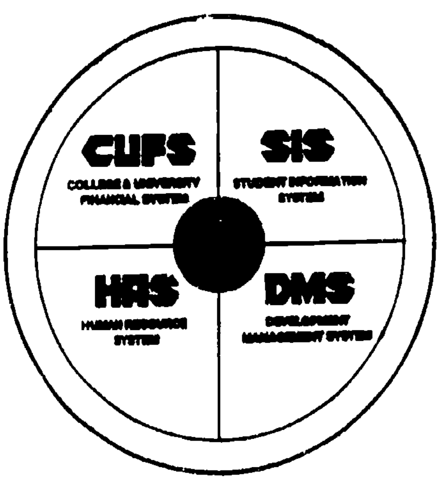
ACT
American Management Systems, Inc.
Apple Computer, Inc.
Business Systems Resources, Inc.
Campus America
CARS Information Systems Corporation
Data Research Associates, Inc.
Dataguard Recovery Services, Inc.
DATATEL
Deloitte & Touche
Digital Equipment Corporation
ECCI
EDUTECH International
Ernst & Young
Gartner Group, Inc.
George Kaludis Associates, Inc.
Hewlett-Packard
Hitachi Data Systems
IBM Corporation
Information Associates
Information Builders, Inc.
Integral
InterVoice
Iron-Soft, Ltd.
John Minter Associates
KPMG Peat Marwick
Larson-Davis Information Systems
Novell
Oracle Corporation
Pacific Bell
PeopleSoft, Inc.
Periphonics Corporation
Quodata
SalePoint Systems Corporation
SCT Corporation
Sequent Computer Systems
Sigma Systems, Inc.
Software AG
Sterling Software
StorageTek
Sun Microsystems, Inc.
Syntellect, Inc.
The Robinson Group
VTLS
Wang Laboratories, Inc.
Xerox Corporation

American Management Systems

"THE NEW MARKET LEADER IN INFORMATION TECHNOLOGY"

AMS would like to extend our appreciation to CAUSE91 participants for your continued interest in our products and technologies. AMS was pleased to once again take the opportunity to demonstrate our products, introduce new business partnerships, and discuss the technology which has made AMS the industry leader in Higher Education Administrative Software.

The AMS/*LEGEND* Series Family of Software Products:



CUFS/*LEGEND*: The AMS College and University Financial System is an integrated, on-line fund accounting and budget control system including a full range of advanced subsystems such as purchasing, inventory control, and fixed assets management.

SIS/*LEGEND*: The AMS Student Information System, is the latest addition to our line of administrative software products. This package contains four comprehensive systems to support Admissions, Financial Aid, Student Records, Student Accounts, and option subsystems for Housing and Degree Audit.

HRS/*LEGEND*: The AMS Human Resource System, provides comprehensive human resource management functionality including payroll, personnel, position budgeting and control, applicant tracking, AA/EEO reporting, and benefits administration.

DMS/*LEGEND*: The AMS Development Management System offers modern, fully automated support for the alumni/constituent records maintenance, gift processing and prospect management requirements of major colleges, universities and not-for-profit organizations.

Important Announcements at CAUSE91:

"**IBM AND AMS ENTER INTO COOPERATIVE MARKETING AGREEMENT:** IBM and AMS have announced a cooperative marketing agreement for the AMS *LEGEND* series. Under this agreement, AMS will become a participant in IBM's Cooperative Program (CP), whereby IBM will actively market these AMS applications. All *LEGEND* systems are designed to operate on an IBM System/370 or System/390 running MVS or VSE operating systems. Relational database support is provided for DB2 and SQL/DS users.

IBI AND AMS ENTER INTO COOPERATIVE MARKETING AGREEMENT: Information Builders, Inc. and AMS have announced a cooperative marketing agreement for the *LEGEND* series and the IBI FOCUS application. Under this agreement, AMS clients will have access to the FOCUS ad hoc query tool and related FOCUS products along with a special discounted pricing arrangement.

SIS/*LEGEND* IMPLEMENTED AT COLUMBIA UNIVERSITY: Columbia University has selected the SIS/*LEGEND* System after an extensive review of available student information systems. Columbia and AMS have also entered into a cooperative agreement for SIS/*LEGEND* enhancements including an improved graphical interface, and the integration of third party tools."

Other CAUSE91 Events:

SPECIAL PRESENTATIONS:

Topic: "Information Technology: Enabler of or Roadblock to Effective Business Process Redesign."

Presenter: Dr. Fred Forman, AMS Executive Vice President.

Abstract: Business Process Redesign (BPR) has already achieved buzzword status in the '90s as commercial, academic, and governmental organizations strive for breakthrough achievements in productivity improvement and cost reduction. These organizations want these benefits fast; in some cases it is a matter of survival. Information technology is usually critical to implementing the redesigned business process, yet to redo information systems typically takes many years and is frequently not successfully done. Is effective BPR doomed to failure because of unresponsive information systems? This talk provided a management perspective of these issues and suggested some approaches that have been effective in practice.

Topic: "Information Technology and the University Admissions Office."

Presenter: Dr. Joseph Chalmers, Vice President.

Abstract: Dr. Chalmer's talk described a vision of the use of the latest advances in information technology to support the University Admissions Office. The viewpoint was that of a former dean of admissions who now serves college and university clients with information technology solutions. The ideal application for today's admissions office must make use of several technologies in a well integrated manner. This talk presented the role of imaging technology, the graphical user interface, and the traditional mainframe-based central data processing system. Illustrations from AMS's experience with university, government, and commercial clients provided real examples of working solutions.

AMS is a leading international firm in applying information technology and systems engineering services to solve complex management problems for large organizations. The company, which completed its twenty-second consecutive year of growth, is headquartered in Arlington, Virginia, and has offices in 26 cities throughout the United States, the United Kingdom, continental Europe, and Canada. AMS's revenues for 1990 were 262 million.

For more information about AMS, our College and University Software products and services, please call or write:

Cris Meyers
Marketing Communications Manager
American Management Systems
1777 North Kent Street
Arlington, VA 22209
(703) 841-2100

Apple Computer, Inc.

Apple Computer would like to thank all CAUSE91 attendees for their continued interest and participation in activities sponsored by Apple and our Higher Education Information Technology partners. We are pleased to have once again participated in the CAUSE National Conference, especially because this year was the 20th year Anniversary of CAUSE, and to have shared with you many innovative and leading edge client/server enterprise solutions for Macintosh that have been developed by your colleagues from across the country. As we move forward in this decade, we look forward to our continued partnership with CAUSE and its membership of campus technology professionals as we work together defining future information systems.

It was our pleasure to host the following activities for CAUSE91 attendees:

- CAUSENet, the CAUSE91 Messaging and Information System enabled conferees to send and retrieve electronic mail through their own campus mail system as well as communicate with others at the conference. The messaging system's TN3270 and Telnet interfaces connected to campuses around the world over an INTERNET connection provided and managed by CSU.

- In the CAUSE91 Corporate Exhibit area, Apple's booth had numerous university professionals demonstrating their enterprise wide Client/Server technologies for integrating Macintosh with host based systems and relational databases. The following colleges and universities featured solutions: Sonoma State University, University of Minnesota, Baylor University, St. Petersburg College, San Joaquin Delta College, University of Michigan, Dartmouth College, and Cornell University.

- The Apple-hosted reception brought everybody together for a fun filled evening of food, conversation, music, dancing, and a look at Apple's new PowerBook™ notebook computers. Two PowerBook computers were given away.

- Throughout this years 20th anniversary conference, conferees were kept informed of activities and conference highlights through the Daily CHAT (CAUSE Has Apple Technology), a conference newspaper that was desktop published with a Macintosh computers.

For additional information about Apple's products, programs, and solutions for higher education, contact your local Apple sales office, or write to:

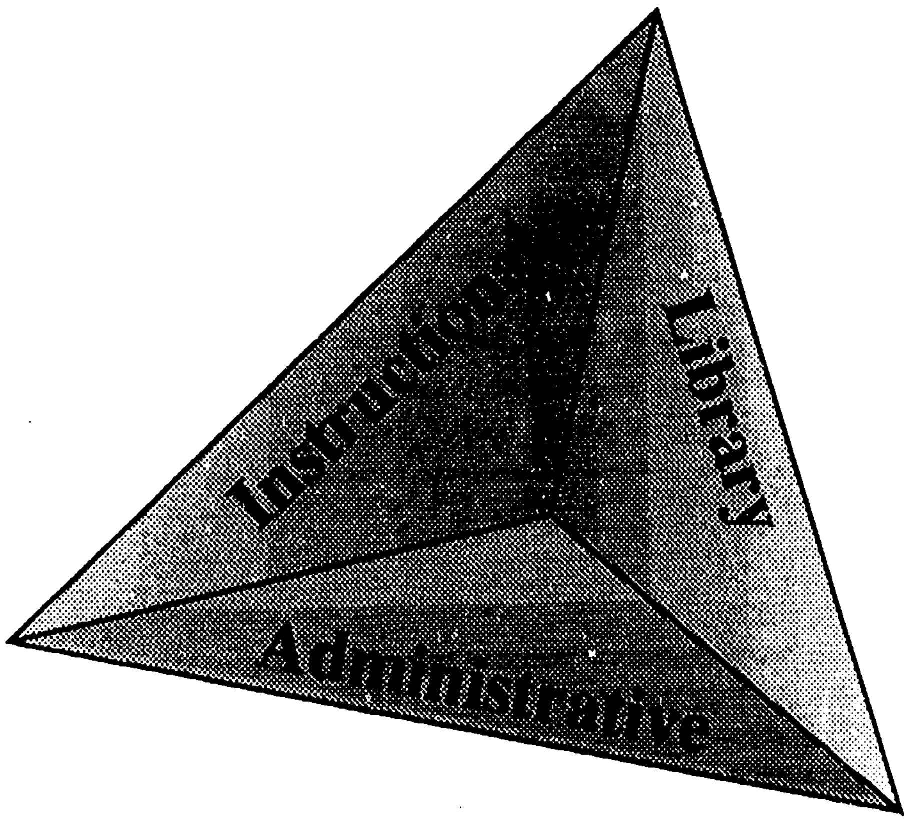
Bruce Stancombe
Marketing Manager, Higher Education
Apple Computer, Inc.
333 West San Carlos
San Jose, CA 95110

Campus America

"Three Ways to Win"

Administrative, Instructional and Library

Campus America, for the sixth consecutive year, participated in the CAUSE annual conference. This year's theme was "Three Ways to Win" which describes the company's triad of products--administrative, instructional and library.



Campus America joined with many others as a volunteer in the "Dunk Tank" at the Digital sponsored "CAUSE 20th Anniversary Fair" on Tuesday evening. This event was the opening reception to welcome all the participants of CAUSE91.

Strategic product and alliance announcements were made at CAUSE91. **POISE-AIS** ***(Administrative Info tion Systems)*** software for education will become Digital NAS compliant, witl. .najor releases beginning the second quarter of 1992. Gaylord Information Systems, Syracuse, NY and Campus America, Inc. have sealed a successful partnership with the cre tion of an Academic Library Division at Campus America.

Dorothy Hess, Director of Administrative Computing at Scripps College and a board member of the POISE Users' Group, made a track presentation Thursday morning in Track I (Strategic Planning and Management). She was also available at the Campus America booth for discussion and questions about Campus America's products from the users perspective.

Campus America's executive office is located in Knoxville, Tennessee. Additional product centers are located in Roswell, New Mexico; Merrimack, New Hampshire; Columbus, Ohio; and Calgary, Alberta.

Continuing to support CAUSE and its efforts to be the major influence in the profession of information technology management in higher education has become one of Campus America's foremost goals. We enjoy the opportunity of sharing our triad of products and discussing our programs with hundreds of convention attendees who stop by our booth each year.

Campus America

Administrative and Instructional Systems for Education

900 Hill Avenue, Suite 205
Knoxville, TN 37915-2523
(615) 523-9506

Dataguard Recovery Services, Inc.

Dataguard Recovery Services was proud to take part in CAUSE91. This being our first exhibition with CAUSE, Dataguard was pleased to bring to the forum information pertaining to our expertise in Disaster Recovery/Contingency Planning.

BUT FIRST, A NOTE OF THANKS!

You've made us the recognized choice for Contingency Planning in the Higher-Education arena and we'd like to say "Thank You".

Penn State University	University of Louisville
Rutgers University	Western Kentucky University
Kentucky State University	University of Pennsylvania
University of Connecticut	Cuyahoga Community College
Morehead State University	Northern Kentucky University
Murray State University	Eastern Kentucky University

At Dataguard, we maintain our commitment to providing you with a complete range of Contingency Planning Products to meet the highly-demanding needs your institutions.

THE GIVE-AWAY WAS A HIT

If you were in the exhibit hall, you know that Dataguard's Louisville Slugger® promotion was a winner.

In case you were wondering, **"Why a Louisville Slugger®?"**
Because Dataguard is based in Louisville, Kentucky!

THE EXHIBIT AREA

From extensive consulting services, to training awareness seminars, to a proprietary PC-based planning tool, Dataguard was on-hand to provide solutions to your questions and concerns.

Recovery Architect™ (Version 1.5), Dataguard's PC-based Contingency Planning Software, made its debut.

Certified Contingency Planners and Marketing Executives were available to discuss the components necessary for a reliable, comprehensive approacn to Contingency Planning.

Training/Awareness Seminars scheduled throughout North America addressing current issues in the Industry were introduced.

THE CONFERENCE PRESENTATION

Another informative and entertaining presentation was given by Charles Kendell, Dataguard's Senior Consultant. The presentation, "Protecting the Universities Information and Critical Function Assets", provided practical suggestions for Risk Assessment and Recovery Plan development. Mr. Kendell's unique blend of humor and know-how made his discussion a memorable one.

////DATATEL

A Commitment to Service and Community...the focus of Datatel at CAUSE91.

Over the last three years Datatel has carved out a special place at the CAUSE conference with innovative and attractive programs to educate and stimulate conference participants. At CAUSE91 Datatel looked beyond itself to develop programs of service to others, particularly in light of the changing economic condition. At each program juncture, Datatel planned a means of giving back to the communities we served.

With CAUSE being so close to the holiday season, it seemed appropriate to carve out a special place for nonprofit organizations that so much need our support. On Wednesday morning, Datatel "kicked off" this commitment by placing blue Datatel bags on the hotel room doors of the CAUSE participants staying at the Disneyland Hotel. Inside each bag was a single lego block and a card inviting CAUSE attendees to bring their lego block to the Datatel booth and enter their name in a raffle; a raffle making them eligible for a $500 donation being made in their name to either the Children's Hospital National Medical Center in Washington, DC, or Children's Hospital of Philadelphia; both organizations which are prestigious Datatel customers. As Datatel covered the $1,000 in charitable contributions, attendees did not have to make a donation to participate in this program.

At Datatel's hospitality suite reception on Wednesday evening, December 4th, the theme was a "Block Party" where ethnic foods and street games filled the suite and created the atmosphere of a traditional block party. At this party, Datatel provided writing pens and giant holiday cards and asked their guest to supply their warmest, heartfelt holiday messages to the children at these hospitals. During the suite party, Datatel's Executive Vice President, Russ Griffith, announced Leo Buckmaster, Director of MIS, North Carolina State University, and Don Spicer, Assistant Provost, University of Notre Dame, as the winners of the Children's Hospitals raffle. Both Messrs. Buckmaster and Spicer were again recognized during the CAUSE Corporate Announcements on Thursday, December 5th, at the CAUSE Hospitality Center located in the exhibit hall area.

The donation presentation to Children's Hospital in Philadelphia was made by Datatel's Vice President, Jayne Edge, on Wednesday, December 18th, and the presentation to Children's Hospital National Medical Center in Washington, DC, was made by Datatel's Executive Vice President, Russ Griffith, on Thursday, December 19th. Both organizations were presented with a $500.00 check, a giant holiday card signed by CAUSE91 conference participants, and lego blocks to be used in their children's recovery play room.

Datatel's spotlight at CAUSE91 also focused on the announcement of their new business partnership with IBM and the availability of their industry leading products, Colleague and Benefactor, on the IBM platform. Demonstrations of Colleague, their administrative computing solution for colleges and universities, and Benefactor, their solution for the professional fundraiser, were performed.

Datatel's Director of Marketing and Product Planning, Dr. Laird Sloan, gave a corporate presentation titled "The Doers and the Entrepreneurs - User Participation in Product Development". This presentation described a methodology that involved the ultimate users in every aspect of product development. During this presentation, Dr. Sloan described the results of Datatel's conscious efforts to involve their users in the direction and scope of their administrative software system.

Datatel has been in the computer industry for over 20 years and has provided quality software and services to more than 700 corporate and institutional customers. Datatel expressed appreciation for the relationship they share with prestigious higher education organizations, such as CAUSE, and look 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 products, please contact Dr. Laird Sloan at Datatel's Fairfax, Virginia, office, (703) 968-4626.

Datatel
4375 Fair Lakes Court
Fairfax, Virginia 22033
(703) 968-9000

digital

"DIGITAL UNIVERSITY" DEMONSTRATED REAL-LIFE BENEFITS OF AN OPEN, NETWORKED CAMPUS AT CAUSE'91

At the CAUSE'91 conference, Digital Equipment Corporation created a networked mini-campus - a "Digital University" that simulated a real campus environment on the exhibit floor.

Each section of Digital's booth represented a different location on a campus - a student dorm, a library, a faculty office, a classroom, an administrative office, and a computer center. Each was equipped with different kinds of systems and software - MS-DOS PCs, a UNIX workstation and server, and Apple Macintoshes - all i...egrated into a seamless network.

The exhibit demonstrated Digital's "Open Advantage" - the ability to create an open campus where products by different vendors can work together in a single, integrated computing environment. The benefits to academic users were dramatically demonstrated in real scenarios. The sections included:

Dorm Room

A student could use Digital's new DECpc Notebook computer, a compact portable computer with a "docking station," to enhance learning in a number of ays - sending electronic mail to faculty, computer conferencing with other students 1 VAX Notes, and accessing bibliographies through Digital's new InfoServer 150 in the Library, which gives network access to CD-ROM databases.

Faculty Office

Representatives from Waterloo Maple Software demonstrated the visualization capabilities of Maple V mathematics software integrated with DEC AVS. Digital's high-performance DECstation 5000-PXG Turbo used Motif to access Maple on the VAX 4000 server in the Computer Center, while DEC AVS ran on the local system. Faculty could also file homework assignments on the VAX 4000, where they could be "picked up" by students on DOS or Macintosh machines, completed and returned via the VAX 4000.

Classroom

An LCD panel was connected to a Macintosh and used with an overhead projector visible to the entire class. Student answers to assignments were issued from the DECstation in the Faculty Office. Highlights included the use of VAX Notes to demonstrate notes conferencing in a teaching environment, and a demonstration of computer conferencing through BESTNET (Binational English and Spanish Telecommunciations Network) based at San Diego State University.

Library

Representatives from Digital's new InfoServer 150 and Virtual Microsystems' V-Server/ Gateway groups demonstrated how users can have access to CD-ROM services across the network using DOS, Macintosh, or ULTRIX platforms networked to CD-ROM servers.

Administrative Office

Users working with a Macintosh or DECpc 425 could issue SQL requests to query DB2 data from the campus mainframe, using an application recently developed at the University of California San Diego (UCSD). The UCSD system has a unique deferred query utility which allows you to issue your requests at any time and come back later to your PC for the data.

Computer Center

Here visitors could find the compact VAX 4000 server that supported the entire Digital University network. There was also a demonstration of a powerful content-based retrieval system from Excaliber Technologies, Inc., running on a DECstation 5000 with ULTRIX.

The foundation for delivering Digital's "Open Advantage" is NAS, Network Application support, a growing set of over 2,000 products from Digital and independent companies that enable VMS, UNIX MS-DOS, OS/2, Macintosh, IBM, SUN, and other systems to work together in a integrated computing environment. Among the NAS products shown at CAUSE'91 were various PATHWORKS products, Digital's family of PC and Macintosh integration products.

OTHER EVENTS

In addition to our exhibit area, Digital was pleased to sponsor several activities at the CAUSE 25th Anniversary Conference in Anaheim.

Opening Reception - Once again a highlight of the CAUSE conference, the carnival atmosphere was just what we needed to kick off the conference with a relaxing social to meet and greet our colleagues. Many of you got the added pleasure of "dunking" your favorite vendor or CAUSE official. None drowned and laughs were abundant.

Digital capped off the evening with an exciting announcement of our newest RISC workstations, with industry leading price performance, a repeat of the national news conference which was held earlier in San Francisco.

Fun Run - Digital once again sponsored a Fun Run for the exercise minded attendees - exercise minded and meeting unemcumbered attendees. WE had a great run, doing a double loop of the Disneyland Hotel complex.

Notebook PC - Digital contributed significantly to the value of attending the conference for one lucky attendee from Texas. Carol Bratton of Southwestern Seminary in Fort Worth took home a Digital DECpc 320. This notebook style PC is in growing demand for todays computer users and Carol was the lucky winner.

SEE YOU IN DALLAS!

GKA

CAUSE91

GKA was pleased to sponsor the Thursday morning coffee break at CAUSE91.

Company Profile

GKA is an executive consulting and management services firm specializing in support to higher education. Since its founding in 1977, GKA has assembled a cadre of senior professionals with first-hand experience as executives and technical specialists in universities and colleges. GKA consultants have achieved a reputation as strategic thinkers and creative problem solvers who are experienced in managing change and who understand the capacities of institutions to absorb change. GKA continues to enhance its information systems and telecommunications consulting capabilities to keep pace with higher education's increasing demand for information technology solutions.

Involvement in Higher Education

The core of GKA business is service to higher education institutions, executives and governing boards in a broad range of areas: transition support, strategic planning support, organizational evaluation, executive recruitment and search consulting, software and hardware consulting, telecommunications consulting, project management, and interim management. A representative sample of GKA's recent clients is presented below:

Agnes Scott College
Brandeis University
Columbia University
Drew University
Fayetteville State University
Gettysburg College
Indiana University
Keene State College
Loyola University of Chicago
Massachusetts Board of Regents
Meharry Medical College
Mount Holyoke College
New York University
Oklahoma State University
Pace University
Plymouth State College
Radford University
St. Lawrence University
St. Louis University
Smith College
Southwestern Baptist Theological Seminary
State University of New York System
State University System of Florida
Union Theological Seminary
University of Chicago
University of Delaware
University of Evansville
University of New Hampshire
University of Pennsylvania
University of Scranton
University of Tulsa
University of Texas M.D. Anderson Cancer Center
University System of Georgia
University System of New Hampshire
Washington University
Wayne State University
Western Carolina University
Westfield State College

GKA

Range of Services

The advance of technology is altering the way institutions collect, store, analyze, disseminate, and use information. University and college executives face an increasing array of technology-related challenges. GKA combines technical expertise and management know-how to support the design and implementation of effective information technology solutions. GKA's Information Technology service portfolio encompasses:

Evaluation and Planning
Operations Assessment
User Requirements Analysis
Internal Plan Review
Strategic Plan Development

Procurement and Implementation
Computer/Telecommunications System Design
Systems Integration
RFP Preparation/Evaluation
Vendor Negotiations
Project Management

Network Planning/Long Distance Service Analysis
Performance Appraisal
Topology/Technology Design
Cost/Performance Optimization

Specialized Services
Office Automation/Cabling Analysis and Design
Facilities Design/Programming
Interim Management
Executive Recruitment
Evaluation of Business Opportunities

For additional information, contact:

John F. Leydon, Principal
GKA
2505 Hillsboro Road, Suite 302
Nashville, Tennessee 37212
Phone: (615) 297-3880
Fax: (615) 297-3884

CAUSE 91

Hitachi Data Systems is proud to be a corporate sponsor of CAUSE. We are pleased to have participated in CAUSE91 in Anaheim, California. Hitachi Data Systems came into being on May 1, 1989 and CAUSE91 is our second CAUSE national conference. The people we met were warm, friendly, and a pleasure to talk with.

"Meeting The Challenges of The 1990's" was the theme of our booth where HDS products and services were highlighted. Our EX Series mainframe computers; HDS 7390 Disk Storage Subsystem; HDS 7490 and 7490E Cartridge Tape Subsystems; HDS 7900 Semiconductor Disk Subsystem; HDS Engineering & Scientific products, including the HDS Integrated Vector Facility; HDS Education Services; and HDS Customer Support Services were presented.

We further participated in CAUSE91 by hosting an Executive Dinner on Monday, December 2, the night before the official opening of CAUSE91. HDS also provided the pencils for the CAUSE91 registration packets. All in all we had a great time and we look forward as a CAUSE corporate sponsor to participating in CAUSE events in 1992.

Company Profile

Hitachi Data Systems (HDS) was founded on May 1, 1989 when Hitachi Limited and Electronic Data Systems joined forces to acquire and expand National Advanced Systems. NAS had established a good reputation for reliable, high quality products; a strong marketing force; a well-respected hardware organization; and a proven systems engineering group. Hitachi Data Systems built upon this heritage and was a billion dollar sales company from its first day. Since it's founding HDS has consistently added about 200 new customers each year. Knowledgeable people who have chosen HDS to satisfy their industry-standard mainframe and storage systems requirements. We've expanded our organization to better serve your needs. We now operate in 36 countries around the world.

Hitachi Data Systems, with Hitachi Limited designs, manufactures, sells, supports and services industry standard mainframes and storage systems of the highest quality and reliability. HDS is a prominent supplier of high-performance mainframe and storage systems to some of the world's leading corporations in segments as diverse as government, aeronautics, insurance, securities, manufacturing, banking, and of course education.

The HDS EX series of mainframe computers includes processors spanning the entry-level, mid- and large-range, with an incremental growth path that ensures you have the processing power you need as you need it. The HDS EX Series offers users the highest quality and the most flexible range of power, features, and upgrades available in the industry-standard market today. EX Series users benefit from comprehensive solutions to diverse on-line, batch, engineermg/scientific, distributed processing, and mixed vendor challenges. And HDS is investing in new directions such as Open Systems in order to better serve it's customers in the future. CAUSE members can gain the competitive edge they need to succeed in today's IS environments while being assured of an avenue for rapid growth in the future - an advantage that marks the distinctive, enduring value of all HDS products and services.

The HDS storage subsystems consist of the HDS 7390 Disk Storage Subsystem; the HDS 7490 and 7490E Cartridge Tape Subsystems; and the HDS 7900 Semiconductor Disk Subsystem. The HDS storage systems are a complete set of high-performance, most reliable storage solutions that attend to every area of your mainframe-based IS computing requirements. The levels of reliability, quality, unique features, and performance that characterize HDS storage systems make IS users around the world the clear winners.

HDS Education Services

HDS Education Services offers a new generation of Applications & Systems Training for a new decade of challenges. HDS Education Services offers comprehensive course curricula that cover the full range of topics in today's computer systems environment: Operating Systems; DASD Management; Languages and Applications; Interfaces, Networks and Communications; General and Management; and Personal Computer Software. You can have courses customized to fit your needs. Choose public courses or have them delivered on site. Take advantage of the HDS Training Needs Analysis. Enjoy special NasPA discounts or the tremendous savings offered through the Partnership Training Program. Contact HDS Education Services at 1-800-543-2979 for more information.

Hitachi Data Systems is uniquely positioned to help CAUSE members address the challenges of the 1990's. With a mainframe platform and storage systems that supports administrative and academic processing requirements, HDS offers financially attractive computing solutions for the 1990's.

For additional information about any of HDS' products and services contact:

Gene England
CAUSE Communicating Representative
Hitachi Data Systems
500 Park Blvd. Ste 1200
Itasca, Illinois 60143
708-773-8150

Note: Hitachi Data Systems, HDS, HDS EX Series, Optical Channel Subsystem, 7390 Disk Storage Subsystem, 7490 Cartridge Tape Subsystem, 7490E Cartridge Tape Subsystem, 7900 Semiconductor Disk Subsystem, and Integrated Vector Facility are trademarks of Hitachi Data Systems Corporation.

IBM Supports CAUSE and Showcases Emerging Technologies

Support

IBM has been a major sponsor of CAUSE since organization was founded in 1971. At CAUSE91, the organization's 20th anniversary, IBM provided special support which included:

- Development of a CAUSE91 20th anniversary brochure, *"Twenty Years of Managing Change."*
- Development of a 20th anniversary video featuring reflections by CAUSE former presidents and board members.
- Development of a multimedia presentation that was given by Mike Roberts, a former CAUSE Board President, and currently an Educom Vice President.
- Development of a multimedia presentation, *"Bells and Whistles"*, that preceded a keynote address by F. G. (Buck) Rogers, retired IBM Vice President.
- Sponsorship of the CAUSE 20th anniversary banquet with entertainment by the musical group *Three Dog Night.*
- Provided PS/2's ® and software for CAUSE Communication Central and for CAUSE track speakers.

Technologies Exhibited

Technology exhibited addressed the application of information technology to solve administrative problems in colleges and universities. Five (three commercial and two collegiate) ehibitors shared the IBM exhibit space. They were:

- American Management Systems, Inc. (AMS ®), Phone: 703-841-6000, 1777 North Kent Street, Arlington, VA 22209
- Computer Management & Development Services, Inc. (CMDS ®), Phone: 703-434-5499, 1661 Virginia Avenue, PO Box 1184, Harrisonburg, VA 22801
- Universal Algorithms, Inc., Phone: 503-227-2790, 111 Southwest Columbia, Portland, OR 97201
- University of Alabama, Charles L. Seebeck Computer Center, Phone: 205-348-9514, Tuscaloosa, AL 35487
- University of Illinois at Champaign-Urbana, Beckman Institute Library, Phone: 217-244-8133, 405 North Mathews Avenue, Urbana, IL 61801

The other technologies exhibited by IBM were: Administrative LANkit, Desktop Publishing, FAX functions in an IBM PS/2 IBM ACIS also conducted six OS/2 ® hands-on workshops and a multimedia class at CAUSE91.

The following is a summary of what IBM exhibited at CAUSE91.

Image and Records Management System by American Management Systems, Inc.

IBM's System Application Architecture (SAA (tm)) Image and Records Management System (IRM (tm)) was demonstrated at CAUSE91. IRM is an IBM offering, it is an integrated image and records management system that revolutionizes records management. IRM provides a modern electronic library and retrieval system; it is a tool kit of utilities that supports the scanning, indexing, digitized storage, and retrieval of images, such as documents, forms and other papers. American Management Systems, Inc. (AMS) supports IBM's SAA IRM. The technology provides enterprise/campus-wide access to digitized images by campus network users. IRM integrates images with existing applications (i.e., student information systems (SIS), and human resource systems (HRS)).

TEAMS 2000 (tm) by Computer Management & Development Services, Inc. (CMDS)

TEAMS 2000 (Total Educational Administrative Management System) and TEAMMATE (tm), a database manager was demonstrated at CAUSE91. TEAMS 2000 is designed specifically for higher education and is available for the IBM AS/400. The application modules available from CMDS (tm) can be purchased as stand-alone systems or as a total fully integrated system. The modules may be installed at any time over the life of the system with ease. TEAMS 2000 provides the capability to have immediate access to strategic, timely information. It is designed to provide comprehensive function and ease of use. TEAMS 2000 is an integrated system, which allows departments to work more cohesively toward realizing institutional goals. TEAMS 2000 application modules include: accounts payable, accounts receivable, advising/degree audit, admissions, development/alumni, financial aid/need analysis,fixed assets, general ledger, payroll, purchasing and registration. It is an on-line information solution that will fit in the following environments: universities, 4-year colleges, community colleges, private K-12 schools and vo-tech schools

CMDS now counts over 225 clients running its administrative solutions on S/36's and AS/400's. Many are 2-year and 4-year institutions with up to 2,500 enrollment. CMDS has also installed applications is some institutions with enrollments up to 6,000. Modules of the TEAMS 2000 solution are also used in schools in a number of universities.

SCHEDULE25 (tm) by Universal Algorithms, Inc.

SCHEDULE25 is a fully automatic, bulk optimizer for college and university classroom scheduling. In use at over 20 percent of the nation's "Research 1" universities (per Carnegie Foundation for the Advancement of Teaching). SCHEDULE25 cuts the decision time for the bulk assignment of space from weeks or months to minutes. On any given run, SCHEDULE25's optimizing algorithm seeks to: (1) maximize the number of classes placed; (2) maximize satisfaction of departmental location preferences; and (3) maximize average station utilization (fill of students per seats). Institutions using SCHEDULE25 report average station (classroom) utilization at approximately 80%.

OS/2 Database Implementation by University of Alabama
IBM OS/2 database applications were demonstrated by the University of Alabama. Client/server technology in an OS/2 environment implementing departmental databases were featured. The database applications shown are used by departments with between 8 and 12 concurrent users of shared data sets. OS/2 Query Manager and other IBM utility programs within OS/2 Extended Edition were used to structure search arguments without the need a a professional programmer. This approach to LAN use of a database is ideal for unique departmental transactions and report generation.

Library Information Workstation by University of Illinois - Urbana/Champaign
The unique requirements of a library information workstation were shown at CAUSE91. Some of the novel functions demonstrated included an expert system interface to Bibliographic Research Service (BRS(tm)). The system provides an integrated solution to access information resources on a campus-wide basis.

Administrative LANkit (tm) Prototype by IBM Corp.
An IBM local area network (LAN) prototype was shown which can provide an easy to install full feature LAN for administrative support. The objective of the project was to show affordable, pre-packaged local area network (LAN) solutions that are easy to install, customize and use. OS/2 Extended Edition was the environment used by the prototype.

PS/2 Desktop Publishing by IBM Corp.
The scanning and laser printing functions of an IBM Desktop Publishing system were demonstrated. Photos, line drawings and text were scanned into the PS/2 for inclusion into documents. Optical character recognition (OCR) functions using Typist (tm) software and a hand-held scanner were used to capture text. The IBM Laser Printer generated camera ready copy from the raw text and illustrations scanned into the system.

PS/2 Facsimile (FAX) Integration by IBM Corp.
An integrated PS/2-FAX system was demonstrated at CAUSE91. The general features shown included transmissions of PS/2 files to a FAX machine, and FAX images to a PS/2. The transmissions included graphics and text. The PS/2-FAX configuration made it possible to down-load a text file from a host and then convert the file to a FAX image for transmission to a FAX machine.

For more information about IBM products and administrative solutions contact:

Rob Baum, Phone: 203-783-7350
IBM Corp., ACIS
472 Wheelers Farms Road
Milford, CT 06440

Professional and Customer Support Services from IA Featured at CAUSE91

Committed to the concept that it takes more than software to deliver a total solution, Information Associates presented its service offerings at CAUSE91.

To address each stage of the IA/ Customer Life Cycle, Information Associates offers both Professional and Customer Support services.

The IA Professional Services Team concentrates on the planning and implementation stages. Using an eight-phase methodology called RESULTS, they deliver a comprehensive range of services including project organization, system installation, all aspects of system implementation, and system evolution.

When IA applications go "live," customers can count on IA's Customer Support Services to ensure that they are achieving full utilization and maximum benefits from their applications. These services are provided under an annual maintenance agreement that represents the best value in the industry.

Marketing VP, Mahoney, Presents Technology Briefing

William Mahoney, VP of Marketing, in his corporate presentation for IA, articulated the company's technological direction for an audience of more than 100 information technology professionals. Mahoney described IA's development work in process and planned client/server architecture in an effort to help customers plan for the evaluation of their information management systems.

Information Associates Unveils EDI Solution

Information Associates (IA) announced the availability of EDI.Smart, an electronic data interchange (EDI) solution for transcript management. EDI.Smart represents a major technological breakthrough for IA and an opportunity for colleges and universities as well as grades K-12 to take advantage of EDI networks to transmit and receive academic transcripts.

On average, colleges and universities send and receive 24 million transcripts annually. Using EDI.Smart, which reduces transmittal and processing time from as many as 27 days to as few as 3 minutes, represents a significant potential savings in labor and costs.

Designed to work with any student information system, Information Associates' EDI.Smart PC-based solution includes translation software for converting transcripts into the industry-specified format and supports a variety of tracking, processing, receipt, and delivery options.

Dun& Bradstreet Software

DB a company of The Dun & Bradstreet Corporation

For more information, contact Bill Mahoney, Vice President of Marketing, Information Associates, 3000 Ridge Road East, Rochester, NY 14622 (716) 467-7740.

Information Builders, Inc. Background

1250 Broadway New York, NY 10001 (212)736-4433

Information Builders, Inc. (IBI), founded in 1975, ranks among the top 20 independent software vendors in the world. The flagship product, FOCUS, was developed by founder and president, Gerald D. Cohen, a pioneer in nonprocedural language technology and author of the first commercially-successful fourth generation language. First installed on MVS in 1976, FOCUS now runs in 35 operating environments, servi the needs of over one million users worldwide. Information Builders is also an acknowledged leader in enterprise-data-access products and IBM selected the IBI Enterprise Data Access/SQL (EDA/SQL) products as the basis for data access and connectivity in its Information Warehouse strategy. IBI is also a leading developer of expert system tools (LEVEL5).

IBI employs 1,600 professionals worldwide ith 26 US sales, support, and consulting offices, 3 Canadian offices, and 13 international subsidiaries, as well as a network of agents in every major international market. The company offers complete educational, consulting and support services and publishes technical journals, a monthly product newsletter, and a news magazine.

THE PRODUCTS

FOCUS®—an application development and decision support environment featuring the world's leading Fourth Generation Language (FOCUS 4GL), with comprehensive reporting, business graphics, statistics and spreadsheets and facilities for generating application screens, logic and databases. Includes a scalable database server and interfaces to over 40 proprietary data structures (see chart), FOCUS offers unmatched portability and connectivity between computing environments and data resources. Graduated tools permit every category of user to access an organization's data and to develop and control information effectively.

Enterprise Data Access/SQL™—IBI's data-access, connectivity and client/server products deliver SQL-based access to relational and non-relational data throughout today's enterprise-wide networks (see chart). EDA/SQL supplies a uniform, relational view of data, regardless of its organization, and is based upon extensible components that can be adapted for new requirements. EDA servers route and handle SQL requests from local or remote clients against relational or non-relational data sources on a host processor. EDA clients include EDA-enabled products, such as IBI's EDA/Dynamic Extender™ for DB2™ and EDA/Datalens Extender for LOTUS 1-2-3™, as well as third-generation language applications and products written for the EDA API by "EDA Enabling" business partners.

LEVEL5™—expert system development tools for building rule-based inferencing systems to run on IBM-compatible PCs, the Apple Macintosh, and DEC VAX/VMS systems and IBM VM and MVS systems. LEVEL5 applications run interchangeably on the supported environments, permitting developers to build applications on PCs and deploy them on midrange or mainframe processors.

LEVEL5 for FOCUS—this complete application development environment integrates the FOCUS 4GL and data management tools with the rule-based LEVEL5 inferencing system. This bundles expert system technology at the core of the decision management process, enabling users to consult and analyze data in all FOCUS-readable files and databases, including DB2, SQL/DS, IMS, Rdb, DBMS and RMS and over thirty other data sources.

LEVEL5 OBJECT—this application development tool combines object-oriented techniques with a choice of inferencing strategies in a flexible windowing environment (Microsoft Windows™). Object-orientation provides control over application design and the ability to organize large amounts of data and procedural commands, while hiding underlying complexity. The modular nature of the LEVEL5 objects supports the reuse of the logic and information in other applications and simplifies maintenance.

DATA ACCESS OPTIONS

Databases/Files	Platforms	Databases/Files	Platforms
Adabas	MVS, VM, VSE, VAX/VMS	Model 204	MVS, VM
Allbase/SQL	HP	Net-ISAM	UNIX
ALL-IN-1	VAX/VMS	NonStop SQL	Tandem
C-ISAM	UNIX	Oracle	VAX/VMS, UNIX, HP
DATACOM/DB	MVS, VM, VSE	OS/2 Ext. Ed.	OS/2
dBase III, III plus, IV	DOS, OS/2, LAN	PACE	VS
DB2	MVS	QSAM	MVS, VM
DBMS	VAX/VMS	Rdb	VMS
DIF	DOS, OS/2, LAN	RMS	VMS
DMS	VS	Sequential files	HP
DMSTX	VS	ShareBase	MVS, VM, VAX/VMS
DOS sequential	DOS	SQL/DS	VM
ENSCRIBE	Tandem	SQL Server	DOS, OS/2, LAN
FOCUS	all	Sybase	VAX/VMS, UNIX, HP
IDMS	MVS, VM, VSE	System 2000	MVS, VM
IDMS/R	MVS, VM	Teradata	VAX/VMS, UNIX, HP
Informix	UNIX, HP	TOTAL	MVS, VM, VSE
Ingres	VAX/VMS, UNIX, HP	ULTRIX/SQL	UNIX
IMS	MVS, DLI for VSE	Unify	UNIX
KSAM	HP	VSAM	MVS, VM, VSE
LOTUS 1-2-3	DOS, OS/2, LAN	WIIS	VS

KPMG Peat Marwick

Addressing Information Technology Issues for the 21st Century University

KPMG Peat Marwick is pleased to have participated in the CAUSE 91 presentation, "Justifying Major System Implementations in Times of Retrenchment" with the University of Minnesota. The presentation was prepared based on the experiences of the University of Minnesota, a KPMG Peat Marwick client, in justifying a major financial system implementation during a period when appropriations were reduced by $70 million.

Mr. David Hemingson, the Partner responsible for KPMG Peat Marwick's Higher Education Technology and Operations Practice, and Ms. Diane Collins, the University of Minnesota Financial Management System Project Director, presented the findings.

The University of Minnesota is a state-supported, multi-campus university system with over 74,000 students and 35,000 employees. Its operating budget approximates $1.7 billion; $260 million of which is committed to research.

The University engaged KPMG Peat Marwick for a period of eighteen months to assist in establishing project objectives, defining requirements and estimating cost savings, and analyzing how a software package -- American Management System's College and University Financial System (CUFS) would be used in the University's environment.

OBJECTIVES

The University's objectives focused on decentralizing accountability and responsibility to the deans and administrative department administrators. These objectives included:

- Providing administrators with tools and information to support the management process;
- Providing flexibility to accommodate change at a minimum cost;
- Exploiting technology to reduce paper flow and time delays associated with manual procedures;
- Decreasing the information feedback loop by identifying errors as close to the initiator as possible;
- Providing more meaningful information to the end user in a more timely manner; and
- Reducing or eliminating data redundancy and facilitating communication.

PROCESS

The University completed Peat Marwick's *Functional Analysis* process in planning its implementation. The *Functional Analysis* approach focused on the timely resolution of issues identified in a methodical manner. During the *Functional Analysis* phase, university and KPMG Peat Marwick professionals mapped the functional requirements to the capabilities of the software package, reshaped policy and procedures and/or identified software modifications, and documented the resulting decisions.

Processes were reviewed on a table-by-table and transaction-by-transaction basis developed specifically for the CUFS software package.

Members of the functional analysis team took the decision forward, in most cases, without additional consulting assistance.

COST SAVINGS OPPORTUNITIES

As the University moved into the implementation phase, it encouraged departmental administrators to extend the process of business function redesign to their departments. Project management pointed out that if changes were not made in the manner in which the department conducts its business, additional work would be required. Deans and departmental administrators were given the latitude of taking those actions necessary to absorb the budget reductions. The University central administration simply indicated the magnitude of the cut and identified the cost saving opportunity.

Cost saving opportunities were derived from:

- Process simplification and redesign;
- On-line approval processing;
- Decentralized definition of certain account classifications and aggregations;
- Automation of certain activities previously performed manually; and
- Reduction or elimination of shadow systems.

Departmental cost saving opportunities ranged from $10,000 to $47,000 in those departments included in a survey of departmental users.

Because many of these cost saving opportunities existed in the approximately 600 departments of the University, the cost saving opportunities were leveraged significantly and presented a goal which cost justified the project.

THE HIGHER EDUCATION TECHNOLOGY AND OPERATIONS PRACTICE

This case study provides a striking example of how KPMG Peat Marwick's focused experience provides measurable results.

KPMG Peat Marwick's Higher Education Technology and Operations Practice serves colleges and universities exclusively. Collectively, the practice has more than 50 person-years of experience in serving more than 40 institutions nationwide.

For more information concerning KPMG Peat Marwick or the Higher Education Technology and Operations Practice, contact:

Mr. David Hemingson, Partner
KPMG Peat Marwick
Post Office Box 4545
Houston, Texas 77210-4545
(713) 221-0116

Focus on CAUSE91

Quodata*

Quodata and CAUSE both celebrated twentieth birthdays at CAUSE91. Anaheim was a great place to meet and renew relationships. Many CAUSE members stopped by to discuss Quodata's updated PC Connection, the new Screen Management System with DECforms, and standards in software. Quodata and Digital are committed to software standards which improve integration, lower costs, and increase software life.

◻ The Company

Quodata was founded twenty 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

Quodata is one of the first companies to make a major investment in following industry standards. Today Quodata can demonstrate an array of integrated 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 flexibilty 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.

(con't)

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 VAX/VMS operating systems architecture and Networked Application Support (NAS) software standards, which Digital exhibited at CAUSE91. 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. Quodata takes great pride in providing excellent service. 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 CAUSE91. Quodata actively supports and encourages its users groups. An annual conference is held each Fall. Sharing is further promoted regionally and through newsletters.

SalePoint Solutions

On-Line Cashiering System for College & University Business Offices

SalePoint's On-Line Cashiering System for College & University Business Offices is a powerful solution that combines IBM hardware, SalePoint's flexible software & superior connectivity, third party products, and complete support by SalePoint & IBM support professionals.

Hardware Platforms. SalePoint utilizes the *IBM 4684 Cashiering Workstation* as its primary hardware platform. The IBM 4684 is an integrated unit designed specifically for high-volume cashiering (essentially consisting of an IBM PS/2 with cashiering peripherals such as a cash drawer, etc., in an integrated configuration). Each IBM 4684 Cashiering Workstation includes:

- Base unit. *With 386 processor, 1.44 MB floppy drive, 40 to 160 MB hard disk, built-in Token Ring or Ethernet network adapter, and 2 card slots for PS/2 Feature Cards*
- IBM PS/2-style cashiering keyboard. *With manager key lock, built-in magnetic stripe reader, and indicator lights (e.g., training mode)*
- IBM 9-inch monochrome monitor
- IBM 38-column receipt/journal/slip printer
- IBM cash drawer(s)

SalePoint offers many other optional components to this IBM 4684 platform. Also available is a *PC-Cash Drawer* option (i.e., an IBM PS/2 with cashiering peripherals such as a cash drawer, etc.).

Software Platforms. SalePoint's cashiering software system utilizes OS/2 and is written in C/C++ using an object-oriented methodology that provides many benefits:

- Comprehensive functionality. *Meets all the needs of college and university business offices. Student payments and financial line items are handled through a single transaction. Bar coding and OCR scanning are available to improve speed and accuracy.*
- Fast transaction processing. *Easy-to-use-and-learn software with on-line, pop-up help, modifiable through word processing applications such as WordPerfect.*
- Flexibility. *Meets current needs and future requirements. The system can easily be modified through parameters, "Lexicon," and custom programming.*

SalePoint also offers a UNIX version.

SALEPOINT

SalePointSolutions

On-Line Cashiering System for College & University Business Offices

Connectivity. Using a combination of IBM Communications Manager and other third-party packages, SalePoint is able to provide a flexible solution for maximum connectivity. The SalePoint Solution features:

- Real-time access to student records. *On-line or batch updating of student, financial, and other subsystems.*
- Network-independent client/server architecture. *Available with a wide variety of host connectivity options in IBM and non-IBM host environments. Options include TCP/IP, SNA 3270/5250, HLLAPI, APPC via LU6.2, and more.*
- Hot key option. *Allows host screens to be accessed on each cashiering workstation at any time during the transaction.*
- Host API software module option. *For Information Associates' IBM and VAX Users. Provides an on-line interface to SIS and FRS (including Plus Series) through Z-Support.*

Service and support. SalePoint, in conjunction with your local IBM Field Service Organization, provides a full range of services to ensure you receive the maximum value from your SalePoint On-Line Cashiering Solution, some of which include:

- Project management and consulting
- Installation and comprehensive training
- Custom programming and technical support
- Toll-free, seven-day-a-week help desk.
- Software maintenance
- IBM on-site hardware maintenance

SALEPOINT

SalePoint Systems Corporation
6199 Cornerstone Court East
Suite 111
San Diego, CA 92121-3710
(619) 546-9400
FAX (619) 546-0725

Please call SalePoint Systems Corporation for complete information and a demonstration disk that illustrates the many features of our On-Line Cashiering System for College & University Business Offices.

SCT's Magic Combination Featured at CAUSE91

Systems & Computer Technology Corp., (SCT) is a leading provider of administrative software and computing management services for higher education institutions nationwide. During CAUSE91, SCT featured the "Magic Combination" of its BANNER software systems and client/server computing. The BANNER series is the first administrative software for higher education to offer this flexible, powerful and affordable technology.

MAGIC COMBINATION

The "Magic Combination" theme was brought to life by Giovanni, the magician, and the Magic Combination Game. SCT's hardware vendors - IBM, Sun, Sequent, Hewlett-Packard and Digital - who were exhibitors at CAUSE91, participated in the game. Each player collected CAUSE91 logo stickers - featuring the CAUSE Twentieth Anniversary logo - from the vendors in order to complete a game board and enter to win one of three Sharp Wizard Electronic Organizers. Playing the game provided everyone the opportunity to visit SCT's booth as well as five of its vendors with hardware platforms capable of running BANNER software. The winners of the Magic Combination game were: Dennis L. Pramhus, Director of Computer Information Systems, Arizona State University; Paul Teitelbaum, Application Analyst, University of Arizona; and James L. Fitchett, Director of Information Service, Harvard Medical School.

GOLF TOURNAMENT

SCT was a proud sponsor of the CAUSE Golf Tournament. The winners of the Men's and Women's Low Scores were Worth D. Roberts and Sophie Sisler, respectively.

CAUSE/EFFECT "CONTRIBUTOR OF THE YEAR" AWARD

For the tenth consecutive year, SCT sponsored the CAUSE/EFFECT "Contributor of the Year" award. The award is presented to the author of the article judged to be the best of all contributed papers published in the quarterly magazine during the prior year.

The award-winning article, "Client/Server Architecture Promises Radical Changes," was written by Grey Freeman and Jerry York. Grey Freeman is Program Director, Information Technology Management Service, at the Gartner Group. Jerry York is Associate Vice President of Information Services and Technology at the University of Medicine and Dentistry of New Jersey.

SCT'S CORPORATE PRESENTATION:

"Client/Server ... A Technology and A Philosophy ... for the 90's"

Presenters, Susan Sheridan, Vice President of Product Marketing, Software and Technology Services Division, and Roy Zatcoff, Vice President, Product Development, Software & Technology Services Division, spoke about client/server computing and the effect it has - and will continue to have - on servicing clients' needs.

Institutions are focused on service to their clients - students, faculty and administrators. Technology providers are focused on service to the end-user community with the coming of age of client/server architecture. The two converge at the MIS director. SCT discussed this convergence through an exploration of the practical application of client/server technology to administrative systems and the resulting client service to the entire education community.

ABOUT SCT...

Founded in 1968, SCT has more than 1,000 employees serving clients across North America and overseas. The company is headquartered in Malvern, PA, a suburb of Philadelphia, and has regional offices in California, Texas, South Carolina, Louisiana, Kentucky and Puerto Rico.

SCT's broad range of proven solutions for administrative computing needs includes: the BANNER series of advanced administrative applications for your Human Resources, Finance, Student, Financial Aid, & Alumni/Development requirements; and OnSite services, the computing management alternative that encompasses the management, staffing and operation of a client's computing resources - through an outsourcing partnership.

For more information about SCT's products and services for higher education, please call our toll-free number, or write to:

SCT

Systems & Computer Technology Corp.
4 Country View Road
Malvern, PA 19355
Call toll-free (800) 223-7036
In PA, call: (215) 647-5930

STERLING SOFTWARE
Dylakor Division

"Where Ideas Become Information Management Solutions™"

Congratulations to the CAUSE organization for staging yet another successful conference last December, this time at the Disneyland Hotel in Anaheim, California. It was a pleasure speaking with the hundreds of CAUSE members who dropped by Dylakor's booth to visit with our representatives.

Sterling Software, Dylakor Division has been working effectively with IS professionals in higher education for over twenty years. Our success in the education market grew out of the positive experiences many CAUSE members have had using Dylakor's information management and report generation software systems.

Dylakor As The Information Management Experts

Dylakor's exhibit featured two products currently in widespread use at colleges and universities across the U.S. and Canada. DYL-IQ *Express* is an online query and reporting system that provides fast, easy and simultaneous access to a wide range of databases and other file types, including DB2, IMS/DB, VSAM, and others. A menu-driven front-end enables non-technical individuals to process their own queries with a minimal amount of training. The second product, DYL-280 II *Relational*, is a program development tool that can be used in dozens of different applications having to do with the management and presentation of information. Whenever there is a need to increase programmer productivity and/or end user efficiency, Dylakor's software systems are one solution to consider because they are designed specifically to lower the time and effort required to manage data resources.

We Hope You Enjoyed Our Hospitality

Dylakor appreciates all the support it has received over the years from CAUSE members. To show our gratitude, Dylakor joined a dozen or so vendors who hosted hospitality suites on Wednesday evening. The atmosphere was friendly and relaxed, with enough food and drink and lively conversation to keep everyone entertained all night long.

Syntellect Inc., provider of the **INFOBOT** Family of Interactive Voice Response Systems (IVR) was founded in 1984 and is currently the largest vendor of interactive voice response systems in the United States. Syntellect has shipped over 5,000 **INFOBOT** systems worldwide to 800 customers in the U.S. and 27 foreign countries.

Colleges are finding out that they must reduce current workloads and lines at on-line registration sites, increase enrollment, and decrease overall costs. Syntellect's **INFOBOT** Interactive Voice Response Systems can help by providing students convenient and efficient touch-tone access to on-line registration and general information 7 days a week, 365 days a year.

Because of the ease of implementation associated with **INFOBOT** systems, colleges utilize this technology to serve their students better and to reduce the expenses associated with these services.

Colleges that have implemented **INFOBOT** say the system provides students with a convenient and efficient method of registration, reduces the registration period, decreases the cost of the registration process, ensures the privacy and security of students' records, improves student services and, this is the best thing we ever did.

INFOBOT easily expands to handle services such as: grade reporting, admissions status, voice bulletin boards, housing locator information, pre and co-requisite information, course changes and modifications as well as tuition payments.

To ensure successful installation of the Syntellect **INFOBOT** Family of Interactive Voice Response systems, Syntellect offers on-site installation support from our application specialists who train customers on how to work with the system. The Syntellect Training System makes **INFOBOT** the easiest in the industry to use. At it's headquarters Syntellect runs an ongoing program of training known as INFOBOT U.

Syntellect provides a 24-hour, seven-day-a-week Help Line to respond to customer needs. To create a forum for user recommendations about product and service strategies, Syntellect was the first voice response vendor to support an independent users group. The group meets annually to discuss industry issues and product applications.

As the needs of the academic community continue to expand, Syntellect will respond by developing applications tailored specifically to the academic market.

The Robinson Group Ltd.
Information Access is Our Business

CAUSE 1991 National Conference
Anaheim, California

"Journey to the New Frontier by Visiting the Old Frontier"

The Old Frontier...do you remember this booth as you walked through the Corporate Exhibit area at the National Conference? The Robinson Group Ltd (TRG) selected the setting of the old Southwest to emphasize CAUSE recognizing its past as the foundation for the future and to illustrate how TRG software and services build upon an institutions past investment in administrative computing by adding new applications, tools, and technology. Not coincidentially, TRG is located in Phoenix, Arizona where we have a joint development agreement with The Maricopa Community Colleges. Read on for more information regarding TRG's frontier activities at CAUSE.

The Southwest Cantina...the Archway...the Desert Sunset... (the TRG Booth)

In our booth, we featured solutions that illustrated the business of TRG: "information access." We demonstrated the Faculty Support System, the Student Tracking System, the Administrators' Almanac, and The Campus Information System. All of these software applications extract data from existing administrative systems and give easy, but secured, access to faculty, students, and administrators. The solutions operate in a networked environment and take advantage of workstation technology. A brief description of each solution is provided below:

The Faculty Support System

We demonstrated how faculty can easily access student records and automate their record keeping functions, all within a networked environment that takes advantage of the speed and power of an IBM RISC System/6000 networked to faculty desktop equipment. The specific components that we featured were the Syllabus Builder; the Grader; Student Records, where progress letters are generated and faculty can add, withdraw, or reinstate students electronically; and the Faculty Directory, accessible by other faculty and students who need to contact faculty. Students may use the system to access faculty by sending electronic messages and/or by checking the status of their assignments and grades.

The Student Tracking System

You also may have seen The Student Tracking System and noted how it could complement your existing student record system by providing individualized or summarized information regarding student demographics, goals, performance, and advising over time for any given student population. This system is designed to track students from kindergarten through postsecondary education. It can provide information that will assist program directors evaluate program effectiveness, such as the success of students who transfer from community colleges to four-year/research institutions or monitor the performance of "at risk" students and offer intervention counseling when appropriate.

2411 West 14th Street Tempe, Arizona 85281.6942 USA Fax: 1 602 731.8850 Telephone: 1 602 731.8900

The Administrators' Almanac

We talked to a number of executives who were pleased when they viewed the graphic presentation of summarized trend information that is accessible from their desktop equipment networked to a file server and mainframe. We showed them how they could view the spreadsheet, graph, and annotated text all in one view and how easily they could change the graph to feature a specific trend line in which they had particular interest. The examples shown at the conference included demographic, enrollment, financial, and personnel trends. The Almanac features include pull down menus from which administrators can point and click to their selected view, thus giving them the ability to have relevant information on their desktop.

The Campus Information System

We discussed how the Campus Information System, accessible through a touchscreen kiosk, can provide better service to students and increase staff productivity. For example, we demonstrated how a student might access and print their course schedule, view their financial aid status, review a list of campus events, obtain an unofficial copy of their transcript, locate a particular building and room using the graphic maps, and access any other sources of information that the institution wishes to make available to students. Visitors to the booth could see how visitors to a campus would welcome the maps to guide them to their destination.

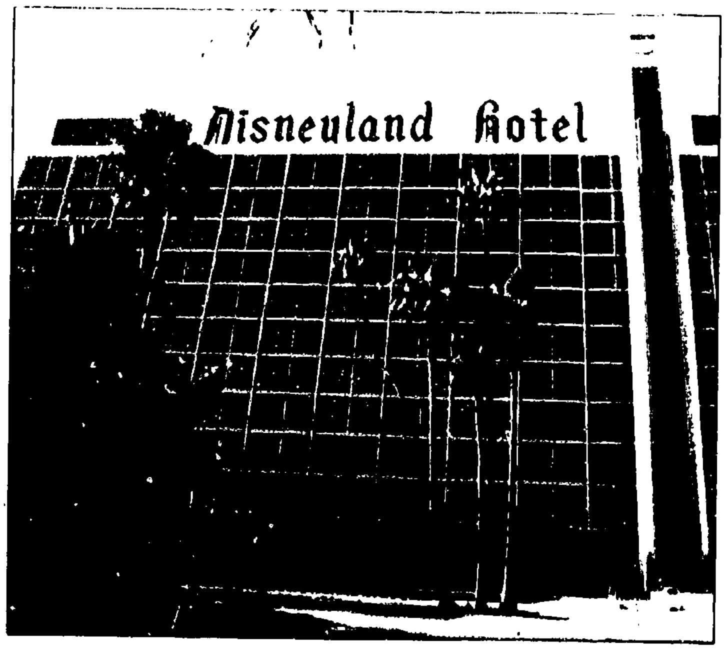
"The smell of Apple Pie"
(Hospitality Evening)

We carried forward our Western theme by serving good old apple pie and coffee. We were pleased that approximately 400 CAUSE attendees visited our suite to talk to John Robinson, the Managing Partner of TRG, Judith Leslie, Senior Partner, and Dick Barber, Senior Partner, along with the other TRG staff. Our guests left with a Western boot branded with the CAUSE Twenty-year Anniversary and TRG logos.

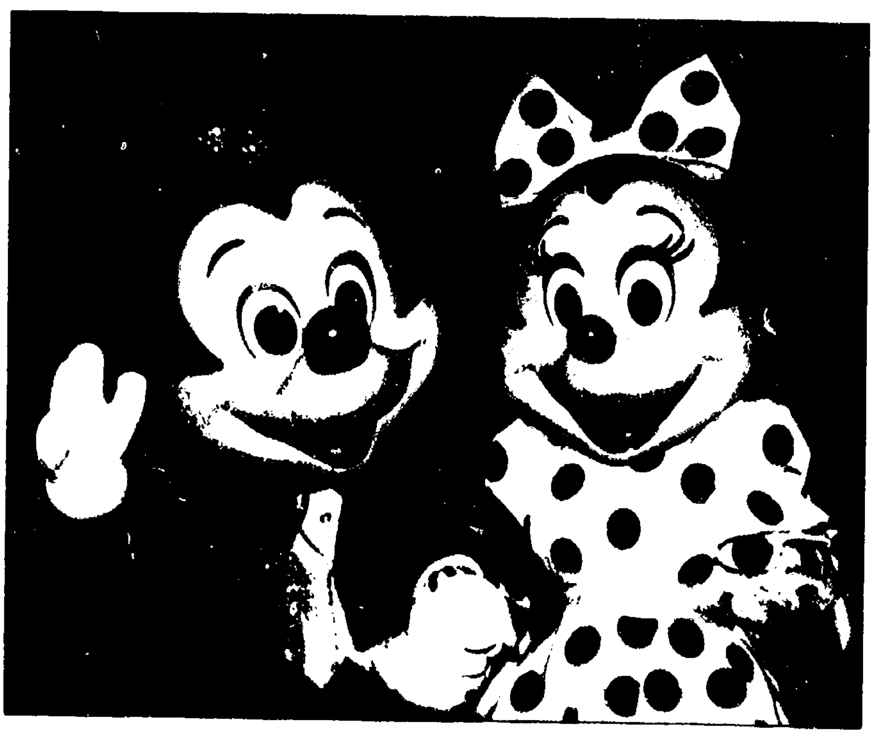
"Ghost Riders in the Sky"
(Corporate Presentation)

We developed our presentation using IBM's Toolbook software that allowed us to demonstrate our solutions interactively and graphically using the PC. We illustrated the similarities between settling the "Old Frontier" with the "New Frontier," by referring to three types of individuals: the explorer, the cowboy/girl, and the homesteader. We shared with the fifty CAUSE participants who attended our session a list of the other institutions and vendors who are joining us on this drive to the new frontier. We explained our partners program that includes IBM, the League for Innovation, and the following institutions: the Maricopa Community Colleges, Houston Community College System, Monroe Community College, Central Piedmont Community College, Dallas Community College District, Community College of Allegheny County, and Central State University Faculty at these institutions and select others will be using the Faculty Support System and participating in the specification of future functionality and the publication of a League monograph on *Guidelines for a Faculty Support System*. We also were pleased to announce that TRG has had consulting engagements at the University of Louisville, George Mason University, and California Polytechnic University.

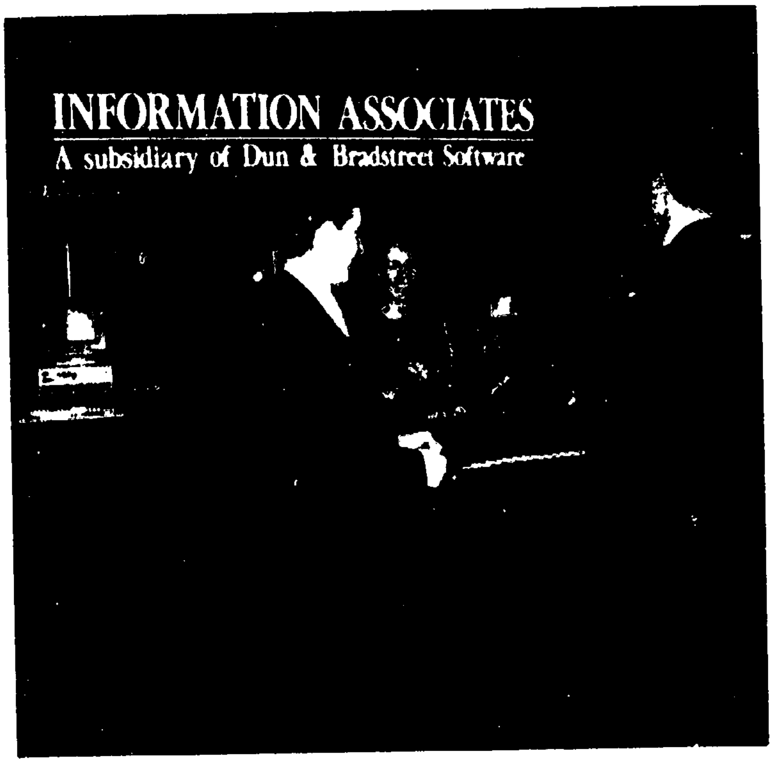
A PICTORIAL REVIEW OF CAUSE91

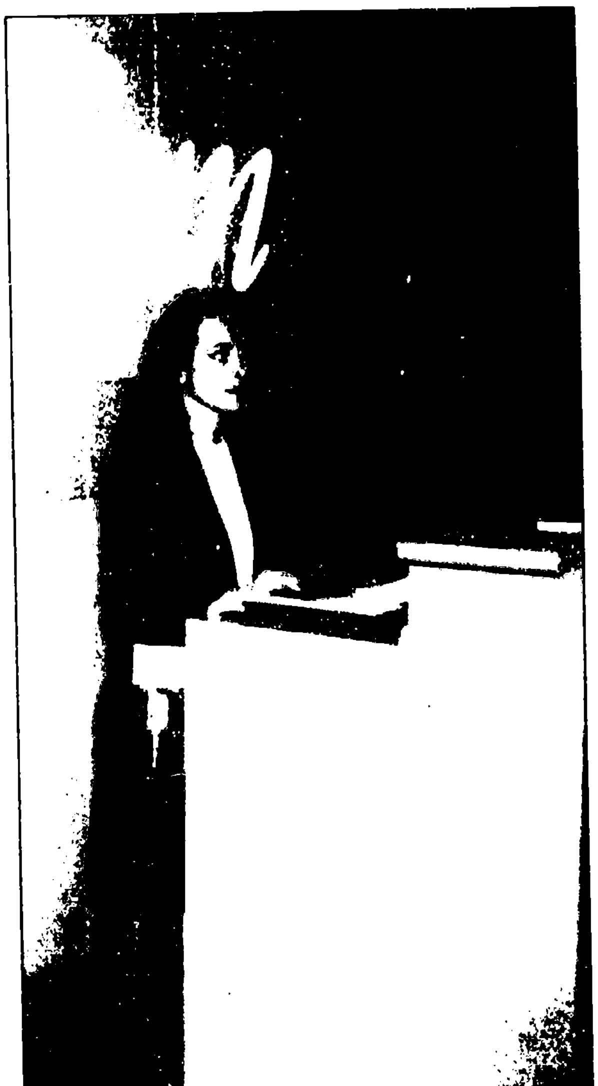


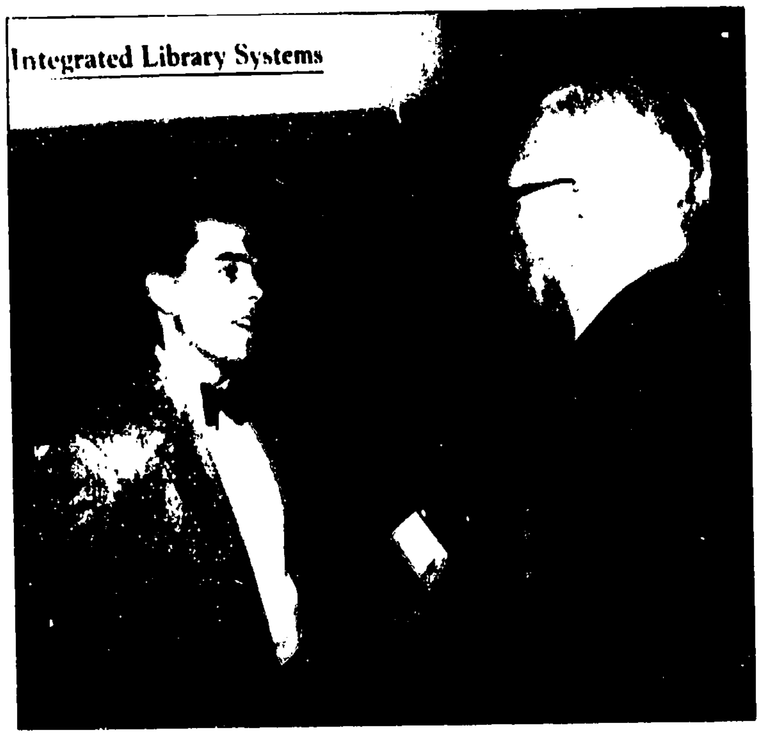
In spite of widespread travel restrictions and tight budgets, CAUSE91 drew a crowd of more than 1,250 professionals involved in management of information technology resources of higher education institutions across the country and abroad. The pictures on the following pages are presented as a reminder to these participants of the variety of good times and opportunities for professional growth last December at the Disneyland Hotel in Anaheim, California.



Corporate participation ...

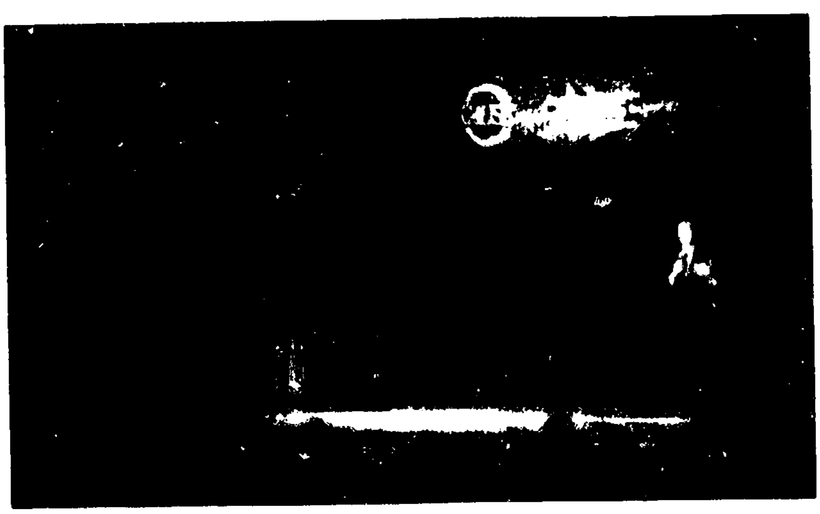


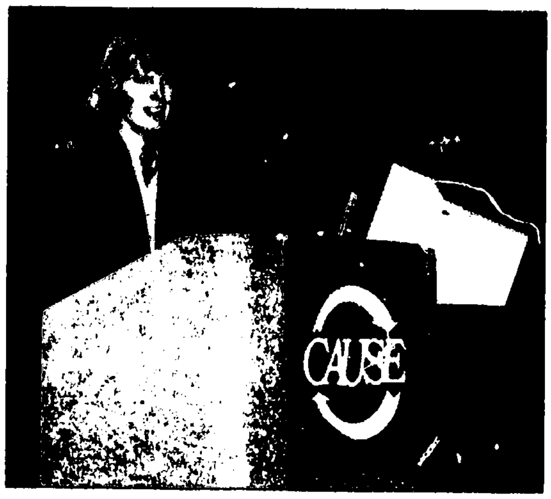




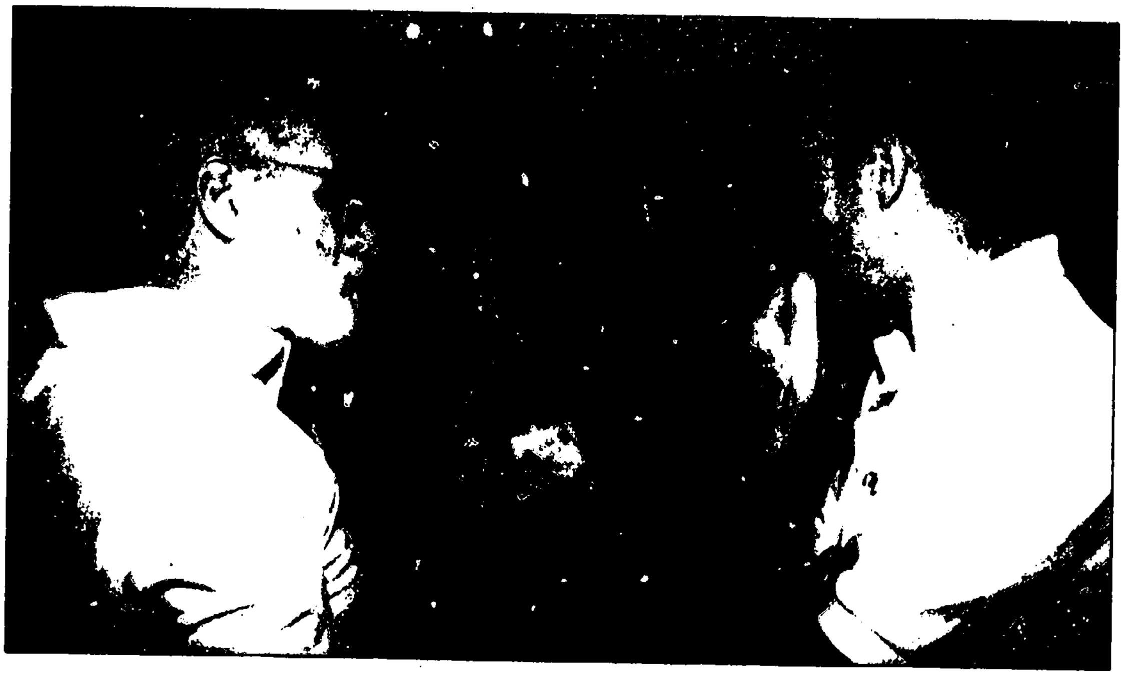
Corporate participation ...

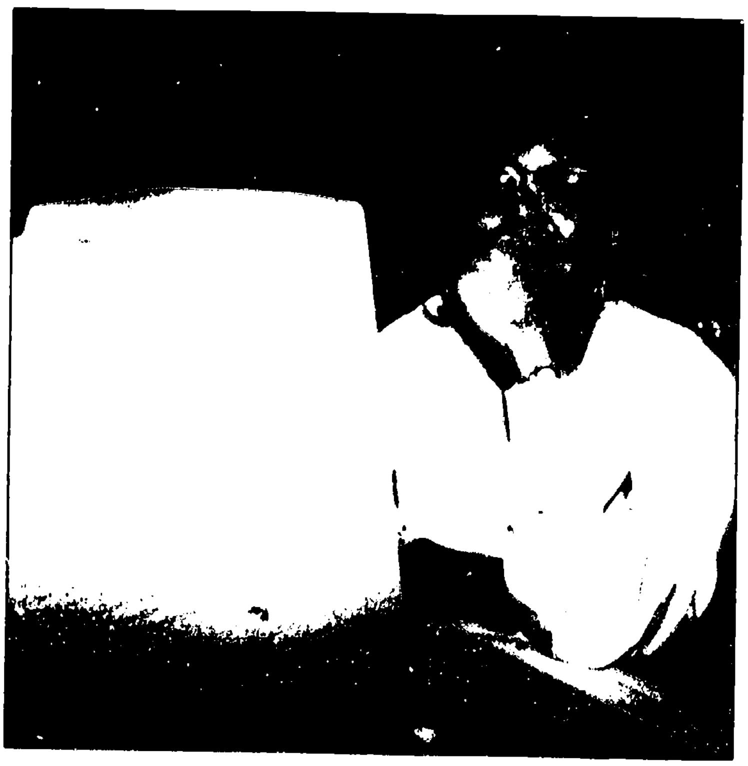
Formal program




CAUSE

in session ...





and out ...

and time for relaxing...

Summary of CAUSE91 Conference Evaluation

199 Evaluation Forms turned in

1. Rate the following CAUSE91 activities in terms of their value to you.

	High	Moderate	Low	No Opinion	Did not attend
General Sessions	115	73	7	0	2
Track Sessions	108	83	3	0	3
Current Issues Forum	52	60	9	4	52
Current Issues sessions	49	52	5	4	71
Constituent groups	55	47	5	5	75
Special interest groups	32	35	7	8	99
"Ask the Experts"	28	29	5	12	109
Round tables	21	27	9	8	122
Poster Sessions	17	32	11	7	119
Communications Central	71	53	4	14	41
Corporate hospitality Suites	59	65	30	8	27
Corporate presentations	61	90	14	3	25
Corporate demonstrations	78	74	17	3	14
Opportunity to talk with colleagues informally	163	21	1		3

Keynote presentations were exceptional - 4*
Buck Rodgers was a disappointment - 8
Buck Rodgers was great - 2
Mike Roberts was a disappointment - 4
Mike Roberts was great - 2
Gene Stanaland was great - 11
Track sessions very relevant, good - 5
Track sessions too basic, vague - 3
Current Issues Forum was most meaningful - 2
Current Issues Forum was a disappointment - 1
Poster Sessions a great idea - 13
Messaging Center was great - 12
Messaging Center was disappointing - 3
Wednesday Reception for committee plaques was great idea - 2
Liked music at Thursday banquet - 6
Didn't like music at Thursday banquet - 4
Constituent Groups are not very helpful - 1

* Number indicates the number of times the comment was made.

2. Do you think anything you learned at CAUSE91 might have an effect on the way you do things at your institution:

Yes	No
170	20

If yes, please explain:

Better understanding of overall issues - 30
Beneficial to learn from other people's experiences - 9
New ideas from informal discussions with colleagues - 9
Many great new ideas - 8
Numerous important contacts - 9
Quality Management - 22
Client Server - 12
Networking - 11
Strategic Planning - 10
How vendors are providing solutions - 6
User Support - 4
Multimedia - 3
Re-engi[illegible] - 3
Email - [illegible]
Disaster Recovery - 2
Imaging - 2
Electronic delivery of standard paper reports - 2
Emphasis on empowerment of people and human resources - 2
Academic computing - 2
Information on Dartmouth's library system
Michigan's data information ethics program
How to better approach senior management
Coping with budget cuts
Budget modeling
Data management techniques
Reemphasis on broadest possible distribution/availability of information
Integrating disparate systems
Performance measures for IT
Micro support methods
Ethics issues
reorganization refinements
New software for DBMS query, reporting, analysis
DocuTech

3. What topics/speakers would you like to hear at future conferences?

Networking - 14
Client Server - 8
Quality Management - 7
Dealing with tight budgets - 6
More practitioners, fewer theorists (want actual implementations) - 6
Distributed technology/computing - 4
Staff reorganization - 4
Strategic Planning - 3
Outsourcing - 3
Improving services to students - 2
Would like to hear from our clients (from an institutional attendee) - 2
Imaging - 2
Data Management - 2
Computer phobia - 2
Long term predictions - 2
Dealing with organizational politics - 2
More of the same
Merging of administrative and academic computing
Adult education programs
Information Management
Human relations with customers, employees, and management
PCs in a mainframe environment
More technical topics
Doing more with less; Build vs. Buy
Administrative computing needs of academic units
Changing the organization's culture
Motivation for employees during periods of profound change
Techniques for obtaining endorsement from university executives for new approaches to implementing technology
IRM
Case studies in use of instructional technology
Organizational changes needed to support distributed computing
Libraries - computing integration
Human impact of technology
Minis and Micros
Documentation and training sessions
Merging technologies
Object oriented software development and software reuse
NREN/Internet

Highly respected speakers - 3
Joel Barker on paradigms, particularly as they relate to education
Gene Stanaland - 4
Buck Rodgers - 2
Bill Gates - 2
Carl Jacobson - 2
Clifford Stol
Brian Hawkins
Steve Jobs
Peter Lyman
Lamar Alexander
James Wetherbe

4. Do you have any comments about the site of CAUSE91?

Excellent choice, very nice - 103
Fair - 11
Too spread out - 23
Too isolated - 13
Over priced - 7
Food was bad - 4
Not organized for business conferences - 2
Hotel too small - 2
Too far from East coast - 3
Too much security
Not good for people with dietary restrictions

5. What CHANGES would you like to see at future conferences?

None - 14
Too many competing activities (add more time or cut activities) 20
More handouts, especially for track sessions - 7
Need a detailed map/floor plan - 7
Different levels of speakers: some basic, some advanced - 5
Some tracks should have longer sessions than 45 minutes - 5
Expand poster sessions (More accessible, extend over breaks, provide technical support, more sessions) - 5
Cancel corporate hospitality suites or have bigger suites -3
Registration materials should be sent out earlier - 3
Open corporate demo area when no sessions scheduled - 3
Videotape sessions - 2
More small groups along regional lines - 2
Spread out constituent groups so attendance at several is possible - 2
Add spouse activities - 2
Meal tickets should fit in name badge - 2
Less food at the lunches - 2
Change time of conference
    Wednesday - Saturday (miss less work; Sat stayover for plane ticket) - 2
    Sunday - Wednesday schedule
    Too close to Thanksgiving - 2
    Too close to EDUCOM
    Have it in the summer
    Have it in the spring
Hold the conference on a cruise ship
Have copies of track papers (Proceedings) available before the conference
Electronic diskette delivery of papers to speed up Proceedings
More emphasis on Round Tables and Constituent Groups
More presentations from small colleges
More activities for first year attendees
More interactive presentations
More vendor sessions that are not sales pitches

Provide a means for conferees to write their most pressing problems and provide that to vendors to offer solutions
Put job title(s) after session abstract in program to indicate for whom the session is recommended
Registration list sorted by title in order to locate peers
Get executives of universities to attend
Look up email by first name
Like to see more HBCUers (persons from Historically Black Colleges & Universities)
Indicate newcomers on badges to welcome them
Large type on badges to identify state
Large type on badges to identify institution
Pin badges should be available
University tours like EDUCOM
Buffets rather than sit down meals
Juice in addition to coffee at breaks

6. What made you decide to attend CAUSE91? Please rank in order of importance the following, with "1" indicating the most important.

	1	2	3	4	5	6	7	8
Program content	41	40	27	22	12	3		
Conference location	4	6	13	16	13	25	20	2
Peer recommendation	22	7	10	10	11	12	22	1
Identification with CAUSE	28	14	18	21	17	16	9	
Networking with colleagues	41	48	34	13	9	7		
Corporate demonstrations	3	8	15	20	26	15	22	
Professional development	35	42	32	22	12	3	2	

Other:

1 longtime attendee; presenter; sent by boss
3 Board meeting; new job assignment; great speakers; presenter; opportunity to learn
4 recruitment
5 networking with vendor reps; another meeting coincided with CAUSE91

7. "I would like to say..."

Excellent, rewarding, worthwhile conference - 60
Best conference I've ever attended - 4
Well organized - 10
Thanks to CAUSE staff and all who helped - 25
I'm tired of vendor manipulated presentations, in particular free ads for IBM. (vendor participant)
I was a first time presenter and feel very proud to have contributed to CAUSE.
Don't get too smug or groupie oriented.
Marginal experience because of poor program content.
Some confusion at vendor area both days.
Convince the conference hotel to make dancing available.

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TRACK PRESENTATIONS - WEDNESDAY, DECEMBER 4

TAPE 1 TRACK I - IMPROVING PRODUCTIVITY IN HIGHER EDUCATION
TAPE 2 TRACK II - ELECTRONIC APPROVAL: A PAPERLESS OFFICE
TAPE 3 TRACK III - DRUCKER'S RIGHT. LET YOUR PEOPLE GROW
TAPE 4 TRACK IV - HERDING CATS AND NETWORKED RESOURCES
TAPE 5 TRACK V - INTEGRATING TELECOMMUNICATIONS AND NETWORKING
TAPE 6 TRACK VI - TECHNOLOGICAL CHANGE IN THE CLASSROOM
TAPE 7 TRACK VII - EXECUTIVE/DECISION SUPPORT SYSTEM
TAPE 8 TRACK VIII - IS CLIENT/SERVER THE FUTURE OF INFORMATION PROCESSING?
TAPE 9 TRACK I - STRATEGIES FOR DEALING WITH 'IT' COMPLEXITY
TAPE 10 TRACK II - QUALITY OF SERVICE
TAPE 11 TRACK III - DOES INTEGRATED SOFTWARE CREATE INTEGRATED MANAGEMENT?
TAPE 12 TRACK IV - DEVELOPING STANDARDS FOR QUALITY INFORMATION
TAPE 13 TRACK V - PLANNING FOR INTEGRATED TELECOMMUNICATIONS
TAPE 14 TRACK VI - THE CLASSROOM A 'VIRTUAL COMMUNITY'
TAPE 15 TRACK VII - E-MAIL AS AN INSTITUTION-WIDE INFORMATION SERVER
TAPE 16 TRACK VIII - DISTRIBUTED COMPUTING, CENTRALIZED SUPPORT
TAPE 17 TRACK I - CHANGING THE CULTURE: IMPLEMENTING TQM
TAPE 18 TRACK II - MEASURES OF PERFORMANCE
TAPE 19 TRACK III - MERGING ACADEMIC AND ADMINISTRATIVE COMPUTING
TAPE 20 TRACK IV - MANAGING INFORMATION TECHNOLOGY ETHICS AND VALUES ISSUES
TAPE 21 TRACK V - NETWORK GROWTH AND EVOLUTION
TAPE 22 TRACK VI - ELECTRONIC LIBRARIES IN THE 90s
TAPE 23 TRACK VII - QUALITY- JUST IN 'CASE'
TAPE 24 TRACK VIII - MOVING TO THE CLIENT/SERVER MODEL

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CORPORATE PRESENTATIONS

TAPE 25 AMERICAN MANAGEMENT SYSTEMS - INFORMATION TECHNOLOGY
TAPE 26 APPLE COMPUTER - INFORMATION ACCESS
TAPE 27 INFORMATION ASSOCIATES - AN ARCHITECTURE FOR THE 90s
TAPE 28 JOHN MINTER ASSOCIATES - CAMPUS POSITION AND PERFORMANCE
TAPE 29 KPMG PEAT MARWICK - JUSTIFYING MAJOR SYSTEM IMPLEMENTATIONS
TAPE 30 PERIPHONICS CORPORATION - VOICE PROCESSING TECHNOLOGY
TAPE 31 SOFTWARE AG - APPLICATION DECISIONS IN A CLIENT/SERVER ENVIRONMENT
TAPE 32 STORAGTEK I - CARTRIDGE TAPE AUTOMATION
TAPE 33 SYSTEMS & COMPUTER TECHNOLOGY - CLIENT/SERVER TECHNOLOGY
TAPE 34 XEROX - UNIVERSITY DOCUMENT SERVICES

ASK THE EXPERTS

TAPE 35 ASK - HIGH QUALITY PRODUCTION PUBLISHING

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TRACK PRESENTATIONS - THURSDAY, DECEMBER 5

TAPE 36 TRACK I - DO YOU HAVE YOUR BACK TO THE FUTURE?
TAPE 37 TRACK II - MEASUREMENT OF THE BUSINESS VALUE OF 'IT
TAPE 38 TRACK III - DESIGNING A STRATEGIC ROLE FOR AN 'IT' ORGANIZATION
TAPE 39 TRACK IV - IMPLEMENTING AN INSTITUTIONAL REPOSITORY
TAPE 40 TRACK V - CWRUnet -A CAMPUS-WIDE FIBER-TO-THE-DESKTOP NETWORK
TAPE 41 TRACK VII - IMAGING SYSTEMS AN OVERVIEW FOR MANAGERS
TAPE 42 TRACK VIII - DISTRIBUTING ONLINE ACCESS--FAST
TAPE 43 TRACK I - STRATEGIC PLANNING GUIDING THE COMPUTING ORGANIZATION
TAPE 44 TRACK II - SECURING TCP IP AND DIAL-UP ACCESS
TAPE 45 TRACK III - DATA ACCESS SERVICES
TAPE 46 TRACK IV - A MANAGER'S PERSPECTIVE ON THE CLIENT/SERVER MODEL
TAPE 47 TRACK V - CENTREX OR SWITCH: MEETING CAMPUS COMMUNICATIONS NEEDS
TAPE 48 TRACK VI - INTEGRATING ELEMENTS WITHIN AND ACROSS INSTITUTIONS
TAPE 49 TRACK VII - A VISION OF THE FUTURE IT STARTS ON THE DESKTOP
TAPE 50 TRACK VIII - CENTRALIZED BUDGET PREPARATION
TAPE 51 TRACK I - A REVERSE ENGINEERING APPROACH TO 'IT' PLANNING
TAPE 52 TRACK II - USING PLANNING MODELS IN TIMES OF FINANCIAL CRISIS
TAPE 53 TRACK III - STUDENT ADMINISTRATIVE SERVICES
TAPE 55 TRACK V - CAMPUS NETWORKING: THE HUMAN SIDE
TAPE 56 TRACK VI - AN EXPERIMENT IN THE REORGANIZATION OF LIBRARY AND 'IT' SERVICES
TAPE 57 TRACK VII - MAKING INFORMATION ACCESSIBLE
TAPE 58 TRACK VIII - PROVIDING DISTRIBUTED SERVICES WITH CENTRALIZED RESOURCES

CORPORATE PRESENTATIONS

TAPE 59 AMERICAN MANAGEMENT SYSTEMS - 'IT' AND THE UNIVERSITY ADMISSIONS OFFICE
TAPE 61 DATAGUARD RECOVERY SERVICES, INC - UNIVERSITY DISASTER RECOVERY PLANNING
TAPE 62 DATATEL - USER PARTICIPATION IN PRODUCT DEVELOPMENT
TAPE 63 DELOITTE & TOUCHE - WILL THE REAL REENGINEERING DEFINITION STEP FORWARD?
TAPE 64 DIGITAL EQUIPMENT CORPORATION - PROJECT SEQUOIA 2000
TAPE 65 GARTNER GROUP - STRATEGIC PLANNING ASSUMPTIONS
TAPE 66 IBM CORPORATION - MULTIMEDIA AND THE COLLEGE CAMPUS
TAPE 67 NOVELL - MAGNIFYING INFORMATION POWER
TAPE 68 THE ROBINSON GROUP - PREPARING FOR THE NEW FRONTIER

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TAPE 70 TECHNOPHOBIA: FROM STUDENTS TO COLLEGE PRESIDENTS
TAPE 71 CONSOLIDATING, OUTSOURCING, AND DOWNSIZING
TAPE 72 THE VIRTUAL LIBRARY
TAPE 74 CLIENT/SERVER ARCHITECTURE AND DISTRIBUTED COMPUTING

FRIDAY, DECEMBER 6

TAPE 79 GENERAL SESSION - TRANSFORMING HIGHER EDUCATION
TAPE 80 THE CURRENT ECONOMY

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