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ABSTRACT

The 1985 annual meeting of CAUSE, the Professional Association for Computing and Information Technology in Higher Education, addressed the current state and the future of higher education computing from a planning and management perspective, and provided participants with a forum to share special problems and opportunities confronting administrators and computing professionals in higher education. The document opens with information on general sessions including the CAUSE Annual Business Meeting, two general session presentations (George Keller, William R. Monat), a current issues forum on the topic of security issues in higher education, and five special interest sessions. The conference theme was addressed through 45 professional presentations in 7 subject tracks: (1) Policy Issues in Higher Education; (2) Planning for Information Technology; (3) Special Environment; (4) Telecommunications/Networking; (5) Microcomputer Issues and Applications; (6) People Issues in Information Technology; and (7) Managing Academic Computing. Information submitted by participating vendors and commentary on and pictures of conference social activities conclude the proceedings. (THC)

CAUSE

1995--Planning and Managing the Odyssey

Proceedings of the 1985 CAUSE National Conference

December 10-13, 1985
New Orleans Hilton

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CAUSE, the Professional Association for Computing and Information Technology in Higher Education, helps colleges and universities strengthen and improve their computing, communications, and information services. The association also helps individual members develop as professionals in the field of higher education computing and information technology.

Formerly known as the College and University Systems Exchange, CAUSE first organized as a volunteer association in 1962 and incorporated in 1971 with twenty-five charter member institutions. That same year the CAUSE National Office opened in Boulder, Colorado, with a professional staff to serve the membership. Today the association serves over 1,800 individuals on 700 campuses representing 480 colleges and universities and twenty sustaining member companies.

CAUSE provides member institutions with many services to increase the effectiveness of their computing environments, including: the Administrative Systems Query (ASQ) Service, which provides information from a data base of member institution profiles; the CAUSE Exchange Library, a clearinghouse for documents and systems made available by members through CAUSE; an Information Request Service to locate specific systems or information; consulting services to review the computing environment and management plans of member institutions; association publications, including a bi-monthly newsletter, a bi-monthly professional magazine, and the CAUSE monograph series; cooperative workshops with other higher education associations and member campuses; and the CAUSE National Conference.

We encourage you to use CAUSE to complement your individual efforts at strengthening your institution's management and educational capabilities through the use of computing and information technology.

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1995--Planning and Managing the Odyssey

INTRODUCTION

As computing professionals in colleges and universities, we have always had to plan strategies for our computing organizations. But the challenges of changing technologies and expanding user needs make a planned approach to managing computing more important than ever as we are called upon to provide guidance in the planning process for the computing environment of the entire institution. Planning, design, implementation, and feedback- as well as ongoing maintenance--are necessary ingredients if we are to successfully navigate the uncharted course of information technology in the next decade.

CAUSE85 addressed the current state and the future of higher education computing from a planning and management perspective and, equally important, provided participants a forum in which to share the special problems and opportunities that confront administrators and computing professionals in higher education.

As we addressed these issues at CAUSE85 we were fortunate to have two distinguished general session speakers: George Keller, one of America's leading educational consultants and author of the best-selling *Academic Strategy: The Management Revolution in American Higher Education*, and William R. Monat, Chancellor of the Board of Regents for the Regency Universities System of Illinois. With forty-nine presentations in seven different tracks and an all-time-high attendance of 702, the conference offered invaluable opportunities for exchanges of information, experiences, management tips and planning advice, as well as the chance to refresh once-a-year friendships.

We hope these *Proceedings* will be a continuing resource throughout the year, and a reminder of the many activities and opportunities offered by both the conference and the association.

Lew

M. Lewis Temares
CAUSE85 Chair

ACKNOWLEDGMENTS

The success of the CAUSE National Conference is due entirely to the contributions of people and supporting organizations. Although it is impossible to identify all of those people who contributed time and effort to the planning and operation of CAUSE85, several individuals and organizations deserve special attention.

The CAUSE85 Program Committee spent many hours working with the CAUSE staff to produce an effective, efficiently-run conference. CAUSE gratefully acknowledges their enthusiasm and efforts and the support of their institutions.

1985 CAUSE NATIONAL CONFERENCE PROGRAM COMMITTEE

From left to right, seated: Karen McBride, CAUSE; CAUSE85 Vice Chair Harry Grothjahn, University of Georgia; Ken Klingenstein, University of Colorado; CAUSE85 Chair Lew Temares, University of Miami. From left to right, standing: Dave Ernst, Stanford University; Chuck Bettinson, Lansing Community College; Deborah K. Smith, CAUSE; Lucinda Cloutier, Gateway Technical Institute; Dick Mann, University of Kansas; Jane Knight, CAUSE; Dave Miller, New York City Technical College; Bob Little, University of Miami; Sam Plice, University of Michigan; Joe Catrambone, Loyola University of Chicago; Dana van Hoesen, CAUSE; and Chuck Thomas, CAUSE.

Dana van Hoesen and Jane Knight of the CAUSE staff supervised the logistics of conference registration, both prior to and at CAUSE85. CAUSE appreciates the long hours they logged behind the registration desk, as well as their helpful attitude. The assistance of Louis Crispino and Florence Brown of Tulane University at the registration desk, and of CAUSE staff member Karen McBride for help with registration and production of the conference program and *Proceedings*, is also appreciated.

A special note of thanks is due Julia A. Rudy and Deborah K. Smith of the CAUSE staff for their untiring and always professional efforts. From the advance preparations which began over a year before the conference through publication of these *Proceedings*, their special expertise and dedication contributed a great deal toward the success of the conference.

CAUSE also thanks the vendors who set up Suite Exhibits and sponsored Refreshment Breaks, the Registration Reception, and the Tennis Tournament, and those who gave vendor presentations and provided an evening of hospitality in their suites.

1985 CAUSE BOARD OF DIRECTORS

Left to right: John Monnier, CAUSE President, University of Arizona; Cedric Bennett, Stanford University; Judith Leslie, Pima Community College; Martin Solomon, Ohio State University; James Penrod, CAUSE Vice President, California State University/Los Angeles; Kathlyn Doty, Loyola University of Chicago; William Mack Usher, Oklahoma State University; Sandra Dennhardt, CAUSE Secretary/Treasurer, University of Illinois System; Charles R. Thomas, CAUSE Executive Director; Charles Naginey, CAUSE Past President, Pennsylvania State University. Missing from the photo is Wayne Ostendorf, Iowa State University.

The continuing support of the CAUSE Board of Directors and the membership they represent is also gratefully acknowledged and appreciated. Retiring from the 1985 CAUSE Board were Charles H. Naginey, Penn State University; James I. Penrod, California State University/Los Angeles; Martin B. Solomon, Jr., Ohio State University CAUSE members elected to three-year terms on the Board of Directors beginning in 1986 were Bernard W. Gleason, Jr., of Boston College; M. Lewis Temares, University of Miami; and Thomas W. West of The California State University.

Phil Charest (above left), and Jack Steingraber (above right) were among those who received certificates of appreciation for their committee service.

The association is supported by five CAUSE Member Committees which are increasingly creative and active. CAUSE appreciates the time and effort contributed by the volunteers who carry out the duties of these committees. At the annual Business Meeting on the morning of the first day of CAUSE85 President John Monnier thanked the many people who support CAUSE through participation on association committees and presented certificates of appreciation to a number of individuals who were retiring from committees. For their service on the Election Committee: James L. Strom, California Polytechnic State University; Joseph A. Catrambone, Loyola University of Chicago; Gary D. Devine, University of Colorado, C. C. Mosier, Iowa State University; Patricia I. Sagadine, Loyola University of Chicago. For service on the Recognition Committee: Michael M. Roberts, Stanford University and John Eoff, New Mexico State University. For service on the Current Issues Committee. Jack Steingraber, Southern Illinois University, and Bill Vickers, Metropolitan State College. For service on the Editorial Committee: Richard D. Howard, North Carolina State University, Philip G. Charest, Villanova University, and Fred Reiner, Johns Hopkins University.

GENERAL SESSIONS

CAUSE85 was highlighted by several general sessions in which all conferees were invited to convene to share in activities of general interest. The conference opened with an orientation session offering information about CAUSE as an association as well as advice from experts on how to "cover" all the activities of the conference. This session was followed immediately by the CAUSE Annual Business Meeting, which included the colorful and informative slide presentation called, "CAUSE Today and Tomorrow." Two eminent educational authorities presented general-session addresses to open the Wednesday and Thursday activities (see pages 6-7). The CAUSE Board of Directors, CAUSE85 Program Committee members, and recipients of CAUSE awards were honored at luncheons during the conference (see pages 8-9). The final general session of CAUSE85 was a Current Issues Forum on the subject of security issues in higher education (page 10).

KEYNOTE ADDRESS

Future Directions for Strategic Management

George Keller
Senior Vice President
Barton-Gillet Company

George Keller, noted author of *Academic Strategy: The Management Revolution in American Higher Education*, presented an address which focused on two new roles facing computing professionals today. One is the arrangement of information to make the new campus management possible. The other is the sensitive incorporation of new technology into the traditional college environment. Mr. Keller advised that computing professionals will need to move from being backroom data-gatherers to full partners in campus management, and will need to prepare themselves accordingly.

Mr. Keller has received *Atlantic Monthly's* education writer of the year award, the Sibley Award for education magazine editing, and the U. S. Steel Foundation medal for "distinguished service in higher education."

Mr. Keller and CAUSE85 Vice Chair Harry Grothjahn.

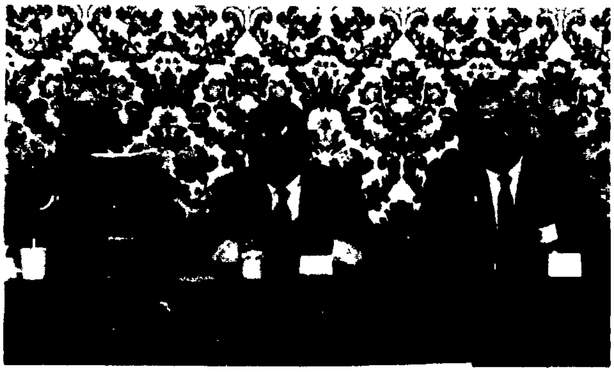
INSTITUTIONAL APPROACHES FOR ANTICIPATING THE FUTURE: STRATEGIC PLANNING, OR FLYING BLIND INTO THE 21ST CENTURY

THURSDAY MORNING ADDRESS

Dr. William Monat discussed the differing and at times divergent information processing and transmission requirements of a university from a chancellor's perspective. He suggested that academic administrators for the foreseeable future will need to invest time and resources in strategic planning to both anticipate and realize the irresistible demands for computing and information transmission capabilities.

In his former position as president of Northern Illinois University, Dr. Monat reorganized all computer operations on campus under the direction of an executive director for computing facilities, and introduced a new telecommunications system with voice and data transmission capabilities.

William Monat
Chancellor
Board of Regents
Regency Universities System
of Illinois



CAUSE85 Chair Lew Temares, Dr. Monat, and Vice Chair Harry Grothjahn.

CONFERENCE LUNCHEONS

At the first-day luncheon, members of the CAUSE85 Program Committee received certificates of appreciation for their contribution to the conference, and registration staff were acknowledged. Newly elected CAUSE Board Members were announced: Bernard Gleason, Boston College; Lew Temares, University of Miami; and Thomas West, California State University System. Retiring Board Members were honored and acknowledged for their service to CAUSE (see below). At the Awards Luncheon, held on the second day, 1986 CAUSE officers were announced (see below) and CAUSE Awards were presented (see facing page).

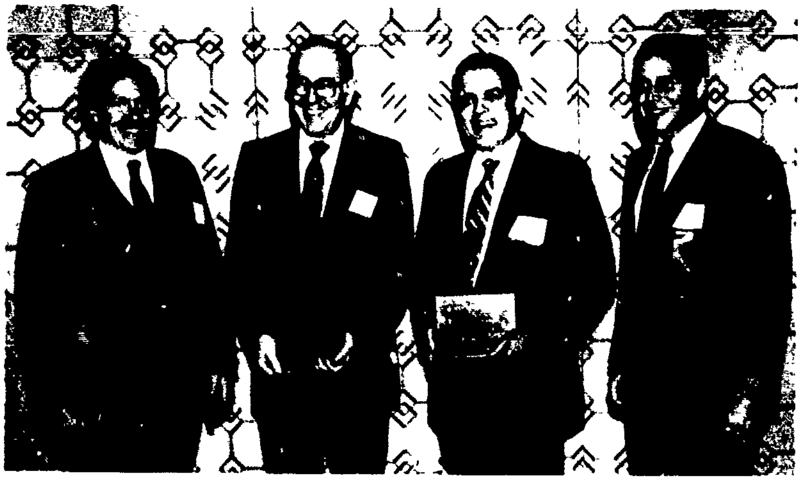
Outgoing President John Monnier presents the gavel to newly elected President Judith Leslie.

1986 CAUSE President Judith Leslie presents a plaque to commemorate his presidency to John Monnier.

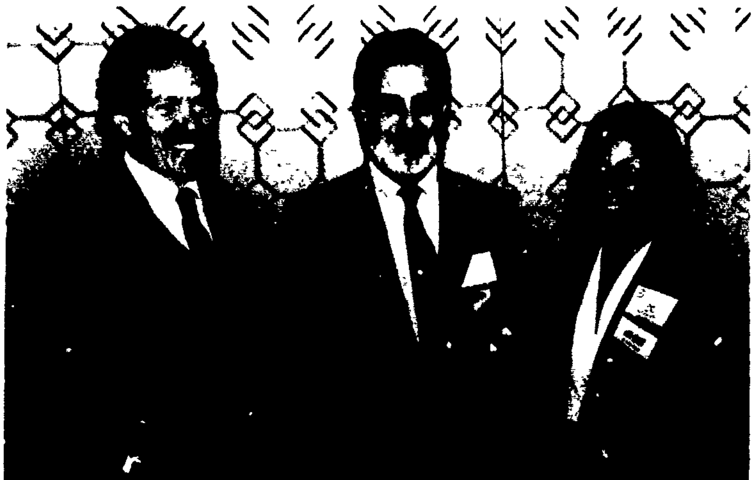
1986 CAUSE Secretary/Treasurer, Cedric Bennett, Stanford University (left) and Vice President, William Mack Usher, Oklahoma State University.

Retiring Board Members receive certificates of appreciation (left to right): Charles Naginey, Penn State University; James Penrod, California State University/Los Angeles; and Martin Solomon, Ohio State University.

AWARDS



Left to right: John Monnier, CAUSE85 President; Erwin Danziger, Director of Administrative Data Processing, University of North Carolina at Chapel Hill; William Lavery, President, Virginia Polytechnic Institute and State University; and John Robinson, President, Information Associates. Mr. Danziger and President Lavery were the recipients of the 1985 CAUSE Recognition Awards for excellence and leadership in the field of computing and information technology in higher education. The Awards were sponsored by Information Associates, Inc.



Left to right: John Monnier, 1985 CAUSE President; Robert Heterick, Professor of Management Science at Virginia Polytechnic Institute and State University; and Claire Reid, Vice President, Human Resources, Systems & Computer Technology Corporation. Dr. Heterick and Raman Khanna (unable to attend the ceremony) received the 1985 CAUSE/EFFECT Contributor of the Year Award for their article, "Servicing Personal Computers," which appeared in the January 1985 edition of CAUSE/EFFECT magazine (pp. 4-11). The Award was sponsored by Systems & Computer Technology Corporation.

CURRENT ISSUES FORUM

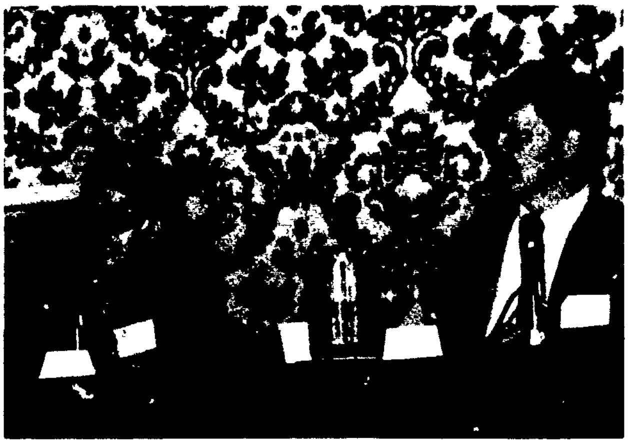
SECURITY IN HIGHER EDUCATION COMPUTING

Moderator Jack Steingraber
Southern Illinois University
Edwardsville

FRIDAY CLOSING SESSION

Security is a key concern for most colleges and universities today, as distributed computing, networking, and information centers all contribute to increased user access to institutional data. This topic was the subject of the closing general session of CAUSE85. The Forum was moderated by Jack Steingraber, Chair of the 1985 Current Issues Committee.

Four panelists discussed different aspects of computing security in higher education. Lore Balkan-Vickers, Data Base Analyst at Virginia Tech presented "Tailoring On-Line Authorization to Responsibility." George Carroll, Director of the Center for Computing and Management Services at Rutgers spoke on "Improving Security: Your Auditor's Role." Michael Zastrocky, Director of Management Information Services at Regis College presented "Cloak and Dagger Security, or How to Protect Your Data Base from PCs." Ronald Langley, Director of the SW Academic Computing Services, University of Alaska/Anchorage, discussed "Hack Attack Defense." Papers based on their presentations follow.



Lore Balkan-Vickers
Virginia Tech

George Carroll
Rutgers

Mike Zastrocky
Regis College (Colorado)

Ron Langley
University of Alaska/Anchorage

TAILORING ON-LINE ACCESS TO RESPONSIBILITY

Lore Balkan-Vickers
Virginia Tech
Blacksburg
Virginia

Virginia Tech has developed an access control system that supports delegation. A manager's access is tailored to his responsibility and likewise, each manager can tailor his subordinates' access. This paper reviews the Administrative Computing Strategy that clarified requirements for our access control system and the concepts we implemented to assure a secure information processing environment. Implementation of these concepts has resulted in Virginia Tech's capability to electronically capture a document at its source and route it through appropriate channels for electronic signature approval. The paper goes on to discuss our immediate plans for capturing access control definitions at source point and ends by examining with 20/20 hindsight, some reasons for our success.

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AVAILABLE AND YET PROTECTED

Data is a resource, it must be available, correct, and protected. The data administrator is charged with ultimate responsibility to assure the data is accessible, has integrity, and remains secure. But who determines what access is appropriate, who ascertains that information is accurate, who are the caretakers? It is not the data administrator or even the security administrator. The real caretakers or data managers are those who are responsible for activities that create and manipulate data or information. Traditional data base management systems such as IMS do not lend themselves to flexible access control because of their rigid data structures and complex access methods. In an effort to overcome these limitations, we formulated our data access goals in terms of responsibility and availability and then looked for tools and techniques to support delegation of protection responsibility.

ADMINISTRATIVE COMPUTING ENVIRONMENT

Virginia Tech is the Commonwealth's land grant university with a current enrollment of 23,300 students. Central computing facilities support all administrative, academic, and research "main frame" computing. Major administrative systems such as student records, purchasing, accounting, position control, personnel, and payroll are IMS data base systems developed in-house and written primarily in COBOL. As systems are developed, they are turned over to a system coordinating group that reports to the director managing the user area. For example, the Payroll/Personnel System Coordinator reports to the Assistant Vice President for Administration and Operations. All computer, communication and information service departments report to the Vice President for Computing and Information Systems. The Systems Development Department, with the System Coordinator participating on the development team, does major enhancements to administrative systems such as redesign or data base changes. System coordinators are responsible for daily operation and routine maintenance of existing systems.

STRATEGY FOR ADMINISTRATIVE COMPUTING

Our access goals were driven by a global strategy for administrative computing adopted by Virginia Tech. This strategy was documented by Vinod Chachra and Robert C. Heterick in a 1982 CAUSE Monograph Series publication entitled Computing In Higher Education: A Planning Perspective for Administrators. The concepts are summarized below.

- Source Point Data Capture - University transaction documents enter the data base systems where they originate. Instead of paper documents being typed and routed into the system, staff type the documents at terminals located in every department on campus and administrators sign them electronically as necessary.

- Value Added Data Handling - Individuals receive documents electronically only if they provide input to the transaction or have signature authority. Access to the document is available for informational purposes but does not delay the document's flow through required channels.

- Destination Point Document Generation - The office ultimately responsible for verifying a document prints the document only as required for communication external to the University.

- Transaction Tracking System - Electronic document processing includes monitoring event sequence and restricting individuals to activities and records that reflect job responsibility and realm of authority.

The final concept came to the heart of the matter. In order for administrators, faculty and staff to truly use the computer daily as a tool, rather than merely a repository for data, activity would have to mirror responsibility and be auditable. Clearly, more sophisticated access controls were required in order to implement source point data capture, value added data handling, and destination point document generation.

THE ACCESS CONTROL FOUNDATION

A university differs from private industry in its commitment to "academic freedom". As a result, formal policy is limited and functional areas have considerable autonomy. Access controls must therefore both secure data and provide flexible data accessibility, managed by each administrative unit according to individual management styles.

The logical terminal (LTERM) security provided with IMS no longer provides sufficient access control. When access decisions vary with each administrative unit and likewise, for each individual within the unit, LTERM security fails to provide sufficient flexibility. Moreover, audit trails must track back to an individual who performs a function, not to the location (terminal) where a function is performed. Finally, the Virginia Tech communication environment is evolving to support efficient resource utilization, allowing users to alternate between various systems and environments from a single personal work station. Without dedicated IMS terminals, logical terminal security is nonexistent.

In considering alternatives to address our changing environment, a major requirement was "to electronically verify an individual's identity each time a function is performed". Each singly threaded IMS system update may require the user's identity to create an audit trail, as well as to authorize update clearance for the particular record. To programmatically do this with optimum security, the user must reiterate his identity each time an update is performed. Since the session concept embraced by both logical terminal security and commercially available access control software does not provide for the required reverification, we developed our own system based on individual authorization and stringent password control. An important policy decision preceded the initial design effort: Update access requires individual clearance. To verify identity and clearance, the user must type his individual password on every screen.

Below is a summary of the proposal prepared by Data Administration and presented to the University administration in the Spring of 1982.

Concepts for On-line Access Control

With the recent move toward source point data capture, the issue of security and authorization becomes more important and also more complex. The very nature of security is to make unauthorized access difficult, if not impossible. Unfortunately, there are instances where some end-user convenience is sacrificed in order to properly secure sensitive data. Methods to authorize distributed on-line access, maintain required audit trails, and prevent abuse of access privileges are:

- Unique IMS Authorization ID for each user who uses IMS transactions with an interface to the Personnel System to verify "active" employee status.
    - Identifiable individuals are held accountable for all update access.
    - The system automatically disables authorization when an employee terminates or transfers departments.
- User defined and controlled Password associated with each IMS Authorization ID. Password entry is required with each access to verify the individual's identity.
    - The IMS Authorization ID owner may change the Password whenever Password secrecy is compromised.
    - The Password is never printed or displayed.
    - The Password is encrypted by the IMS Message Format Service prior to program execution. Only an encrypted version of the Password is stored by the system and accessible by application programs checking validity.
    - A user is programmatically forced to set the Password the first time he uses the IMS Authorization ID and to change it at periodic intervals thereafter.

  - Edit rules for Password composition are enforced so a user may not select easily guessed combinations such as initials, portions of first or last name, or the IMS Authorization ID itself. The Password may not be set equal to the character string used for a defined number of preceding change iterations.
  - The Password must be a minimum of five characters to decrease the possibility of speedy "trial and error" guessing. This is a widely accepted standard.
  - If a Password is keyed incorrectly a specified number of times, the IMS Authorization ID is disabled with the assumption that someone is attempting to guess the Password.

- Systematic distribution of authorization system update to those individuals who have been delegated the responsibility for managing University data.
  - The procedure for providing new users with authorized access is automated with input captured at the source.
  - The system supports delegation of access privilege and maintains a "distributor" record to indicate the original owner, and therefore supervisor, of the delegated function.
  - A systematic audit trail is maintained for all assignment of authorization.

- A user classification scheme to reflect the extent and distribution of authority over the most pertinent University data, both financial and academic.
  - The extent of access for a user is dependent on responsibility for expending University resources or making University decisions.
  - Update and inquiry access to data is distributed in a consistently controlled manner across the University community, e.g., a common level of access is granted to individuals who have similar responsibilities.
  - A new function (group of related transactions) is systematically and consistently distributed to all potential users.

Data Value Control

In order to capture data and resulting documents at their source and electronically route them for further processing and approval, data dependent restrictions have to be associated with access. For example, an individual in the Biology Department can only be allowed to enter graduate student appointments for funding associated with that department. Likewise, the required approval for each appointment document depends on the funding. Our terminology for this kind of access restriction is "data value control". Various Virginia Tech systems have different kinds of data value control. For example, a grade change for an Art major can be done only by the dean's office in the related college, Arts and Sciences. Similarly, electronic fund transfer for Computing Center run accounts can only be done by someone with master account authority

Nearly all update applications require data value control to insure that changes are made within the appropriate realm of authority. Many inquiry applications also use data value control to protect sensitive data and privacy.

There are two primary data bases that control authorized access. The first is the Authorization User data base with a record for each IMS Authorization ID that includes the status of the ID, who created the ID, when the ID was last used, and when the password was last changed. The second is the Authorization Data Value data base which contains a record for each data value, such as an account, the functions related to each data value, and for each function, the IMS Authorization IDs that can do the function for the data value. If no data valu checking is required, the function is dependent on a null data value.

The Authorization Transaction data base is a supporting file containing a record for each transaction and grouping transactions for the functions found in the Authorization Data Value data base.

<u>All new on-line IMS transactions must be secured with the Authorization System unless they can be available to all IMS users and therefore, remain unsecured.</u> In order to gain access to an authorized transaction, a user must have an active IMS Authorization ID with a password that has been changed within the last 90 days. When a user enters an IMS transaction, he receives an IMS Authorization Menu which requests his IMS Authorization ID, his password, and key data pertinent to the particular application. The application calls the Authorization Data Value Check subroutine that verifies the IMS Authorization ID status is "active", and the password correct. It then verifies that the IMS Authorization ID is cleared for the re ited function as well as for the requested record or data value.

ACCESS CONTROL SUPPORTS OUR STRATEGY

A number of Virginia Tech systems have incorporated source point data capture. The Virginia Tech Library System and the Graduate Plan of Study system are two prime examples where data electronically enters a system at its point of origination. New library collections are entered on the system as they are received and graduate students have the capability of entering their plan of study and modifying it as they progress.

Supporting Electronic Signature Authority

The Graduate Student Payroll Appointment, which is referred to as a G-3, was the first source point document to use the enhanced authorization system for both entry and electronic signature approval. Virginia Tech began signing documents electronically in August 1984. Source point capture of the G-3 document automated the numerous edits that were performed as the document was routed through University channels. Most of these control points were eliminated, with summary and detail information still available to all concerned "for information only". Data value control supports multiple levels of signature approval authority. A document is electronically routed to each sequential level of the signature hierarchy. The signature hierarchy is specified by departmental units and validated by the University Controller, who is ultimately responsible for verifying University financial transactions.

It is the responsibility of those with signature authority to query their on-line inbasket regularly and to optionally approve or disapprove electronic documents awaiting signature. The electronic signature approval process has a generic design so that all documents supported by this system are available with one inbasket query. A second document type for source point entry and electronic signature, Wage Payroll Timecards, is scheduled for production implementation in February 1986.

Supporting Required Edits and Audits

The signature hierarchy data in the Data Value data base includes a begin and end date for each signer within account and function. This allows signature authority to be assigned for a designated period of time or to be terminated. When signature authority changes, the system takes an audit trail of how the signature authority looked prior to the change and who made the change.

The Inbasket data base consists of document facsimiles that are waiting for signature. Each document has a "signature mask" the inbasket signature application uses to display the correct documents for a given IMS Authorization ID (signer). The "signature mask" or signature dependent data may be different for different kinds of documents. In the case of a G-3 document, the funding account is the "signature mask" and the Inbasket data base holds a facsimile for each account that funds the graduate appointment. The inbasket application matches the signer's "signature authority mask" with the document "signature mask". Matched documents are dynamically placed in the signer's inbasket when he issues the IMS inbasket signature transaction.

For example, assume that a G-3 appointment funded by account XXYYYZZZZ is entered in the system. The Inbasket data base has a facsimile of the document with the funding account XXYYYZZZZ as the "signature mask". When any SIGNER uses the IMS inbasket signature transaction, the application program looks at the Data Value data base to determine all potential "signature authority masks" or accounts for which the SIGNER IMS Authorization ID has signature authority. For each one found, the program looks for a matching "signature mask" or funding account in the Inbasket data base. Dynamic building of individual inbaskets makes it possible for signature hierarchies to be changed at any time. Each execution of the inbasket signature transaction uses the most current signature hierarchies found in the Data Value data base.

An Audit data base is updated to indicate when departmental units have completed signing a document and it is ready for the end user department, in this case the Payroll Office, to take final action. The Inbasket History data base has a record of each signature actually applied to a document. Additionally, cancellation of a document results in creation of an Inbasket History record. Each history record includes date, time, and who signed or cancelled the document.

DISTRIBUTING THE ACCESS CONTROL FUNCTION

If you stop to imagine the potential mass of information that must be maintained to support unique data value control for a variety of entry and/or signature applications, it becomes clear that the access control function itself is a priority candidate for source point data capture and electronic signature approval. Fortunately the source point of this information is in fact distributed throughout the campus, in each and every department. It is the Department Head who delegates responsibilities which then can be translated into access control definitions.

Development work is currently underway to support distribution of access control. Department Heads will have access to a given set of functions, which we call toolkits. They will have both use of the functions and the authority to distribute the functions. They will have the option of distributing entire toolkits or select functions from a toolkit.

A function may include one or more IMS transactions, all using the same type of data value control. Each function can be redistributed for all the distributor's data values or further limited to more restrictive data values. For each data value type, we will define containment rules and employ indexing to assure that data value masks are valid. Thus, application programs will handle instances where one data value mask is contained within another to prevent redundant masks.

Department Heads will have the option to distribute a function for use only or for use as well as further distribution. They will distribute directly. However, execution of delegated distribution rights will trigger creation of a document that will require Department Head electronic signature.

The distribution program will support individual tailoring of access. The more tailoring desired, the more complicated the process will be. However, distribution by toolkit for a complete set of "departmental" data values is likely to be the most common method used and it will be simple and straight forward. Assistance will be available from the distribution program by way of HELPS that will define and describe functions that comprise a toolkit and the transaction/s included in each function.

In addition to distribution, the enhanced system will support audits to monitor implementation of access controls. This review will be available by function or by data value. Not only will we show a user's complete access profile in terms of either function or data value. We will also have the capability to review by data value type and by function, "who can do what?" or "who could have done what?" at any point in time.

SECURITY, USER RESPONSIBILITY

If you have doors, locks, layers, limits, rules, and policing, are you secure? If they are used, perhaps one can answer with a decisive "yes". The more significant question may be: Are they useable? If they aren't useable they are not used and you are not secure. Lock the door and throw away the key, and nobody gets in. Lock the door and make a thousand keys and a thousand get in. Maybe more than a thousand get in, but you don't know about them. If you change the lock, you must make a thousand new keys. Where are those thousand people who should have new keys? Someone is worrying about the thousand, but no one can do much about them.

If Virginia Tech is well down the road toward data security, it is not because we have the best engine or use the best fuel. Our system has its kludges, our data base design its inadequacies, our screens some unfriendly idiosyncrasies. We have "groupthinked" ourselves into a corner more than once on this project and we have paid and will continue to pay a price for our limited vision. So what is the key to our success? Nobel prize winning physician, Albert Szent-Gyorgyi's may have zeroed in on our critical success factor when he said, "discovery consists of looking at the same thing as everyone else and thinking something different".

Our system had to be so very flexible to accommodate the way things get done at a University. As we tried to understand the global rules that govern access, we always came up with three answers, "yes", "no", and "maybe". Computers don't understand "maybe" and for that matter, "maybe" doesn't mean much to people either. We were forced to think about security differently. We abandoned our earliest ideas regarding centrally controlled access and discovered something that makes incredible sense: Distribute access control management to those who can answer decisively "yes" or "no" and be held accountable. We put the tools for managing security in the hands of those who truly have responsibility for access decisions.

No one worries about a thousand keys anymore and that is precisely why Virginia Tech management information systems operate in a secure environment. The responsibility for data security is distributed to the caretakers, those with a vested interest, Virginia Tech faculty and staff, our users. Not unlike other employers, Virginia Tech trusts that its employees, our users, have integrity and then provides means and methods for evaluating performance. All who access and use University information also have responsibility for protecting the data resource, it is part of the job.

Improving Security: Your Auditor's Role

George A. Carroll
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New Brunwick, NJ

Abstract

University computer center managers have much to gain from a cooperative working relationship with qualified EDP auditors. Both the computer center and the audit department have a role in computer security. This paper explains how computer managers can benefit from effective EDP audits. It also provides suggestions and recommendations on how to cultivate computer center/audit department teamwork to help improve security.

Background

Rutgers University has separate administrative and academic computer centers which report to an Associate Vice President for Computer Services. The administrative center, which I direct, serves the entire University community through use of a large IBM mainframe and a wide area network of approximately 350 on-line terminals. The Center employs a staff of 100 including the applications development, data base, technical support and operations functions. We run most of the common University administrative applications including student records, admissions, financial aid, financial accounting, payroll, alumni records and fund raising.

For many years our computer center was subject to occasional routine audits by the internal audit department and the University's outside audit firm. The audit reports usually placed stress on good documentation and controls in the financial systems. Security was not a topic of major concern. Two things happened to dramatically change our relationship to these audit organizations. The first occurred in July of 1983 when a serious case of misuse of computer resources was discovered at the Center. The second occurred in August of 1984 when the internal audit department hired a technically competent, qualified EDP auditor.

The misuse of computer resources involved some members of the computer center staff who were operating an outside business. They were using the University computer at night and on weekends to process work for their customers. The discovery of this unauthorized computer usage prompted an investigation and review of security policy and procedures which lasted more than a year. The topics of security, control of computer resources, authorized use etc. occupied a considerable amount of our time as we participated in a University Police investigation and special audits of the computer center. This rather stressful experience taught me several lessons about the role of EDP auditors which I would like to share with you.

Quality EDP Auditing Can Benefit Computer Center Management

My perspective on the auditor's role in security is that of a computer center manager. The question I ask is how can this function help me? How can the auditors help me run a more effective, reliable and more secure data center? Experience has taught me that the following key benefits can be achieved:

1. The computer center staff takes the issue of security more seriously.

   When auditors ask questions about passwords, account numbers, security software, written procedures and access policy, the staff pays attention. There is renewed interest in the subject and increased acceptance that security is important.

Computer center staff are service oriented. They are usually more concerned about providing access to data than securing it, and they may tend to pay lip service to security matters. Strong emphasis on security from both computer center management and the auditors will usually get more attention.

2. Security becomes a shared function.

When auditors complete their review, they make recommendations. If the DP center implements all recommendations, the auditor then becomes partly responsible for the security measures in place. A partnership develops. Both the auditors and the computer center are answerable to the University Administration. This partnership has evolved at Rutgers and it has proven to be very effective.

3. Computer security is tested.

The auditors test usage of account numbers and passwords, they review files stored off-site, and they test physical security. This testing is a valuable service for the computer center manager because it is done by an independent outside organization, not the computer staff who implemented the procedures.

4. The computer center gets help enforcing rules and procedures affecting users.

We are not alone when justifying security to the diverse user community. It certainly helps to be able to say, "The auditors require it."

5. The computer center may get additional resources.

The audit department can be a strong ally when computer managers need to justify resources to improve security. Additional staffing, security devices, special purpose software are a few examples of items requiring funding which can be supported by your auditors.

6. Good EDP auditors are valuable investigators in the event of a computer crime or breach of security.

Auditors with a knowledge of computers are trained to ask the right questions and gather data in a systematic way. They will probably be better prepared to handle this kind of problem than the campus police. A good EDP auditor in this situation can channel the investigation properly so that it does not go off onto irrelevant tangents. He or she can help determine the extent of the problem, whether or not a crime took place, and action needed to correct the situation.

Building the Computer Center/EDP Auditor Team

Computer center managers should view EDP auditors as allies who will help them manage more effectively, especially in the area of security. A cooperative team approach must be fostered. It will not simply happen. I recommend that you make an effort to cultivate this relationship. Here are some suggestions for doing so:

1. Support the data processing needs of the audit department.

    Auditors often use special purpose programs to sample data files and do analysis work. The DP center should provide good systems analyst and operations support for this work.

    The audit department should be provided with the same tools and services provided to other areas of the University. On-line terminals or personal computers connected to the administrative mainframe can be valuable tools for auditors. They assist the department with their regular mission of financial audits while at the same time enabling the staff to become familiar with the computer center from a user perspective. They learn first hand about account numbers, passwords, data lines,, RJE service, downloading to PCs, etc.

2. Involve the auditors in the planning process for major systems projects.

    The EDP audit staff should be given the opportunity to review systems development plans. When the purchase of packaged software is being considered, they should be on the evaluation team. Obviously this is true for systems such as financial aid, accounting and payroll; however, the audit department may be interested in other than financial type systems and the door should be open to their review.

3. Provide computer training for the audit department staff.

    The computer center and the University will benefit most from technically competent EDP auditors. The Center should provide tours of their facilities with special emphasis on items such as magnetic tape storage, the network control center, check storage facilities, fire protection devices, and control of physical access.

    If the center offers courses the auditors should be invited to attend. If not, recommend that audit staff attend off-campus seminars and conferences along with the computer center staff. Some examples are classes in security software, data communications and the annual Computer Security Institute.

4. Be open and honest with auditors.

Don't try to give auditors a "snow job". Be candid about such things as systems development controls, disaster planning, access controls and software in use. Let them know if there are problems with existing operations or procedures or if you believe their recommendations are unworkable. It is better to enlist their aid in solving a problem than attempting to avoid it.

An open, honest approach will serve you best in the long run. In an audit situation it is vital to maintain your credibility.

Cloak and Dagger Security
Or How to Protect Your Database From PCs

Dr. Michael R. Zastrocky
Regis College
Denver, Colorado

A recent microcomputer survey by NCHEMS Management Services, Inc. indicates that by the year 1990, many institutions expect a microcomputer to student ratio of 1 to 2 or greater and a microcomputer to faculty ratio of 1. While the proliferation of micros on campus and off campus is generally perceived as a positive trend, institutions face a greater risk that PCs can be used to access and possibly alter the database in an "unplanned" manner.

It is important to remember that information is a corporate asset and while it may be more difficult to place a dollar value on that asset than buildings, securities or other institutional assets, it none the less must be viewed as an important asset that must be managed properly and protected. When thinking of its true value we may need to be reminded that it's probably easier to replace a building that's been destroyed or stock certificates that have been lost than to replace a database that's been destroyed or severely damaged. The mass use of micros, while generally viewed as a modern blessing, can cause some severe problems for the people who are responsible for managing the information flow of the institution and whose job it is to protect the database. Sensitive personnel information, grades and transcripts, or donor information can be captured easily on a microcomputer, stored on a diskette and carried off by anyone with little attention drawn to an unauthorized release of sensitive information. Micros can also test combinations of passwords quickly allowing access by unauthorized individuals to the database. This could lead to corruption of the database which may be difficult or nearly impossible to detect.

How can an institution adequately protect its database from the misuse of PCs? Are there safeguards that can be implemented to help manage effectively or does management and staff have to live with a potential timebomb waiting to explode?

Good planning can minimize the potential risks that we face with the use of PCs to access the information system. While most institutions have done a good job of building security measures into the information system, once data is downloaded to a PC, security bets are generally off. The umbrella is missing and other procedures and policies must be implemented, both before and after data is downloaded to the PC.

There are several issues that should be considered when planning for PC use. First, PCs should be viewed as a device that can access the system; however we must remember that access can and should be controlled. The normal password clearance procedures should be followed for PCs. Users should not be allowed to enter the system from a PC without following the same security procedures used by a dumb terminal. Users need to be taught that command files for accessing the database must not be used. (It's relatively easy to store identification and passwords on the PC as an easy way to perform automatic logon. However, anyone with access to the PC has the users' access to the database.)

Second, once data has been captured on the PC, anyone with access to the PC has access to the data that now resides on the PC. Therefore physical access to the device should be controlled if sensitive information resides on a hard disk. If information has been stored on a diskette, the diskette must be protected. Generally, users who capture data on PCs should deal with diskettes as they would any sensitive report. Diskettes should be stored in a safe environment where unauthorized access is difficult. Guidelines for downloading data onto PCs should be published, regularly reviewed and changed as needed. Encryption of data stored on PCs or diskettes should be considered for sensitive information stored on a hard disk or diskettes where access is difficult to control. There are many available software packages that encrypt data on PCs. While some packages are more elaborate and difficult to "crack" than others, the basic premise here is that encryption discourages most unauthorized users like a lock discourages honest people from "breaking in".

Third, direct uploading of information to the database through PCs should never be allowed outside of the normal data entry and updating procedures. While security is one important consideration on this point, another is contaminated data. Edit checking routines should not be bypassed. (For example, edit checking might be used to ensure that alpha or other non-numeric characters are not entered into fields that expect numeric characters are not entered into fields that expect numeric characters only, as in the case of phone numbers. If edit checking routines are bypassed, contaminated data may follow or worse yet, record keys may be in error. At Regis College, several IBM PC/XTs are used as point-of-sale cash registers in the bookstore. These are linked to the database with student charges linked to AR, department charges linked to the journal entry system and cash and charge card transactions linked to the cash receipts module. Transaction data is uploaded at the end of each day to a "temporary" file on the system. This provides the accounting office with an opportunity to review data for reconciliation purposes before it hits the database. Business office personnel can correct data errors which may occur during data entry or uploading. Transactions are checked for data quality, proper format and codes are checked against code tables for accuracy. If data entry were to bypass these check points, quality might diminish. Once data quality has been checked, then data is passed through the normal data flow of the system. Other than the PC- based bookstore module, data entry and access to files for data entry or changes is allowed only through the normal, menu driven screens.

A fourth point to consider is the use of dial-up access to the database. If dial-up ports are available, anyone with a PC becomes a "potential user". Access to modem telephone numbers should be limited and people who have access to the database through modems should be trained on security implications. (At Regis, there is only one dial-up port that is used exclusively for maintenance by field engineers. The modem is physically turned off until the FE notifies the computer center of the need to access the system. The phone number is changed at irregular intervals to prevent "accidental" intrusion. Where dial-up access is needed, the security system should monitor all dial-up lines and automatically disconnect a line that has repeated failed access attempts. Dial back devices provide another security measure in some instances. (A dial back device disconnects the caller and dials back a "pre-established number" for that user. This procedure checks the user for security and ensures that the access request is coming from a valid location.)

Any breach of security should be dealt with immediately. Violators should be disciplined according to a published set of procedures and repeat offenses should be considered as a basis for dismissal and/or prosecution. The database must be treated as a corporate asset that must be protected. The system cannot be considered a playground where anyone can "mess around" and play with data and information. Once the community understands the value of the system, and after policies and procedures are established and published, committment to and adherence to policies will be easier to encourage and enforce. There is an old adage that security begins in the personnel office. A new adage might be "microcomputers do not break into systems, people break into systems using microcomputers."

PROFESSIONAL PRESENTATIONS

The CAUSE95 theme, "1995--Planning and Managing the Odyssey," was addressed through forty-nine professional presentations in seven subject tracks, as well as through less formal sessions on topics of special interest.

SPECIAL INTEREST SESSIONS

The conference provided informal sessions for conferees to meet and exchange ideas on topics of special interest or concern. At seven such scheduled sessions, conferees met to discuss the topics listed below. Summaries of these follow in this section.

ARTIFICIAL INTELLIGENCE
Moderator: Thomas R. Mason
MIRA Incorporated
Minnesota

BYYTEBAACK
Moderator: Michael Zastrocky
Regis College (Colorado)

COMPUTER ASSISTED ADVISING/ DEGREE PROGRESS TRACKING
Moderator: Jack Southard
Miami University, Ohio

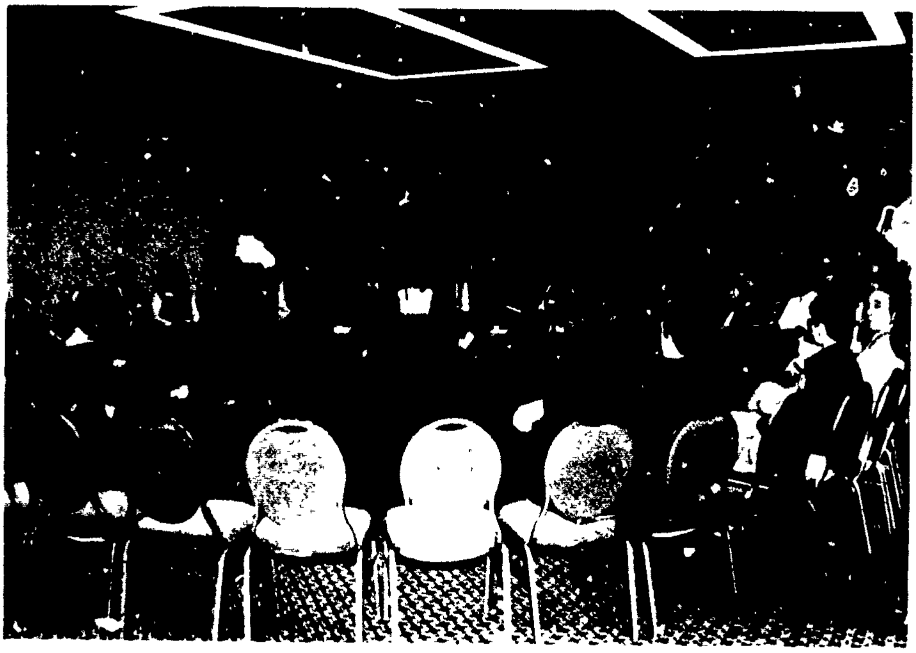
CREATING CIO POSITIONS
Moderator: James I. Penrod
California State University/LA

IDMS *
Moderator: Janice Peterson
University of New Mexico

INFORMATION CENTERS *
Moderators: Arthur Krumrey and
Jerry Sanders
Loyola University of Chicago

NETWORKING MICROCOMPUTERS
Moderator: Robert C. Heterick, Jr.
Virginia Tech

*Summary unavailable



S U M M A R Y

Special Interest Session on Artificial Intelligence

CAUSE85 National Conference
New Orleans Hilton Hotel
December 13, 1985

Thomas R. Mason
President, MIRA Incorporated
Moderator

Participants in the Special Interest Session on Artificial Intelligence discussed immediate and longer term impacts of AI on higher education computing and information technology. Among more immediate potential uses are enrichment of decision-support systems with knowledge-based expert heuristics. One participant argued that expert systems are not really artificial intelligence but are extensions of conventional programming. Artificial intelligence requires self-generative learning capacities. Major breakthroughs to artificial intelligence will come when computers are programmed with cognitive capacities -- including contextual speech recognition, visual interpretation, and the ability to learn and change independently of the programmer or user.

Byytebaack Special Interest Group Session

Moderator: Michael Zastrocky
December 13, 1985

For the third consecutive year, a special interest group session was held to discuss the formation of Byytebaack and its current status. Byytebaack was formed in 1983 after a major higher education software supplier, AXXESS, went bankrupt. Twenty-four of the twenty-eight current users of the AIMS product formed Byytebaack to protect their investment in AIMS and to plan future growth and development of the AIMS product.

Participants discussed the history of Byytebaack, its current status, the history and current status of AIMS and the problems and benefits of colleges and universities working together to maintain and grow a complete information system like AIMS. Some of the issues discussed were:

1. How do you get 24 institutions to agree on product changes and growth issues?

2. How does maintenance of the product get handled?

3. What happens to the marketing issues?

4. Can a consortium-type arrangement really be handled effectively?

5. Can institutions rely on this type of arrangement over a 5-10 year period of time?

Some of the solutions that were discussed and are being implemented include:

1. The AIMS Users Group meets twice a year to discuss current modules, their use and future needs. Each meeting has a primary module (or modules) as the focus of the meeting, with general topic sessions also on the agenda. A committee on the future development of AIMS meets prior to each meeting and reports back to the User's Group on the current status of issues and projects.

2. A software group, The Watchung Software Group, Inc., manages the maintenance and the R and D of the product. This support group includes many of the original designers and creators of the original AIMS. The company works in higher education and industry and add a breadth of knowledge and experience that enhance the user's perspective considerably.

3. Information Solutions, Inc., one of INC's top 100 companies of 1985, was chosen to market AIMS. Their experiences as one of the largest Prime Information Dealers in the Country, (AIMS runs on Prime Information and other Pick-like operating systems) adds to the overall support to the Product. (ISI has offices throughout the USA and regularly offers support classes on the operating system, hardware and other software support products.)

4. Management of Byytebaack is handled by a Board of Directors. The current board consists of a College President, an Executive Vice-President of a University, a corporate lawyer, several academic officers, several MIS directors and a paid Executive Director to handle day-to-day affairs.

5. After three years and continued growth, the idea that the consortium can continue to grow and support both current and future users looks good.

Overall, the conversation was stimulating and led to the exchange of many ideas. The idea that an institution who purchases a turnkey package is at the "mercy of the vendor" was challenged. In answer to a paper presented at CAUSE 83 by Dr. Paul Plourde and Dr. Michael Zastrocky, the response to the question "Is There Life After Death of Your Software Vendor" still seems to be "yes."

Special Interest Session

COMPUTER ASSISTED ADVISING

Moderator: Jack Southard, Miami University, Oxford, Ohio

Fifty or so persons attended this session which first afforded the opportunity for brief statements regarding each person's home institution and where in the computerized degree audit process that institution was. Most were thinking about implementing some computerized assisted process and were in an information gathering phase. Motivating factors for this review came from various directions within the campus--with quite a few coming directly from top management.

The Miami University computerized degree audit system was broadly reviewed for the group as was another--to a lesser extent--in use at Virginia Tech. It was mentioned that a few such systems, including the ones at Miami University and at Georgia State, were being made available to other institutions. By way of further sharing information regarding this topic, Miami University had held, and was continuing to offer, "workshops" covering computer assisted advising.

CREATING CIO POSITIONS

Special Interest Session 9:00 - 10:00 a.m.
Friday, December 13, 1985

CAUSE National Conference
By
James I. Penrod, Vice President for Information Resources Management
California State University, Los Angeles

The rapidly evolving Chief Information Officer (CIO) position in Colleges and Universities typically is a policy level position, reporting to the President or the Provost. Line responsibilities usually include office automation, academic and administrative computing, telecommunication and sometimes mail services, reproduction services, printing, institutional planning, media services and the library.

This special interest session addressed questions such as: How prevalent is the position? What qualifications are needed by candidates for a CIO role? Where are such people usually found? What are the critical success factors for a CIO? And, where does the position go from here?

A recent informal survey found that currently there are about 100 CIO positions in Higher Education in the United States. [1] Institutions most likely to now have or to soon create the CIO position, are mid to large sized and are making an institutional commitment to the significant utilization of information technology, academically and administratively.

Qualifications for a CIO role are in many respects similar to other senior administrators stressing policy level skills. Individuals should have a background in strategic planning, be comfortable in the role of a change agent, have strong fiscal management capabilities including contract negotiation and fundraising, have experience in the classroom, familiarity with the needs of researchers, have definite leadership traits, and possess broad-based technical understanding. The need for at least some aptitude in each of the listed areas perhaps illustrates why such positions are difficult to fill.

Given this difficulty it is reasonable to find that it is not unusual to promote a "home grown" individual into (especially newly created) CIO positions. Areas from which CIO's come appear to include: Academic Computing Directors, Directors of Institutional Research (Particularly when the function includes planning analysis), Directors of Telecommunications, Directors of the Library (where significant automation has occurred and Media Services has been part of the Library), faculty members from Business Information Systems, Engineering, Computer Science and in Medical Schools Epidemiology and Preventive Medicine. When an institution recruits a CIO they most likely come from another CIO position in Higher Education. Incentives which might entice a move are broader responsibilities, greater resources, a larger or more prestigious institution, and reporting at a higher level.

Critical success factors for the CIO are heavily dependent upon the particular institution and the current environment. Some of the following, however, would appear on almost any list: Presidential and other top management support, an institutional strategic planning process, the existence of a high level information resources policy committee, some sort of participative decision-making process, a scheme for prioritizing IRM projects, a system for resource allocation, and a feedback process that incorporates end user service appraisal.

The concept of Information Resources Management (IRM) which has resulted in the development of CIO's emerged in the mid 1970's and will evolve thru the 1980's. The precipitating forces are the convergence of data processing, telecommunications and office automation technologies. Objectives include integrated management of information technologies; treating information as a strategic resource; and, linking management of automated and manual information resources. IRM relies on the basic technologies of distributed data processing, integrated (voice/data) communication networks, multifunction workstations and personal computing. In this period the CIO position has moved organizationally from higher middle management to lower senior management. 2

The next stage of development, from the late 1980's thru the 1990's will be knowledge management. The precipitating force will be increased dependence on and penetration of information technology into operational and managerial decision making at every level of the organization. The strategic objective will be the integration of physical/technical management of information technology with management of information processes for decision-making, management and routine operations. The basic technologies employed will be expert or knowledge based systems, decision support systems, and office intelligence systems. 3

If this scenario by Dr. Donald Marchand is correct the CIO will be seen as an integral part of the senior administration of an organization. He/She will significantly influence the decision-making processes of the institution, be concerned and involved in creating and keeping open institutional communication channels, and will play a key role in initiating institutional change desired by the President and the Board.

FOOTNOTES

1) See Fleit, Linda H., "Choosing a Chief Information Officer: The Myth of the Computer Czar" in these proceedings.

2) Marchand, Donald A., "Information Management: Strategies and Tools in Transition", Information Management Review, Summer 1985, p29.

3) IBID

Special Interest Session

Networking Microcomputers

Moderator: Robert C. Heterick, Jr., Virginia Tech

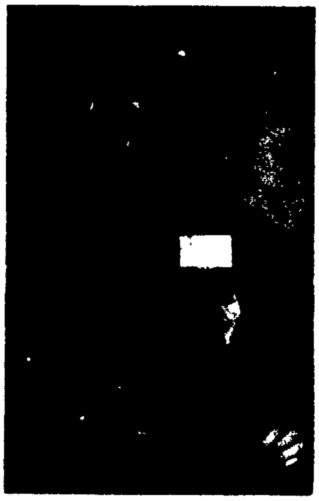
This special interest group had a broad-ranging discussion of campus networking strategies. Major points of concern were privacy/security and protocol translation for the increasingly diverse array of personal computers found on many campuses. It was observed that both software and hardware vendors are increasingly designing their products to standards--standards which are developed without formal input from the higher education community. It was suggested that it might well be appropriate for CAUSE, acting as an agent for that community, to seek representation on certain of the standards setting bodies.

Track I
Policy Issues in Higher Education

Coordinator:
Richard L. Mann
University of Kansas

A. Wayne Donald
Virginia Tech

Linda Fleit
EDUTECH International



Gerald McLaughlin
Virginia Tech

Mike Staman
Systems & Computer
Technology Corporation

An Information Systems Strategy

Robert C. Heterick, Jr.

Virginia Tech

Blacksburg, Virginia

The rapid proliferation of personal and mini computers into the campus computing environment has reinforced the need for a coherent information systems development strategy that integrates both voice and data (and possibly video). The need for a strategy, as opposed to a set of goals, is discussed in light of rapidly changing technological parameters. A single system image is proposed to address the pluarlism of native computing environments increasingly found on most campuses. The image provides a single view, for all users, of electronic mail, database access, archival storage and access to global resources for printing, plotting, microforms, etc. The single system image offers a development prospectus that can be undertaken in small increments by highly disparate groups, allowing the total campus community to participate in its development.

The First Stages

> Wherever we are, it is but a stage on the way to somewhere else, and whatever we do, however well we do it, it is only a preparation to do something else that shall be different.
>
> Robert Louis Stevenson

Most institutions of higher education entered the world of computing machines in the late 1950s or early 1960s with the acquisition of first or second generation computers. Institutions continued to grow in their computing activities during the ensuing five to ten years with a succession of second-generation computers. During this time the administrative and academic computing activities were established, generally as separate entitites.

By the end of the 1960s most institutions made their second major commitment to computing by moving into third-generation computers and, frequently, consolidating all of their computing activities under a single organizational umbrella. These moves were made in recognition of several currents in both computing and higher education:

- Computing science and technology appeared to have the capability of significantly changing higher education by improving the quality of its instructional and research programs and the cost effectiveness of its administrative activities.
- The economics of computer technology was dominated by "Grosch's Law," an economy of scale phenomenon that observed that computing power increased as the square of the cost of equipment.
- Computing was sufficiently ubiquitous that it should be available to everyone, as an essentially subsidized commodity funded as an "off the top" commitment by the Institution.

This second major commitment to computing by the Institution was accompanied by a significant increase in the Institution's computing budget and appropriate changes in the Institutions's organizational structure to complement this new level of activity. From that time, Institutional computing activities developed under the auspices of professional management—with the planning and development tools consistent with a major Institutional activity.

We are now at another crossroad, marked technologically by the maturation of the fourth generation of computing. The last several years have demonstrated implicit recognition of this by several occurrences:

- Many institutions have elevated the position of principal computer professional to a Vice Presidency
- A number of colleges and departments have begun to require the purchase of personal computers by entering students, and many others have the subject under active consideration.
- A new organizational structure to consolidate the communication activities (voice, video, and data) of the Institution has been created or is under active study.

The growth of computing and communications technology has merged into a new area that we refer to as information systems—incorporating activities in computing, communications, and databases.

As we remap our strategic planning efforts, the time seems propitious to ask if we are not at the point of another major institutional commitment. It is generally agreed that the advent of the digital computer signaled the end of the "industrial revolution" and the beginning of the "information age." As computing science and technology has matured we have begun to recognize that we may have overvalued the obvious computational capabilities of computing machines and undervalued the informational capacities that they offer.

The information age in computing is characterized by several phenomena, some of which are new, but some of which represent a negation of previously accepted principles. A listing of these new viewpoints would include:

- The replacement of "Grosch's Law" with the mass production phenomena· cost declines as the volume of production increases.
- The widespread belief that many, if not most, computing needs can be handled by personal computers.
- The emergence of national networks for both information retrieval and computing resources—specialty suppliers are beginning to emerge and predominate.
- That office automation will have a significant impact on the day-to-day activities of nearly everyone in the modern university

These new viewpoints suggest that it may be more than just sound management to rethink the institution's commitment to information systems technology. It may well be appropriate to set new directions and develop new initiatives in light of emerging technology and changing economic parameters.

Strategic Planning

> Goals are important, but it is the strategies employed that matter the most.
>
> Sun Tsu (3000 BC)

Classical approaches to planning usually emphasize the establishment of goals. In a time where technology is growing and and changing so rapidly, such a static approach is clearly myopic. What seems more fruitful is a strategic view of the institution's computing and communication future—a view that attempts to articulate a growth philosophy that permits seizing opportunities when the state of technology is right. Some technological advances are clearly predictable; others are not so easily foreseen. Whatever strategic position the institution assumes *vis-a-vis* computers and communication, it must be predicated on foreseeable technological advances, and flexible enough to accommodate those that are not so easily discernible.

It might be useful to outline several philosophic opinions about the future of higher education and computer and communications technology, and from them attempt to glean a strategy that provides for the incorporation of new technology and the flexibility to adapt to unforeseen developments.

- Increasingly, institutions will perceive their constituency to be off campus as well as on—the need to reach out across traditional boundaries will assume an increasing importance.
- Interconnection—the capability for human and machine linkages—will become an important issue in higher education.
- The fifth generation notwithstanding, the next round of technological innovation will occur in the communications, not computer, arena.
- The capacity of the institutional budget to absorb continuing developments in computers and communications is significantly attenuated.

An appropriate strategy might also be unfolded in terms of a number of questions that currently present themselves. Each of these questions raises, in turn, a whole host of ancillary questions.

- To what extent should computing requirements on campus be satisfied centrally?
- What are appropriate staffing patterns and levels within the central computing facility?
- To what extent should voice and data communications be merged?
- What are the roles of broadband, baseband and other subnetworks on campus?
- What are the best means for students, and off-campus personnel to access the campus communication network?
- Will access to the institutional database become more widely required, and are current data management techniques appropriate for the next five or ten years?
- How should electronic mail and office automation be supported?

Central Computing: The advent of the personal computer has called into question the philosophy of providing computational access to members of the academic community through a central computing facility. It is useful to speak of three levels of computing: global, regional, and personal. In many respects these levels may be equated to the "size" of computer: mainframe, minicomputer, and microprocessor.

Global computing has been with us the longest and has been subjected to the most extensive study in terms of delivery economics, operational strategies, etc. This is the primary base of computing on the campus, delivered generally on mainframes, and accessed by users via time-sharing terminals. The bulk of computing power is concentrated here, as is the predominate amount of electromagnetic storage and high quality printing and plotting equipment.

The primary source of regional computing is special-purpose minicomputers. Maturation of computing science and technology has led to specialty suppliers in the computer marketplace. Where there is a relatively small number (10 to 50) of individuals working on closely allied problems, it has been found to be cost effective to create specialized computing environments. This is particularly the case for CAD/CAM, library automation, or machine and process control environments such as mass spectrometers, numerical machine control, and robotics.

Personal computing is a relatively new concept—one created by the confluence of VLSI and economies of scale in production and marketing. Personal computing permits the creation of highly-specialized, custom-tailored computing environments for an individual. The relative newness of personal computing may go a long way toward explaining why it is the least understood of the three computing environments. Unfortunately it has also been beset by a plethora of inferior software and a large number of hardware vendors who have lacked staying power in the market.

Many questions need to be resolved regarding global computing resources. We currently have a somewhat mixed approach to central support of computing facilities. Global computing support is a central administration task. The situation is less clear when regional and personal computing support is considered. Generally, regional computing efforts may be supported centrally by a facilities management arrangement, or directly by the laboratory or department. There are exceptions to this principle as epitomized by central ownership and operation of VAXs—clearly minicomputers that belong in the regional category. Personal computing is generally viewed as a college, departmental, or individual faculty or student responsibility. There are exceptions to this principle as evidenced by frequent Computing Center sponsorship of personal computer laboratories.

We might inquire as to whether central (Computing Center) support of regional and personal computing is appropriate. Should global computing be provided centrally, regional computing by colleges and departments, and personal computing by departments, faculty, and students? Clearly, financial support for computing is not unlimited. Just as clearly, the closer to the user the funds are spent the better the users computing needs are likely to be satisfied (at least in the user's perception). A fundamental question is to what extent can a central organization be expected to understand and respond to the diverse computing needs of students, faculty, laboratories, and departments? This raises the ancillary question of how computing funds should be distributed if some are to be allocated directly to college and departmental budgets.

If computing needs are to be satisfied by a more decentralized philosophy, what percent of computing support should be supplied by the institutional budget and what percent by individual faculty. staff, and student purchase? Is it reasonable to expect students to acquire their own computing support—for faculty and staff to acquire their own? In general, what percentage of the institutional budget is appropriate to spend on computing at all levels, no matter how distributed?

If a significant amount of computing resources are supplied by students, faculty, laboratories, departments, etc., what implications does this have for staff levels and skills in the central computing activity? Will it require the same number of systems programmers as now employed? Will it require the same (or more) number of people generally, but with different skills? Should individuals with computer skills be allocated directly to departments and colleges as is currently the case with many administrative departments. Are individuals with such skills already employed by colleges and departments, but with non-computer specialist job titles—faculty and graduate assistants for instance?

Personal Computing: The time has come to assess the role of personal computing in higher education. An implicit assessment has been made if one reads between the lines of computing policy changes over the last several years. Is it now time to make an explicit statement of policy?

The cost of providing both ends of the communications link for terminals is quite high. The terminal/port ratio is quite low. More widespread use of personal computers (and an operational policy that supports this environment) can significantly improve the terminal/port ratio, thereby reducing (or shifting to other sources) the increasing cost of providing connections to centrally supplied or supported computing and information resources. Strategies for supporting either a network of "dumb" terminals or a network of personal computers are significantly at variance. Is it time to adopt a strategy that favors connection of personal computers in the campus network?

Will personal computers provide the bulk of computational support required by the average student and faculty member? Will the personal computer provide as convenient office automation support as is currently available through mainframe software and terminals? In a personal computing environment, how should institutional database queries be supported: as they are now, or through some completely new data management scheme? How would online-transaction processing be changed in a personal computing environment?

If personal computer requirements are not dictated centrally, and they probably shouldn't be, how will the institution avoid the chaos that might accompany undirected choice of systems? What should be the role of the central computing facility in dealing with personal computing: should consulting activities be redirected toward the personal computer, should the central negotiation of hardware and software contracts and site licenses for personal computer equipment be expanded, etc?

Communication Networks: Communication issues are the major concerns of the next five years. Any strategy needs to consider to what extent, and how, voice and data networks will be merged. To this must also be appended the question of video networks and the extent to which they should be merged with either voice and/or data.

Perhaps the predominate question is whether or not communications networking should be a subsidized activity of the institution. That is, does the institution have an obligation to provide communications access to staff, students and faculty? Logically prior to that question is whether or not it is economically efficient or educationally necessary to provide such interconnect capabilities? In what ways are the missions of the institution enhanced by a more open set of communication paths? Is a major communications networking capability critical to the growth of the institution? If the institution perceives a need or commitment to service off-campus constituencies, is a relatively wide area communications network (voice, data, and video) necessary? important?

Are significant cost savings or avoidances available to the institution if it chooses to operate its own voice network? Are any potential cost savings offset by a new set of managerial or political problems? In the wide area domain, are there opportunities for microwave operation or band sharing that the institution should investigate? Are there opportunities in satellite communication we should investigate, either for ourselves or in concert with other agencies or institutions?

Will the local (or wide area) distribution of video (or combined voice, video, and data) see a significant increase? Should students have access to data networks from dormitories? Should they have access to video networks? If students in dormitories have such access, how will we handle students who live in town, or participate in off-campus instruction? Should the institution provide faculty with access to the campus data network from their homes? If it does, are there certain job assignments that could be performed as well (or better) from the home as on campus?

With a large number of personal computers on campus is it appropriate to consider local personal computer networks linking two, five or ten personal computers in adjoining offices? Is it appropriate to consider baseband networks for entire buildings? If so, how will they be bridged into a campus broadband network and how should building wiring standards be established and enforced? Do all personal computers need a permanent connection to the local area network, or may several share a single connection? If several may share a single connection, how many?

Office Automation: Current office automation, electronic mail support, and access to the institution's databases are provided with global mainframe resources. Will those users (primarily administrative) continue this mode of operation for the next five years? Considering the number of devices currently capable of connecting to the local area network, such "dumb" devices are probably in the minority and become an ever smaller minority every year. Should the communication network provide for intelligent device communication without passing through one of the network hosts? Should the Computing Center redirect its development efforts to provide intelligent device communication support as the norm, treating host-connected terminals as a technology we wish to terminate?

On most campuses the commitment to a mainframe text formatting system is significant and pervasive. Can personal computers provide an equivalent level of support. Will the proliferation of personal computers cause a significant upsurge in the number of large files passing through the communications network? Is there an office automation facility available on personal computers to which we should encourage user migration?

Many campuses currently support many different electronic mail protocols, and several more are in use by individuals and groups that are not supported centrally. Few of these protocols can be used to reach gateways outside the local campus network. To what extent is off-campus electronic communication likely to be important in the future? What protocol should the institution settle upon, and how should we deal with the incompatibilities that this may cause with other heavily used software?

The Institutional Database: Many institutions made the decision to move to a database environment in the late 1960s or early 1970s. At that time, the most advanced transaction processing systems were hierarchical or network model systems. They provide a relatively high level of security features and are generally robust. They are also expensive and old technology. For the average administrator on campus, spreadsheet relational models are simpler to use and more consistent with what they do on personal computers. Is it appropriate to reconsider the DBMS decision?

Relational technology has certainly matured, but is it sufficiently proven in its operational efficiency to consider moving the Institutional database to a relational model? And if it is, which commercial product should we choose? Is it important to be able to download relational snapshots to database users? This could be done via current as well as by a relational systems: Are the benefits of a relational system sufficient to dictate a change?

In the more ubiquitous personal computer environment of down-loaded file snapshots, there is a host of operational, security, and privacy questions that do not have well-defined answers. In the longer run, can we expect the institutional database to be distributed across multiple CPUs? Have we the resources to think through these questions independently or is it sensible to wait several years for others to pioneer the effort?

Should the hardware and software resources needed to support the institutional database be considered a regional-like computing resource? To what extent can user departments develop their own reporting systems if the institution only maintains a central database and the associated database administration responsibilities? Is it appropriate to view systems development as a contract programming resource and part of an "Information Center" complex which is operated centrally by the Institution?

Time For A Change

> It is a misfortune, inseparable from human affairs, that public measures are rarely investigated with that spirit of moderation which is essential to a just estimate of their real tendency to advance or obstruct the public good; and that this spirit is more apt to be diminished than promoted by those occasions which require an unusal exercise of it
>
> James Madison
> The Federalist

The foregoing litany of questions doesn't identify the strategic course we should set, but it does raise a sufficient set of problems to suggest that it is appropriate to forge a strategic plan Whatever strategy finally evolves, it should be one that provides a philosophy in which these and other questions can be reconciled. In general, it is probably inappropriate to try to craft the strategy from specific answers to such questions. Rather, we should attempt to discern what role the institution plans to establish for itself and, within the context of how the institution views itself, set a compatible information systems strategy.

Underlying all the institution's aspirations is the need for an effective information systems infrastructure. This infrastructure can be divided into three major components:

- Communication networks (voice. video, and data)
- Computer support (global, regional, and personal)
- Professional staff (communications, computing, and managerial)

Communications: Most institutions have only recently begun to recognize the effort required to put into place a comprehensive communications network. To a large extent, this is due to the autonomous development of voice, video, and data communications. The major step of placing all these activities under a single management has yet to be taken for most institutions.

It remains now to provide a description of the communications infrastructure needed by the Institution. Voice service is probably the most broadly used of the categories. The two principle planning issues in this arena have to do with: (1) the merger of voice with video and data in the institution's network; and (2) the associated question of the appropriate division of responsibility between the institution and the local common carrier. For strategic purposes, it is probably useful to divide this issue on a geographical basis: those voice applications required off campus generally falling within the purview of a local operating company, and those on campus that would be operated by the institution.

It is not likely that the institution can provide voice service levels that exceed those provided by the common carrier. The rationale for institutional operation of voice services would be twofold—and probably only different views of the same issue at that There exists significant potential cost savings for institutional operation of its own PBX, least-cost call routing algorithms, and locally installed and maintained point-to-point connectivity (either by wire or otherwise) In a broader context, because the institution must run its own video and data networks on campus, there is a significant concern that common carrier operation of the campus voice network leads to substantial sub-optimization. Put in the positive, by integrating voice with existing video and data networks, there may be significant cost savings available through optimization of a larger network—avoidance of duplicative cabling, bandwidth sharing, etc. While a digital switching facility permits a more rational integration of voice and data services, it also presents the opportunity for new services. Principal among these is voice mail, the ability to digitally store voice messages to be picked up later by the intended recipient.

Assuming for the moment that the appropriate course of action to address the on-campus issues is clear, let us turn our attention to the local, but off-campus issue. Commonly, many in-residence students do not live on campus A similar situation exists since many faculty and staff work at home evenings and on weekends. There seems to be no reason to expect that local common carrier voice service has been less than satisfactory, or should be expected to become so.

At the moment, and for the next several years, data communication is the high growth area that is forcing decisions regarding the communication infrastructure of the institution. Laying aside for the moment any consideration of the synergistic impact of merging data with voice and video, we can identify four major data communication areas:

- Intraoffice networks
- Intrabuilding networks
- Interbuilding networks
- Wide area networks

The proliferation of personal computers is bringing with it a demand for intraoffice networking—the networking of several (perhaps up to six or eight) personal computers in a departmental or laboratory office. Most users perceive that there will be a dominant node in this network, probably providing large [illegible] disk storage, high quality printing, or some other sharable resource that is cost effective when distributed across a half dozen or so devices. The advent of 32 bit, time shared micros will only accelerate this requirement.

Such networks can be created with logic cards for the personal computers and cable that is installed departmentally. There exists the potential for literally hundreds of such networks to develop—with a great diversity of products and protocols. This is not necessarily bad, provided the network contains a server that provides a gateway to the campus (or intrabuilding) network. The difficulty with such homegrown networks is that they may prove to be unsatisfactory because of user naivete and consequently represent a less than desirable expenditure of scarce resources.

While the development of intraoffice networks is debatably a central support issue, intrabuilding wiring and protocol standards must clearly be established centrally. There are many issues here that require some debate before standardization. As with most construction related efforts, more cost-effective installation is likely if longer-term needs and technological developments are considered prior to initial installation.

There are a number of cost-related issues that must also be resolved. What number of connections within a building is required to justify the cost of intrabuilding networking rather than point-to-point connectivity? In what time frame is it appropriate to consider bringing campus buildings into intrabuilding networks? As a more global question, in what way should voice and video be considered in the intrabuilding domain?

The issue of wide-area networking is the most amorphous of all, related as it is to the strategic plan of the institution in terms of reaching off-campus constituencies. Clearly, the more serious the institution is in its plans to engage in significant off-campus efforts, the more critical is the aspect of the infrastructure. Some rather specific guidance on this issue is called for.

Computing: For the convenience of dividing the subject computing support can be looked at in terms of global, regional, and personal effort. It may be appropriate to start with the personal level, as this seems to be the current driving force in the computing arena.

From the strategic viewpoint, the paramount question is whether personal computing will, in the next five years, provide the principle base of computing support for the Institution. If it will, then clearly we need to rethink our approach to global computing and set new directions. One way to approach this issue might be to consider whether, and under what circumstances, we can expect a large percentage of students, faculty, and staff to have relatively immediate access to personal computing. Certainly by 1990 we can expect 32-bit, 20MHz (5-10 MIPS) processors that can be purchased at prices approximately equal to current-generation machines. This would infer that the power of today's minis would be available in desktop (probably lapsize, if desired), personal machines.

Currently a good 8-bit, CP/M machine can be acquired for less than $500, a good 16-bit DOS machine for under $2,000, and the emerging generation of 16- and 32-bit Unix systems for $5,000 and more. Faculty members usually opt for the latest and most powerful machines—in spite of the fact that they hardly ever exercise the machine to anywhere near its full capacity. If the prices of computers continue their current trend, then today's high-end machines will cost less than $1,000 in 1990, and such machines should be powerful enough and sufficiently inexpensive, that access to one could be taken for granted. In brief, there seems to be no technological or financial impediment to assuming that by 1990, anyone who wants a personal computer will have one.

If we accept the ubiquitous personal computer as providing the base of computing for most people on campus, what then is the role for global computing resources? Certainly the role of providing general purpose computing resources will be significantly reduced in the total context of computer-related services provided globally. It may not be unreasonable to see the provision of native computing environments as a regional issue. There are still a number of activities (for the moment, ignoring native environments as one of them) that should be provided centrally as part of the global base. These would include:

- The institutional database
- Printing service
- Graphics service
- Archiving
- Supercomputing
- Specialized software

One might very well extend the list, but the characteristics of what might make a global service item are probably more important and interesting. A global service seems in order where a broad cross section of users must access the same data. This is certainly the case with the administrative records of the institution.

A global service also seems in order for very high priced peripheral devices. High-volume laser printing, high resolution graphics, microforms, photographic media, and typesetting are typical devices that would fall into this category. Another category of this type is high-volume storage devices for machine readable data.

There will continue to be a need for special purpose software which either must run on a large mainframe or is too expensive to acquire unless its cost is amortized over a larger u[illegible]ommunity. Increasingly, we can expect a role for [illegible]ercomputing related to such software packages. The supercomputer of the 1990s will be on the order of 10 giga-FLOPS, bringing a new set of problems within the realm of practical computability.

If personal computing is expected to provide the bulk of computing service for most users, then the global service should redirect its support efforts from "dumb" terminals to intelligent workstations. This transition will take time, perhaps five years. During this transition period there will likely be a number of temporary tasks that will also become candidates for global support–store and forward of electronic mail, gateways to external networks, and file transfer are examples.

The economics of computing technology suggests that regional computing will become more important in the future. Our economy has always favored specialization, and value-added services in computing are becoming increasingly commonplace.

If we accept the principle that regional facilities service a limited base of users, we can identify a number of computing services that would likely be of the regional category.

- Office automation
- CAD/CAM
- CAI and CMI
- Library automation
- Robotics

Again, it is probably more interesting to discern the characteristics that make a computing service a candidate for the regional category. Clearly, one such characteristic is the need for computing power beyond that likely to be available on the next several generations of personal computers. One characteristic of the preceding list is the intensiveness of computing for the activities mentioned.

Perhaps the thorniest question regarding regional computing is the source of funding. Where total funding is from soft sources such as grants and contracts this is not an issue. More generally, we would need to resolve to what extent funding for such facilities be considered a global question. If regional facilities are at least partially subsidized by the institution (and all are at least to the extent of certain overhead costs), what portion of the cost should be subsidized and how will the global facility plan for such acquisitions provide for the disbursement of funds?

There is a second-order effect attributable to regional facilities that may well raise issues more critical than those of cost sharing. Regional facilities require systems programming support, site preparation, gateways or bridging into the campus communication network, and other labor intensive support activities. Replicating the skills available in the global facility ten or more times over is probably not possible, much less cost effective. To some extent, certain of these labor intensive skills will be provided by faculty and graduate students. There is a real question as to whether this is cost effective and whether the support level will be adequate.

Supercomputing is another category that effects a relatively limited number of faculty and students. The main issue here seems to be whether to supply the service on campus or provide access to one of the universities funded by NSF to purvey supercomputing. We might begin by directing on-campus users through a network to such a site. If such is the choice, there are two issues that must be resolved. First, how is such access to be funded? Should we consider this a global service requirement and fund it centrally? If we do, how should it be budgeted? Second, user experience with remote site access to supercomputing suggests that relatively high speed connections are important. The speeds most often mentioned are 19.2KB as a minimum, and 56KB as more desirable. It is not clear that any of the potential remote sites are prepared to handle this speed of traffic. Without some on-campus supercomputing capability, it may become increasingly difficult to attract researchers in computationally intensive disciplines.

Staffing: The infrastructure questions relating to professional staff have already been alluded to in other contexts. The primary questions in this domain have to do with skills that will be required, the number of personnel necessary, and the distribution of those individuals. This problem is exacerbated by the shortage of skilled computer professionals, the even greater shortage of highly qualified technical management personnel and, as a consequence, the extraordinary salary levels commanded by individuals with these scarce talents.

Avoiding for the moment the question of numbers of personnel with information systems responsibilities, consider the skills likely to be of most value in the next several years. As the campus builds toward thousands of intelligent workstations, the first level, and likely predominate, need of users for information, will concern their personal computer hardware, software and interface to various communication networks. When we consider the number of personal computers on the marketplace (probably over one hundred) and the number of software packages (probably close to 10,000), we recognize that it is not possible to provide expert consulting for all of them. We might possibly consider specializing in one or two machines and perhaps a dozen pieces of software. Given that the half-life of micro hardware and software technology is about 18 months, and given that any point in time will likely find three generations of the technology in common use on campus, the problem of expert consulting still seems beyond reasonable grasp

It seems inevitable that the burden of consulting will have to shift even further to faculty and students. Attempts to proscribe either hardware or software configurations seem antithetical to the purposes of a university and should probably be avoided. What then is the role of central computing activities in the personal computer mileau? There would seem to be several initiatives that ought to be maintained centrally.

- Standards for electronic mail
- Global printing access
- Global file service
- System maintenance of global software packages
- Quantity purchase arrangements for selected items of both personal computer hardware and software

The foregoing list is not all-inclusive, but is indicative of the types of activities that ought to be provided centrally. The common characteristic of these activities is support of devices, protocols or software, rather than direct support of the user. As the personal computer workstation becomes the norm on campus, the capacity and capability to provide user consulting is diminished, but the need to provide network access to special services is amplified.

It is probably in the personnel area that the most radical shifts in thinking will need to take place. We can visualize an intensified need for systems programming skills accompanying a shift of focus from the user to device support. The user interface for global services may well shift to a "computer store" that negotiates attractive prices for a few brands of personal computers and a few software packages for those computers. It is not difficult to envision this activity ultimately residing somewhere such as the campus bookstore, where a $100 profit on each of the several thousand machines sold each year provides the overhead to meet the payroll of the "computer store."

As the global service becomes more directed to device support, it is reasonable to imagine direct user charges for items produced, rather than for computing equipment exercised in their production. For instance, we can imagine charges imposed for pages of output printed, slides or microforms produced, graphic frames plotted, etc. In this environment we can envision page printing to be a service of the Print Shop rather than the Computing Center. We can envision slide and graphic production to be a service of the Learning Resources Center rather than the Computing Center—the focus of global computing support shifting to provision of the network intelligence to provide the interconnect capability for the devices in the network.

Such an environment may require the services of "print specialists" in the Print Shop, "graphics specialists" in the Learning Resources Center, etc., where the focus on the printed page of output has shifted from the Computing Center to the Print Shop. It cannot be argued too forcefully that modern information systems technology has spawned a whole new set of value added services—services that are distinct from the computer and communications networks, but dependent upon them for their existence.

Pluralism: If there is one notable characteristic of this new generation of computing it would have to be pluralism. The age of centrally directed and supported computing has passed along with typing pools, keypunch and word processing centers, and the punched card itself. The economy of scale phenomenon applies only to a few hardware devices attached to computers and to the computer-communications infrastructure itself.

Whatever strategic plan we craft must recognize this as the paramount fact of modern computing and communications technology. The freedom to innovate is also the freedom to fail. As a consequence, we must be prepared to have groups propose, and implement, computing environments that have little apparent chance of providing successful, long-term solutions to the problems for which they have been devised. Hopefully, an occasional brilliant success that couldn't have been predicted in advance will help offset some of the naive failures.

Pluralism will be most evident in the personal and regional computing areas. The tendency of users to want highly specialized computing environments that are mirror images of the latest technology being used in industry will accelerate. Most of these environments will be clearly ephemeral, seldom having an industrial life of more than a few years.

This pluralistic computing environment will place increasing pressure on centrally provided services to have some cognizance of the multiplicity of software/hardware configurations that are attempting to access global services. It is clearly not possible or economically sensible to centrally design software that is capable of printing a file edited on any one of a hundred different what-you-see is what-you-get text formatters. A similar observation could be made regarding down-loading file snapshots in a format suitable for any one of twenty commonly used spreadsheet programs.

A Single System Image

> There is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all who profit by the old order, and only luke-warm defenders in all those who would profit by the new order. This luke-warmness arises partly from fear of their adversaries, who have the law in their favor; and partly from the incredulity of mankind, who do not truly believe in anything new until they have had actual experience of it.
>
> Machiavelli
> The Prince (1513)

Prior to attempting a statement of strategy, it might be useful to remind ourselves that the major problems we will need to solve will occur in the transition from where we are today to where the strategy suggests we should be in five years. We should treat such problems as tactical questions, resolved in the context of the strategy we follow, but addressed in terms of the technology available when the tactical problem is identified.

We should be working toward a single system image for all users. Recognizing the pluralism that exists (and is desirable) within the academic computing environment, we should expect a very large number of native environments for users of the campus computer and communication network. Some users will opt for a native environment on a personal computer using Lotus, dBase, BASIC or some other software base. Others will choose a regional mini-based system as their native environment—a CAD system, a laboratory data collection system, etc. Still others will find PROFS, CMS, VMS or UNIX to be their native environment of choice.

The user can be expected to know his or her own native environment. What must be provided globally for the user is a standard interface to services not part of the user's native environment—such things as electronic mail, access to institutional databases, and access to other computing sources (global, regional, and perhaps even personal). This interface might be viewed as a single system image—a unitary image of the world outside the user's native environment. Every user should be able to see the same image, hence the word "single" in the term "single-system image."

The Imager: A conceptual model of the single-system image that is envisioned for the institution, which we can refer to as the Imager, would comprise five functions:

Communicator	The hardware, software, and protocols required to physically transport data between source and target systems.
Accessor	The data manipulation functions required to query (and perhaps store) data anywhere in the single-system image, and to route data (perhaps electronic mail, files, etc.) to a target.
Translator	The ability to translate data and/or accessor commands from source to target formats.
Director	Knowledge of where data can be found or how targets can be accessed. If data needs to be translated or headers modified, how the target is addressed.
Administrator	Rules for access and update authority, invocation of consistency requirements, privacy and integrity requirements.

Ultimately, the Imager evolves into a major knowledge-based system providing a standard specification of all systems participating in the single-system image. It incorporates some of the functions of data administration, user services, and network services into an "intelligent" communication interface.

As a strategy, the single-system image provides a development prospectus that can be undertaken in very small increments by highly disparate groups. It has utility at any stage of its development; the more fully developed, the more utility it will provide. Further, it is easily understood by the user, requiring the user to know only the accessor commands in addition to the manipulation requirements of his or her own native environment. Ultimately, it makes the entire computer and communications infrastructure convenient for the user, permitting data maintainers to be concerned primarily with the collection and storage of data and only secondarily with user access to it. Hardware, software, and communications technology may be changed without impacting users.

The global service, then, is the single-system image and the software, hardware, and communications spine that supports it. Included in that support base are the CPU(s) on which the Imager resides, the software that makes up the Imager, peripheral devices that comprise part of the image (laser printers, high speed plotters, etc.), and the communication links and appurtenances to effect the image.

Computer/Communication Responsibilities: If we accept this view, then the answers to a number of the questions raised previously become rather self-evident. A first cut at where typical current and proposed resource responsibilities fall is shown in the following figure.

	University	College	Department
Global	Image E-Mail Archives Printing Broadband net		
Regional	Office Auto. Supercomputing Baseband nets Spec. software Data admin.	VAXs CAD/CAM Libraries Laboratories Faculty consul.	
Personal	Terminal conn. PC maintenance Site licenses PC demos	PC Networks PC labs	Terminals Faculty PCs PC software Student instr.

Figure 1. Responsibility Matrix

As the strategy evolves, we should find the Computing Center less and less involved in the user's native environment and increasingly concerned with image-associated activities.

Information Center: Accompanying such a shift in emphasis should be a commensurate shift in staff expertise. Systems programming skills will become increasingly important, and user consulting skills less needed. At the same time, systems programming skills will be required for an even greater diversity of hardware and software configurations.

A similar analysis of skills within systems development could be made. We can expect decreasing need for constructing DBMS procedures and screen interfaces, and increased emphasis on the conceptual model of data supported within the institutional systems. Interfaces to the image in the form of translators and administrator rules will become increasingly important. Systems development should be able to expend more effort on metadata issues and the development of metaoperations on data dispersed throughout the institutional database.

As the strategy evolves, the current organizational structure within the computer and communications area may need to be changed. Currently a substantial effort is related to activities supporting special native environments. The fact that the image is a singular entity which is composed of hardware, software, and communications, necessitates a change in the current organizational structure, which separates quite distinctly on these grounds.

This new operation incorporates many of the tasks that currently go under the name "information center." It is probably appropriate to observe that there are functions now provided in other organizations, notably the Library and Learning Resources Center, that might be logical candidates for inclusion in the Information Center.

However transaction processing is handled, the longer term future is for distributed databases operated in the context of the single system image. Data administration will become an image related function. Query and reporting from the institutional database will be an Information Center function—composed of extracting reporting information for non-computer users (or providing interpretation of data) rather than the coding of routines to be used by the user in his or her native environment.

The Single-System Image and the Information Center are opposite sides of the same coin. The Information Center provides much of the facility of the Imager, but through personal interaction rather than automatically as an extension of the user's native computing environment. Over time, the personal interaction is replaced by implementation of the Imager. It seems appropriate to vest responsibility for the Imager with the Information Center.

As the Imager is implemented, the Information Center can begin to concentrate on high level consulting with faculty and staff attempting to construct complex computing environments. The Information Center should have highly skilled personnel who can consult on the selection of native computing environments, selection of hardware and software systems and the design and installation of local (intraoffice and intrabuilding) communication networks.

	University	College	Department
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As the strategy evolves, we should find the Computing Center less and less involved in the user's native environment and increasingly concerned with image-associated activities.

Information Center: Accompanying such a shift in emphasis should be a commensurate shift in staff expertise. Systems programming skills will become increasingly important, and user consulting skills less needed. At the same time, systems programming skills will be required for an even greater diversity of hardware and software configurations.

A similar analysis of skills within systems development could be made. We can expect decreasing need for constructing DBMS procedures and screen interfaces, and increased emphasis on the conceptual model of data supported within the institutional systems. Interfaces to the image in the form of translators and administrator rules will become increasingly important. Systems development should be able to expend more effort on metadata issues and the development of metaoperations on data dispersed throughout the institutional database.

As the strategy evolves, the current organizational structure within the computer and communications area may need to be changed. Currently a substantial effort is related to activities supporting special native environments. The fact that the image is a singular entity which is composed of hardware, software, and communications, necessitates a change in the current organizational structure, which separates quite distinctly on these grounds.

This new operation incorporates many of the tasks that currently go under the name "information center." It is probably appropriate to observe that there are functions now provided in other organizations, notably the Library and Learning Resources Center, that might be logical candidates for inclusion in the Information Center.

However transaction processing is handled, the longer term future is for distributed databases operated in the context of the single system image. Data administration will become an image related function. Query and reporting from the institutional database will be an Information Center function—composed of extracting reporting information for non-computer users (or providing interpretation of data) rather than the coding of routines to be used by the user in his or her native environment.

The Single-System Image and the Information Center are opposite sides of the same coin. The Information Center provides much of the facility of the Imager, but through personal interaction rather than automatically as an extension of the user's native computing environment. Over time, the personal interaction is replaced by implementation of the Imager. It seems appropriate to vest responsibility for the Imager with the Information Center.

As the Imager is implemented, the Information Center can begin to concentrate on high level consulting with faculty and staff attempting to construct complex computing environments. The Information Center should have highly skilled personnel who can consult on the selection of native computing environments, selection of hardware and software systems and the design and installation of local (intraoffice and intrabuilding) communication networks.

FORMULATING SECURITY POLICY IN CONJUNCTION WITH AN AGGRESSIVE LONG RANGE APPLICATION DEVELOPMENT EFFORT

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Attention to and concern about security issues are escalating. Networking, data base oriented applications systems, distributed processing and micro-computers complicate these issues. The University of Miami has recently developed and implemented new security policies in conjunction with implementation of its Long Range Information Systems Plan (LRISP).

Overviews of the LRISP planning process, development methodology and status of the implementation are presented as background to security policy issues.

Security policy development at U.M. is discussed. Responsibilities have been assigned to users and facility managers. Data Custodians have been implemented to grant access to domains within the global data base.

FORMULATING SECURITY POLICY IN CONJUNCTION WITH AN AGGRESSIVE LONG RANGE APPLICATION DEVELOPMENT EFFORT

BACKGROUND

The Long Range Information Systems Plan (LRISP)

In May 1983 the University of Miami undertook a Long Range Information Systems Planning (LRISP) effort. This resulted in a plan to replace all administrative applications. Academic system needs were to be addressed later by separate planning efforts. A recommendation to implement the plan over seven years, at a cost of approximately 13.6 million dollars (in 1983/84 terms) was sent to the Board of Trustees in October 1983. The board approved the recommendation and the implementation began in January 1984.

Status - Then

The then current status of administrative computing was depressing. All systems but one (financial assistance) were batch oriented. Most systems (all but three: the student information, financial assistance, and financial reporting systems) had exceeded their reasonable life expectancies (approximately seven years). System interfaces were in very poor shape, limited documentation existed, and the Information Systems Department had just reorganized after resuming management of its facility from a facilities management firm.

Computing was done primarily on a Univac 1100/80 which was saturated. The only "on-line" system operated on an IBM 4341. There was only limited hardware interface capability and very limited telecommunication capability.

The organization was maintenance oriented, with a number of important functions unaddressed (Security, capacity planning etc.). While the personnel were strong technically, they lacked university experience.

The Methodology

The planning methodology used to develop LRISP (Arthur Andersen's Method One) called for a determination of information needs, followed by development of specific strategies to address them. Strategies were identified for: Applications, Hardware, Systems Software and Database, Communications, Office Automation, and Organization. An assessment of the cost/benefit impact of each of the strategies was accomplished.

Information needs determination (and development of the preliminary drafts of the plan) was accomplished by a project team of eleven (senior systems analysts, senior programmer analysts, a systems analyst, a key user and the project manager who was the assistant director for administrative application programming) after being trained in the methodology. Interviews were conducted with 107 campus administrators from all major functional areas located over three campuses. A high level global university data model was constructed and 44 individual application systems were identified.

Application Strategy

Prioritization of efforts became a difficult task. Four separate prioritizations were identified:

- By data availability, that is basic building blocks first, a conscious effort was made to avoid addressing systems until other required "feeder" systems had been put in place.
- By benefit/risk, that is placing the systems with the highest benefit and/or least risk first, those with the lowest benefit/highest risk last.
- By compromise sequencing, doing the "feeder" or building block systems needed for those with the highest benefit first.
- By review of the Management Advisory Committee addressing U.M. Priorities.

A determination of the final priority set was made by the Management Advisory Committee. In order to accomplish the needed applications development effort within seven years, concurrent development of six applications was necessary.

Systems Software and Database Strategy

It was decided to use a shared database management system for routine production processing. A subset database would be used for ad-hoc processing. Additional software licensing would be provided as required. We elected to use state-of-the-art software development tools. This meant assimilation of new tools and new skills. Cullinet's IDMS database, data dictionary, ADS On-Line, Culprit, and prototyping were all new. No one was knowledgable in these tools, so we prepared for a learning curve.

Communications Network Strategy

The university installed an integrated voice/data communications switch (ATT System 85). We began development of a dedicated point to point administrative network, while working with the Telecommunications Department to develop a long range plan for data communications. The need for data communications between all three campuses was identified as was the necessity for access to external data communications networks.

Security Strategy

This strategy called for development of policies and implementation of procedures. Needed improvements to physical security were identified. A valid case for uninterrupted operation (a U.P.S. system) was documented. Development of a disaster recovery plan was identified as a major and critical task. A redesign of the computer for physical security was undertaken.

LRISP IMPLEMENTATION - USER INVOLVEMENT

User involvement and participation is engendered by:

- Using committees composed of administrators at executive and management levels,
- Fostering and requiring direct user participation in the role of chair for an individual project steering committee,
- Assigning each fulltime development team up to two individuals from the user department area.

Computer Advisory Committee

A Computer Advisory Committee was established as an offshoot of the Management Advisory Committee at the onset of LRISP. Its mission was and continues to be:

- To provide communication between management and Information Systems, Planning and Institutional Research.
- To ensure application development objectives and strategies are consistent with those of the university.
- To evaluate and recommend scope and changes to application system implementation priorities.

Its responsibilities include:

- Confirming individual projects' objectives, scope, and products.
- Communicating definitions to key personnel.
- Securing cooperation and participation of operational management.
- Recommending priorities and approving systems projects.
- Monitoring project status and performance.
- Reviewing and approving project implementation plans.

This committee is designed to insure broad based administrative and academic executive involvement.

Systems Coordination Committee

This committee was established shortly after implementation of the second LRISP application system. It is composed of the head of each major administrative functional unit, the chair of the Computer Advisory Committee, the Vice President of Business and Finance, and the Associate Provost. Its function is to provide a forum for administrators to help ensure that individual projects meet university needs. Issues of integration and functional interdependence are discussed and investigated. Monthly status reports are presented. Issues affecting more than one project, or impacting more than one administrative unit are discussed.

Long Range Academic Systems Committee

This committee was formed to address long range planning issues related to academic and research computing at the university. Understandably, consensus was difficult to obtain. There have been two reports presented to the Office of the Provost. A clear cut plan, with appropriate consensus and/or business plan, has yet to be accepted for implementation. It is expected that when the new Provost assumes position this planning effort will resume and a subsequent implementation will be effected.

Project Steering Committee

At the inception of each project a steering committee is formed. It is chaired by the primary administrative unit's head. This committee is charged with oversight responsibility, and with project definition responsibility. The committee meets at least monthly, and more frequently when necessary. Individual application system development teams are composed of a project manager, a systems analyst, three programmer analysts, and two information analysts.

Information Analysts

The other vehicle for encouraging intense user involvement and committment to LRISP is the Information Analyst position. Each project has two Information Analysts assigned to it at the onset. These two positions are funded by the project from inception through implementation. Information Analysts, come from the user's shop and are to be experienced professionals. They should understand the functional requirements of the user. While they are not expected to have technical information systems skills, they are expected to have good basic analytical skills, to thoroughly understand user functional requirements and to be excellent communicators. At the end of the project they are returned to the user department(s). Their technical skills should have improved considerably, and they should thoroughly understand the newly implemented system. While identified by the user as key personnel at the onset of the project, they will become even more important to the user because of their direct participation as fulltime project team members.

EVOLUTION OF COMPUTER SYSTEMS AND SERVICES

The 1950's and early 60's were characterized by batch processing. Time sharing began to be more widely accepted in the mid 60's through the early 70's. In this era, centralized computer systems and services were the accepted standard. Efficiencies of scale, large one time installation costs associated with introduction of automation in areas not yet automated, and the relatively high cost of programming maintenance were reasons cited.

The mid 70's brought dispersed computing, and an associated mixture of central and dispersed systems and services. This was enabled by the advent of cost effective mini-computers, as well as cost effective packaged application software products.

What we see evolving today is distributed computing. That is, a combination of networked resources. A "network" of shared resources, both dispersed and central. In short, the era of distributed computing is here. We see the role of a central service unit, in these times, as support of a distributed computing environment.

An appropriate strategy for this era is:

> To create a structured environment fostering the evolution of distributed computing.

- Networking heterogeneous system resources.
- Selectively supporting interfaces and facilities.
- Providing system and application expertise.
- Supporting users in selecting, tailoring, and applying their best options.

From the user's perspective a "First-class computer environment" is easy to use, has quick response, is available when needed, contains secure and reliable information, and has functional richness. A "good" computer environment can help people to produce higher quality results, do more productive work in a shorter time, and broaden the scope of their work. Investing in the computer environment is really investing for peoples' effectiveness.

POLICY DEVELOPMENT

Individual policy statements are drafted by subcommittees of the

Computer Advisory Committee, the Systems Coordination Committee and/or Information Systems. When the draft policy has been finalized, it is brought to the parent committee and the Computer Advisory Committee for consensus building and endorsement. After obtaining endorsement from these committees the policy is submitted to the Provost and/or Vice President for Business and Finance for final approval and publication.

Data Management

Working within the context of the Long Range Information Systems Plan it became apparent to senior management that administrative data have value and that they should be managed a basic institutional resource. This was central to the elec 'on to develop a centralized, global, data base of institutional data. One of the long term goals is to organize and control data so as to make data available as requirements dictate and as they may change.

The development of policy in this area was guided by the provisions of the federal privacy act. The issues of data residency and level of control and protection were investigated. LRISP espoused the ideas that the central facility should house widely shared data and that less widely shared data should be properly housed at a distributed site or at the departmental level. The level of control and protection was determined to be dependent upon both the nature of the data and the extent to which those data were needed in order to conduct the affairs of the university.

The adopted policy has the following provisions:

- Information Systems has overall responsibility for control and centralized data registration. This is not meant to imply that Information Systems has responsibility for all aspects of data management. As the coordinating functional unit, it is responsible to know where data are located, and to register that information so data may be made institutionally useful.

- Individual functional units have responsibility for data creation, maintenance, content, accuracy and for authorization of access rights to others.

- A unit managing a data facility (the central facility, or an individual department managing a distributed facility) has responsibility for physical integrity. That is, protection from hardware and/or software failure.

Security and Control

Institutionally we recognized security is dependent upon a combination of factors, including concerns about both logical and physical integrity. We recognized there is no absolute security. Rather we see the level of security to be provided as a trade-off between perceived risk, costs, and benefits obtained from security.

Accordingly, our security and control policy includes the following provisions:

- Information Systems and users are responsible for providing the means for securing hardware, software, and data under their direct control.
- Physical security is defined as:
  - o Controlling access to hardware (terminals as well as CPU's).
  - o Preventing service interruptions.
  - o Planning for contingencies.
- Logical security is defined as:
  - o Controlling access to software and data.
  - o Recovering data, transmissions, and software.
  - o Archiving data, software, and documentation.

How It Works

Our concept of the global data base is that it contains various domains. A domain is the combination of data for which a particular user has responsibility. These domains within the data base have been definable, for the most part, without redundancy. In areas where redundancy existed, a concept of hierarchy was used to eliminate the redundancy.

For instance, our first implementation was a name directory. This was designed to replace name and address information carried in various batch applications - student information, payroll, accounts receivable, alumni records, etc. A particular name could logically appear in each of these different "domains" or user areas. The conflict was resolved by establishing:

- Employee names, even if they were students, owed accounts receivable balances, or were alumni, would be controlled by the Personnel Department.
- Student names, provided they were not employees, would be controlled by the Registrar.

- Names of others who owed accounts receivable balances would be controlled by the Bursar.

- Donor names, provided they did not fall into one of the above catagories would be controlled by the Alumni/Development Department.

With the above in mind, the Data Custodian function was defined. The data custodian is the person within a particular user functional area responsible for authorizing access to a particular domain within the global data base. Because different kinds of access had to be provided for (inquiry, add, change, delete, copy, etc.) profiles were developed. A profile is defined to describe both those data that may be accessed, and the type of access. Each profile represents a different combination of type of access (inquire, add, change, delete, etc.) and subset of data elements (student, alumni, personnel, admissions, etc.) within an application.

<u>Steps for data access:</u>

- Those requiring access to date send a formal request to the data custodian.

- The data custodian reviews the request, and if it requests access to a different domain than the data custodian has responsibility for, the request is routed to the proper data custodian(s).

- Within his/her domain the data custodian makes decisions and grants or denies access.

  - o Denials are returned to the requestor with an indication of why the request was denied.

  - o Approvals are forwarded to the Security Manager located at Information Systems where the approval is implemented. Information Systems maintains logs of authorizations granted and notifies the requestor of the approval.

When users sign on, they enter their ID and Password. That ID and Password is checked. If it is found to be invalid, access is denied. If it is found to be valid, access is granted, consistent with the "profile(s)" authorized for that ID, password combination.

STATUS - WHERE WE ARE NOW

At this juncture, we are approximately two years into the Long Range Information Systems Plan implementation. Three projects or applications have been implemented. One more is now being implemented and should be fully operational next month.

We are completing our first iteration of capacity planning. We should have our first multi-year hardware plan encompassing both administrative and academic hardware needs for the central facility ready shortly. This plan is expected to be reviewed, revised, and extended each year.

We have formalized accounting rules for each of the various elements of cost associated with implementing our very ambitious plan. Project costs, those cost elements directly chargeable to an individual application development project's account, are amortized over seven years. Other Information Systems and/or user costs are expensed as they occur.

Priorities for individual projects have been shuffled in accordance with the changing needs of the university. Additionally, some projects have been merged together to form larger application projects - we've learned the hard way why and how this increases risk. We now perceive such consolidation as considerably less than optimal. Projects have been deleted from the job queue, because they were applicable to a micro-computer environment, or because there was no real need for them to be contained within the global data base structure. More importantly, these decisions were made in concert with the administrative users.

Not surprisingly, resultant project costs have exceeded original forecasts. This is attributable to the original cost being forecast in terms of uninflated 1983/84 dollars. Surprisingly, we have managed to contain costs this past year. Our latest update to the Board of Trustees, in November of this year, showed total implementation costs equal to last year's. We have not, as yet, obtained hoped for programmer productivity enhancements. What we have obtained is dramatically improved levels of service to our administrative user community. This was our basic goal.

SUCCESS

Our success is attributable to the extent to which our competent staff have worked with and motivated intense user involvement in this ambitious endeavor. Participation at every level, executive, middle management, professional, and clerical as well as participation of those who see themselves as both administrative, and as academic in nature has been critical. Our ultimate aim is to provide the administrative central computing resources necessary for the university to achieve its over-arching academic goals.

THE FOUR P's OF A SUCCESSFUL MICROCOMPUTER PROGRAM: PLANNING, POLICY, PROCEDURES, AND PRACTICES

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ABSTRACT

Virginia Tech is the first public institution of higher education in the country requiring students to purchase their own personal computer. In this paper, the long-range (5-year) computing plan at Virginia Tech is examined with special emphasis on microcomputer issues -- increased growth, communications, education, and overall support. This paper also reviews the overall microcomputer policy that was approved and how the policy dictates University procedures and practices for a successful microcomputer programs. Experiences gained over the last 2-3 years are also recounted. Insight is given on implementing a major microcomputer program -- requirements and planning at department, college, and university levels; financial considerations; involvement of the necessary people; and actually getting the job done.

THE FOUR P'S AT VIRGINIA TECH

The definition of the word plan is not so complex that management textbooks or documents have to be consulted for its meaning. *Webster's Dictionary* defines plan simply as "a method of doing something." Vacations, shopping trips, investments, education of children, and games in various sports are all planned. However, observe the reaction of management level individuals when they are asked for a copy of the computer plan or a particular curriculum plan. Such plans are often a mental formulation, and they are not presented in any tangible document that can be exhibited.

Constant technological changes dictate the need for planning in a computer intensive environment. Institutions must develop a computing plan and have it available for distribution. Policy development is one planning technique and is normally a guide that can be used by management to direct certain activities. The governance structure within many institutions of higher education will often find policies being issued from a Vice President level. Typically, a policy is accompanied by procedures that are specific guidelines describing a step-by-step method for completing a certain activity. For this discussion, practices will be viewed as customs or developments arising from procedures, policies, and plans.

Other P's have contributed to successful computer programs at Virginia Tech, but planning, policy, procedures, and practices form the backbone. In addition to these four components, support has come from top management down, which is also extremely important to a successful plan.

VIRGINIA TECH'S COMMITMENT

Virginia Tech was founded in 1872 as a land-grant college under the Morrill Act and has moved through several transitional stages to its present status as a comprehensive public university. With a student enrollment of 22,000 and faculty and staff numbering 6,000, Virginia Tech is located on a 2600-acre campus in Blacksburg, Virginia.

Virginia Tech's first association with computing was in the late 1950s and growth has been continued through the years. In the late 1960s, the administration recognized the need to review the impact that computing was making in higher education. The administration recognized that computing offered the opportunity to improve the quality of instructional, research, and extension programs. In addition, computing would also have an impact in the administrative area as improved batch systems and new online applications were developed and implemented. This review of computing brought several major developments: the University consolidated all its computing activities into one computing center; a significant increase occurred in the computing budget over a three-year span; computing was viewed as a "utility" and funded as an "off the top" commitment; and appropriate organizational changes were made to support the commitment to computing.

Since the administrative review of computing in the late 1960s, significant events have occurred within computing at Virginia Tech, and changes with major impact on Virginia Tech's computing environment have occurred since 1983. It was that year the University decided to consolidate the departments involved in information systems and create the position of Vice President for Computing and Information Systems. That same year, the College of Engineering concluded a study that recommended entering freshmen purchase their own personal computer. In 1984, the areas of voice, data, and video communications were consolidated, and the department of Communications Network Services was established.

These events are only a few examples of the commitment Virginia Tech has made in the area of computing and information systems. The University will continue to enhance its missions by planning for changes in technology and continuing the commitments that make Virginia Tech a leader in computing in higher education.

AN INFORMATION SYSTEMS STRATEGY

An interview with William E. Lavery, President of Virginia Tech, was featured in the September, 1985, issue of CAUSE/EFFECT. When asked about a plan or strategy for information technology, Dr. Lavery emphasized the importance of a plan or strategy and said "one major benefit of having a strategy is that it protects us from long periods of indecision and hence inactivity. In this field one cannot stand still. A plan or strategy then becomes a guiding document." Virginia Tech has done adequate planning in years past, but, as Dr. Lavery responded, "we don't necessarily document it and advertise it and put it in a popular publication." That situation changed in the summer of 1985 when University Provost David Roselle appointed a group headed by Robert Heterick, professor of Management Science, to develop and document a five-year computing plan. This committee produced An Information Systems Strategy, a document divided into four major sections: The First Stages, Strategic Planning, Time For A Change, and A Single System Image.

The First Stages, section 1 of the computing plan, provides a brief background of computing at Virginia Tech and recognizes the need to continue a planning process. Strategic Planning is the second section and adopts a somewhat different approach to the planning process than what might be found in most textbooks. John Naisbitt, in his best selling book Megatrends, indicates "Strategic planning is worthless - unless there is first a strategic vision." The vision consists of what the end point is and how it can be achieved. Virginia Tech's plan defines its vision by presenting questions that focus on goals and objectives in several areas. The third section, Time For A Change, develops a strategy plan for computing and information systems based on the questions in section two. Strategies are outlined for Communication Networks, Computer Support, and Professional Staff. The final section, A Single System Image, recognizes that a major task is moving from the present to the end point. The concept of a single system image is presented in the plan because it is, in itself, an important strategy. Virginia Tech has diverse users who work in their own computer environment. The single system image concept provides the user a standard interface to services not part of his environment, hence, the word "single" in the term "single system image."

Virginia Tech recognizes An Information Systems Strategy is a guide for the next five years (although it will be reviewed and updated on an annual basis). It is viewed as a flexible guide that still affords the University the opportunity to handle unforeseeable changes - technological and others.

MICROCOMPUTERS AT VIRGINIA TECH

A major decision was made in 1983 that required entering engineering freshmen to purchase a microcomputer. Projections indicated that the number of microcomputers at Virginia Tech would increase at the rate of approximately 2,500 per year - beginning in fall, 1984. Based on this projection and the detailed process needed for approving the engineering program, a policy dealing with microcomputer issues was formulated.

Members of the computing resources staff worked with the Vice President for Computing and Information Systems to formulate a policy for microcomputers. The University Computer Committee reviewed the policy, and, after some revisions, the policy was issued in early 1984. Experience gained from the implementation of the engineering and the computer science programs that required student microcomputers dictated a policy revision in late 1985.

The microcomputer policy at Virginia Tech has five major sections: Need, Other Machines, Software, Microcomputer Approval, and Support. The policy was issued by the Vice President in an effort to provide guidelines for the purchase of microcomputers. Much of the policy is directed to student required programs because guidelines issued by the Department of Information Technology in Richmond, Virginia, were used for the majority of purchases with state and grant funds. The exception is special bids that might be issued to support student required programs.

Need

The section on need is intended to stimulate some planning by the user. Is a microcomputer really the best alternative? What are some of the characteristics of microcomputers and how do they apply to the environment? How will be a microcomputer be used? What software and hardware might be required? Answers to these questions emphasize the importance of a need evaluation. Special attention is given to student required programs as the policy stresses the need for strategic and careful evaluation and planning. The college/department must consider costs for students and the university and how the microcomputer will be incorporated into the curriculum. One point made in this section is that purchase of a microcomputer does not necessarily mean a user will no longer need the mainframe. However, purchase of microcomputers will increase the mainframe workload overall, but the way the mainframe is used will change.

Other Machines

Mainframes, minicomputers, and microcomputers are normally considered the three machine classifications (although some might add supercomputers as another classification). The section on Other Machines identifies, in very general terms, how a mainframe or minicomputer might be used.

The mainframe computer is normally used for the following purposes:

- Intensive computer tasks
- Data requirements
- Special software
- Special devices

The minicomputer is normally acquired with departmental budgets, research contracts, or as a gift. Special need often dictates minicomputer use in the following situations:

- Research sponsor designates special hardware and/or software
- Software requirement is limited
- Clientele is very restricted
- Machine can run essentially unattended
- Special educational needs

Software

An important issue associated with microcomputers, particulary in a university setting, is software - acquisition, management, and support. The microcomputer policy allows the university to do whatever possible to obtain attractive financial arrangements. Such arrangements may involve site licenses, special bids, volume discounts, package offerings, and other incentives.

The Virginia Tech Computing Center operates several microcomputer laboratories for general use, that is, the laboratories are available for faculty, staff, and student use. Distribution of software placed in these laboratories (whether by the Computing Center or other departments) is based on the "reserve book" concept found in libraries. General purpose laboratories also maintain copies of software available for 'free" distribution, that is, in exchange for a blank diskette. Software placed in a private laboratory is the responsibility of the college or department.

Microcomputer Approval

Any data processing procurement at Virginia Tech must follow certain procedures. Procurement of hardware and software with state, federal, or grant funds is clearly defined in local and state documents (Computing Center Users Guide <u>Procedures for Purchasing Computer Related Equipment).</u> However, hardware and software purchased in a student required program are covered by an approval process defined in the microcomputer policy.

Required Student Microcomputer Programs

Any college or department at Virginia Tech may submit a proposal to require its students to purchase a microcomputer in support of academic programs. These internal steps must be followed to seek approval:

- A college or department committee must justify the need and state how the machines will be used in the curriculum. Such a recommendation must be approved by the College Dean.
- Financial implications must be submitted to the Vice President for Finance in two categories:
  - Cost to the student
  - Support expected from the University

  Both implications must be reviewed and approved by the Vice President for Finance.
- Academic implications must be defined and reviewed with the University Provost and his staff.
- The Vice President for Finance and the Provost will confer with the President.
- The college or department must designate a minimum of one person as a coordinator.
- A Request For Proposal (RFP) will be prepared, reviewed, and approved by necessary departments and state agencies.
- The RFP will be issued by the purchasing department and conform to all state regulations.
- An evaluation and selection team will be organized, and the Office of the Vice President for Computing and Information Systems will be responsible for documenting the entire process.
- All necessary departments will be included in any post-award negotiations.

It is recommended a college or department considering such a program have approval 15 months prior to implementation. Such a schedule provides sufficent time to complete the RFP process, inform students, prepare faculty, and arrange the actual delivery of hardware and software.

College/Departmental Microcomputers

A college or department may only purchase through a student required contract if non-state or non-federal funds are used. Any other procurement is governed by local and state procedures. A college or department is encouraged to purchase a machine that best suits its environment but the college or department is cautioned to purchase a machine that is supported by the University.

University Acquired Micrcomputers

Microcomputers purchased by the University, that is, with special allocations, will normally be placed in general purpose laboratories. No chargeback is accessed for use of the micrcomputer laboratories, and a designated number will connect to the mainframe(s). A policy from the Office of the Provost states that a general purpose laboratory may only be reserved for a defined percentage of available time. This policy is enforced by the Office of the Registrar, which is responsible for classroom and laboratory assignments.

Support

Virginia Tech is committed to support microcomputers and student required microcomputer programs. This does not mean that computing resources will support every microcomputer or software package on the market -- an impossible task. Many items are considered when any level of support is determined, and microcomputer purchasers are encouraged to evaluate various types of support available.

Special support was required when the first student required microcomputer program was approved. The University designed a personal computing (PC) auxiliary, which receives no state funds and recovers all costs. The PC auxiliary manages the business portion of any student microcomputer program and works with the college or department coordinator. Responsibilities include:

- Student contact concerning hardware, software, maintenance, costs, financing, and so on.
- Finance options available through the University.
- Ordering process for hardware and software.
- Receive, store, and distribute hardware and software shipments.
- Provide for warranty and maintenance service.
- Maintain necessary records for vendors, auditors, and the University.

In addition to these specific services provided by the PC auxiliary for student microcomputer programs, the Computing Center provides other levels of support.

- Work with departments to evaluate software offerings.
- Maintain an awareness of software restrictions and copyright laws.
- Acquire software that best integrates with software already on mainframes and minicomputers.

- Acquire software that best facilities direct connection to mainframes and minicomputers.

- Provide adequate documentation for hardware and software in general purpose laboratories.

- Provide consulting service for faculty, staff, and graduate students.

This microcomputer policy is a valuable document at Virginia Tech, and, together with the Users Guide (that specifies procedures for state, federal, and grant procurements), provides guidelines and information that are important in a microcomputer decision.

MICROCOMPUTER PROGRAMS AT VIRGINIA TECH

As of September, 1985, approximately 5,500 microcomputers have been purchased by Virginia Tech and students attending Virginia Tech. In 1984, the College of Engineering was the first to require entering freshmen to purchase a microcomputer. That program was followed in 1985, with a similiar requirement by the Department of Computer Science. Other departments have taken other approaches and set up private laboratories for use by undergraduate and graduate students.

The lessons learned since the first program was implemented would cover several pages, but some are obvious. Valuable lessons have been learned in the entire RFP process and in post-award negotiations with vendors. Experience has been gained in resolving issues between the University and a vendor. The cost of a microcomputer program is one concern, but the reaction by students and parents has been good. Applications to the College of Engineering and the Department of Computer Science have increased since implementation of the programs. The logistical tasks associated with acquiring and distributing the hardware and software continue to be complex, but, with experience, the process is becoming more efficient. Software purchase, development, and integration into the curriculum continues to be a major issue and is being addressed at various levels within the University. In most cases literacy programs are not the best approach to faculty training, and are unnecessary for students. Both student required microcomputer programs have had some positive public relations. The microcomputer programs provide an ongoing learning process and will enhance existing and future programs.

The student microcomputer programs at Virginia Tech are successful! They have created an enthusiastic environment and are having a positive impact on the quality of education. When the college committee made its recommendation to the Dean of the College of Engineering in 1983, it made a statement: "Does the College want to lead, or do they want to follow? Or, can it afford to wait?" Once the program was approved and implemented, the College set another goal: "Learning with computers; not learning computers."

Even though the College of Engineering and the Department of Computer Science have the only required microcomputer programs, many other departments at Virginia Tech have accepted the College of Engineering goal as a challenge. The Department of English has worked closely with the College of Engineering to incorporate a word processor into classroom requirements. A number of other departments, such as math, physics, chemistry, political science, sociology, theater arts, communications, and others, are using the microcomputer on a regular basis. At the College level, Agriculture and Life Sciences, Architecture, and Business have a number of departments involved in using microcomputers in instruction and research. The College of Education has sponsored a computer camp for several years and is developing computerized programs with primary and secondary schools throughout Virginia and the nation. The Extension Division is realizing benefits and has equipped 110 extension offices across the state with microcomputers, developed software, and conducted training sessions. The situation is contagious and must be monitored through proper planning and appropriate policies and procedures so that each user gains the ultimate from his computer environment.

THE FUTURE AT VIRGINIA TECH

A recent report to t Virginia Tech Board of Visitors emphasized that computing and communications will play major roles in planning toward the year 2000. The number of microcomputers (or intelligent workstations) at Virginia Tech is projected to grow at the rate of 2,500 to 3,000 per year. This realistic figure means that in 1989 Virginia Tech will be approaching 14,000 workstations. This is a 1 to 2 ratio with 22,000 students and 6,000 faculty and staff. Such growth raises a number of questions and issues:

- When does the growth level off?
- Can computing needs be measured?
- What will be the communication requirements?
- How will software be developed for the curriculum?
- What is the impact on all levels of support - hardware, software, and personnel?
- How will upgrades and replacements be handled?
- Will a high level of enthusiam and interest be maintained?

Other issues could be added to the list, and it will probably be redone during the next few years. Issues outside Virginia Tech will have impacts on microcomputer requirements and use. Technological changes, especially in computing and communications, will impact how thngs are done, and probably why things are done. The Commonwealth of Virginia is currently planning to implement a program to fund higher education for workstations. The amount received by each institution will be based on a formula, and input for that formula can have a major impact on the student microcomputer programs at Virginia Tech. For example, if microcomputers being purchased by students as a requirement are counted "against" Virginia Tech, the programs will have to be re-evaluated. It might be in the best interest of Virginia Tech and the students to simply use special state funds to add more general purpose laboratories.

Whatever happens, it is important for Virginia Tech, as a comprehensive university involved in instruction, research, and extension, to remain on the leading edge of technology. At the 1985 EDUCOM conference in Austin, Texas, one of the keynote speakers stated the Law of the Yukon: "The view only changes for the lead dog."

Note

On December 4, 1985, University's Computer Committee recommended the section on <u>Other Mac</u> be deleted from the microcomputer policy. A revised copy of Virginia Tech's microcomputer policy is available from the CAUSE national office (ID number is CSD-0162).

Choosing a Chief Information Officer: The Myth of the Computer Czar

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Increasing numbers of institutions are looking for, or have already found, a computer "czar" in the form of a Vice President for Information Services or some similar title. But is this a reasonable and effective thing to do? This talk will explore what the position is really all about, and what it signals in terms of the institution's direction. We will discuss what kinds of institutions need one (not all kinds), when the right time is to hire one (perhaps not ever), what the job description should look like, and how to guard against unrealistic expectations.

I was reading through the Chronicle the other day, and came across this item:

Position Announcement: Computer Czar

Job Description: Responsibility for all high-level decisions involving technology on campus; including, but not limited to, computers of all sizes, shapes, and manufacture, telephones for communicating everything from local campus gossip to Star Wars research data, networks (local, interuniversity, and intergalactic), videodisc technology involving computer-assisted instruction as well as yesterday's episode of Search for Tomorrow, all office automation, and if there's time left over, administration of both mail services and all of the campus libraries.

Qualifications: Profound technical skills, infinite patience, uncommon intelligence, extraordinary interpersonal abilities, a proven management track record, and a Ph.D. in either artificial intelligence or cybernetic socioeconomics wouldn't hurt either. Merely walking on water really doesn't matter much here; it's the ability to mix water and oil, jump into it headfirst, and come out smelling like a rose that counts at this institution. In other words we want someone who is smart enough to do the work and dumb enough to take the job.

Sound familiar? Similarly-worded advertisements (although perhaps not quite so blatant) have appeared with increasing frequency over the past couple of years in the pages of the Chronicle. I'm sure you've all seen them. Sometimes the position is called Vice Chancellor for Information Services; sometimes it's Associate Vice President for Computing and Related Technologies; or sometimes it's just plain Vice President. Whatever it's called, the position really is Computer Czar, a relatively new, quite powerful, but often misunderstood position on campus. The tip-offs are that it is at least one level above a Director, and that it in turn reports to a very high level in the institution, occasionally even directly to the President.

Well, why not? It really makes a lot of sense, in a way, doesn't it? After all, it's been estimated that American colleges and universities are spending somewhere around four and a half billion dollars a year on computing activities, and surely that requires a tremendous amount of coordination to know that it's being spent wisely. With the growth of microcomputers over the last few years, and more and more people on campus wanting to do their own thing with computing, it just stands to reason that there should be a single point of responsibility in each institution to make sure it all happens properly. There are communications to worry about, and user satisfaction to be concerned with, and effectiveness as well as efficiency to consider, and heaven knows, the technology itself is changing so quickly that everyone can't possibly be expected to keep current. So it makes perfectly good sense to have this new position to take care of it all. Right?

Well, I'd like to be able to say "Right!" with a nice neat exclamation point but what I'm going to say instead is "Not necessarily...", with some equivocating little dots after it. In fact, I'm going to go even a step further. Not only does it not make sense for many institutions to establish and staff this new position, it can be downright harmful in the long run.

<u>Caution</u>: Having a Computer Czar can be hazardous to the health of your institution!

Now, why am I saying this? We can all point to universities that established this position even long before it became fashionable, institutions that are merrily computing away, and are very glad they made this decision. With all of the publicity, by the way, you might think that there are lots of schools that have done this.

But in fact, according to a survey I conducted recently, there are fewer than 100 institutions that actually have a czar (or czarina) in place. But there are many more that are in the process of either establishing the position or trying to fill it. And here we come to the first problem inherent in this picture. Significantly, Judith Axler Turner headlined an article in the Chronicle last year with "As Use of Computers Sweeps Campuses, Colleges Vie for 'Czars' to Manage Them." The fact is that there simply are not enough people to fill all the positions available. And this situation is only going to get worse and worse.

It's not just that the position expectations may be unrealistic; the very nature of computing itself has always, since its inception, led to shortages of people qualified to deal with it. This is true whether we're talking about programmers, operators, systems analysts, or the guys who sneak in under cover of darkness to do preventive maintenance on the mainframes. But it's especially true for the higher levels - the people who can mix technology with management perspective with organizational skills. These people are so few and far between that they just rotate among institutions, leaving vacancies in any given number of schools at any given time. The truth is that, just as in all areas of technology, the number of czar positions coming available is outpacing the number of people qualified to fill them.

But that's just the first problem. We can add to that some related problems; the fallout, if you will, of the shortages.

The salaries for the czars can be - and often are - far in excess of what the most well-respected and long-tenured faculty member on campus receives. Does this alone suggest something may be out of whack? The administration of an institution is supposed to be overhead, isn't it? Something to be reduced and kept to a minimum whenever and wherever possible? But the marketplace and the laws of supply and demand require that these certain administrators be paid much money, and even worse, sometimes even a bounty must be paid to get them to come to you in the first place! Known in the old days and in less dignified circles as employment agency fees, the tab for having someone help you recruit a czar can run as high as 30% of his or her annual salary!

Now let's get back to the schools that already have a czar in place - the hundred-or-so out of the 3700 schools in the US who went to the trouble to define their needs, establish the position, and were lucky enough to find and attract someone to fill it. Let's even be rash and say that every one of those schools is content and feeling that a wise and cost-effective decision was made. Question: what kinds of places are these, and it is reasonable to assume that they should be used as role models for other institutions? In other words, might there be schools that are particularly compatible for a czar because of institutional characteristics, without which the czar's position might be untenable and even unhealthy? I think yes.

Let's get more specific about the term "czar". Industry refers to this position as Chief Information Officer (or CIO), and William Synott, in his excellent book, <u>Information Resource Management</u>, defined it this way: "(The) senior executive responsible for establishing corporate information policy, standards, and management control over all corporate information resources." Substitute the word "institutional" for "corporate" and I think we have it.

This definition tends to suggest some of the institutional characteristics which will lead to success or failure. As an example, let's take a look at an institution I was recently called in to do some consulting for. This is a strong school academically, modestly endowed, but doing okay, enrollments are holding pretty steady, and they've been getting increasingly involved with computers over the past couple of years. They have about 8,000 students in all, and have microcomputers and a minicomputer to support academic computing. The administrators are using a combination of microcomputers and a rather large IBM mainframe to get their work done. All in all, a fairly typical picture.

But then suddenly, a few things happened to them in rapid succession, causing quite a bit of turmoil. First, their alumni/development people came back from a conference with the notion that they ought to have their own computer system, rather than continuing to rely on the central data processing services, especially since the school was about to launch a sizable capital campaign. Several people at the conference had told them it would be impossible to accomplish their goals without the proper computer support. And obviously, what they were getting now wasn't proper, since they had to share it with other administrative offices. One of the software vendors displaying his wares had taken them out to dinner on the second night of the conference, and they felt pretty sure they knew which system they wanted.

Next, several faculty members began lobbying in the faculty senate for a requirement for all students to bring their own microcomputers with them to school next year. After all, there were several schools around the country that had already adopted such a requirement, and this institution certainly didn't want to be left behind. Besides, if such a proposal were endorsed by the faculty senate, it would only stand to reason that the administration would then have to accede to their requests to buy microcomputers for the faculty as well.

Then the financial vice president decided that what the campus really needed was its own private telephone system so that they could control costs better. And of course, in this modern age of technology, he felt that they should transmit data as well as voice over the very same lines! At least, that sort of seems sensible, doesn't it? And, oh yes, he wanted to set up the new telephone system in such a way so as to be able to resell long-distance telephone services to the dormitory students. All computer controlled, of course.

Finally, the Dean of the Business School privately negotiated an excellent arrangement with a local computer manufacturer to supply a student computer room with 35 of the latest and greatest 38-bit, 5-nanosecond cycle-time, bubble-memory, fixed-disk microcomputers. And the students were actually able to use them for four and a half weeks before the manufacturer went Chapter 11 and they needed some spare parts.

Well, needless to say, the computer people were beginning to feel a little outnumbered and more than a little overwhelmed. The computer center director was starting to feel like a normal university administrator, spending more time in meetings than at his own desk. And with the normal demand level increasing as usual in the midst of all of this, things began to really break down. Service levels dropped dramatically, and normally calm and patient people began to act demanding and frustrated and angry.

So the institution did what any normal institution would do under the circumstances: it looked to the outside for a solution. It decided what it really needed was one person who could coordinate all of this stuff. Someone who would stay technologically current, who could keep track of everything that was happening on campus, make sure the right people were talking to each other, help everyone make sensible technology decisions, and devise and implement information resource policies. Yes, what they needed was their very own chief information officer.

And now, the rest of the story. They did actually find someone and everything was great for a while. Soon after arriving on campus, the new Associate Vice Chancellor for University-Wide Information Services and Computer-Based Support Systems began dealing with the issues that had brought him to campus in the first place. He was named to all of the right committees, of course, including the University Executive Long-Range Planning and Strategic Outlook Task Force, which he knew was something very special because it had 43 of the most important people on campus, and met regularly at least once a semester.

The alumni/development people were very happy to see him, since they figured that his honeymoon period on campus would allow him to get whatever new stuff he thought was needed, and they were among the first to take him to lunch. The faculty were just a little bit wary, since he was hired as a full-fledged administrator with no teaching duties, and it was part of their responsibility to be wary of administrators. Nevertheless, they figured they could count on him as an ally since he had come from a school that had just instituted a computer purchase requirement. The financial vice president, who had been instrumental in hiring this particular person, was especially pleased, since it was clear that the new czar favored centralized controls over computing. The Dean of the Business School was equally pleased, because it was obvious that the new czar was a strong supporter of decentralized computing. They had both been on the search committee, and had made sure to ask all the right questions.

But somehow, things just didn't turn out the way everyone was expecting. When the new czar actually began negotiating with various constituencies, he found that many people on campus were already polarized around particular positions, and furthermore, if anyone of them was able to catch the president's ear with a reasonable-sounding argument, that person stood a good chance of getting what he wanted. It was up to the new czar to make some tough decisions, and sometimes some unpopular ones, but the tougher and more unpopular these decisions were, regardless of their merit, the less chance he had of being able to rely on the support of the rest of the executive staff to actually carry them out. The words of David Stonehill, the vice-provost for computing at the University of Pennsylvania, began to echo in his ear: "The only thing we have in common with a czar is the ability to be assassinated".

Despite a great deal of enthusiasm on campus toward computers and other kinds of technology, the new czar discovered a tremendous amount of resistance to dealing with the issues surrounding technology and its appropriate incorporation. People were reluctant to serve on committees unless it looked as if they would directly benefit from doing so, usually in the form of getting more computer equipment for themselves or their offices; people were reluctant to have their own vendor decisions challenged, even by someone who clearly had more technical expertise than they; and people were reluctant to postpone the satisfaction of their own needs, even when it was likely that the interests of the overall institution were being jeopardized.

Although things were fine for a short time, the same problems began arising that had been there in the first place. And why? Because by hiring a high-level officer to be in charge of all the technology issues, they weren't solving the real problems - they were trying to make them go away. For this particular institution, the impetus to have a computer czar was to be able to continue to allow all of the other top-level people to avoid learning what they themselves needed to know about technology. They wanted all of the responsibility in one place and in one position, so that they didn't have to deal with it.

While we can't necessarily generalize to every institution from this experience, I do think there are a number of important traits that need to be present to increase the chances of success with a computer czar. But more important than the presence of these traits in successful schools, is the absence of one or more of them in schools that are contemplating taking this major step.

> The first trait that should be present is a well-thought-out position on computing, resulting from a great deal of experience, including having made some big mistakes. In other words, the school is not looking for someone who will make sure they don't make any mistakes on the road to technological sophistication. The truth is that technology is fraught with risk; to want to avoid mistakes is to not want to take risks, and that is an inherently incompatible position with respect to technology. Even if someone else has done the same thing a hundred times before, even if you yourself have done the same thing a hundred times before, there are no guarantees in computing.
>
> The second is that the upper level administration and faculty already know a great deal about technology - they are (to use a terrible and already hackneyed phrase)

"computer literate". Now of course, I don't mean that the president knows how to program in FORTRAN, but by having a computer czar or campus, the others are not looking for an excuse to not have to know anything about computers.

Third, the computer people already know a great deal about their institution and about higher education in general. They know what the goals of the organization are, they know how they are contributing to them, both as department members and as individuals, and they know a college is different from a business enterprise or a manufacturing company. By hiring a computer czar, the institution is not looking to make up for the fact that the computer people working in the basement don't know where they work.

Fourth, the upper level has internalized enough of the issues surrounding technology in higher education to be able to make informed judgements. They are not looking to rely on an "expert" or a high priest to do the decision-making for them, this being an anathema to the very nature of collegiality. The decision-makers at the school are in a position to be able to distinguish the merits of different arguments and viewpoints in computing, just as they can in other areas, such as financial matters and enrollment management. The school may have a chief financial officer, but that doesn't mean that the president can't decide the merits of setting up a limited partnership for the new dormitory construction.

Fifth, the school has a governance structure in place so that input can be heard and listened to from all over the campus. There are sufficient and well-functioning computer advisory groups, staffed by people who know what's best for themselves as users as well as being able to take a broad look at what's best for the institution. In other words, the school is not looking to concentrate power in the hands of a single individual.

Sixth, the school has already made significant inroads into end-user computing and distributed processing, and has begun to come to grips with the issues of "who's in charge here?" and "who should be in charge?". They are not looking to stem the tide of personal computing by hiring someone who will revert to strict centralized control. The school has already passed through this stage, and has seen the wisdom of computing being in the hands of the people who need it most - the end users.

And finally, the school either already has an overall strategic plan in place, from which the long-range computing plan can be drawn, or else it is prepared to have the computer people have significant input into the development of a strategic plan. In other words, the czar is not expected to develop the long-range plan for computing in the absence of the institution's long-range plan.

The bottom line: by hiring a computer czar, the school is not looking for someone who will make all the problems go away. A very wise person once said that owning a computer is a lot like having a spouse to help you with problems you wouldn't have if you hadn't gotten married. Well, having a computer czar in an institution that isn't ready for one is like having commencement at the end of the freshman year. There's a whole lot more work to be done before that major step makes sense.

And what of the schools that don't have these characteristics. What if they go ahead and hire a czar anyway? Will it really hurt? Will it really be any more than perhaps a few ineffectively spent salary dollars? I think yes. I think it could lead to some very serious long-range implications and positions that are ultimately so detrimental as to be potentially disastrous.

And that's because this one position is more than just one position. It is a signal. It indicates how an institution is dealing with perhaps one of the most important forces to hit higher education in its history: the force of technology. It indicates whether the college is dealing with it well or badly, in an integrated or a disintegrated way, effectively or ineffectively.

The timing here is so critical. Having a czar come on campus too early means risking that there won't be the right support structure in place for that person to succeed. He or she could be a czar without a government, just a figurehead. Or it could be that there will be either too much or too little power placed in the position, although it may very well be that no one will really know how much genuine power there is. The difference in this instance between real and imagined power can be the difference between success and failure.

Worst of all, the expectations for the position may be so entirely unrealistic that they will lead to nothing but a great deal of frustration and disappointment, both on the part of the institution as well as for the individual.

In light of all of this, perhaps a new position announcement is in order. What most institutions could probably use is not a czar at all really, but rather someone more benevolent. I don't know who the person in this picture is, but his white horse says something about him, I think. What is needed most places is someone who will help educate others about the issues, but not necessarily about the technology, and someone who will help shape the future, but not dictate its outcome. Perhaps the

Chronicle needs to have something like this:

Position Announcement: Chief Information Officer

Job Description: To help educate others on campus as to what can be done to make more effective use of information resources through the development of such things as efficient delivery systems. To help bring information to those who need it, when they need it, and in the form they need it. To coordinate, but not control. To translate but not interpret. To have vision of technology as a tool, but not as an end unto itself.

Qualifications: A good understanding of the potential of technology to help further the educational process, and an ability to communicate that understanding with those who may not be as technically proficient. Walking on water is not at all necessary, but a willingness to at least get one's feet wet, while showing others the value of doing so, is. And, oh yes, a sense of humor is essential, because we're all going to have to muck through this together somehow, and laughing along the way certainly will help.

What we need to be looking for is someone who can help expand our horizons and our opportunities, someone who will be an enabler. And while we want to have someone to help us take the very best advantage of technological innovations, it is critical that we provide the right environment for success.

INFORMATION ENGINEERING FOR HIGHER EDUCATION
- A MODEL FOR THE 90'S -

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Growing numbers of colleges and universities are making gnificant investments in "fourth generation" hardware and ftware. These investments are results of decisions made by senior administrators who are assured by vendors and MIS staff members that the money spent will be returned many times over due to higher staff productivity, end-user computing, and operational efficiency.

Actual results of ventures into "fourth generation" computing at many colleges and universities has been less successful than hoped for, and in a number of instances costs of computing have soared with service levels showing little change.

This paper deals with policy and methodological issues related to creating an environment for success with fourth generation hardware and software. The issues and suggestions come from actual implementation experiences combined with reported case studies of industrial implementations of these methods. The major point is that fourth generation computing is not a mere extention of past practice using better tools, it is in fact an entire new approach to information system management and as such requires new policies and methods if success is to be obtained.

1 INSTIGATING AND MANAGING A REVOLUTION

1.1 PAST PATTERNS AND FUTURE DIRECTIONS

Common Misunderstandings

People often discuss topics such as "fourth generation computing", information centers, and end-user computing as though these issues are yet another continuum in the evolving history of data processing. In a way this is in fact the case, but viewing these recent developments as just another and better MIS tool misses the point entirely. Hardware and software technology of the past several years has brought about entirely new tools, which offer an entirely new approach to managing information in an organization. Use of these tools not only implies methodological change for MIS professionals, but basic changes in the way an organization is structured and managed. Policy changes are an essential part of the restructuring process that these new technologies mandate, if their promised productivity and information delivery is to be realized.

A number of reasons exist for these misunderstandings. First, the marketplace has been confused about the issues of direction and standards for the past few years. Marketing hype has further confused MIS professionals and upper management, leaving many with a "wait and see" attitude. Understanding the methodologies and new tools is threatening to established MIS professionals for a variety of reasons, and many of them inhibit or discourage change.[1] The "how" of fourth generation software technology is not entirely clear to most managers and MIS professionals, and occasional stories of failures fuel the fires of dissent.[2] Regardless of this temporary confusion, the marketplace is moving ahead with ever more sophisticated and powerful products, and some organizations have enjoyed great successes using these products. The gap between the "new ways" and "old ways" is rapidly growing wider.

Past Patterns - Future Trends

Administrative computing in the early days usually originated as a sub-function of the business office or accounting department. Slowly, as other administrative departments realized the potential advantages of computer usage those responsible spread the wealth of data processing, but only after serving the needs of the group controlling the computer resource first. Over time, this pattern led to a proliferation of individual departmental applications, each with it's supporting file structure, and ittle interconnection between departmental systems. Struggles for computer resource allocation prompted many institutions to move computing to a separate department charged with serving user departments on some sort of an allocated basis.

The rule rather than the exception was to have administrative computing directed by an administrator at a lower organizational level than would be indicated by the importance of the resource he/she controlled.[3] As top leadership learned of the usefulness of management information systems increasing pressure was put on the MIS staff and the departmental staffs to integrate their information so that more relevant, accurate, and timely management information could be available. The onset of the microcomputer revolution accelerated this process. Top management began to learn first-hand of the potential power of management information systems, decision support systems, and executive information systems, but the data to properly fuel these systems was nowhere to be found, thus the concepts remain largely buzzwords.

THE DATA BASE ERA

The advent of data base management systems in the late 1970's seemed to promise organizations a logical and effective method of organizing information so that it could be truly integrated, and available to those people responsible for designing applications as well as to those needed data for management information purposes. Some institutions built new applications systems using data base managers, and others purchased ready-made application systems which worked on data base managers. Unfortunately, the great majority of these ventures produced results which were far from those intended, and many of the adventuring institutions ended up back where they started - with a set of rigid application based "file like" data bases which the MIS staff could not easily change, and end-users could not access.[4] The reasons for these developments were largely that MIS staff and top management could not or would not understand the magnitude of the change they were proposing, thus they entirely underestimated the effort, expense, and change necessary to convert the organization from a departmental based information model to an organizationally based information model. Figure 1 shows the nature of the proposed change. Until top management fully understands the nature of the change, and the demands of the process, successes will continue to be far and few between.

1. STEPS TOWARDS A NEW INFORMATION ENVIRONMENT

1.2.1 DETERMINING IF FOURTH GENERATION IS FOR YOU

RATIONALE FOR FOURTH GENERATION

The economic pressures that brought "fourth generation" products to the marketplace are primarily (1) the maintenance of existing application systems, and (2) the backlog of new, approved, and prioritized applications.[5] James Martin begins his book SOFTWARE MAINTENANCE - THE PROBLEM AND ITS SOLUTION with the statement "Over $20 billion per year are being spent worldwide on maintenance. If the techniques in this book had been employed everywhere they were appropriate, at least half of the $20 billion would have been saved."[6] While this may seem a remarkable and almost boastful statement, case histories of organizations which have been successful with the implementation of fourth generation methodologies are beginning to surface, and in general support Martin's statement. On a localized level, this means that if an organization is spending $10 million on computing, $7 million of this on staff salaries, and maintenance is taking 60% of staff resources (4.2 million), then successful use of fourth generation methodologies might save the organization about 2.1 million dollars per year. In addition to this potential savings on maintenance costs, resources can be freed up to work on new applications using productivity tools which have reported effectiveness ratios of from 10:1 to 100:1 over COBOL and other "third generation" design tools. The integrity of the data structures can potentially be sounder and easier to modify when using fourth generation data base products, so an overall assessment could be made that it is perhaps possible to have more stable information of higher quality; greatly improved application system development (speed of development and quality of product); and save money at the same time.

This sounds too good to be true, and in many cases the hoped for dreams of less cost and higher productivity have not come about in spite of great effort and expense put towards these goals. This paper suggests a managerial approach to assessing the organizations readiness for change, and manners of organizationally addressing change in ways to bring about the maximum chance for success with information systems improvement efforts. There is an increasing body of reported knowledge relating to successes and failures of fourth generation ventures. By evaluating this information, and then relating the findings against the literature and the marketing claims of vendors, it is possible to develop scenarios which have high probability of success or failure. This paper will present some of the scenarios for success, and hopefully serve as a guide for top level managers who are contemplating trying new methodologies.

ORGANIZATIONS THAT BENEFIT FROM FOURTH GENERATION METHODS

Prior to accessing products and the readiness of an organization to make use of these products the more basic question of "do we need this methodology at all?" should be addressed. Certainly vendors will tell you that you need it all, but what are the organizational determinants of the worth of such a venture? The needed answers should be available within the organization; from the accounting office; the MIS governance or advisory groups; and from indicators of service quality and cost information regarding services forgone. Areas for examination include:

Applications backlog (approved and prioritized AND the extent of applications not requested because of frusration over the existing backlog)

Maintenance costs (percent of staff devoted to maintenance; mandated reports not available; cost of changes not made on time)

Management Information (have managers the information necessary to do their jobs? - would additional and easier to obtain information allow them to do their jobs better from a cost savings or income generation perspective?)

Service Quality (do clients get high quality service? Are waiting periods for registration long? Are required notifications sent on time to the right place? Is advisement working well? Is graphics production working as effectively as it should?

Staffing Levels (How do your clerical staffing levels compare to other organizations handling tasks of the same general nature as your organization handles? Is the organizational attitude such that increased system effectiveness could result in decreasing staff levels or would these staff merely find something else to do? Are your cost accounting controls working and producing information that is useful?

These questions and areas for investigation are not exhaustive nor applicable to every organization. The point is, that prior to setting forth on a "fourth generation journey" a thorough evaluation should be made of exactly what the great cost of properly taking such a journey will buy the organization. Even the most modest implementation of an information environment such as those described by DBMS vendors will cost several million dollars, and take multiple years to implement. Prior to beginning ANY activity with fourth generation methodologies a reasonably reliable assessment should be made of the exact problems that are to be "fixed" and what cost savings (or product improvements) are expected to come from "fixing" these problems. It is likely that if a thorough assessment of this type was undertaken by all candidate institutions less that 50% would find the venture justified AT THIS TIME in the development cycle of technology. Within a few years the methodologies and hardware will be much less costly, and easier to implement. Institutions undertaking the change today without a clear picture of the magnitude of the cost and effort; and without an analysis of exactly what is expected are very likely to be unsatisfied with the results which they will attain.

Once the analysis has been completed, and a determination made that a change may be cost justified, the tasks of assessing needs, products, and organization structure begin.

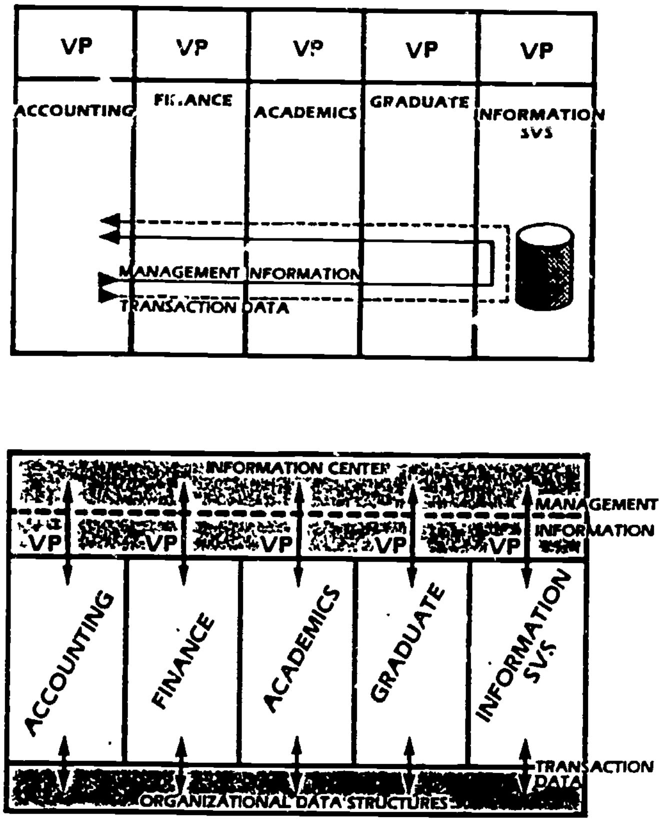
1.2.2 SPECIFIC DIFFERENCES IN ENDS AND MEANS

COMPONENTS OF A FOURTH GENERATION ENVIRONMENT

Figure one illustrates the general nature of an "information environment" - an environment in which information is viewed as an asset and a resource worthy of inhabiting an organizational environment of its own. There are several basic components to such a model, and each component has a set of related management and organizational issues. In basic form these include:

The Information Resource

The information resource is the entire set of information, logical and physical, which makes up the data base environment. This includes information in three states: (1) logical data models; (2) software schemas; and (3) physical data bases. In addition to these data related issues, the information resource includes people, machines, and procedures. Pieces of this resource now exist in every data center, regardless of the state of sophistication. The major difference between a data center "data library" and an information resource is that the information resource exists REGARDLESS of the current demand for the information. Typical data libraries include only that information which is required to fuel an application which



Department Model

Information Environmnment Model

FIGURE 1

Organi... for an Information Environment

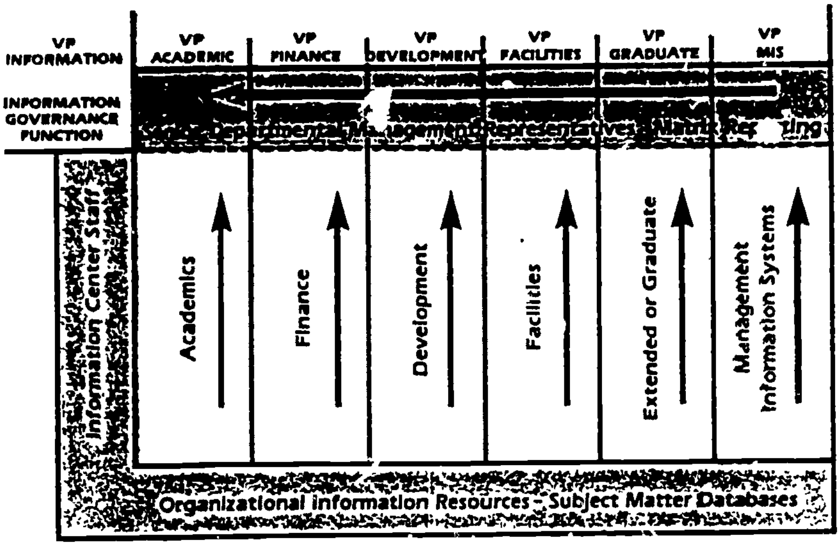


FIGURE 2

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exists. This means that the traditional development pattern is to ignore data until a program demands it, then scurry around to collect, sort, merge, or create that data. An information resource is a planned, methodologically sound set of interrelated information which has been selected for inclusion because of its relevancy to business operations - not the fact that a program currently demands it. The data to be included in such a resource is purposefully determined through the information engineering practices of data modeling, and data base planning and design.

The Organizational Environment

The information resource crosses organizational boundries, and potentially alters the accepted methods of doing business for managers, departments, and workers throughout the organization. Due to the nature of the changes in the workplace together with the cross-organizational cooperation and coordination required for the successful implementation of an information environment attention must be given to the orgnizational structure which will best enable these changes to successfully take place. Counting on the MIS organization to usher in the new environment has not proven to be successful in many of the major projects which have been reported on. Stereotypes created by past MIS projects, and fixed personality and organizational roles have made it diffifult for MIS professionals to lead the way to information environments. Furthermore, many MIS professionals are guarded and/or defensive about fourth generation methodologies, and tend to resist sweeping change or parcel out change when it benefits the organization as they perceive it. Common sense and experience both indicate that the best organization for such change is a department level entity which is responsible for the design, creation, control, and organizational implementation of information as a major organizational resource. Strategies for this type of organization are presented in this paper, and are increasingly being reported on as more case studies of actual implementations appear in print.

1.2.3 ORGANIZING FOR CHANGE

Of all the ingredients of an information environment, the most important is the orientation and involvement of senior management. Once adequately educated about the nature and design of an information environment, senior management will realize that if such an environment is justified and to be created there will be many serious organizational reactions to the required changes. Data processing may lose control over the information resource, and will certainly lose control over a substantial portion of application development and maintenance. Departments will lose total control over information access and rule creation, and positions within every department will be subject to changing job duties and in some cases elimination. Managers will react to changes in their span of control differently, and senior management must act as a guide and referee through these changing times.

Senior management can orient and educate themselves to the nature and operation of the information or "fourth generation" environment by attending one of several high quality seminars being held regionally such as the James Martin Seminars, put on by the Technology Transfer Institute located in Santa Monica, CA., or the seminars just started by E.F. Codd offered through the Relational Institute located in San Jose, CA. E. F. Codd could be considered the "father of Fourth Generation" since he founded the mathematical models upon which the software is based, and James Martin has acted as the major evangelist for the movement.

An absolute rule should be that "no consideration will be given towards purchasing or implementing fourth generation tools until senior management is adequately oriented." Allowing data center management to procure these tools and employ them as solutions to departmental problems only prolongs the misuse of these products organizationally, and should be avoided even though a perfectly sound rationale can be developed by data processing management for the procurement of the tools. A great deal of money has been expended by data center managers to purchase fourth generation languages and relational data base systems, and because of the departmental rather than organizational use of these tools adequate payback is usually not forthcoming. Once senior management understands what the information environment is all about the stage will be set for the orderly development of a new information organization.[7] The key to this understanding is the simple fact that information is not a by-product of computer applications. Information is a critical and substantial organizational resource, and one that must be developed and cared for with as much attention as buildings, personnel, or customers.

Figure 1 shows the contrast between classical MIS organization and the general organization required for an information environment. Although the exact nature of the new organization will vary with mission and philosophy, the idea of placing information into a full departmental status will not vary. Because information is an cross-organizational resource, and one that will be frequently interacted with by all parts of the organization, it is suggested that a matrix management structure such as that suggested in Figure 2 be explored. The most important element of the plan is that the controller of the information resource be of equal organizational rank to other senior managers, with direct access and participation in the senior management council (cabinet, etc.).

Equally as important as proper organization structure and management is the establishment of two "clearing house functions" which will serve to control (1) the nature and content of the information environment; and (2) the nature and content of the end-user application environment. These can be committees, or small heirarchical groups of designated managers who report to the senior information official. Regardless of the specific mechanism decided upon, these very important groups will be responsible for:

> Establishing database policy with regard to structure, modifications, changes, access rules
>
> Approving ad-hoc or departmental databases which will exist separately from the information environment
>
> Approving end-user applications which exceed an agreed upon scope for an individual department; then ruling on whether the application will be developed through the Information Center or by the MIS Department.

It is believed that management of the information environment must be outside of the established MIS organization in almost every case. This is because (1) established MIS management usually has a perspective towards the appropriate roles for end-users which is not conducive to fourth generation success; (2) the political realities lessen the chances of existing MIS management to change things within their Departments rapidly enough; and they have almost no chance to change things outside of their Departments; (3) it is necessary to focus ORGANIZATIONAL attention to this venture at the highest level, and establishing a new organizational environment will help greatly towards this end. In very few cases, the MIS group has been established at a full departmental level, headed by a senior manager who is equal in rank to other major department heads (controller; Vice President for Administration, etc.) and who is viewed by the organization as a dynamic change agent. In these few cases the information asset may be placed in the hands of MIS, but only when it is positioned at a level equal to the ongoing MIS activity.

1.3 RULES AND ROLES OF INFORMATION ENGINEERING

The word "engineering" has become a common addition to descriptions of software curricula and is now being used in conjunction with information to convey a similar message. Professor C. A. R. Hoare, of Oxford University's Computing Department states that "The attempt to build a discipline of software engineering on such shoddy foundations must surely be doomed. like trying to base chemical engineering on phlogiston theory, or astronomy on the assumption of a flat earth." [8] He is suggesting that most curricula or professionals using the descriptor "engineer" in conjunction with software or information have no substantial, consistent theory base upon which to base these claims. While this is no doubt true, proven rules are beginning to become established which may be applied to the various phases of information design activity that begin to form a discipline. These involve rules and techniques involving the stages of developing an information environment which include (1) Strategic Information Planning; (2) Entity Relationship Analysis; and (3) Data Modeling.[3] The proper design of an information environment is as difficult and critical as the design of a new bridge between the top floors of two adjoining buildings. It is unlikely that an organization would trust retrained physical plant staff to design this bridge; it is equally unwise to allow quickly retrained MIS staff to design the information environment.

2 INGREDIENTS FOR A SUCCESSFUL INFORMATION ENVIRONMENT

2.1 TOP DOWN PLANNING ACTIVITIES

Top down planning for the future information environment is crucial to the success of the venture, for the most important outcomes of the plan will be that (1) separate systems will have an interface to a common network so that they can exchange data; and (2) separate systems will employ compatible data in their data bases, structured according to a common data model.[8] The organizational and managerial considerations suggested in this paper are directed at achieving these goals, together with assuring continued adherence to the outcome of the plan and implementation of the information environment. Top down planning will inherently insure that (1) top management is actively involved with the process; (2) no piece of organization activity is left out of the plan; (3) accountability will be to the highest organization level.

Rarely will an organization be staffed with persons adequately versed in the process of planning and implementing an information environment. If this change is to be attempted, money will be wisely spent to (1) educate selected staff through appropriate seminars and classes; (2) encourage visitations and in-depth studies of organizations already in the process of change. Further, consulting assistance will be a must for most organizations, whether it is to frame and monitor the activities, or to actually direct them. There are a FEW organizations (especially those noted earlier in this paper) who can offer these services. Many firms, including the "big eight" CPA firms will claim to be able to offer such guidance, but results thus far generally prove otherwise. It is again stressed that this is an ENTIRELY NEW APPLICATION OF ENTIRELY NEW THEORY AND METHODS. Firms offering "born again" products or consulting services will not only waste the organizations resources, they will send the organization down a path which will lead to great frustration and expense in the future.

2.2 COMMON REASONS FOR FAILURE

In his book <u>MANAGING THE DATA BASE ENVIRONMENT</u> James Martin details the reasons for the failures of many attempted conversions from a departmental MIS environment to an information environment.[4] Top on the list are political dissension; lack of understanding of the information environment by senior managers and MIS professionals; overselling by vendors and insiders; grandiose, all embracing project plans; and applications pressure. Martin lists many more, together with reasons for successes. It is necessary that all senior managers about to undertake this conversion become familiar with this valuable case study research. After more than five years of fourth generation product implementation, and ten years of DBMS implementation there is an adequate base of case study research that will enable management to avoid repeating past mistakes. Proper education, top-down planning, and the assistance of the right consultants will enable an organization to avoid the pain and expense of an outright failure, or a less-than-hoped-for success. The direction away from these problems has not come from MIS professionals. Senior management must become personally involved and knowledgeable if an adequate return-on-investment is to be realized.

3 MANAGEMENT POLICY FOR AN INFORMATION ENVIRONMENT

3.1 RECOGNIZING AND MANAGING INFORMATION AS A RESOURCE

The suggestion that senior management become familiar with the concepts and case histories of migrations from departmental to organizational information environments has been stressed in this paper. The primary cause of failure, frustration, and suspicion over the value of expended resources is the lack of senior management understanding, support, and direction of information activities. In the past (prior to the late 1970's) it was permissible for senior management in large, complex organizations to leave data processing and applications development to the MIS professionals. The scope and importance of the information resource has now grown beyond the MIS Department. Further, vendor hype and staff resistance or prejudice tend to confuse direction, lengthen implementations, and cause morale problems at lower staff levels. There is no alternative to the sincere involvement of senior management if these difficulties are to be dispelled.

3.2 COORDINATING PLANS, ACTIONS, AND TECHNOLOGY

A case can be made for every organization to begin information planning, even though the transition from departmental to organizational information may be some time off. An ongoing process, involving senior managers and senior departmental representatives can make great progress with staff education, planning and evaluation that will help to insure that ongoing projects can be brought into line concurrently with information planning so that excess conversion efforts will not be required in the future. New applications, together with hardware and software plans should be brought under the umbrella of organizational information resource planning. In addition to this, organizational changes can be initiated, and new applications and data governance activities started well in advance of the actual migration to an information environment.

In addition to advance planning it is often possible to experiment with fourth generation methodology on a test-case basis. Many vendors have scaled-down versions of their product available for use on microcomputers, and using these tools in an information center can be an important educational asset AS LONG AS applications developed in this activity are viewed as experimental, and are linked by design to the eventual information environment in a way that will not impose constraints on the future tasks of information engineering. A rigid structure of existing applications programs combined with a variety of fourth generation "experiments" which are now being relied on by organizational components will limit the value of future information engineering attempts by placing undue pressure on the planners for certain types of data structures. Any activity towards a fourth generation/information environment must be included in the information planning process, and carefully managed from the top down.

Information engineering towards an environment in which information is viewed and valued as an asset and resource holds perhaps the greatest promise for organizations to remain competitive in the 90's. This reward is attainable by most organizations, but the process will be long, difficult, and expensive. Today is the best time to start educating, planning, and organizing for tomorrow's information resources.

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THE INFLUENCE OF POLICIES ON DATA USE

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ABSTRACT

In "Some Thoughts on Expert Software", Chambers (1981) warns us that:

> "...Software in its present form, made widely available by cheap computing, will precipitate much uninformed, unguided and simply incorrect data analysis. We are obligated to do something to help." (p. 37)

Institutional policies are needed to guide the responsible use of data, especially in a decentralized operating environment. This paper explores the factors which influence the development and implementation of such policies for decentralized data use. Institutional philosophies regarding data use, technological developments, and the needs and responsibilities of both user and the institution are among the factors which must be addressed if consistent, comprehensive and effective institutional data policies are to evolve.

INTRODUCTION

Due to shifts in administrative styles and responsibilities, and in response to the technological revolution, institutions are being forced to reexamine and, in some cases, to develop data-use policies Implementing or changing such policies requires an understanding of how to isolate causal forces, how to identify those specific relationships which the situation requires and how to restructure the policies to meet the resulting needs of the situation. The following is intended to help those involved in higher education start the policy development process. First, the role of administrative style is reviewed. Next, structural changes which support policy decisions are discussed. The final section looks at some specific policy needs and alternatives.

THE ROLE OF ADMINISTRATIVE STYLE

There are three major traditional administrative styles of organizations: monarchy, collegial, and managerial (Peterson, 1985). While most institutions exhibit a predominance of one of these styles, almost every institution has some of each style operating at different locations within its structure. The different characteristics of the three styles are summarized below.

MONARCHY. In a monarchy, operating procedures are specified, there are clear lines of authority and responsibility, and decisions are made on specific items at specific times. In this environment, it is common to find centralized data management and tight information control consistent with formal and political power. Planning is linear and focused, and the data used are census data. Census data represent "official" data for reporting purposes, such as counting students at the end of four weeks of classes.

COLLEGIAL. In the collegial style of administration there is no effective single force from the top. There are less stringent requirements for accuracy, consistency or timeliness than in the monarchy. The governance structure assumes that the data flow is governed through a shared understanding of the purposes of the information rather than by specific procedure. Planning is related to the cultural requirements of the organization, and data are primarily from incidental sources.

MANAGERIAL. In the managerial environment, information flow is decentralized rather than diffused (collegial) or tightly controlled and centralized (monarchy). While accuracy is needed in external reports so that the institution maintains its credibility, there is less tendency to use specific information for internal political purposes.

Policies are enforced by legal means rather than by the sanction power of the monarch or the moral overtones of shared values from the collegial. Strategic planning is employed, and there is a balance between census data and real-time data depending upon need.

THE CHANGING NATURE OF OPERATING ENVIRONMENTS

The tolerant operating environment of the 1950s and 1960s allowed the flourishing of the monarchs. The availability of resources and growing prominence of higher education provided powerful and charismatic leaders an opportunity to expand programs, facilities and faculties to meet new demands placed on higher education by Sputnik, the early baby boomers and various groups seeking equitable access to higher education. In these halcyon times, faculties could focus their collegial efforts on developing programs to support the momentum that the monarchs had cultivated.

With the decline of resources and the dramatic acceleration of inflation during the 1970s, coupled with the decline of the traditional college-aged cohort in the 1980s, the management of resources and the ability to explain how resources were being used became critical. Demands for accountability increased, and colleges and universities reacted by developing rational processes to manage their resources, and to explain how their operations meshed with their various institutional goals. Many institutions found that a more managerial style of operation was being demanded by those who provided the funds.

Along with this shift in institutional style there has been a concomitant movement towards decentralizing information and data. This situation has been precipitated by the onslaught of advanced communications and computer technology reaching the campus, where an increasing number of people now have inexpensive computing power at their fingertips.

Thus, accountability, scarce resources and technological change are forces which support the move toward the managerial style. Accountability requires efficiency, scarce resources require adaptive behavior and technological change drives the decentralization of decision making and power (Strange, 1983). This decentralization has included the return of strategic planning to the operating level. Since the data/information required to support different administrative styles varies (Jones, 1982; Chaffee, 1985), the movement to the managerial style will impact the way information and data are handled. It is the development and implementation of institutional policies related to the handling of data and information that is the focus of the balance of this paper.

DEVELOPING NEW STRUCTURES FOR DECENTRALIZED DATA AND INFORMATION MANAGEMENT

Instead of total dependence on a large expensive mainframe computer with specialized personnel to manage and run it, small microcomputers which can interface with the mainframe or stand alone have become prominent in many offices. With this technology has come increased computer literacy, primarily among younger mid-level managers whose academic training included the use of computers. Their analytical appreciation reinforces their use of computers, which has resulted in a shift in decision-making power towards the operating level (Masland, 1985). The trends toward decentralization have been enhanced by increased availability of user-friendly software which allows large data bases to be handled at low cost. This trend emphasizes the need to govern information and data use with policies instead of dictates or consensus. Clearly, the development of such policies must be consistent with the environment in which they will be used. This may require changes in the organization so that the appropriate authority relationships exist and the procedures of policy development are based on rational-functional reasons of the managerial style.

To understand the complexity of the situation, one only has to realize that in the decentralized information environment it is reasonable to assume that every manager will have access to at least three sources of data. The first are the "o icial" data from the university. Often these data are generated from a census file as of a certain date. The data do not change and their use helps ensure consistency in reports. The second set of data comes from the dynamic files of the university. These numbers change daily as updates are made. Managers will seek to obtain these data to closely monitor critical activities. The third type of data comes from the data bases or files that the manager develops. These may contain information relevant only to the manager or duplicate information where the manager is not satisfied with the access to or accuracy of the institutional files.

With these three sources of data, the manager will be involved in multiple data operations, including development, access, manipulation, analysis, quality, ,orting and archiving. Data use will have to take in' account insuring a higher level of consistency, reliability and validity, security and accessibility than required under other administrative styles. It is critical that the policies are developed, implemented and adhered to from a campus-wide perspective. Since campus-wide policies will be detrimental in individual situations from time to time, it will be essential that a strong, but not necessarily large, centralized data management function be created to help develop and ensure compliance with such policies. Mechanisms must be in place to allow involvement of key perspectives

Data-use policies in a managerial environment must be comprehensive, yet flexible enough to allow managers to adapt to opportunities or reversals. Below are some proposals of how the development of policies might be pursued to increase the likelihood that appropriate policies will be enforced. While not intended to be inclusive or proscriptive, they contain key components which are important.

An effective data-use management function must be supported from the top and this support could well be centralized in a "data administration" function with an appropriate office or individual identified to undertake these responsibilities.

For the purpose of this discussion, data administration should not be confused with data base administration which is concerned with the technical aspects of managing data bases. Factors to be considered in assigning the data administration responsibility include:

- familiarity with institutional data bases;
- experience in retrieving data from data bases;
- experience in analyzing and presenting data;
- experience in user-friendly software for end users;
- knowledge about microcomputers and links to mainframes;
- experience in responding to external data requests;
- sensitivity to the political aspects of information; and
- independence from local interests with high credibility and adequate functional authority to make information a university resource.

Offices of institutional research, information centers, data base administrators, among others, are likely candidates for the responsibility.

In addition to the assignment of the specific responsibility, the institution should consider establishing several types of committees to augment this function. The first group could be an advisory committee to the data administrator. Its major task would be to formulate policies and consider enforcement of these policies. It might also advise the data administrator on the relative priority of specific activities which have funding implications. It would be naive to assume that an institution can move to a decentralized data environment without costs. This group might include the individuals noted above who were not given functional authority for data administration, and could also include representatives of the custodians of the major data bases and representatives of the institutional computing enterprise. The institution's legal counsel might also be a member.

In addition to the policy group, it is important to develop user groups around the major data bases. These groups provide a mechanism for educating the users about the peculiarities of a specific data base. They also provide for feedback on inaccuracies of the data, inadequacies of the data base and difficulties with various policies. User groups provide opportunities for participation from the operating level and help ensure appropriate policies, which enhance the quality of the data and compliance with policies.

It may be desirable to establish another committee consisting of representatives from the computing enterprise, staff from the functional office the data base supports and potential users of the data. This would provide a nucleus for the user group after the development process is well established. An alternative to this group is to require data base custodians to develop data element dictionaries, documentation, software, and data base design. This decision depends, at least in part, on the existing conditions of institutional data bases and the desire for permanent computing resources in the custodial units.

POLICY NEEDS AND/OR ALTERNATIVES

Institutions which have begun to distribute data without proper policy preparation have found 1) internal control systems weakened, 2) erroneous conclusions by end users because the quality of the data does not meet expectations, and 3) the possible loss of data integrity in central files if the users have write capability (Canning, 1983).

Policies are needed to help guide the data administrator and users about a number of issues. The following is not exhaustive but is intended to be indicative of some of the most pressing concerns facing institutions in managing decentralized data.

- Who may access centrally-maintained data?
- How shall the access be controlled?
- What data will be accessible?
- When will data be available, in what format, and for what time frame?
- How will resources be allocated to develop and support decentralized data use?

Decentralizing Data

Custodians of the data (e.g., personnel office may be the custodian of the personnel data base, the registrar may be the custodian of the student records data base, etc.) may be concerned about allowing "their" data bases to be accessed for fear that "numbers" contrary to official statistics may be reported due to erroneous or mistaken interpretations.

This is not an easy fear to overcome but in reality detailed data reported in hard copy to interested users can be, and often are, rekeyed into microcomputers and manipulated regardless of the concerns of the data custodians. Any user who has hard copy access will demand access to machine readable data. Based on the data-sharing philosophy of the institution, users may also demand access to data other than their own.

Given a policy to decentralize data, policies to govern data access are needed. An expansion of the five points outlined above concerning data access includes:

- Will real-time access be allowed or only access to census data "snapshots" be permitted?
- How good are the data?
- Where do the resources come from for a custodian to maintain data elements which they do not use but which are desired by other users?
- Are fully developed data element dictionaries available to explain characteristics and properties of each data element and to assist users in choosing elements appropriate for their applications?
- Will debugging assistance be provided?
- Will user-friendly tools be provided and training to support the use of these tools be available?

As is apparent, these are policy questions which balance the needs of individual users against the resources required to provide services. Often it appears to be a zero sum proposition with a built-in predisposition for conflict

Data Access

The data administrator can serve as the gatekeeper to the data and require each user to complete a request to access data so that the data custodian has an opportunity to approve access to their data, and to provide a record of who has accessed what data. The data administrator might also be assigned responsibilities for "quality control' through a review of analytical procedures and a check of outputs that test the reasonableness of the outcomes. This is appropriate only if the data administrator is well experienced in analyzing the institution's data and has adequate support from top management.

Data Confidentiality

Policies are needed which will reconcile the "right-to-know" with "privacy" concerns, particularly in personnel and student data. Data down loaded to diskettes are particularly vulnerable since they are easily transported and copied. Bulky printouts, while not preventing data abuse, do not facilitate the process like diskettes. Users may be required to read and sign statements acknowledging their legal responsibilities to maintain confidentiality of sensitive data. Headers on diskettes reminding users of their responsibilities may also be useful.

Data Security

Data security can be enhanced by the use of census data "snapshots" to eliminate possible loss of data integrity due to accidental or deliberate change of data in central files. Census data also minimize conflicting data problems, especially in external reporting of data. At the same time, they may not be sufficiently current to support adaptive and strategic management.

To further ensure consistent reporting of data to external agencies, policies are needed to identify units responsible for specific reports and data bases to be used. In particular, reports having funding implications, accreditation reports, federal reports, among others, should be reviewed centrally to ensure consistency and accuracy.

Data Documentation

To use decentralized data successfully, accurate documentation and data element dictionaries are needed Individual data bases must be documented so users can use them appropriately. Likewise, the properties and characteristics of data elements must be documented. While the data administrator may or may not be responsible for maintaining the data element dictionaries, someone must be responsible. Documentation of individual data bases customarily would be the responsibility of the programming team that created and maintains the system; all documentation should follow a consistent format.

Data Quality

The related concern of data quality is an issue the data element dictionary should address, or at least document. As data elements are used in analyses, element weaknesses often become apparent. This "auditing-through-use" is one of the major potential advantages of decentralized data use. The data administrator should duly advise the custodian of the data of the flaws and record problems until problems are resolved.

Decentralized Data Use Support

After considering the above policy issues, an institution must decide how sophisticated the software will be to support "decentralized data users." Hahn (1985) discusses four possible options. One option is to ignore the lack of technical expertise and let users fend for themselves. Disastrous results can be anticipated if it is important to maintain a consistent translation of data into information. Left to their own devices, users will tend to make mistakes which tend to favor their organizational unit and which will undermine the concept of reporting consistent data to external constituencies.

A second option is to provide resources for an answer and referral service. This is a role the data administrator would play if appropriately charged. In this case, the user would have someone to contact in case of a question. The need is to train the users to know when and how to ask questions.

In the third option, expert guidance information would be built into the system. Certain questions would prompt the system to provide help. In this supportive type of system, the institution can provide a general decision-support type of system where the users ask questions and the system determines the best way to respond. The quality of this type of system would depend upon the resources spent to develop and support it.

The fourth option presents an ultimate system which would support the user through automated consulting and analysis in the software. This most sophisticated option might be something to which to aspire, but it will be very expensive. Realistically, most institutions should probably focus on providing an answer and referral service (second option) through a data administrator.

Depending on the choice of software, an institution must be prepared to train users in the use of that software. Also to be considered is making users knowledgable about the strengths, weaknesses and maintenance of existing data bases. As microcomputers become more widely distributed on campuses, everybody will have a gun! (Mann, 1985) Institutions must be prepared either to train users about hardware, software and data or to be shot in the foot. The user groups discussed previously are one of the better mechanisms for educating and training users.

A final step in the evolution of data use policies involves the allocation of money, space, personnel, and time to support promulgated policies. Development of specific software and hardware configurations, data bases and specialized training all cost money. Questions to be considered include:

- How much should be spent on what and when?
- Should purchases be centralized?
- Should purchases be standardized?
- Which needs are met first?

- How much has to come from current budgets and how much is an add on?
- Is the information center, if created, costed out to the users and if it is, how?

These policy issues questions are linked to the mission and goals of the institution. The decisions which will influence the way the institition does business are best made at high levels in the organization with recommendations from the data administrator who has obtained advice from an advisory committee with an institutional perspective.

SUMMARY

If one believes that "effective methods of decentralization are essential if the administration is to avoid the rigidities which are destructive of the initiatives which keep the institution alive" (Litchfield, 1959, p. 165), then thoughtful consideration must be given to the development of policies to support the decentralization of data and information. Consideration also must be given to the management style of decision making on campuses and how they affect the way in which information and data are managed The decline of available resources of the past decade has resulted in increased accountability for higher education, and advances in computing and communications technology have provided the tools to meet the demands for accountability. In addition, these same tools have provided a means for increasing the amount of information available to all levels of institutional management. The increase of "computer literate" managers has resulted in a push for decentralized access to institutional data bases as well as the development of independent, specific data bases (Sheehan, 1982).

As such, the managerial style of decision making will become dominant in higher education and will result in decentralized data use throughout our institutions. It is apparent however, that with managers directly accessing and manipulating institutional data bases, as well as creating their own specific data bases, comprehensive institutional policies governing the development, maintenance and access of data must be developed. It is also clear that the institutional organization processes reponsible for data base and the concomitant policies will need to meet certain characteristics of the management style of administration. Effective policies will have to maintain a validity in and of themselves. They cannot be expected to evolve by the magic of consensus or be created by the dictates of a monarch

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OWNERSHIP, PRIVACY, CONFIDENTIALITY AND SECURITY OF UNIVERSITY DATA

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SCT CORPORATION

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INTRODUCTION

As the use of computing in support of administrative functions at Universities has grown, approaches to handling, storing and retrieving of data have changed dramatically. From manually written and stored records, Universities are moving to magnetically encoded records on disk and tape. These records, which were originally stored as single use files, are now becoming large, integrated data bases with multiple uses. Access to these data bases is changing from printed reports to on-line inquiries, and centrally controlled batch updating is being replaced by data entered via a terminal by a user in his or her own office. Thus, the methodologies of data maintenance and usage are evolving rapidly.

Apart from the mechanisms of data storage and retrieval, however, exist the larger issues of management and control of data, issues which normally require policy statements and guidelines from upper management. The purpose of this document is to present model recommendations for policies and procedures to address the areas of data ownership, confidentiality, privacy and security. It is written in a manner which should be adaptable by most University data centers. The intent is to provide a document which can be rewritten and tailored to a variety of environments.

OWNERSHIP

BACKGROUND

The ownership of all data bases clearly resides with a University. However, the University should have a designated point of responsibility, or a steward, for each of its data sets. The University, as an institution, cannot be a steward.

Traditionally, the stewardship function has rested with a computing organization. In an institution with a relatively small set of applications accessing dedicated or single use data sets containing only basic data, this approach functions quite adequately. Over time, however, these systems have evolved and matured to the point that they require data which can only be supplied by systems which are maintained and monitored by other administrative areas. Furthermore, the data contained within these systems have been expanded from a very limited set to a comprehensive resource, and now require a new generation of data support methods, procedures and policies.

In effect, the key skill or knowledge in the old environment was related to computing hardware and/or software. In the new environment, it is knowledge about data and its use. There has been an orientation away from mechanical skills and toward service and applications.

SUGGESTED ENVIRONMENT

Based on the above considerations, there is a requirement for data sets to have a designated steward, preferably from within a user department or division. As an example, the Comptroller could be the steward of Financial Information Data Sets.

In the suggested environment, every data base and subset of a data base would have a designated steward who would be responsible for the integrity and content of the data. In this context, integrity is defined as a measure of the quality, security and confidentiality of the data within the data base, including extracts from the files, and content deals with the definition and description of data elements within a data base.

A data base is defined as any collection of records stored on a computer disk, tape or other medium, or any extraction or subset of that collection of records including terminal display of data, printed reports, and data processing cards. A vital data base is a permanent set of data whose loss, destruction, alteration or dissemination would severely impact the operational capability of a University.

MODEL RECOMMENDATIONS

A policy, relating to data bases, should state:

- An appropriate steward will be designated for data bases currently existing or under development;
- The steward will be appointed by senior level management from persons within the operating organization; and
- The steward is responsible for the integrity and content of the assigned data base.

Areas of responsibility of the steward should include:

- Administration within the context of University policies and procedures: The steward has responsibility for decisions regarding the data base. Where a decision affects several areas, the steward should be responsible for assuring that the decision is made known at the appropriate levels.
- Defining Data Elements: The steward should be responsible for the definition and description of data elements within the data base and for assuring these data elements meet the requirements of the University. The University Computer Center should plan an active role in this process. In addition, where an action may affect the operation of other segments of a University's administration, such groups should also be involved.
- Security, Privacy and Confidentiality: The steward should be responsible f assuring that policies and procedures relating to security, privacy and confidentiality of the data base are enforced.
- Funding: The steward should be responsible for assuring that a cost/benefit study is completed prior to development of a data base. This study should normally address funding and costs of the data base including development, maintenance and storage. All such studies should have the active participation of the University Computer Center.
- Training: In order to provide the stewards with the specialized knowledge needed to perform their roles, the Computer Center should develop and administer a training program.

CONFIDENTIALITY

BACKGROUND

A University has an interesting problem when dealing with confidentiality of data. If the University is a public institution, a portion of its data bases may eventually become public record. It also collects and processes data that requires a very high level of confidentiality. Therefore, a University often must provide access to certain sets of data as requested while strictly limiting access to other sets. Additionally, while some information may be public, it is in the best interest of Universities to have control of the access to this information and the context in which it is accessed and used.

Most Universities have developed and implemented security systems to protect data or programs from accidental or intentional destruction, and to prevent misuse or unauthorized use of its computing resources. In a computing environment where the processing systems were oriented toward producing hard copy reports from single use data bases, this security system served the additional functions of limiting access and of providing some confidentiality of data. However, as Universities begin implementing systems oriented toward access to integrated or multiple use data bases, the use of a security system as a confidentiality or access system creates problems. The problems become evident when the objectives of a security and confidentiality system are examined.

The prime objective of a security system is to protect the data. This involves creating defenses which strictly limit access to the data resource. The role of a confidentiality system is to use the controls provided by the security system to allow structured and monitored access for purposes of update and retrieval, while at the same time assuring that the integrity of the data is maintained.

With respect to confidentiality, an area of concern in many environments is a high dependence upon printed reports or hard copy. One of the most important keys to confidentiality is the limitation of the number of copies of a data element. In other words, the confidentiality of data is dependent upon the number of persons who can gain access to it. Information on paper has a large potential audience. Thus, the greater the shift away from printed reports towards the usage of terminal access, the greater the potential gain in the level of confidentiality.

There is a practical limit on the data to which one can reasonably expect to control access. While access should be controlled to those data bases developed centrally, it is not practical to develop an access control system that addresses every possible data base developed by every organization within a University. This paper assumes the confidentiality recommendations are directed toward centrally developed data bases, but the recommendations could be used with other data bases if they conform to the characteristics of the centrally developed ones.

Finally, it is important to note that all efforts to increase the confidentiality of a system will be limited by two major considerations. The first of these involves the requirements of external agencies and groups who set both access guidelines and require access for their own purposes. The second factor is the need to minimize the bureaucratic burden of implementing a set of policies and procedures.

SUGGESTED ENVIRONMENT

Extreme care needs to be taken in developing a confidentiality system to prevent the imposition of cumbersome controls. A confidentiality system, like a security system, can be as complex and expensive as a University desires. The prime objective, however, should be to allow authorized persons easy access to data at a reasonable cost.

The optimum solution is to provide centralized access control via stewards who are responsible for discrete, yet comprehensive segments of a data resource.

MODEL RECOMMENDATIONS

Model recommendations for confidentiality are:

1. Prepare a policy on confidentiality of data sets which states:

> All data bases and subsets of data bases owned by the University shall be reviewed, and a level of confidentiality shall be established for each. This review shall be conducted by the designated data base steward and should involve the internal auditing department, the Computing Center, the legal department, and any users of the data beyond the office responsible for the data.
>
> - Levels of confidentiality are:
>   - Available to anyone;
>   - Available only to persons designated by the steward; and
>   - Available only to the steward.

2. The Computer Center should be charged with:

    - Conducting a systems definition effort to define the specifications for a confidentiality/access control system that is implementable within the long range computing strategies and philosophies of the University;
    - Assuring that the system specified permits easy access to data while allowing for the strict limitation of the data accessed;
    - Where possible, encouraging and supporting the use of non-hard copy access to data. Consideration should be given to developing a long range program for substantially reducing the number of printed reports and restricting the data printed on existing reports to essential elements; and
    - Developing a confidentiality standards document to be followed by development efforts.

PRIVACY

BACKGROUND

Privacy is concerned with the rights of those individuals on which data is maintained. In the broadest definition, an individual is a student, former student, alumnus, employee, contributor, and other person who interacts with or receives services from a University.

As integrated data bases are developed and implemented, particularly within the administrative areas, the potential for violation of an individual's privacy is increased. The problem is not unique to higher education. In addition to current legislation, general public concern has initiated legislative studies at the Federal and State levels with the objectives of determining the need for legislation relating to the privacy of data.

It would appear that a University should be able to assure any individual that it is not collecting excessive information about him, using it in unfair ways or disseminating it indiscriminately. While it is impractical to review and receive concurrence from every individual on every element of data collected, processed, or disseminated, there should be an overall policy on privacy.

The following section presents model recommendations to assure that the individual's rights are protected with regard to privacy of data. Recognizing the impracticalities delineated earlier, it defines approaches that permit the assurance to individuals that their University is aware of, and making conscientious efforts to assure individual rights to privacy.

The privacy of the individual is being impacted by several forces. These are:

- The cost of capturing, processing and storing data is continuing to decrease dramatically;
- The implementation of data bases that are accessible by multiple application systems is increasing rapidly.
- The means to access data, either through terminals or in a printed form, are becoming more available and are easier to implement, and
- The general public is learning more about the power and capability of computing systems, resulting in an increased demand for data and analysis at all levels of institutions.

The impact of the above forces on the privacy of the individual can be summarized as:

- Universities have the ability, in hardware, software, and development skill, to gather and organize significant amounts of data pertaining to any single individual; and
- While it is obviously not the intent to misuse this capability, safeguards need to be established that assure that a University does not accidentally violate an individual's privacy or give the appearance of doing so.

SUGGESTED ENVIRONMENT

In the suggested environment, two functions are addressed: the gathering of data and the release of information. Additionally, two types of data bases are of concern. The first is the formal, computer-supported data base developed by a central computing organization within a central administration or a campus. The second is developed by a department or individual and may or may not be computer-supported. These are discussed as formal and informal data bases, respectively.

Gathering of Information

The key to privacy of data is control of the data gathering and dissemination processes. The emphasis of any program should be to collect only the data required. For formal data bases, the approach is to require that each data base being developed undergo a privacy review. This review would determine if there is a legitimate business requirement for each element of data within the data base. Over some reasonable period of time, reviews of currently existing data bases should be conducted to assure that the same requirement is met. If not, corrective action should be initiated to remove those data elements for which there is not a legitimate business need.

While the above review procedure is practical for formal data bases, the number, size, and location of informal data bases makes this impractical for informal ones. One possible alternative for these informal data bases could be to exhibit good intentions and faith by:

- Developing and distributing management directives and bulletins which emphasize the need for University management to guard against collecting data not authorized for collection, and which could be used to violate an individual's privacy; and
- Charging a department of Internal Auditing with the function of evaluating the privacy standards of data bases and files identified in their normal auditing functions.

Release of Information

While the above procedures would assist in assuring privacy by limiting the data gathered, the release of data should also be addressed. Management bulletins emphasizing the need for privacy and defining the types of information that can be released should be distributed. At regular intervals the bulletins should be reviewed for applicability and for agreement with other policies and directives, both internal and external.

MODEL RECOMMENDATIONS

Model recommendations for privacy are:

1. A policy should be approved which states:

> The University is concerned that the privacy of an individual's records is protected. Designated data base stewards will conduct privacy reviews on the information stored within the data bases to:

- Assure that each piece of information related to an individual is required;
- Assure information related to an individual is assigned the appropriate level of confidentiality;
- Assure safeguards are in place to prevent release of information in violation policy; and
- Make certain that all reasonable efforts are taken to assure the validity and reliability of all data.

The reviews should include representatives from an internal auditing department, computing systems development, the legal office, and seni .dministration.

2. The stewards, on a regular basis, should develop and issue guidelines relating to use of information concerning individuals contained in data bases under their control.

3. A survey should be conducted to identify potentially sensitive data bases that may have been developed, either formally, or informally. These data bases, if present, should be brought into conformance with policy and procedures.

SECURITY

BACKGROUND

The definition of security as it applies to data is relatively simple. It is the protection of data from the accidential or intentional alteration or destruction. It can also be extended to include limiting access to data to only authorized individuals. In other words, a piece of information placed in a computer resident data base should be retrievable by authorized individuals at any time, and that piece of information should be unchanged in any way.

While the definition is relatively simple, the execution is not. The potential for security violation is virtually unlimited. A partial list includes:

- Natu l disasters; floods, tornadoes;
- Man-made disasters; sabotage, fire;
- Malfunction of hardware, software; and
- Human error.

The number of ways that data could be destroyed is frightening. But, these are compounded by a final exposure. In the end, all security systems must eventually depend upon an individual or group of individuals who have the knowledge and capability to break the security system. In effect, despite all the elaborate safeguards that may be developed, security will hinge on the integrity of an individual.

While the task of data security appears large, a University must have a security program to protect vital data. Because it is not financially feasible or practical to address all possible exposures, it may be that the best possible plan is to limit the negative impact of a violation and to have a means of recovery in the least possible time. Concern for the safety of data should result in the selection of security measures that reduce the risk associated with storing the data within tolerable limits at the lowest cost.

SUGGESTED ENVIRONMENT

In defining the proposed environment, several areas are discussed. These include:

- The University;
- Computer Facilities; and
- The Steward or Data Base Administrator.

The University

The responsibilities of the University organization should be identified in two areas. The first responsibility is that of providing direction and support for security. Like other functional areas, general management must be responsible for setting policy and establishing goals. Once enunciated, it should become the responsibility of other functional groups to conform to the stated policy and goals. The second responsibility of the University organization is to set up a security group. The security group should have as its charter the continual review of existing security policy to ensure that the desired level of security is being achieved. In addition, the security group should review new laws and reporting requirements to determine if existing policy and procedures need revision to conform with the changing environment. Finally, the group should provide overall support for security throughout the University.

In general, it seems appropriate to have an independent group whose responsibility is to oversee security throughout a University. This group would utilize whatever expertise is required to certify that the policies concerning security are being followed and to be supportive in attempting to strengthen identified shortcomings. In the area of computer security, this group should not be under the administrative control of any existing computer managing body.

Computer Facilities

It is the responsibility of a computer facility to provide security for all data located at the site. With much of a University's data stored on computing systems, ongoing provisions need to be made to insure that the data are protected against accidental and intentional destruction or modification.

Physical security should include policies and procedures for limiting access to the facility, limiting the introduction and removal of equipment (e.g., computer equipment) and media (e.g., paper, cards, tape volumes, etc.) to defined guidelines or schedules. In the event of a disaster (natural of otherwise), a recovery plan should exist to return the facility to an operational status as quickly as possible. The plan should be audited on a regular basis and modified as conditions warrant.

The University's Computer Center should provide hardware and software to insure the integrity of the data resident at the site. In addition, the Center should provide reports or monitoring facilities to insure the proper functioning of the security provisions. As new systems, hardware or software are installed, verification of the security provisions should be made to determine the impact of the new facilities.

In addition to providing for the safety of the data and hardware housed at the central site, the Computer Center should also have responsibility for providing the remote sites with assistance or notification in the event that security provisions are threatened or have been breached. However, the integrity of data sent from remote sites should be the responsibility of the remote site. Limiting access to the physical facilities is one safeguard for that integrity. For example, students studying operating systems should not be manipulating the same computer that is used to send grades to the central site. Another aspect of integrity is determining that materials are released only to authorized representatives of the steward and protecting the materials until such release.

The Steward or Data Base Administrator

Data base administration is an organizational role often created when traditional department boundaries are crossed. The thrust of computer data bases is to integrate operational data from diverse organizational units to facilitate management reporting. One side effect is to blur the identity of the single steward. A data base administrator should be the individual designed as the steward for the integrated data bases.

Stewardship responsibilities for physical facilities are limited to the equipment under the steward's authority, usually terminals. The responsibilities for data integrity include:

- Input controls to validate data being placed in the computer system;
- Backup copies of data stored in the computer to protect against operational errors;
- Off-site backup copies to protect against natural disasters or other destructions surrounding the comuter itself;
- Audit trails to log activity with the data;
- Procedural measures to prevent a single individual from controlling both the data entering, and results existing from the system; and
- Processing checks including reasonableness checks, check digits, batch totals, record counts, and identification cross checks to insure that data going into the computer is as valid as a machine can verify.

The data inquiry safeguards should be tailored according to the risk analysis conducted by the data base administrator or steward.

Access to the data is the responsibility of the steward. This responsibility includes the safeguarding and periodic changing of passwords. It includes proper safeguarding of the operating procedures needed to use in the system to change data, and it includes establishing a procedure to authorize people to obtain and/or accept output. The intent is to prevent unauthorized individuals from obtaining comuter output. Where access privileges are tied to a terminal under the steward's authority, access to the physical terminal must be limited.

In capsule form, the steward retains responsibilities for the data and processing results. Whether using manual methods or machine methods, responsibilities for the end results remain with the steward.

The data base administrator or steward carries responsibility for communicating security awareness to University personnel and performing operational audits to insure continued security. The data base administration role should also have responsibility for the security of shared data or terminals. Where the steward role is divided, the responsibility for security should be placed in the data base administration role.

Security awareness begins with a risk analysis conducted on new computer uses. The risk analysis will determine the extent and nature of the security measures warranted for a system. Communicating security awareness acquaints the people using the new system with the responsibilities of stewardship. Appropriate measures should be chosen by the steward to meet the risks identified in the risk analysis. The role of data base administration is to maintain a complete list of alternative measures. Once initiated, data base administratioin should then be responsible for periodic operational audits to insure continued use of the security measures.

MODEL RECOMMENDATIONS

Model recommendations for security are:

1. A policy on data set security should be approved which states:

   All data sets designated as vital to the operation of the University will be copied periodically and stored in a highly secure area located remote from the computing facility holding the data set. This secure area will be sufficiently protected to assure against destruction or theft of the data set by any reasonable force.

2. The Computer Center should detemrine:

   - Responsibility for data base security; and
   - If current security systems need revision or upgrading.

3. Using the recommendations contained in the proposed environment section, a security manual should be developed. Based on this manual, a set of security seminars should be conducted on a continuing basis for data base administrators and stewards. The seminars should be designed to:

   - Teach the use of the security system;
   - Define security responsibilities; and
   - Define effective procedures for security.

4. At a facilities level, the recommendations are that:

   - A physical Security Task Force be established;
   - A task force be trained with emphasis on backup/recovery techniques and physical security techniques;

- The task force develop a physical security plan, including backup and recovery procedures, for each major computing installation; and

- As follow-up, the task force should conduct annual reviews to identify additional measures or changes to the plan.

SUMMARY

Computing and information processing have evolved to a point where many Universities are presented with both the need and a well-timed opportunity to review and revise their policies on ownership, confidentiality, security, and privacy of institutional data. This paper provides a background, definitions, and model recommendations for each of these policy issues.

OWNERSHIP

This term refers to the actual management of data as both a resource and a responsibility. The concept further requires its own set of terms, definitions and policies. Among these are:

- A data base is defined as any collection of records or any extract thereof, regardless of the method of storage and/or retrieval;

- A vital data base is a permanent set of data whose loss, destruction, alternation or dissemination would severly impact the operational capacity of a University; and

- For all vital data bases, a Steward should be designated. This person is responsible for the proper management of files in all phases of their design, administration and maintenance.

CONFIDENTIALITY

This aspect of data management is associated with the control of access to files, use of data therein, and the release of data or information. There are three levels of confidentiality:

- Available to anyone;
- Available only to persons designated by the steward; and
- Available only to the steward.

Activities can be recommended in several areas:

- The data steward for each data base should assign a level of confidentiality for the data. This effort will normally require the support of an internal auditing department and any data users not otherwise a part of the steward's area of responsibility;

- Computing Centers should be charged with:

  - Definition and support of an access control system(s) for all data bases;
  - Assuring that access control methods provide limited and controlled access without undue difficulty of use; and
  - Encouraging the use of on-line access to data to reduce the problems of control and disposal of printed material.

- Universities should develop a full set of standards on confidentiality, which should then be distributed and enforced.

PRIVACY

Privacy is concerned with the rights of individuals on whom data is maintained. Since the rights of privacy are governed extensively by agencies and bodies which are external to a University, the role of an institution in this area is that of setting up procedures and guidelines by which these rights will be assured. In order to fulfill this role, the following steps should be taken:

- Any current policies on privacy should be reviewed and, where needed, revised so that all areas of concern will be addressed;
- As an ongoing process, the data stewards need to conduct privacy reviews on data within the data bases to:
  - Confirm that the data is required;
  - Confirm that appropriate levels of confidentiality have been assigned; and
  - Confirm that the assigned safeguards are in place and are being utilized.
- Data stewards should review and/or revise guidelines for the use of data entrusted to them. These guidelines should be made available to persons involved with the data and should state that final authority is the data steward; and
- Conduct regular surveys to identify data bases which are not in compliance with standards.

SECURITY

Security involves those daily practices and methodologies which assure that the integrity of the data is maintained. As such, it is the most technically related of the concepts discussed in the paper. The following recommendations can be made:

- Guidelines for off-site storage of data should be developed. These guidelines should include policies, schedules and procedures for copying, off-site storage and the restoration of data bases;
- A security manual should be produced, and data administrators should be trained in its concepts and use;

- A Disaster Recovery Plan should be developed. The development of the plan should be managed by the Computer Center with supervision and approval by a University-wide disaster recovery team. The team should be comprised of personnel representing key areas, those most affected in the event of an interruption of computer services; and
- A physical security task force should be established by the Disaster Recovery Team. This group should be trained and should then perform security audits on the data bases within the University. Once the initial cycle of audits is complete, they should be repeated on an annual basis.

Track II
Planning for Information Technology

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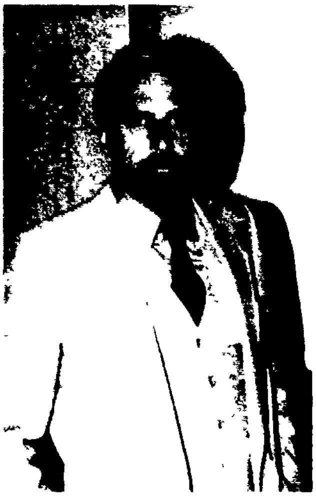

Democracy and the Development of MIS

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The planning for and implementation of new and integrated management information systems is a complex and major task whose success is as much dependent upon user acceptance as it is upon technical considerations. The University System of New Hampshire (a relatively small five campus, 25,000 student system) has recently completed the planning and entered into the multi-year implementation stage of comprehensive MIS.

This paper describes the method which was used to establish user committees in the areas of financial, human resource and student systems, to outline these groups' responsibilities and the process by which a final recommendation was made. The paper discusses the successes and failures of this method.

The University System of New Hampshire (USNH), consists of a land grant university (University of New Hampshire), two state colleges (Keene and Plymouth State), a two year college (Merrimack Valley College), an adult learner oriented college "without walls" (School for Lifelong Learning) together with a systemwide administrative unit. In 1984 there was a University Systemwide total enrollment of 25,200 with 17,727 of these degree candidates. The University of New Hampshire accounted for 60% of the degree candidates.

The core management information systems for USNH consist of centrally located, USNH-wide modules for financial and human resources, together with campus based student information systems. The financial system consists of a purchased and much modified batch oriented financial accounting system first acquired in 1973 together with internally developed software for receivables and payables. The human resource systems consist of internally developed payroll, personnel and position control that has been regularly upgraded and suffer more from inadequate computer resources than from any lack of functionality. Student systems vary from campus to campus, with the University's SIS primarily based upon a purchased student records system acquired in 1976. Data base/query systems are used extensively and have been the basis for a large number of enhancements and modifications to these and other systems.

Over the course of the past few years, it became clear that the growing management needs could not be met by continuing to modify and enhance existing systems. Documentation was not consistent, operations and procedures were becoming more and more dependent upon individuals with a historical rather than technical understanding of the processes. Integration of information from the various systems was becoming a critical factor and was difficult to accomplish. With a growing applications base and a growing reliance on computerized information systems the existing hardware was not powerful enough to meet current, much less future demands.

Given emerging software and hardware technologies it was decided to review what was commercially available and look to implement totally new systems in which processing would be as interactive as was possible and in which normal MIS activities could be primarily operated by end users rather than by a data processing staff.

In planning for this operation it was recognized that the success of an information system is more a function of the active acceptance of those who must make that system work than it is a function of the technical capabilities of the hardware and software involved. While the participation of various offices is critical in knowing what is needed to support their functions, any implementation almost always requires compromises which are more palitable when groups and individuals can feel they have been active participants in the selection process. It was on this basis that it was decided to introduce "democracy" into the process. As a consequence three user groups, one in each of the core information system areas were established.

The actual method of selection of individuals for the core areas was considered to be important to the ultimate success of the project. Each campus of the University System was asked to select individuals to serve on the committees as was each area within the University System Offices. At the University of New Hampshire additional representaton was sought to cover most of the diverse functions which might be unique to a particular area. In no case was a selection not accepted. These groups were truly representative of their respective areas.

However, even before this exercise in democracy began, it was understood that one of the primary goals of this project was to construct a system in which information could be integrated and analyzed at various levels. This meant that any functioning system would have to cross the boundaries that were necessarily established with the formation of the core user groups. As such, it was clear that any recommendation would have to address MIS as a coherent whole and not a set of isolated systems. It was also unlikely that such a solution would simultaneously optimize each group's stated needs. There was a need for a method to receive the groups responses, react to them and ultimately produce a comprehensive recommendation.

At the University System of New Hampshire one of the responsibilities of the Executive Director of Computer Services is the design and implementation of management information systems and as such it was this individual's duty to propose a comprehensive solution. The selection and implementation techniques were estabished to address the conflicting needs for broad representation and close coordination.

In order to develop an understanding of the realizable needs of users of each of the core areas of USNH's management systems it was necessary to establish a charge and a methodology for each of the three groups involved in the process. Each group was established with as broad a representation as was possible, with between 10 and 18 "official" and a number of unofficial members, chaired by a member of the user community and with a computer specialist supplying technical support for the group. The charge to each group was to provide a functional, not hardware or software specific, needs statement for their areas. Each group was encouraged to visit and speak to other colleges and universities. Software vendors were visited and asked to visit the University System and make presentations. In each case the group members were asked to use these visits as a means of educating themselves as to what MIS functions were available and how well those functions met their needs. They were explicitly told not to try to think in the direction of a recommendation which cited a particular product as much as one that listed specific processing and information needs that they had. The level of expertise of the group members and their history of success with automated systems was extremely varied. As such, their initial attitudes and levels of expectations were equally varied.

The first meetings of these groups was held in September of 1984. Each group was given its charge and was told that their reports were to be delivered to the Executive Director of Computer Services by December 24, 1984. In each case this was accomplished. These reports were reviewed and a draft implementation recommendation document was produced and delivered back to the groups on January 2, 1985. This document provided specific hardware and software options, time sequences and priorities, and attempted to analyze the costs and benefits of each. The groups reacted to this draft and a new document was produced. This process was repeated four times until a formal "MIS Implementation Plan" was submitted and approved in June of 1985.

The implementation plan outlined a three year phased in conversion process in which all application systems would be supported on all new hardware. It calls for the purchase of a comprehensive financial software system to be installed and in operation on July 1, 1986. Human resource systems are to be developed internally within the structure of the core software of the financial system and this development will take place parallel to the financial implementation. The purchase and installation of student systems was recommended as a process following the financial and human resource implementations. In each case the human support structure for the implementation was documented.

In structuring groups to support the implementation process the broadest possible representation was once again sought. However this goal had to be tempered by the reality that large implementation teams are generally disfunctional. As such, small "core" implementation teams were established with a number of "adjunct" members, with specific areas of expertise, who would serve in an "on-call" capacity. Each team is chaired by a member of the user population and there are two computer specialists who served on both the financial and human resource core teams in order to insure coordination of efforts. Campus based implementation groups have been formed and there is a high level Oversight Committee to deal with policy issues as they arise. After four months of operation this structure is well accepted and functioning.

Although the implementation process has really just begun there is enough information available to analyze the effectiveness of the methods. Because of the broad representation during the selection process the installed systems will be closer to the actual needs. The review process truly did provide an education for those involved and many have been able to intelligently question policies and procedures of the past. The communication that occurred as a result of the reaction to and modification of the draft reports has generated a feeling that the end product will truly be a user's information system.

Because the planning has been across application systems there has been and will be greater integration of the systems which makes for a better information tool. The fact that people from various departments and areas are cooperating and feel that they have an active role in the success of the implementation is making the process learning the new systems easier.

Finally, the process feeds on itself in the sense that more people are working together to come up with good ideas that spawn other ideas. This would be much less likely in an environment in which one specific interest group is given the task of designing and implementing a system which will address broad based needs.

However, a process such as this is not without its liabilities. A cooperative and broad based effort naturally calls into question some established policies and procedures. It requires that groups that have been able to be quite autonomous become less so. The institutional, integrated focus does not fit into a context that allows "ownership" of various components of MIS: "turf" questions begin to surface and must be addressed. Since many of these issues must be settled at a level that is removed from those actively involved in the evaluation process, there is the possibility that individuals feel that they were deceived and that their insights and needs were ignored. Without adequate communication these feelings can work their way up an organization.

In addition to these types of problems there is also the problem of reality. Financial considerations, justifiably, play a role in any decision and people who have been able to see what is possible with unlimited resources must make accomodation to what is possible. The need for integration of the various core systems requires concessions that individuals involved in determining the needs in one area could not have foreseen. Some of the feelings that the process has been a democratic one is eroded as a final plan develops that compromises items that an individual or group feel are important in order to accommodate an area that that group or individual does not see as critical.

With any process such as this someone must make recommendations upon which decisions will be based. That individual or group must be viewed as fair and unbiased, and be given the direct and recognized authority to make those recommendations. If there is no such an individual it is critical that the institution find a way to create a mechanism to establish a recognized authority in the process.

In conclusion, the benefits of a relatively free and open selection process are significant. Not only is there a better understanding of the actual information needs of a complex organization, the process itself serves to facilitate the actual implementation and use of the system. However, it must be recognized that the more open the process the more easily it can become politicized. Addressing this possibility is the most critical issue to be faced.

THE CALIFORNIA STATE UNIVERSITY:

CASE STUDY IN STRATEGIC TECHNOLOGY PLANNING

by

Thomas W. West

INTRODUCTION & BACKGROUND

The California State University (CSU) is a 19 campus system serving 324,000 students. The system was formed in 1960. Since the beginning computing has been an important factor in the development of the CSU. In 1968, the Legislature mandated the creation of a division within the Chancellor's Office to provide centralized leadership, direction, management and control of computing. As part of the new division, a group was created to develop, implement and maintain administrative systems for all 19 campuses and the Chancellor's Office.

Since 1980 there has been a growing realization that the centralized approach to administrative systems development and implementation was not meeting the organizational or management needs of the individual CSU campuses nor the CSU system. In 1983, the CSU made two strategic decisions to: 1) split the administrative computing hardware from the current campus mainframe and 2) move toward a more distributed approach for applications development and implementation.

As part of the FY 1984/85 CSU budget, the State appropriated $250,000 which was matched by the CSU to hire an outside consultant to assist the CSU in developing a comprehensive plan for administrative computing. Price Waterhouse was selected by competitive bid. Between November, 1984 and September, 1985, Price Waterhouse worked with the CSU Information Management Systems Committee to develop the <u>Administrative Information Management Systems (AIMS) Plan</u>.

The AIMS planning effort was but one of several currently in process within the CSU Information Resource Management Program. The CSU Information Resource Management Program consists of <u>academic computing</u>, including student access and faculty access; <u>administrative computing</u>, including the <u>AIMS Plan</u> and library automation; and <u>telecommunications</u> which involves voice, data, video and mail. There are major planning and development activities in each of these arenas, and they are treated in a highly interrelated fashion within each <u>Campus Information Resource Plan (CIRP)</u> and the systemwide information resource plan. Figure 1 depicts the framework for information resource planning throughout the CSU.

The CSU Information Resource Management Program has one goal --

> "To increase the effectiveness of each individual participant in the performance of his/her roles within the institution." (1)

Thus, CSU planning not only has a focus on the program functions of academic and administrative computing, but more importantly starts with the individuals and their needs as they relate to the programs or activities in which they are involved.

The remainder of this paper is designed to focus on a topic to which CAUSE has given considerable attention over the past decade. It may or may not provide any new information or add to the knowledge base of the reader. Hopefully, at a minimum, it will help individuals stop and reflect on what they have done, what they are doing, and what they should be doing relative to strategic technological planning for their respective institutions. The message is simple, that is, as information resource managers, we must give our attention and priority to the strategic long range future of our respective institutions. The seeds planted today will reap harvest in the future.

This document will discuss the CSU's AIMS planning process, the AIMS strategy, the ingredients for a successful plan, and the lessons learned to date in the AIMS planning effort.

AIMS PLANNING PROCESS

Impetus and Goal. In late 1983, two strategic decisions were made which set the stage for the AIMS planning endeavor. First, the decision was made not to upgrade the current CYBER 700 hardware located on each of the 19 campuses but to split administrative and academic computing hardware. The CYBER 700 serves both administrative and academic computing. As the result of the installation of major administrative application systems, the CYBER 700 was determined to be an inadequate resource to serve the CSU's long range administrative needs. Second, the decision was made to shift the approach in the development of administrative systems from a totally centralized approach to a distributed approach where individual campuses would assume more responsibility.

The CSU goal was clear, namely to focus the AIMS effort on increasing the effectiveness of the 16,000 staff members in their roles as administrators and staff members of the 19 campuses and the Chancellor's Office. Our objectives within this goal were equally clear. Unless we were able to demonstrate the direct payoff to the faculty and students in their roles as teachers and learners the <u>AIMS Plan</u> would be doomed for failure. Unless there is a direct benefit, good academic freedom-minded faculty members are not going to tolerate spending money to administer the institution, no matter how badly the institution is being administered. Therefore, the first and most important objective was to increase the academic computing planning responsiveness. This could only be accomplished by separating the administrative computing hardware, thus, liberating the planning efforts for the academic planners and faculty to be more responsive to the rapidly changing academic program needs. The second objective was an elaboration of the overall goal in terms of increasing the effectiveness of the respective administrative units in being more responsive in servicing students and in operating and managing the 19 institutions.

The first task in the AIMS effort was to hire a consultant with the $500,000 budget. The CSU Information Management Systems Committee that had been formed in March, 1984, set up a steering group to develop a request for proposal to competitively bid for a consultant. The request for proposal was issued in July, 1984. Price Waterhouse won the competitive bid and signed a contract in late October. The real planning effort for AIMS started November 15, 1984 with the target for completion set for August 26, 1985, or 10 months of effort. The actual completion date was September 10, 1985.

<u>Planning Phases</u>. The AIMS planning process, as conceived by Price Waterhouse, involved six phases. These phases included: 1) setting goals and objectives, 2) describing the current environment, 3) prescribing the target environment, 4) articulating an implementation strategy, 5) implementing the plan, and 6) performing a post-implementation evaluation. The first four phases have been completed. The initiation of the implementation phase is contingent upon the Governor and Legislature approving the necessary funding.

The first four phases were depicted somewhat differently by the CSU political strategist and AIMS guru. The first four phases were described as involving the following activities:

> "In the beginning there was an idea that was planted from which the goals and objectives of the AIMS project were set. With the formal launching of the project and the hiring of the consultant CSU entered the "ain't it awful phase" when all the CSU participants who were interviewed by the consultant described a very bleak current environment. Once the current environment was described, the consultant then

> asked "what does the CSU want to do in the future?" and everyone dug into their pockets and brought out torn and tattered "wish lists" to describe the target environment. The next phase involved "reality time", or the articulation of an implementation strategy which was practical and implementable." (2)
>
> At this point the political strategist indicated that two additional phases needed to be added to the Price Waterhouse phasing. He said: "Once the IMS Committee spelled out the <u>AIMS Plan</u> implementation strategy it would necessary to "build consensus" elsewhere in the institution, with the campus users, the presidents and ultimately with the Board of Trustees. Then the final phase of development would be the most difficult. It involves gaining the approval of the external agencies; In this case this involves the Department of Finance, the Legislative Analyst, and finally the Governor and the Legislature. This phase is called the "negotiation/concession" phase. It is in this phase that the idealism of the <u>AIMS Plan</u> will give way to potential practicality. It must give way to potential practicality if the <u>AIMS Plan</u> is to succeed." (3)

At the time of writing this paper, the first five phases of the political strategist's outline for the <u>AIMS Plan</u> have gone precisely on schedule. The CSU is now in the final phase, as negotiation/consensus building for the approval of the <u>AIMS Plan</u> and the FY 1986/87 Budget Request take place with the State agencies.

<u>AIMS Plan Framework.</u> Price Waterhouse brought a discipline to the AIMS process and a framework to be used in the planning effort. The AIMS planning framework was simple but effective, not unlike that which has been used by other corporations and institutions. Figure 2 depicts the framework. It starts with the business needs of the CSU. These are translated into application systems which drive technology and together determine the management approach to be used.

<u>Phase I & II</u>. Phase I simply involved the CSU Information Management Systems Committee and Price Waterhouse concurring on the goals and objectives which had already been determined.

Using the framework and the goals and objectives, Price Waterhouse started its effort by describing the current environment, Phase II, for each of the major administrative components. Price Waterhouse did the normal things. First, they laid out the administrative business processes to be performed by the CSU. There were no surprises. However, this was the first time it had ever been done in the CSU. Second, they inventoried the current applications, equipment and staff. Third, they assembled the policies and procedures used in the Information Resource Management Program as specifically applied to the administrative computing needs. Finally, they described the major problems and issues confronting the CSU.

This process was accomplished through interviews with 700 CSU personnel, and discussions with the Department of Finance and the Legislative Analyst. It also involved conducting a two day "Other Universities Workshop". Seven other multicampus institutions were brought together with the IMS Committee and Price Waterhouse to exchange information on how they had gone about a similar task.

The organization for Phase II of the AIMS process was heavily dominated by the Price Waterhouse team. They organized along the lines of the framework components, Figure 2. They had one group concerned with applications, a group concerned with technology and a group focused on the management issues. The input from the 700 CSU individuals was direct to the Price Waterhouse team. A draft of the <u>AIMS Current Environment Volume</u> was given to the IMS Committee for distribution to the campuses. The campuses were given an opportunity to comment on errors of omission and errors of commission. However, the final <u>AIMS Current Environment Volume</u> was the product of Price Waterhouse.

In essence, Price Waterhouse, in describing the current environment, reaffirmed knowledge the CSU already had developed in 1983. Namely, Price Waterhouse found that the CSU administrative functions performed were very much alike for all 19 CSU campuses. However, these administrative functions lacked a high degree of automation. The systemwide applications that had been developed and implemented over the years provided only partial solutions to the CSU business needs, and were not highly integrated and lacked high quality documentation. Likewise, the application systems developed at the campus level suffered the same malady.

As for technology, Price Waterhouse found the current hardware environment at capacity. They indicated there was a dearth of application software available for this hardware environment. Also, programmer and user productivity tools and office automation technology were not highly prominent within the CSU nor available in the marketplace for the existing hardware environment.

Finally, they reaffirmed the earlier strategic decision that the centralized approach to the development and implementation of applications systems had resulted in limited effectiveness and, furthermore, was very highly suspect among the CSU campuses.

Phase III. The next phase of the AIMS planning process involved prescribing the target environment for the CSU. This entailed defining the 53 business processes that comprised the CSU administrative environment of the CSU. Out of these 53 business processes, Figure 3, it was determined that approximately 25 were baseline - essential core to the operation and management of the CSU, Figure 4. For these baseline applications, this phase entailed establishing the requirements, as well as establishing the requirements for the technology environment.

The target environment also involved determining the management approach to be used in the future, namely a more distributed involvement where a systemwide office would have coordination and strategic planning responsibility, while the implementation and operational management responsibility would fall to each of the 19 campuses and the Chancellor's Office as functionally autonomous management units.

A final task in prescribing the target environment was to assess the availability of application software and technology in the marketplace to meet these needs. A high level market scan was conducted by Price Waterhouse. This was done to determine the availability of software/hardware to meet CSU requirements.

The organization for Phase III involved Price Waterhouse transferring the ownership for the AIMS process to the CSU by having over 700 individuals heavily involved in the articulation of the requirements, deciding the baseline processes, and determining the best overall management approach. This was accomplished by establishing five Applications Specification Review Groups (ASRGs), a Technology Specification Review Group (TSRG) and a Management Review Group (MRG). In addition, each campus had an AIMS Committee. These CSU groups decided on the major ingredients in the target environment. Products of Phase III included the AIMS Target Environment Volume, a Market Scan Report and the first section of the AIMS Feasibility Study Report. The AIMS Feasibility Study Report was a requirement of the Department of Finance and involved three major sections -- a statement of the requirements, an analysis of alternative approaches and, the recommended solution with a cost/benefit analysis.

Phase IV. The next phase of the project involved the developing the AIMS Implementation Strategy and Plan. First, this meant identifying and prioritizing the program needs, a very difficult task because there are different opinions and varying needs among the campuses. Second, it involved deciding on a specific strategy for applications software, that is, whether to develop applications systems, convert existing systems or to buy new application systems in the marketplace. Likewise, the technology strategy involved, analyzing the alternatives of a campus-based hardware environments versus establishing a regional or a centralized computing center for the CSU. Third, it involved determining the degree of centralization vs. decentralization in the management of AIMS. The final activity in this phase entailed projecting the resource requirements in terms of staffing, facilities, hardware, software, and most importantly, budget. In essence, the AIMS Implementation Plan resulted in the decision to buy applications software for a campus-based technology environment with the management responsibility being primarily campus-based within systemwide coordination and strategic planning guidelines and standards.

AIMS IMPLEMENTATION STRATEGY AND PLAN

Phases of Implementation. The AIMS Implementation Strategy and Plan involves five phases. It includes: Phase I - preparation planning at the campus level and conducting a systemwide procurement; Phase II - the installation of the technology and the student financial aid and student records systems; Phase III - the completion of the student records system; Phase IV - the installation of the financial management system. Phase V - the implementation of the human resource management system.

Two levels of organization were developed for AIMS implementation. At the systemwide level there is to be an AIMS implementation organization with a small staff of nine or ten, to provide overall leadership, interfaces with vendors and overall project coordination with all the campuses. Figure 4 depicts the central organization. At the campus level there is to be an AIMS implementation organization consisting of a manager, applications development staff, and technical support and operations staff. This staff is to be integrated into the existing campus organization. An increase of 11 to 23 staff members is projected depending on the size of the campus.

Principles of Implementation. The principles of AIMS implementation include: 1) adherence to a systemwide team approach; 2) the acquisition of an integrated baseline application systems capability for each functional area as well as across all functional areas; 3) the implementation of a standard accounting system; 4) the reaffirmation of the split of administrative and academic computing hardware; 5) the acquisition of rich user and programmer productivity tools; 6) a growth potential for hardware and software; 7) maximum decentralization of management responsibilities within systemwide standards; and, 8) the acquisition of a total AIMS environment.

Benefits of Implementation. The benefits of AIMS were perceived to include cost avoidance, that is, the ability to redirect personnel years productivity savings to activities that are currently undermanned; increase in the service levels that are currently less than adequate; reduced costs; and enhanced revenue .

INGREDIENTS FOR SUCCESSFUL PLANNING

A number of ingredients for successful AIMS planning were identified. First, the plan had to match the AIMS solution with the organization's culture. In essence, the AIMS Plan had to match the management philosophy of the CSU organization. This meant more distributed management responsibility for AIMS inasmuch as the CSU is a confederation of institutions. Likewise, it called for a greater degree of decentralization of operational and management responsibility while retaining strategic planning coordination on a systemwide basis.

Second, the management control needs of the CSU had to be met. That is, the Chancellor's Office concern for stewardship of resources and the quality of education had to be adhered to within the AIMS Plan, while the management control needs of the campuses to be able to express their mission uniqueness, to manage their programs effectively, to have the flexibility in setting priorities and to allocate the resources to meet those priorities had to be incorporated in the AIMS Plan. Finally, the management control needs of the Department of Finance and the Legislative Analyst office had to be met. They are concerned with cost efficiencies. Therefore, the AIMS Plan had to insure that economies of scale were being met.

Third, having the appropriate organization for the AIMS effort was imperative. The use of a systemwide committee to provide policy advice and guidance was critical. Heavy user involvement was vital to the CSU gaining ownership of the AIMS Plan. The use of user task forces spread the responsibility for the effective development of the AIMS Plan proved invaluable. Finally, the use of a consultant provided an indispensable catalyst to the effort.

The use of the outside consultant on the AIMS project brought to the CSU certain things that could not have been possible had AIMS been attempted internally. First, Price Waterhouse brought a fresh perspective and unbiased objectivity to the AIMS Plan. They brought a discipline to the project in form of a planning framework and process. Price Waterhouse also brought special staffing expertise to the project, as we all know it is difficult to take a staff member and give that person a special assignment and have that individual devote 100 percent of their energy on that new activity and forget their ongoing responsibility. Most of all the Price Waterhouse acted as a catalytic agent of change, especially in this turbulent environment where there are as many opinions as there are participants. Price Waterhouse was able to have the CSU deal with conflict, while buffering against open confrontation. The AIMS effort was certainly a case where conflict was prevalent and healthy within the planning effort, but confrontation was minimized by using Price Waterhouse as a sounding board and as a synthesizer of these varying opinions into a meaningful strategic AIMS Plan.

Fourth, the involvement of top level leadership can not be overstated. The Chancellor and the Vice Chancellor, Administration for the CSU were deeply involved in strategic development of the AIMS Plan. The Chancellor made it the top project priority with the Board of Trustee's and with the Governor for funding in FY 86/87. Likewise, there was competent executive leadership on the respective campuses. Finally were capable, understanding and eager users involved throughout the CSU to guarantee success of AIMS.

Fifth, the use of the planning framework and process cannot be overstressed. It was the framework and process which enabled the CSU to keep on track and to develop a meaningful AIMS Plan. Finally, the implementation of the AIMS Plan is dependent upon garnering sufficient resources. This means resources for the end users, for the campus information resource management function, and the systemwide AIMS team to enable them to acquire quality applications software, productivity tools, the appropriate technology environment, adequate facilities, and the appropriate staffing to effectively implement the AIMS Plan.

LESSONS LEARNED

Several lessons were learned from AIMS project, including: top level commitment is essential; user involvement is vital; conflict is healthy as long as confrontation can be minimized; politics are keystone; (political decisions are imperative to accomplish such a task); technocrats have power, particularly in State control agencies; timing is everything; and the proper chemistry makes it happen.

SUMMARY

It was chemistry among the users on campuses, and in the Chancellor's Office working through the Information Management Systems Committee with the aid of an outside consultant, which resulted in a quality AIMS Plan. Now it is up to the vision and understanding of the Governor, his staff and the Legislature and its staff to see fit to provide the funds to enable the CSU to implement the AIMS Plan so that future generations of CSU students will be better served.

FOOTNOTES

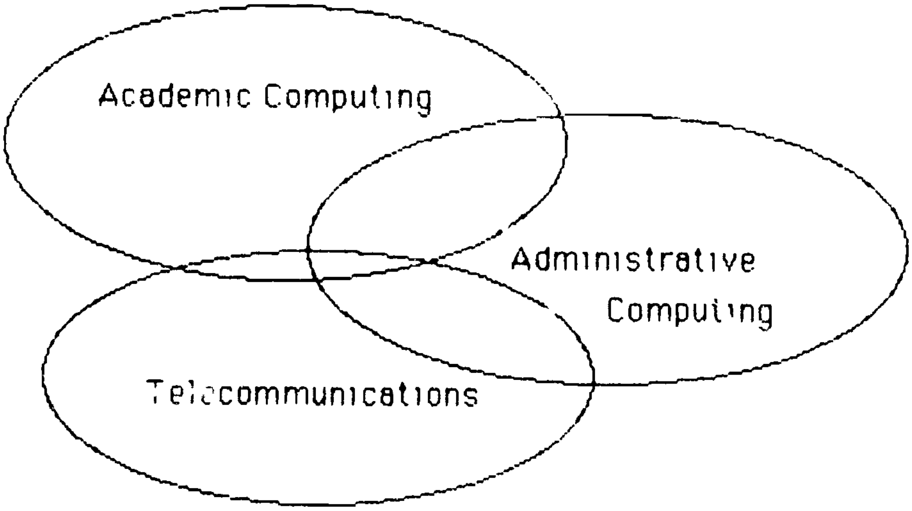
(1) The California State University Information Resource Plan: 1985-90, p. 12.

(2) Ray Clark, Associate Director, Division of Information Systems, Analysis & Planning Group, Memo, January, 1985.

(3) Ibid.

FIGURE 1

FRAMEWORK FOR PLANNING



THE CALIFORNIA STATE UNIVERSITY
AIMS PLANNING PROJECT
COMPONENTS OF INFORMATION PROCESSING

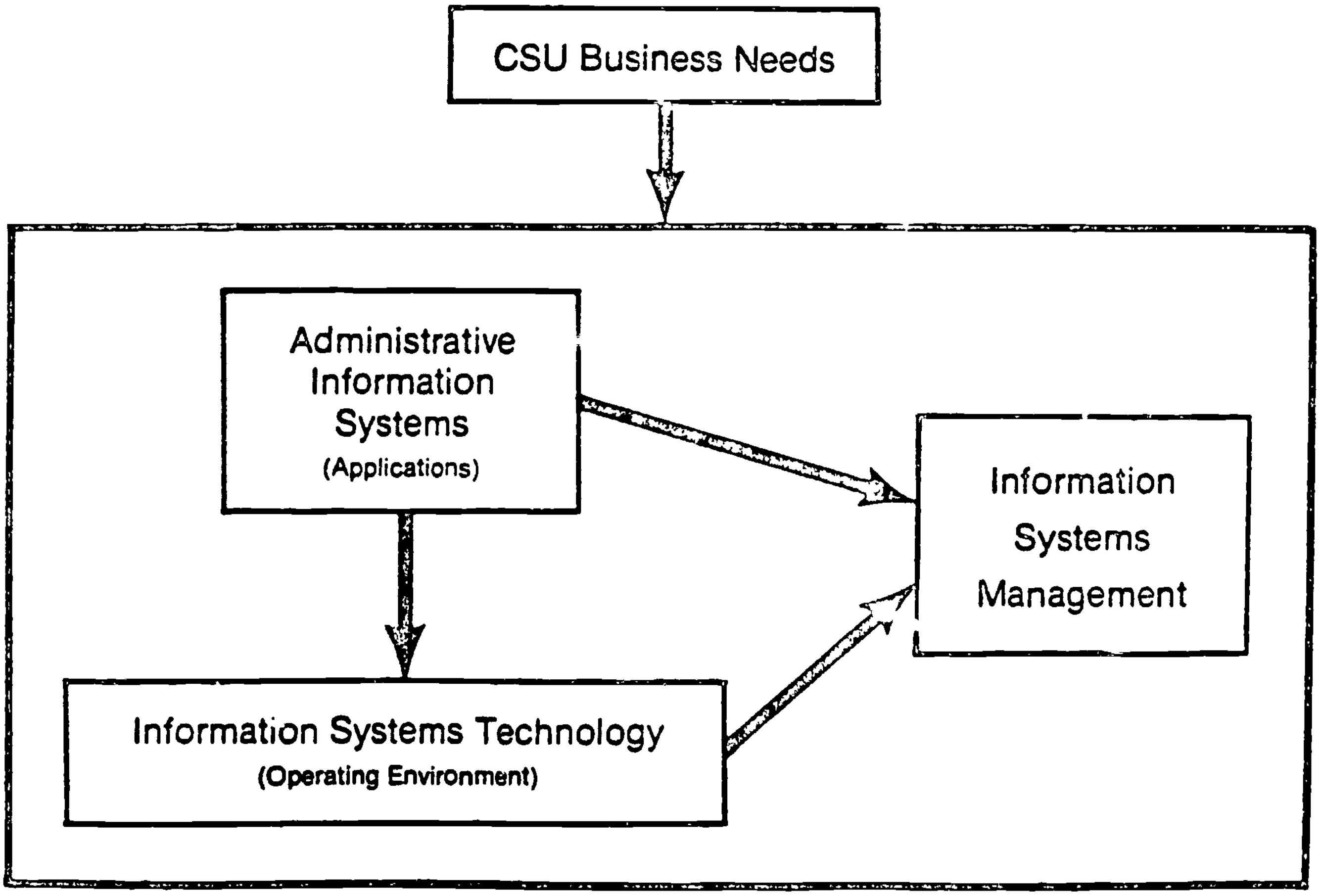
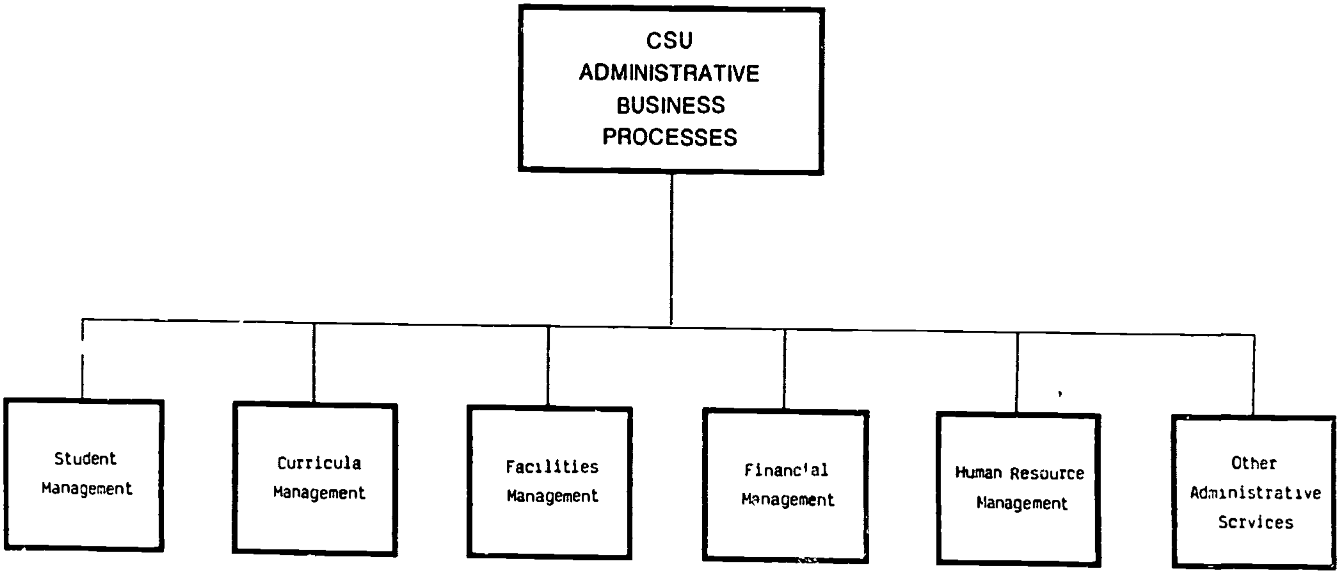


FIGURE 2

The California State University

Administrative Business Processes by Major Area



Academic Evaluation
Admissions
Career Planning
Extended Education
Financial Aid
Outreach
Registration
Special Student Services
Student Records

Course Scheduling
- Curriculum Planning

- Contract Management
- Course/Event Facilities Scheduling
- Energy Management
Facilities and Capital Planning
- Plant Maintenance and Operations

- Accounts Payable
- Accounts Receivable
- Cashiering
- Financial Accounting
- Financial Budgeting and Planning
- Procurement

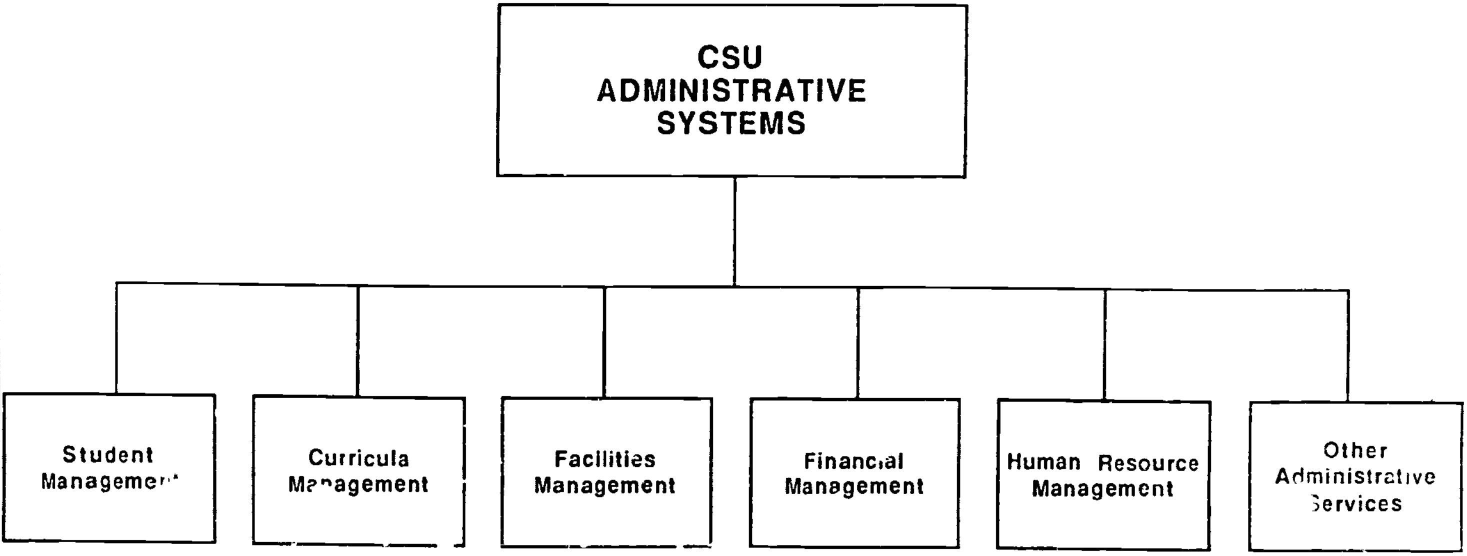
- Payroll Administration
- Leave Accounting
- Position History and Inventory
- Performance Appraisal
- Retention, Promotion and Tenure Analysis
Service and Seniority
Credit Analysis
Affirmative Action Analysis
Applicant Information Management
Benefits Administration
Skills Inventory
Training

- Alumni/Fund Development
- Analytical Studies and Institutional Research
- Central Support Services
- Health Services (Interfaces Only)
- Housing (Interfaces Only)
- Library (Interfaces Only)
- Public Safety and Parking

FIGURE 3

The California State University
AIMS Planning Project

Baseline Administrative Processes



Student Management*

- Academic Evaluation
- Admissions
- Financial Aid
- Registration
- Student Records

Curricula Management

- Course Scheduling
- Curriculum Planning

Facilities Management

- Course/Event Facilities Scheduling

Financial Management

- Accounts Payable
- Accounts Receivable
- Cashiering
- Financial Accounting
- Financial Budgeting and Planning
- Procurement

Human Resource Management

- Payroll Administration*
- Leave Accounting
- Position History and Inventory
- Performance Appraisal
- Retention, Promotion and Tenure Analysis
- Service and Seniority Credit Analysis
- Affirmative Action Analysis
- Application Information Management
- Benefits Administration

Other Administrative Services

- None

FIGURE 4

** Payroll Administration requirements will be addressed by the CAPPS project.*

A CAM MASTER PLAN FOR COMPUTING, COMMUNICATIONS AND INFORMATION SYSTEMS

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ABSTRACT

In early 1984 the Río Piedras Campus of the University of Puerto Rico decided to acquire a Student Information System to replace an obsolete card-oriented system. It became clear that it would be much better to acquire a fully integrated information system containing student, financial and human resources components, plus MIS and decision support features, and that such a system would require corresponding changes in our computing and communications infrastructure. To address these needs, the Computer Center prepared a five year Master Plan for the planning and implementation of computing, communications and information systems. The Plan has now received Campus approval and awaits funding by the Board of Trustees.

This presentation describes the development of the Master Plan, from the identification of campus needs, to the synthesis of specific strategic and tactical plans to fulfill these needs by 1990. It also discusses related budgetary, personnel and management considerations.

A CAMPUS MASTER PLAN FOR COMPUTING, COMMUNICATIONS AND INFORMATION SYSTEMS

A) INTRODUCTION

THE UNIVERSITY OF PUERTO RICO AND RIO PIEDRAS CAMPUS ENVIRONMENTS

The University of Puerto Rico is very much like a typical state university system. The original, main campus was established in Río Piedras (San Juan) in 1903. There are two other large campuses--one specializing in engineering and agriculture, in Mayaguez, and the Medical Sciences Campus in San Juan. In addition there are two four-year university colleges and a system of six two-year regional colleges scattered around the Island. The various campus chancellors report to a Central Administration headed by a President, who in turn reports to a Board of Trustees called the Council on Higher Education.

The Río Piedras Campus has about 22,000 students out of a total of 52,000 for the entire UPR system. Student costs are quite low--$15/credit hour for undergraduate students--and there are only two dormitories, so about 90% of the students are commuters. The student population has been essentially constant from year to year, so we are not a tuition-driven campus. Most university funding is assigned according to a formula from the Commonwealth government. Most students receive substantial amounts of financial aid. Several departments on our campus have doctoral programs, which bring in perhaps $3-4,000,000/year in mainly federal grants, and supplements the approximately $80,000,000 campus operating budget. Most instruction at the undergraduate level is in Spanish, decreasingly so at the graduate level.

COMPUTING, COMMUNICATIONS AND INFORMATION SYSTEMS ON CAMPUS

The Computer Center presently has an IBM 4341-M11 processor for administrative use (MVS), linked by RSCS to an IBM 4381-M02 which is used for academic work (VM). The 4341 will probably be changed soon for another 4381 in order to support planned large-scale information systems. A conversion to SNA is underway on both systems. Computer time is presently free except for external users. By next year we will have about 250 terminals or PCs connected to those processors, including clusters of terminals located in a number of schools on campus. The number of institutional microcomputers is growing rapidly, but few faculty members and fewer students can afford them at present prices.

Communications--both voice and data--are currently handled by our rather old (1972) campus telephone system, with data mostly transmitted between the 3705 front-end processors and 3274 cluster control units via short-haul line drivers. The number of telephones and telephone lines is grossly inadequate.

Our information systems, like those at many other schools, frequently depend on old, batch-oriented programs which do not communicate amongst themselves, and so are unable to provide accurate and timely information when decisions need to be taken.

B) DEVELOPMENT OF A STUDENT INFORMATION SYSTEM

For many years it has been obvious that the Río Piedras Campus needs better systems of information. This has been especially true in the processes related to our students--Admissions, Registration, Financial Aid, etc.--all of which are batch-oriented programs using punched cards. We had already converted many other systems considered more important from batch to on-line, including Personnel, Payroll and parts of the Library and Finance systems. Limitations in our ability to recruit and retain people within our computer center who could develop more integrated software in these areas led us to utilize local consultants for that purpose. This too was of only limited success, since the consultants tended to know programming very well but not the functioning of, say, the accounting office. They knew even less about how to integrate the systems needed by our entire collection of administrative offices.

Beginning in 1982, outside consultants were brought in to make recommendations about a Student Information System. IBM provided an Application Transfer Team, which made a valuable start in defining our needs. In 1983 the Campus contracted other consultants to survey the companies that offered systems which might be suitable for our Student Information System needs.

Early in 1984, the Campus decided to complete these evaluations and to proceed with the implementation of a state-of-the-art Student Information System. A Steering Committee was formed, consisting of the deans of administration, academic affairs and students, plus the directors of planning and of the computer center. A project director was designated to head the project. He reported to the Steering Committee via the Computer Center Director. Since most of the members of the Steering Committee normally report to the Chancellor anyway, communications were reasonably good between the project and the top campus administration.

During the remainder of 1984, the computer center and project directors dedicated a substantial part of their time to investigate the experiences of other universities in search of a state-of-the-art Student Information System. The search soon reached the CAUSE office in Boulder, where its director provided an invaluable orientation about information systems in general. Subsequently, we attended other meetings, including EDUCOM, CUMREC, SNOWMASS SEMINAR IN ACADEMIC COMPUTING and a NACUBO/ACUTA telecommunications seminar. The information shared at these meetings and copies of Requests For Proposals (RFPs) that we acquired proved to be invaluable in helping us make our own plans for improving our information systems.

We thus began the effort of defining our own needs, so that we could synthesize our own Student Information System RFP. This was done by forming a number of working committees including many of the middle managers who knew our present system intimately and who would later have to make the system work. In this way the RFP that was finally produced would be seen by them as fulfilling their requirements, and the proposals that they would subsequently evaluate would lead to a final product which they would be personally proud of, and enthusiastically help to implement in their respective offices.

C) THE NEED FOR A MASTER PLAN

As our search for a state-of-the-art Student Information System progressed, it became clear that only two companies could provide such a system for a complex institution like ours. Since each of these companies offers an integrated package consisting of three basic components--a Student System, a Financial System and a Personnel System-- it became increasingly important to consider the interfaces between the Student Information System we wished to acquire and our other existing systems or the other two component systems which the vendors would wish to sell.

At UPR, financial aid is calculated by the Student Aid Office, and paid out by the Bursar's Office. Both of these are part of the Student Information System. Unfortunately the Finance Office has to fiscalize these payments independently of the Student Aid Office, so we need an interface between the Student and Financial Systems. In addition, the Bursar's Office is in charge of collecting other accounts receivable, so it too must have an interface between the Student and Financial Systems. When all of these interfaces were identified, we found a strong case for acquiring the Financial System as well as the Student System, rather than spending time and money making modifications to the new Student System and/or the existing Financial System, so that they would be integrated.

To support institutional research, we also need interfaces between the Personnel System and the other two systems. An obvious case might be in determining the cost of instruction, which requires knowledge of the budget of each department, the number of professors and other staff in each department and their salaries, plus the number of students in each course and department. In the absence of strong existing systems, we found it easy to argue in favor of the acquisition of the entire integrated set of systems from a single vendor, subject only to limitations of budget and of time for their implementation.

The acquisition of new information systems in all of these administrative areas will also require significant additions to our communications network in order to provide computer access from many more offices. Since our present telephone network is inadequate at best, it quickly became clear that we would have to do a thorough overhaul of our communications system as well as of our computing and information systems.

Since it became clear that significant changes in our information systems would only be successful if carried out in a coordinated fashion with our computing and communications systems, the Computer Center decided to carry the matter to its logical conclusion by preparing a comprehensive Master Plan for all of Computing, Communications, and Information Systems on campus. In this way we could also incorporate plans for related fields such as text processing and the Print Shop, office automation, an on-line library catalog, local area networking, and other components needed for strong academic and administrative infrastructures.

D) THE DEVELOPMENT OF THE MASTER PLAN

Neither the Río Piedras Campus nor the UPR as a whole have adopted comprehensive Master Plans or Mission Statements, although various efforts have been made in those directions in recent years. Thus it is not surprising that little, if any, policy making or planning has been done in such dynamic fields as computing, communications, and information systems.

The situation has not been helped by a lack of centralized responsibility and authority in these fields. The Computer Center is responsible for both academic and administrative computing on campus, and reports to the Dean of Administration. The existing Student Information System has been under the control of the Registrar, who reports to the Dean of Academic Affairs. Finally, the Director of the Office of Planning and Development reports directly to the Campus Chancellor. The Computer Center has attempted to deal with all of these entities in what may be called an "informal consultation model"--our approval is required on every requisition for computer-related equipment before it will be acted on by our Purchasing Office. We thus have an opportunity to consult with users in an attempt to match their equipment requests with the needs of their office. Needless to say, though, this is not the most satisfactory long-term solution to our needs for planning and policy-making.

In preparing our Master Plan, we did not appoint a series of committees which would make detailed needs analyses, consult formally with large numbers of academic and administrative staff, and make long lists of recommendations, to be combined into a lengthy and comprehensive report two years later. Such a report would then be further delayed by passage through the Academic Senate and Campus Administrative Board before being considered by the President and Trustees who would have to approve and fund the Plan. We felt that the most likely reaction by the top administration to such a report would be to request a shorter summary of the most important facets of the Plan. We thus attempted to save two years time by informally consulting those same groups of people about their needs and recommendations, digesting these down to a short list of comprehensive campus strategies, and elaborating brief but specific tactical plans for each, together with a suggested timetable and budget--all in a readable 75 page report. If a particular tactical plan seemed more like only the skeleton of a final plan, we felt that was not a problem, since in these dynamic fields any specific plan would soon become obsolete, even as the planning process would continue. This somewhat unorthodox approach to the planning process has turned out to be quite successful. Work on the Plan was begun in August, 1984, a first draft was approved by the Dean of Administration by the end of November, and the final version was approved by the President less than a year later.

It is interesting to note the reactions we received from different persons and offices on campus when they found out that a serious effort was being made to alter the systems they had used for many years. With one or two exceptions, we encountered very little resistance to our plans, even from those who were not consulted as extensively as they might have preferred before the part of the plan affecting their office was first presented to them. Most reactions were of the type "Thank goodness somebody is finally going to do something about ....". We were careful to balance both academic and administrative needs, so as to obtain as wide a spectrum of support as possible. By the end of this process, the only people complaining were those who felt left out, and who then helped to make us aware of other opportunities for mechanization which we might have overlooked.

Since the Master Plan was a logical outgrowth of our search for a Student Information System, it was subsequently submitted for the approval of the Steering Committee in charge of that System. This assured high-level campus support for the Plan, and minimized opposition.

After additional rounds of consulting and rewriting, a second draft was circulated on campus in February 1985, at the time of the visit of an accreditation team from the Middle States Association. The very favorable comments made by that group while they were on campus and in their subsequent report were most helpful in gaining subsequent support for the Plan from the Chancellor and from the Central Administration.

After one last round of consultations and changes, the Plan was submitted on May 1, 1985, by the campus Chancellor to the President and to the Board of Trustees. A new President took office in July, and shortly thereafter gave his full support to the Plan, saying that he hoped that some of its information system aspects could be applied on other campuses as well.

E) COMPREHENSIVE CAMPUS STRATEGIES AND TACTICAL PLANS FOR THEIR IMPLEMENTATION

We began this project with a needs analysis, identifying many systems that needed to be improved or totally changed. From these we synthesized a smaller group of 11 strategies which we hope will fulfill these needs by about 1990. We then developed a tactical plan for the implementation of each of these strategies. It is convenient to list the strategies at this point, and then further explain them and their corresponding tactical plans.

1) AN INTEGRATED CAMPUS INFORMATION SYSTEM
2) OFFICE AUTOMATION AND ADMINISTRATIVE COMPUTER LITERACY
3) FACULTY AND STUDENT COMPUTER LITERACY
4) MICROCOMPUTER ACQUISITION
5) LIBRARY AND BIBLIOGRAPHIC/REFERENCE SYSTEMS
6) INSTRUCTIONAL COMPUTING FACILITIES INFRASTRUCTURE
7) RESEARCH COMPUTING FACILITIES INFRASTRUCTURE
8) TEXT PROCESSING AND PRINTING
9) TELEPHONE/TELECOMMUNICATIONS SYSTEMS
10) LOCAL AREA (CAMPUS) NETWORKS, UPRENET AND BITNET
11) ORGANIZATION AND PLANNING

<u>1) AN INTEGRATED CAMPUS INFORMATION SYSTEM</u> --Our existing systems of information--student, financial and personnel--should be replaced with an integrated state-of-the-art system from a company that is expected to maintain and enhance its product for the indefinite future. This must be complemented by MIS and DSS tools, to fully utilize the resulting information.

Our primary concern has been and remains the installation of a new Student Information System to replace the weakest of our existing campus information systems. Thus, a 100 page RFP for this system was issued on June 3, 1985, and sent to three companies which had expressed an interest in submitting a bid. Two proposals were subsequently received by July 31.

For evaluation, we selected a committee consisting of 20 persons, most of whom were chosen from among the 50 persons who had helped draft the RFP, and also a few fresh faces. This committee then evaluated the written proposals from both companies and also listened to two-day live presentations by each company on our campus, while they were interactively connected to their state-side computer systems. As a result, one of the companies was clearly the winner. As an additional check on our evaluation, a group of members of the evaluation team subsequently visited two sites where the winning company's products had been recently installed, to satisfy themselves that those products can be expected to function properly in our environment with a minimum of modifications.

We are now beginning final contract negotiations with the winning company, and hope to begin next February to install both the student and financial systems, and the personnel system about 18-24 months later. Since we are but one campus of a larger university system, the installation of their products by other campuses as well as by the UPR Central Administration is also being considered.

MIS and DSS tools will be provided partly by the integrated system itself by its report-writing and query software. We can also use our existing software, including SAS products and the Stanford SPIRES DBMS. The NCHEMS DSS screen-oriented Demonstrator will serve as a model for developing our own DSS.

We believe that effective middle management requires that each departmental office participate in the MIS in order to be able to access, and perhaps download, (but not alter) the files of students, personnel and accounts corresponding to that department (only). Similarly, each academic dean would have access to all files for his/her faculty or school, while key offices such as the Planning Office or the Chancellor's Office would have access to all such files. A number of other files containing aggregate institutional data should be made widely available.

2) OFFICE AUTOMATION AND ADMINISTRATIVE COMPUTER LITERACY --Each administrative or academic unit must become sufficiently computer literate so that they can carry out the administrative functions required by the above system. Adequate equipment, programs, and training will be required.

The implementation of our integrated information system will require the conversion of many academic and administrative offices from being paper- and signature-driven towards a paperless, on-line environment. Such mechanization must be accompanied by appropriate concerns for personnel. So far our experience has been positive, in that we have involved as many middle managers as possible in the preparation of the Student System RFP. Other offices, which might have resisted changing their existing systems have more often adopted a "Me, too" attitude. We will try to identify persons in each office who are eager to computerize office functions, and then aid them by providing needed equipment, training and moral support. The key element is training in the use of standardized software packages, including a word processor, a spreadsheet, a data base package, a graphics package, and some knowledge of communications.

3) FACULTY AND STUDENT COMPUTER LITERACY --Faculty computer literacy must be promoted so that there will exist a permanent pool of persons available to train succeeding generations of students to be "computer literate" according to the needs of their particular disciplines.

We clearly cannot require our students to purchase their own microcomputers, nor can the institution provide sufficient computing resources so that there will be micros in every classroom, laboratory and dormitory. What we can do is to acquire an adequate number and kind of micros and terminals on campus so that all graduating students can be required to reach a minimum level of proficiency in computer or microcomputer usage suited for their particular discipline--graphics and design in architecture, spreadsheets in business, text-processing and bibliographic data base systems in the humanities, etc.

We thus need adequate equipment and trained faculty members. We are rapidly acquiring clusters of micros and terminals in all of the schools on campus, and as prices keep coming down, we should soon be able to acquire enough equipment to be able to achieve student computer literacy. The problem is to first achieve faculty computer literacy. This problem will be attacked by some combination of techniques--offering seminars to faculty members in small groups or even a one-to-one basis; providing release time or equipment loans to faculty members who design or revise courses to make use of computer applications; or adopting other reward mechanisms such as recognition of these faculty improvement efforts by appropriate personnel committees.

4) MICROCOMPUTER ACQUISITION --We must provide microcomputers (or terminals), as cheaply as possible, to all administrative and academic offices, and to faculty, staff and students capable of utilizing them, plus appropriate training in their use.

The new integrated information system will help to some extent, since it will require installing terminals in many additional offices. IBM now gives individual microcomputer purchasers the same 32% discount as it does for its institutional sales. The Computer Center has acted as go-between on this program, providing orientation both before and after the purchase, for a charge of $50. We have been less successful in obtaining discounts from other suppliers, since while IBM considers Puerto Rico part of its domestic market, Apple and Digital do not. Recently an Apple Educational Foundation of Puerto Rico was formed, and we are attempting to negotiate discounts with them, perhaps as part of a consortium of Island universities. Another technique which might help increase individual microcomputer acquisitions would be for the University to provide no- or low-interest loans to professors or students, repayable in 12-24 months.

5) LIBRARY AND BIBLIOGRAPHIC/REFERENCE SYSTEMS --On-line library catalogs and other bibliographic tools and data bases should be accessible to all users--academic or administrative--in as wide a variety of locations as possible.

Although the Library presently has on-line systems for ordering, cataloging and circulation, the "card" catalog is still on cards. We propose to acquire a more up-to-date system that will replace the present catalog with an on-line catalog which permits interactive searching of the collection. We hope to extend the communications so that library access is possible from essentially any terminal on campus, and eventually from other UPR campuses and from other universities on the Island.

6) INSTRUCTIONAL COMPUTING FACILITIES INFRASTRUCTURE --The expansion of instructional computing facilities begun with the acquisition of our IBM 4381 computer should be continued by acquiring additional minicomputer systems and/or clusters of terminals or micros for those colleges not already equipped.

Several of our colleges have already established their own academic computing centers, with clusters of terminals, groups of micros and two minicomputers. We will complete a basic equipment infrastructure by adding similar clusters of terminals or micros in other colleges that presently lack them, plus additional minicomputers in one or two schools that need large amounts of computing power. We recently acquired an IBM 7171 protocol convertor with 64 ports, with which we can provide access to smaller academic units via inexpensive ASCII terminals or micros.

7) RESEARCH COMPUTING FACILITIES INFRASTRUCTURE --Researchers should be provided the quantity and quality of computing resources required for carrying out their work, including reasonably fast processors, color graphics terminals and plotters, and access to remote data bases and networks.

There is often a strong correlation between good research and good instruction. If a good infrastructure of instructional computing facilities is provided, then it will in large part satisfy the needs of the research community. What is needed in addition for researchers are some more specialized facilities. They will have adequate processor capacity for the next few years via the 4381. An upgrade to the 4381 or an array processor may be needed in 2-3 years, and is provided for in the budget. High quality color graphics equipment and a medium speed laser printer will be provided at the Computer Center. Finally we will provide access to a variety of bibliographic data base resources. In some cases, such as the federal government census data and crystallographic data bases, these will be available on-line on our system. In other cases, access to DIALOG, LEXIS, etc., or to a supercomputer facility can only be made at present via DDD or TELENET. We will try to reduce the data transmission costs.

8) TEXT-PROCESSING AND PRINTING --Facilities must be available in the Computer Center and Print Shop so that users may have inexpensive word processors, microcomputers and printers in their offices, yet be able to communicate with suitable laser or other high-quality printing equipment for printing theses and proposals, forms design, and producing catalogs and journals.

We have already begun to experiment with newer facilities-- this manuscript was prepared using Waterloo SCRIPT and a Xerox laser printer. We plan to go from this pilot project to a more versatile device, such as a Xerox 8700. This will eventually be the basis for serving several types of users: 1) Academic users all over the campus will be able to prepare theses or manuscripts on their own inexpensive equipment, and print the final draft, in camera-ready form, on the laser printer. 2) The University publishes catalogs of courses, of telephone numbers, of warehouse materials, etc. Many of these can be word processed using SCRIPT and a new version produced on the laser printer at more frequent intervals than at present. 3) A number of schools and departments also publish scholarly journals through what are presently time-consuming, expensive methods. This process will also be considerably simplified. 4) Finally, our Office of Systems and Procedures will be able to be much more flexible in its design of forms with a laser printer, with its fine control of printing locations and fonts, than with traditional methods. We hope to reduce the costs of printing reports on special forms, since the laser printer will permit merging of the form design with the data to be printed on the report, using blank paper rather than more expensive, preprinted forms.

9) TELEPHONE/TELECOMMUNICATIONS SYSTEMS --The present obsolete telephone system should be replaced by a digital PBX which permits maximum flexibility for use of voice and data. If the campus needs to be rewired, then such rewiring should provide the capacity for voice, data and video transmission adequate for the next 15 years.

Local telecommunications firms have already offered the campus a new digital PBX with modest data communications facilities for less than we are paying in rental fees to the Puerto Rico Telephone Company for our present obsolete voice system. Unfortunately, these vendors generally make a beautiful visual presentation accompanied by a several page proposal which is full of promises and telecommunications jargon and a place to sign at the bottom. In view of the complexity of this issue, we are going the RFP route, so that we end up with what we need on our campus, and n what the vendor wants to sell us. We have formed a Telecommunications Committee to begin our needs analysis, and are accumulating RFPs from other institutions to help us. Sooner or later we will need the services of outside consultants to help with the more technical aspects, such as how much data can or should be transmitted via the PBX, and whether or not Local Area Nets are needed or whether our network of 3274 units on leased lines will be sufficient for many years to come.

It seems almost certain that the campus will need to be rewired, since only about half of the offices that require telephone service are provided for, and a new telecommunications system that requires more than one pair/apparatus would be out of the question. A lesson learned from other universities is that we should estimate our wiring needs, and then double or triple those estimates. We should also take advantage of any rewiring of the campus to add coaxial and optical fibre cables, in case they are needed later for a LAN.

10) LOCAL AREA (CAMPUS) NETWORKS, UPRENET AND BITNET --Together with or in addition to a new PBX, provision must also be made for campus LANs for transmitting large quantities of data, connecting an increasing number of microcomputers, and for applications such as video technology, security systems and electronic mail. Better communications must be established between our campus and the network of the UPR system (UPRENET) as well as with BITNET.

Some of these issues are related to the acquisition of the PBX mentioned above, and will be dealt with while consulting about its design and purchase. We will experiment with networking schemes, in the Computer Center or as part of our Office Automation project, probably starting with the new IBM token-ring network. When both of our processors are connected via their front-end processors and SNA software, then any terminal on campus can, if permitted by our security system, access applications on either the administrative or academic computers.

Most other UPR campuses and our Central Administration are already connected via DECNET in a network called UPRENET. We will install a DECNET/SNA gateway to permit Río Piedras to participate in UPRENET. In the near future we hope to connect our IBM system to BITNET, so as to access the growing number of universities on that worldwide network. At present we are limited by the $2,500 cost of a leased line to the mainland, so currently we have only indirect access via our account at Stanford. Hopefully, cheaper X.25 techniques will soon become available.

11) ORGANIZATION AND PLANNING --A new organizational scheme is required on the Río Piedras Campus to integrate the presently dispersed units in charge of the planning and implementation of computing, communications and information systems. Such a scheme must provide for implementing the strategies indicated above via appropriately chosen and managed project teams.

The campus presently operates via an "informal consultation model" in that various offices (usually) consult with the Computer Center when decisions are taken affecting computing, communications and information systems. For the Student Information System, it was realized that that system needed top management level control, and so it was placed under the control of a Steering Committee which reports to the Chancellor. The responsibility of this Committee has gradually evolved so as to include all aspects of the Master Plan. For the duration of the Plan, 1985-90, we have proposed that the Plan be administered by the Director of the Computer Center, who would report to the Chancellor directly, and also via the Steering Committee. The present Student Information System Project Director would become an Assistant Director of the Plan, in charge of its largest project--the Integrated Campus Information System. Other project directors and ad-hoc committees would be appointed as required, as in the case of the Telecommunications Committee.

A growing number of universities have recognized the interrelations among computing, communications, and information systems, and the importance of combining the responsibility for all of these into one office, which goes by different names such as the Office of Vice-Provost or Vice-Chancellor for Computing and Information. We think that sooner or later our campus should consider a similar reorganization.

F) SOME COMMENTS ON BUDGET AND TIMETABLE

Here we summarize the budget requested by fiscal year for the period 1985-90. The calculation of costs for each fiscal year period assumes that some cost items are financed over the five-year period (IBM equipment and the principal software contract). This spreads the cost out fairly evenly, and puts the payments more or less in line with the expected implementation timetable. After 1990 recurring costs for maintenance and additional permanent personnel come to approximately $600,000/year.

SUMMARY OF PROPOSED COSTS (In thousands of dollars)

PROJECT	1985-86	1986-87	1987-88	1988-89	1989-90	TOTAL
1) Int Inf System	332	395	490	418	488	$2,123
2) Office Automat	51	53	55	57	59	275
3) FS Comp Lit	100	110	120	130	140	600
4) Micro Acquis	22	22	22	22	22	110
5) Library/Ref	300	100	50	50	50	550
6) Instruc Facil	435	170	70	70	70	815
7) Research Facil	30	80	35	35	35	215
8) Text Process	92	32	87	42	42	295
9) Tel/Comm	162	85	85	85	85	502
10) Networks	30	15	15	15	15	90
TOTALS:	$1,554	1,062	1,029	1,024	1,006	$5,675

G) CONCLUSIONS AND SUGGESTIONS:

We hope that this case study of a campus Master Plan and its development in a brief time period will be of value to others considering a similar task. A few bits of advice might be added:

1) DON'T assume that major plans must come from the Planning Office.
2) DO attend conferences, visit other universities and collect RFPs so you don't reinvent the wheel.
3) DO involve users in writing RFPs and evaluating proposals--they have to make the final plans work.
4) DO include something in the plan for as wide a variety of academic and administrative offices as possible, to generate widespread support and minimize opposition.
5) DO remember that much of your plan will change, including its budget distribution. Any plan becomes obsolete the day it is approved, but the planning process continues.

INFORMATION TECHNOLOGY PLANNING: A MOVING TARGET

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Rapid changes in information processing technologies are creating unprecedented opportunities and challenges for Colleges and Universities. Throughout higher education, there is mounting concern for the need to plan for information technologies and deal effectively with emerging issues.

How is it possible to plan for information technologies in a rapidly changing information environment? Organizational responses to this challenge vary according to institutional style. This paper presents the information technology planning method developed at Northern Kentucky University. The NKU approach borrowed elements from models used at other institutions, melding them into a strategic planning mechanism suited to NKU's management style. Primary focus is on the need to develop a strategy which can remain current and flexible while guarding against capricious action. Organizational implications and planning issues are discussed.

Background - A Time of Change

Rapid changes in information processing technologies are creating unprecedented opportunities and challenges for Colleges and Universities. Computers are at the heart of a profound revolution that promises to rock our campuses. According to John McCredie, the real power of computers lies in the ease and rapidity with which they are becoming integrated with other technologies ranging from wristwatches and telephones to robots.[1] The synergy resulting from technological convergence provides new opportunities to change the way organizations function and to amplify the creative processes of people using these technologies.

There are, however, growing pains associated with rapid change. Each permutation of technological advance identifies new issues to be resolved. For example, institutions still reeling from an invasion of microcomputers, are now facing demands for communication networks to link distributed computer resources and support research access to remote sites. Higher education is becoming increasingly concerned about developing planning strategies that can anticipate and cope with the inevitable technological changes ahead.

Planning Issues

Before institutions can develop successful planning strategies, they must recognize that the technological planning horizon extends across traditional organizational boundaries. The complicated interrelationships resulting from merging technologies (and the accelerating rate of change) require constant attention and coordinated planning over broad technical areas which in the past have functioned independently of one another.

Reorganization of functional units may or may not be needed. However, regardless of the management structure under which the various technologies operate, integration of technologies for long-range and capital planning purposes is crucial to avoid overlap, incompatible systems and wasted funds.

A number of other planning and policy issues must also be addressed by each institution. Computer/technical literacy is a fundamental issue to be clarified. Since there is no universally accepted definition of technical literacy, each institution must determine appropriate levels for its constituents - students, faculty and staff. How are these levels to be attained? How quickly? Institutional responses to these deliberations will form the basis for developing appropriate planning strategies.

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[1] John W. McCredie, Campus Computing Strategies (Bedford MA: Digital Press, 1983) p. 3.

Implicit in the information processing revolution is the probability that opportunities and aspirations will far outpace available human and financial resources. Thus, successful planning strategies must include some mechanism to set priorities, ensure that they are established within the context of institutional goals and objectives, and weigh the relative merits of allocations in the context of:

1. Academic versus administrative needs. Major emphasis will usually focus on academic needs since resource allocations to this sector quickly impact the educational program. Administrative allocations typically sustain less visible activities related to cost avoidance. planning support, or expanded services. In an era of increased institutional accountability and efforts to serve diverse constituencies, the non-academic functions are as essential for institutional vitality as the instructional component.

2. Expansion - how much is essential and achievable? Expressed wants and actual needs are always difficult to differentiate. Further, a large scale implementation is usually needed to achieve a critical mass for any given technology. However, high cost and rapid technological change often mandate incremental implementation, a less than ideal circumstance.[2]

3. Reallocation of existing resources. Given the current fiscal constraints within which higher education functions and the major resources required to provide information processing services, many institutions will find that the only way they can move ahead is by reallocating existing resources, a difficult decision.

4. Improvement/expansion of services. With the many opportunities available, hard decisions will need to be made about whether funding is to be directed toward new activities or if more benefit can accrue from expanding existing services.

Organizational Implications

Organizations must either manage information processing technologies or risk being managed by them. Effective planning strategies will:

- meet institutional needs to stay informed and knowledgeable about technological advances and related institutional implications;

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[2] James I. Pe..rod, "A Case For The Chief Information Officer," CAUSE/EFFECT, September 1985, p. 3.

- provide a mechanism to coordinate the planning for technical units so as to define common standards and develop integrated plans;

- develop information technology plans to directly support institutional goals and objectives.

- ultimately result in better stewardship of fiscal resources and the more effective utilization of technology by personnel within the organization.

Planning and management responsibilities are traditionally housed within the same organizational unit - those who provide services are expected to plan for their continued growth and development. However, with the rapid blurring of the boundaries between once distinct information processing technologies, separate planning for each area is no longer desirable. There are two basic approaches to developing planning strategies to cope with this changing environment. One option is to reorganize so that information processing units are coordinated under the same organizational umbrella. The second option is to develop a planning mechanism that transcends established management channels without changing operational reporting. Both approaches are in use.

Many institutions have responded to this challenge by appointing a senior level administrator to coordinate implementation and use of information technologies and to integrate the planning process.[3] The role of the chief information officer (CIO) usually includes management responsibility for the technical units as well. Other institutions have created organizations such as the Center for Information Technology at Stanford University which has responsibility for planning and management of the major campus information processing technologies.[4] Both models typically include one or more advisory groups as part of the planning process.

In institutions where management responsibility for information processing technologies is dispersed throughout the campus, some institutions have responded to planning needs by establishing high level steering committees charged with coordination of the planning process and establishing

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[3] John Gantz, "Telecommunications Management: Who's In Charge?," Telecommunication Products + Technology, October 1985, p. 18. Also see Judith A. Turner, "As Use of Computers Sweeps Campuses, Colleges Vie for 'Czars' To Manage Them," Chronicle of Higher Education, May 30, 1984, p. 1.

[4] Paul R. Kaufman, "Stanford University," in Campus Computing Strategies, John W. McCredie, ed. (Bedford, MA: Digital Press, 1983) pp. 149-154.

long-term directions.[5] In this model, formal coordination of planning becomes the catalyst to initiate communication among unit heads who report to different vice presidential officers, while the increased convergence in information technologies tends to create a common sphere of interest to draw the groups together.

The Northern Kentucky University Response

The strategic planning mechanism used at Northern Kentucky University (NKU) evolved as the information environment moved from highly centralized computation toward a future of decentralized information processing. Historically, computing and the other information processing technologies at Northern Kentucky University had been guided by a handful of people, relying on informal consensus rather than university-wide planning to guide their efforts. Capital planning was linked to the statewide biennial budget process.

About five years ago, recognition of the need for a more structured method of defining priorities led to the establishment of a Computer Services Policy Committee. Membership was composed of the university's chief line officers and the Budget Director, thus insuring both an institutional perspective and high-level support for major decisions. In turn, the Committee utilized both a task force and a team of outside consultants to assist in developing a long-range plan for information systems and office automation technologies.

During the Fall of 1982, the Vice President of Administration recommended to the Policy Committee and to the President that the information resource functions of computer services, word processing/office information systems, and institutional research be grouped under the umbrella of information management and that a new position of Assistant Vice President for Information Management be created to head the unit. Approval was given and the position filled in October 1983. Although Information Management personnel are responsible for data networking, responsibility for voice and video systems was not transferred. However, all functions ultimately report to the Vice President for Administration, thus planning coordination is feasible.[6]

After the appointment of the assistant vice president, the Policy Committee was renamed the Information Management Policy Committee and the scope of policy decisions broadened. It is this group that reviews and makes final recommendations

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[5] John W. McCredie, Campus Computing Strategies (Bedford MA: Digital Press, 1983) p. 11.

[6] Phyllis A. Sholtys, "Impact of Information Management in the University Setting," CAUSE/EFFECT, September 1985 pp. 25-26.

to the President regarding direction and priorities for information processing activities.

The resulting NKU information technology planning process borrows elements from both the chief information officer model and from the steering committee model described earlier: The university designated a chief information officer who directly organizes and coordinates computer services, office automation/information processing, institutional research, and information center functions. The CIO also has an assigned leadership role in coordinating the planning for voice and video networks with data network planning.

There are, nonetheless, other information technology planners and functions outside the jurisdiction of administrative affairs. The university library reports to the Provost as do the Directors for Media Services and Academic Computing. The Director of Media Services has a leadership role in defining academic video needs and the Director of Academic Computing is responsible for defining faculty and student computing needs. To counterbalance this split reporting structure, the Information Management Policy Committee functions as a steering committee by providing a mechanism to insure that coordinated planning takes place among units. It also provides legitimacy to plans that involve cross-jurisdictional lines.

Assessment and Implications

The two year period after initiation of the new organizational and planning mechanism has produced significant accomplishments: A development plan is in place, needs which had been placed on hold are now being addressed, stalled projects have been reactivated and planning for the future of information technology at NKU is an on-going process. For example:

- Institutional research has been reorganized and revitalized. Expanded support services are being provided to the University community and external reporting is marked by increased precision.

- An institutional commitment was made to base all new mainframe systems on database technology; installation of a relational data base is complete and the system is in active use.

- An extensive evaluation process of vendor-supplied application packages was accomplished and a decision made to develop new in-house systems instead. A major student information development project is now underway.

- A plan for office automation was developed and approved, equipment and software policies are in place, a dedicated word processing system and approximately 200 new microcomputers are in use throughout campus offices.

- Information center services in support of user-computing are being provided. A small cadre of part-time personnel provide classes, consulting and hot-line support for all University office personnel. The information center has also become the vehicle to deliver instruction for the administrator-staff portion of the University computer literacy program. Almost 300 administrators and staff personnel have taken courses offered through the information center for a total "seat count" of more than 900 registrations.

- A Campus Communications Committee has been formed under the leadership of the CIO and is addressing long-range campus communication needs for data, voice and video.

The introduction of a chief information officer, combined with a policy committee that also functions as a steering committee, provides a successful approach to strategic planning for information technologies at Northern Kentucky University. While the planning mechanism developed at NKU may lack elegance when viewed from the perspective of organizational theory, it accommodates the political realities and management style of the University.

Alternative approaches to planning may be more suitable and effective in other campus environments. However, whatever specific strategy is employed, it is important that the issues raised by information technologies be addressed at a policy level. The impact of rapid evolution is further compounded by convergence of the technologies. Colleges and Universities must take steps to ensure that an institutional perspective is incorporated in the planning process for development and implementation of information technologies. The void created by the lack of coordinated planning will bring costly mistakes in the use of both technology and personnel.

Tackling Security Issues from a Management Perspective

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Security, or the lack of it, is a problem that is often considered a technical one. Universities focus their energies on making certain that the technology can provide as much security as possible. While all of this is certainly worthwhile, it misses the central point: that security is a managerial, not a technical problem and must be approached as such.

This paper will focus on how to move the discussion of security from the technical to the managerial relm, how to enlist and enlighten the upper levels of university administration, and, in particular, how to define and organize security problems so that they can be understood and tackled effectively by the university community.

Tackling Security Issues from a Management Perspective

The central premise of this paper is that information security is a management issue, not a technical one. Security, or the lack of it, is a significant issue in any complex organization dealing with information but it is often considered only a technical headache. Security is usually given minimal attention by senior management who look to the appropriate computer center to implement the necessary technical details. But those of us in data processing know only too well that while software and hardware can provide the means for protecting information, only policies, education and effort can ensure that protection. Computer centers are not in the position of being able to set policy for an entire university, but they are considered responsible in many ways for the security of the institutions data. In addition, computer center personnel often feel frustrated and undermined at the lack of understanding of security issues shown by the institution at large.

Security must be pulled from the technical ranks and the realm of departmental managers to a position where an institutional perspective can be provided. Often each department that controls data has its own rules and regulations, i.e. registrar, payroll, financial aid. One security plan must exit for the institution with each department having local objectives that support the global plan. This will require new ways of thinking, new ways of tackling the issues, and perhaps, where security is concerned, radical surgery to exisiting organizational lines. As politically difficult as this seems, the current trend in telecommunications management can serve as a model for this effort. Telecommunications systems are currently being managed and decided upon centrally and involve many of the same issues as security. Security issues must be dealt with at the top and must be managed before they consume management.

This is not a new or a novel idea. Over 15 years ago Joseph J. Wasserman wrote in the Harvard Business Review " no one group should bear the complete responsibility for protecting the computer system. The need for controls should be instilled in the entire organization, starting with top management and extending to all personnel." This is even more pertinent today because of expanded access to information. Management must develop a security plan with the same sense of urgency as a strategic plan. Management, especially the senior executive, must dictate the need for security, get involved and tackle it for proper results. A general sense of security is not enough, for universities are now vulnerable in ways that risk the integrity of the entire institution. The problem is both one of defining what security means in a particular institution and putting this important idea into practice.

Computer centers alone cannot ease the risk, but each center can begin a campaign to involve senior management in this most important problem. The campaign should have three major stages: initially, you have to get their attention. Secondly, you have to show them what has to be done and why. And finally, you have to evaluate the results of these efforts.

This paper is not a standard audit security checklist, but a discussion of a recommended strategic approach to addressing security issues. In addition, we have tried to be pragmatic by recognizing that total security is pie in the sky. Security and information are more manageable issues when dealt with by senior management of the institution in tandem with the senior management of the computer center.

Action must be taken in five crucial areas for strategic security planning:

(1) institutional policy review
(2) security awareness
(3) digitalization of the institution
(4) risk assessment
(5) auditing and evaluation

Getting Their Attention

Like it or not, computers and complex systems are more and more linked to the operation and survival of the institution. How they are managed has real impact on the organization. So why does the senior management of the university pay so little attention to those of us who manage them? For one thing, we don't talk their language. Despite our complaint that security is a management issue, we often discuss it in language mired in the minutia of technical details. We talk about mainframes, interfaces, passwords, operating systems and vendor promises. When we do this we are unwittingly supporting both the current assumption that the technology can provide the necessary security and, perhaps the even more outrageous fallacy that the computer is the cause of the loss of privacy and fraud. How, then, can data processing center management address the issues in ways institutional management can understand?

Law suits are one way to attract attention. Do the senior managers in your institution have any mechanism for learning about law suits involving information security? Certain Federal laws exist which place the responsibility for enforcement of privacy directly upon the shoulders of the administration. The Federal Privacy Act of 1974 mandated many requirements for the Federal government's record keeping system in all areas and established privacy requirements for their operation. Many states have followed that direction and state laws exist to further protect the rights of individuals within the state and institution. The Foreign Corrupt Practices Act of 1977 requires adequate internal accounting to insure the protection of corporate assets. This Act has also served as a model for state laws. The advent of the telecommunications explosion, coupled with the enormous growth in the computer hardware, software and microcomputer sector have again stirred the interest of legislators, and congress is currently looking at many possible legislative actions in the area of computer and security. The significance of this legislation is that institutional management will have a further responsibility not to misuse, destroy, or disclose computer data while at the same time guaranteeing more and widespread use by institutional and related bodies. Do not take it for granted that the management of your institution are aware of the difficulties of providing this level of information protection. In addition to the mix of reality and legality that must be balanced, the area of data protection is a mixed bag of responsibilities. Management must not abrogate its responsibility to the technicians, and clear institutional policy must dictate policies. Likewise, it is the responsibility of data processing management to provide the information needed for these policies to be developed and to let senior managers know why and how institutional data is at risk. It is unproductive for data processing personnel to assume that university management is aware of all the problems of data security. The data processing center must clarify for itself its role as the provider of technical consultation and information. The data processing management knows the ways in which information is vulnerable and the university management knows how the information must be used to support the goals of the unversity. Together they are accountable for data security in the organization and have the means to provide it. Remember, that while the first step of involving senior managment is the most difficult, the process of reexamining existing policies and updating them where appropriate is an ongoing one because security legislation is constantly changing. And further, while there is a cost to enforce security, this cost can be planned and managed but the cost of a lawsuit cannot.

The threat of lawsuits will get the attention of many people, but others feel quite removed from the stirrings of the legislature and the courts. This makes bringing home the problem very important. Talk about security problems in terms of what management, not the data processing center, would lose in the event of a major problem:

What would happen if the admissions system were not available for a month during the critical recruiting season? How many students would the institution lose if the financial aid system were lost for a semester? Could payroll be run manually if the system were sabatoged? Developing these scenarios in writing and asking senior officials to discuss them with you is an important step toward convincing them that their operation - not just yours - is at risk if security measures are not taken.

If your organization is like most, a common argument for not developing security plans is that the institution cannot afford to use its limited computer staff on these non-critical overhead functions. This approach misses the central point: one major security breach can be a lot more expensive and time consuming than planning against disasters. Data processing center management should develop and cost out examples of what breaches of security could mean to its institution. Security and its related issues must be given the same prominence as strategic planning, and the responsibility for bringing this concern to senior management rests squarely with the data processing staff. The data processing center must make discussions of security routine. Every new budget request should include, and highlight, the cost of security. And any efforts at strategic planning -- planning that seeks to answer the question of the role of the center in the university -- should include a major discussion of the primary role of security and "what if" scenarios.

The Computer Securit urnal, 1982, stated that "The following objectives are gener accepted by those who work in the field of data security.

(1) Insure the accuracy and integrity of data
(2) Insure the protection of sensitive or confidential data
(3) Provide protection from acts that would cause either hardware or program malfunction, errors and omissions, or the unauthorized disclosure or destruction of data
(4) Insure the ability of the organization to survive business interruptions and function adequately after survival
(5) Protect employees from unnecessary temptation to misuse data while fulfilling their job responsibilities
(6) Ensure management awareness of the need for security and their participation in the development and implementation of security policies
(7) Protect management from charges of imprudence in the event of any compromise of data security"

Let your university's manager know if their organization can get a clean bill of health on these issues.

What they should do:

Once you have established communication with senior officials and asked for their involvement in solving security problems, make sure you don't undo yourself by directing their attention to issues which really can be solved at your level. There is a great deal of literature on how to have a secure computer center. That literature is for you, not them. Keep them focusing on policy issues. We think these are the four things that require action by policy makers:

(1) Review Institutional Policies

Computers are here and the institution must reexamine its policies and update them to coincide with the realities of computers and security needs. Computers and related security issues are just beginning to surface and are beginning to mix with all institutional policies and procedures in all areas. It is in every institution's best interest to reexamine all existing institutional policies and procedures, especially at the board level, to take into account the legal and security requirements which are required of an institution.

Three other areas of concern should be pursued when investigating instututional policies. These are (A) the consistency [illegible] implementation of labor contracts and (B) the awareness of software requirements for computer systems (C) the physical security of hardware, software and data.

(A) Labor contracts - Labor contracts have a myriad of rules and requlations and as sophisticated computer systems are implemented to enforce these contracts, there must be a correlation between what is actually required and what is actually implemented.

(B) Computer software - Many computer software packages require certain rules and regulations to be followed as they are implemented. Often, a computer programmer may make a decision which can have far reaching legal impacts. For instance, in implementing a computer security package, there may be an option to put all transactions on the system into a backup file for monitoring and security purposes. A programmer may determine to not implement this option as the overhead on response time and disk space is too high. This is a valid decision from the programmers perspective but it is doubtful whether a court of law would accept this as a valid reason for inability to produce records on data access.

(C) Physical security of hardware, software and data is the base or essential component of any institutional policy. There exist many corporate and institutional standards which management assumes are in place. This may be the case, but let me pose a question. Can management guarantee that software, which is proprietary, is not being copied illegally throughout the institution? What is the institutional policy for the individual who is caught? Such a policy should exist or a University may find itself at the end of a legal suit by a software company that is losing revenue due to this legal violation. Without proper policies, the institution and its management are at risk, not the individual.

(2) Develop a Security Awareness Program

People are the key to security awareness, not the computers and the software and hardware they use. Individuals at all levels from the President to the janitor present the greatest risk to information security. At the risk of being trite, let's restate the obvious --computers cannot commit crimes. Gone forever are the days when only a few key executives had access to classified data and information. Job roles are constantly changing, and more and more staff have access to more and more data, but little has been done from an institutional perspective to change the individual's awareness. Institutional cooperation and research alone has resulted in the mass proliferation of data bases containing mountains of previoulsy "classified" data. With the advent of downloading, micros and networking, data access has passed to the hands of literally hundreds of employees at some institutions. Each individual who has access to information plays an important role in data protection.

This is, of course, especially true in the computer center areas, whether they are administrative, academic, combined or distributed to a department. How many times have you heard that information is confidential but someone in the computer center said that so and so salary is this, or a student worker has checked the grades before the professors roster is complete, or look who got the biggest raise, etc. These selected groups of individuals can also wreak the most havoc. Everyone has read of the programmer who manipulated funds, the disgruntled employee who destroyed company records upon leaving, or the person who was paid to change a transcript. Software and technological advances are helping to combat these situations, but the bottom line is still people.

What can be said of the computer center is now duplicated many times over with the advent of distributed systems. These large systems with readily available software are now being made available to user departments all over the university. The information which was once on large disks in the computer center is now on diskettes in every office. The information is the same but now with minimal central control. The problem for the university is the same - it must protect its data. But instead of being able to handle it through the computer center, it must be managed throughout the institution.

The organization must begin a security awareness program and make it part of normal daily operating procedures. The responsibility of each individual must be stressed. For new employees, require them to sign a security awareness statement and introduce this security training as part of your employee orientation program. When you implement a new program, don't forget current employees. Make sure that they are made aware of how seriously the organization takes this problem. (Please refer to Exhibit A for an example of the University of Massachusetts' Data Processing Center's confidentiality awareness statement). Above all, enforce the statement if the agreement is violated or it will serve no useful purpose. For employees who are leaving and are disgruntled and in a position of trust, remove them immediately from their position and allow no access to any university data. Put this in writing to them and make them aware that you intend to follow through with court action if violated.

(3) Manage the Digitalization of the Institution

Almost every possible piece of data or information is being digitalized in our society and our institutions. Computer data, microcomputer data, voice, copiers, fascimile, word processing, optical scanning and more are capable of being converted to a digital format, transmitted over a medium and then stored or printed. The possibilities are endless and the controls for protection minimal. A real dichotomy is established when systems are required to provide management and operational departments with an infinite amount of data while the laws are requiring much more stringent controls of data, access and individual rights. What manager can absolutely guarantee the status of an individual's record, or who has had access to it or where is it in the system? The situation is perplexing and very complex and management has an obligation to protect the guaranteed right of confidential data. The reliance on computers and this digitalization and transmission of data over medium obligates management to action to upgrade computer security.

In order to do this, every piece of data, regardless of the residing computer or storage mechanism, must reside in a file. Management must dictate that each file, and subsequently each piece of data, have an owner. These owners should have the right to secure and release the access to that data. Release of the data to any other user, whether in printed or digitalized form, must first require a written release from the owner. This will involve institutional decisions with appropriate policies. The process of defining owners is tedious and tactically difficult, but is the primary requirement for proper control. Only when this is done can software and systems can be implemented to manage policies.

The concept in practice is data administration and each computer center should have a person responsible for this task. The data administrator will work with security and manage the data. The data administrator should insure that each data element has an owner, will validate update and access procedures for the data and files.

(4) Assess the Institution's Risk

In light of what senior managers have learned about legal responsibility and information vulnerability through your efforts to involve them in security issues, they must reassess their position regarding areas of information vulnerability and prepare a detailed risk analysis of key institutional security areas. There are a myriad of security areas and each institution must take their critical areas and perform the risk analysis according to priorities as all areas cannot be covered at once. Some of the more critical management related areas with institution and executive vulnerability include but are not limited to:

1. Physical Security

    Computer room access, office access, building access
    Security guard
    Visitor logs
    Lost keys, badges procedure
    Environment (air conditioning, humidity, fire, water, power)

2. Data Security

    Data access/control - security package (ACF2, RACF, Top Secret)
    Data files, system files, production files, libraries
    Password administration (authorization, change frequency, control, violations)
    Audit trails
    Communication lines
    Disposition of documents (listings, forms, microfiche, testing, documentation)
    Back up procedures
    Off site storage

3. Controls and Procedures

    Data responsibility (file owners, authorizing agent)
    Data classification (public, confidential, critical, proprietary)
    System responsibility
    Exception reporting

4. Change Control

    Authorization to add, change, production programs JCL
    Use of test files
    Documentation changes
    System utilities, system programming, staff issues

5. Contingency Planning/Disaster Recovery

   Risk analysis
   Critical services determination
   Backup sites
   Recovery plans and testing of plan
   Off-site storage/rotation

6. Personnel Considerations

   Selection, security check
   Consultants/vendors
   Security awareness
   Segregation of duties
   Resignation/dismissals
   List of authorized personnel
   Campus security involvement

7. General Considerations

   Control of sensitive forms (responsibility, procedure)
   Trustee/State/Government/Institution policies
   Information Center access
   Role of Auditing (Internal, External)

Essentially, risk assessment is the process of defining the problem. The institution needs to determine what its risk is for data losses. The baseline concept of security assumes that all well-run computer and information systems have adequate security over physical access, input/output control, backup copies of data and system files, logs, journals and so on with key computer staff in positions of trust. The risk analysis must deal with the exceptions or extremes. What exposures are worth the risk? Which are not? For example, can the institution run the payroll if the system were unavailable for a week? How about a month? What would happen if the on-line files were not available during the first week of school or registration? Or even worse, could the institution recapture days of on-line updates throughout the institution. Do the institution executives know their risk and recovery capabilities?

The institution must have a plan to assess and managerially decide what is worth and what is not worth protecting. What data is really confidential? Should the computer center spend more or less money and time on security? The institution may pay a great cost in time and productivity for recapture of data, or in dollars for an expensive lawsuit. Real guidelines are required. These guidelines should also be tied to the budget in the same way as strategic planning. Where is the exposure not worth the capital investment?

Data processing officials cannot make these decisions, but they can inform the decisions of the university management by providing information about what data is at risk and why. Additional information will be generated by the carrying out the previous recommendations. The next step should be to put a senior executive in charge of organizational security. This person may or may not come from the computer center. The security administrator would then convene a university wide task force from several disciplines. Specific goals and objectives should be mandated from the needs assessment and then a realistic action plan established. The old trend was to secure, lock and fasten the computer room. Lines and terminals to the outside world were tightly controlled. Current security problems are much more complex and systems of the future will be even more vulnerable due to the telecommunications tie-in to micros and mainframes. That once secure fortress of the computer room can now be electronically broken and cannot be effectively managed due to the breakdown of its components. Data can be downloaded to a diskette, handed to an individual thereby losing institutional control. Dial-up capabilities prevent many computer centers from knowing who is attached to the other end. In the old days we had control of terminals in a department through the supervision of line managers.

In addition, management has certain statutory responsibility, mentioned previously, which must be weighed in any risk assessment. The Federal laws impose the responsibility of maintaining accurate records and that an internal accounting or control system be present to execute daily business in accordance to management's authorization. Internal controls, which must be approved by management, must then be in place to allow the institution's staff to enforce the security plan.

(5) Develop a New Role for Internal Auditing

There are traditionally many areas of audit concern. The normal audit text contains hundreds of pages of standard questions for management and computer center staff. The role of audit is critical to the management of security and information in an organization. However, internal audits should be done in a collegial manner and they should take the approach that the auditor is there to assist and help the computer center and institution. The audit function should be upgraded to include what is referred to by auditors as the EDP (Electronic Data Processing) function and resources in that organization should be dedicated to this task. To properly introduce the EDP audit function, management should insure that the internal audit function include an EDP auditor and that auditor work in concert with data processing and the instituti n as an ally for positive change. The auditor should be a team player, and should provide both an institutional and a detailed computer security role, parallel to the equivalent of a management and an operational audit.

With this approach in mind, the computer center should undertake a friendly audit which is managerial confidential to the data processing center. Contract a willing and knowledgable computer center director or a collegue from a peer institution to work with you. Investigate key concern areas and begin a plan to manage your security issues. Involve management, the computer center and the audit area. Prepare a plan with specific institutional objectives and concentrate on the macro issues. A friendly audit will also alleviate the pressure when the next major internal, or external audit is thrust upon the organization. The outside state, federal or private audit will then be able to concentrate on scrutinizing the housekeeping functions and the internal audit will assist the institution with strategic functions.

Summary

The audit takes us full circle in the process and links all of the other four areas of management strategy. Efforts should be concentrated in the five strategic areas:

1. Review Institutional Policies
2. Develop a Security Awareness Program
3. Manage the Digitalization of the Institution
4. Assess the Institution's Risk
5. Develop a New Role for Internal Auditing

The CAUSE organization can provide invaluable assistance in the security efforts by providing documention from participating institutions, and perhaps keeping a list of people who are willing and qualified to participate in friendly audits. With the involvement of its members, CAUSE could also produce a security standards policy manual for all institutions to use as a guideline for institution management.

It should be remembered that security will not add to your productivity in the short run but it will assure confidence and protection levels in relation to the institution, the individual and the laws. Senior management will require strategic input from the computer center. Computer centers will make their own jobs easier if they exercise leadership and initiative in tackling security issues from a management perspective.

DATA PROCESSING CENTER

Confidentiality Awareness Statement

As an employee of the Data Processing Center, I am aware of my individual responsibility and position of trust as it relates to the protection of information implied by my employment. I will not release or divulge information obtained as a result of my position in the Data Processing Center. In addition,
I will not compromise my right to access data or files by the release of personal logons or passwords assigned to me by the management of the Data Processing Center to access information, data, systems and files.

For your information, the Trustee Document (T 77-059) on <u>Fair Information Practices Regulations</u> is available for your perusal in the Documentation area, and the following is an excerpt from it:

> "401 <u>Sanctions</u>
> (a) Any employee of the University found breaching the confidentiality of data subjects through violation of these regulations shall be subject to reprimand, suspension, dismissal, or other disciplinary actions by the President or Chancellor consistent with the rules and regulations of the Board and laws of the Commonwealth governing its employees, and may be denied future access to personal data and removed from any holding responsibilities In addition to the remedies provided in G L. c 214, sec 3B, as added by ST. 1975, c. 776, sec 3, the President or Chancellor may by administrative action revoke the authorization to hold personal data of any officer, employee, college, school, department, agency, institute or station under his supervision."

By signature below, I am recognizing the overall responsibility and mission of the Data Processing Center to protect the rights and privacy of individual and institutional data and information at the University of Massachusetts and agree to abide by established policies, procedures and standards.

____

Signature

____

Date

INSTITUTIONAL CHANGE - A FAST TRACK APPROACH

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ABSTRACT

In January of 1984, key officials at St. Louis University, a three-campus, complex, research, residential university decided that the extant administrative computer systems were inadequate t manage, much less to plan, for a $200 million enterprise. January of 1985, the University decided to switch to VAX hardware and purchase the Series Z application systems from IAI. The General Ledger (and integrated Accounts Payable) system went live July 1; Alumni & Development went live July 1; Personnel/Payroll went live December 1. Four student systems will begin implementation after New Year's. The software selection process and simultaneous implementation process are discussed in this paper.

INSTITUTIONAL CHANGE - A FAST TRACK APPROACH

St. Louis University traces its history to the foundation of the St. Louis Academy by the Bishop of Louisiana, in 1818, three years before Missouri was admitted to the Union. It received its charter as St. Louis University in 1832, thus becoming the first university established west of the Mississippi River. The University is a co-educational institution offering undergraduate, graduate, and professional degree-granting programs. The University enrolls more than 10,000 students. It includes eleven (11) colleges and schools and offers degrees in over one hundred and sixty (160) fields of study. The University's educational facilities are situated on three campuses encompassing over 338 acres. The Frost Campus, the University's main campus is in Midtown St. Louis. This campus houses the Central Administrative Offices, the College of Arts and Science, the School of Business & Administration, the School of Law, the Student Union, Student Residence Halls, the University's main Library, and the University's Department of Computing & Information Systems. The Medical Center Campus, one mile south of the Frost Campus, includes the Medical School, the School of Nursing, the School of Allied Health Professions and the University's Hospital, a 318 bed tertiary care facility. In addition the University's Parks Campus, located seven miles east of the Frost Campus in Cahokia, Illinois, contains the facilities for the University's aerospace engineering program. Parks also operates a satellite facility at the Spirit of St. Louis Airport, Chesterfield, Missouri.

The University employs more than 5000 faculty and staff and has an annual operating budget in excess of $200 million dollars. We are an institution that demands excellence in the classroom, in the research lab and in the delivery of patient care. We hadn't demanded the same of our administrative systems. With an institution the size and complexity of ours, we needed to insure that we were managing our affairs as efficiently and effectively as possible. Specifically it was critical that our "Computer Resource" be optimally used. Ours wasn't and therein was our problem. Although several reports had pointed out the problems, none clearly specified a cohesive and coordinated remedy to the situation. We were simply not coping with our own informational and management needs. When I started at the University in July 1983, our President, Thomas Fitzgerald, indicated that the first item on my agenda was the Computer Situation -- it had to be corrected. With this mandate we proceeded. Clearly we needed to do something. We knew where we were and we knew where we wanted to be, of course that was the easy part, the hard part was getting from here to there. The first step we took was to engage the services of George Kaludis Associates (GKA), Nashville, Tennessee to validate the situation in the Computer Center as well as the status of our administrative computer systems. We analyzed the previously prepared reports, interviewed Computer Center staff and spent a considerable amount of time talking to users. Based on our evaluations and on-site reviews we began to better understand our options.

Our entire computer situation, in particular administrative computing, indicated a distinct lack of concerted management attention. While many institutions have had a good history of developing and operating transaction systems and many have moved into the more difficult dimensions of management control and are now at the forefront of planning and policy systems development, St. Louis University had major deficiencies and gaps in basic transaction processing, very little experience with on-line systems and no experience with data base management systems. The systems were archaic, the data suspect and the management information non-existent. All systems in use had been developed in-house over the years in batch mode and a change to on-line operation would have been useless. The Computer Center staff did not have the requisite depth or experience for analysis and design of new systems and the user community would have been hard pressed to detail reasonable specifications for modern systems. Programs were poorly documented and often only one individual understood the code. We had an extensive inventory of single purpose systems, each designed to meet the specialized needs of a particular office. File information was, and to a degree still is, duplicated sometimes several times. As a result file maintenance/coordination was impossible and management data was often contradictory; obviously this caused problems in all areas of the University. The University was decidedly under capitalized in computing generally and administrative systems specifically.

Control over institutional finances was strained by the total absence of timely, accurate information. Data was not managed as an Institutional resource. On the contrary we were being managed by the data! It was -- every man for himself, or more accurately every department for itself. Cumbersome manual procedures were used to provide the aura of control, but were at best ineffective and more often than not disruptive. The situation concerning the computer hardware wasn't much better, downtime was totally unacceptable and what was worse improvement didn't look promising at least in the immediate future. The University was facing a crisis - it didn't have the personnel, the systems, nor the hardware and it couldn't afford not to do anything - it had to act and it did! The University was prepared to fundamentally change the way it did business.

In January 1984 we came to the conclusion that we had to bring to the University modern administrative computer systems and operate them on reliable computer hardware. We made certain personnel changes including the assignment of the responsibility for the day-to-day management of our Computer Center to Lawrence Hester, CKA Vice President, while we began a search for a new Executive Director of our Computer Center.

Early on we recognized that our enemy was time. There simply wasn't enough of it. We couldn't possibly follow the classic approach of having our own staff prepare a detailed set of requirements and specifications for all of our major administrative computer systems and then analyze whether or not we could develop the systems in-house or send our specifications out to bid to commercial software houses. We weren't sophisticated enough to follow this approach, and we didn't have the time to become sophisticated. A key assumption we made was that although we are academically a superior institution, we weren't all that different from hundreds of other universities in our needs for a modern set of administrative computer systems, and if so, why re-invent the wheel. What we needed to do was obtain commercially available administrative software that had proven itself in the market place. To meet the press of time, we inverted the classical approach. We started with vendor selection and ended with an understanding of which system would best facilitate the management changes needed at the University. Chief among these needs were an integrated base of data for planning and management, user owned systems, and a pathway to decentralizing the business functions of the University. In March, 1984 we made the following decisions:

- We would purchase commercially available software to replace our existing major administrative systems in the areas of financial records, payroll/personnel, student information and alumni/development.

- The vendors' software had to be operational at other colleges and universities.

- The user departments were responsible for evaluating and recommending what software was purchased while the Computer Center was responsible for selecting computer hardware.

- We would limit the number of vendors to a few so as to concentrate our efforts in evaluating their systems.

- We would permit no program modifications -- we would change the University's policies and procedures prior to customizing the vendors' systems.

- We would insure that the computer resources for the academic and research user would be greater than it had been before.

- Schedules once set wouldn't be changed.

In March of 1984 Task Forces were formed for Financial Systems, Payroll/Personnel Systems, Student Information Systems and Alumni/Development Systems. These Task Forces were intentionally organized to give broad institutional user representation with minimal Computer Center Personnel. The chairman of each Task Force, a user, was responsible for insuring that all of the schedules were met and that all voices were heard. Each Task Force had ten to fifteen members. Only one or two members were from the Computer Center. This was a key element in our plan; the user had to take responsibility for the system.

The charge to the Task Forces was to evaluate a selected group of software vendors and to determine how well each of the systems presented met their needs. They were not to concern themselves with computer hardware, nor cost, nor whether the system/vendor they recommended was able to be integrated with a system/vendor one of the other Task Force Teams recommended. They were given four months to complete their task and their recommendation had to be submitted by July 1984.

The Task Forces invited the vendors to make a marketing call and demonstrate their products. To provide discipline in the evaluation of vendors, each team was provided with one or more Request for Proposals (RFP) released by other institutions. Working with these documents and their own experiences they produced "Requirements Checklists" which were sent to each vendor. The checklists were often a bit rough, sometimes vague, occasionally inconsistent, and were not boiled down to absolute needs, but served their intended purpose very well. It was at the same time the best training device we could have had for our user staff. In many ways it brought to each member a detailed look at what a modern system could do.

Vendors were asked to respond informally to the checklists; to travel to the University for a discussion of the response; and then to respond formally. The discussion sessions proved extremely valuable since many of the University's questions and the vendors' responses were modified across the table. This process also provided an opportunity for the vendor to explain why a particular function might not be desirable or feasible, why alternate approaches had been used elsewhere, or how the same result could be achieved through a different approach.

In July 1984 each Task Force was required to submit with their recommendations the evaluation process used to make their decision. The requirements checklists included thousands of items. Distilling this information for executive decision making proved another challenge. Although each group's process was slightly different, they were all based on a point system. The Payroll/Personnel Task Force, for example, chose 29 points of evaluation and awarded each vendor a "score" of 1 to 10, where no two vendors could receive the same score on a particular evaluation point. Among the points of evaluation were payroll and fringe benefits processing, data base technology, paperwork reduction, effective departmental management, reporting, security, tenure management, A-21, training and vendor support. To help insure that the teams weren't snow blinded by the vendors marketing blizzard, and to strengthen the convictions of the team members, phone calls were made to anyone that anybody knew at any of the schools where the top rated vendors' systems were operating. One vendor was preferred by two of the task forces and acceptable by the other two. Those latter two preferred a second and third vendor. A single vendor for all systems was obviously desirable. At this point it became apparent that despite our use of four separate task forces it was possible that a single vendor might meet all of our needs. However, our commitment to user owned systems required that the other two task forces embrace the selection of that single vendor. This took the rest of the summer. With a tentative decision in hand, a small group from each team visited one or more installed sites to assure themselves that they understood the operational and management consequences of the proposed software. By seeing the system "live" they could also put into perspective the various horror stories they had heard about individual systems. What they learned was that there were going to be glitches, but the other institutions had worked their way through them and had successfully installed a working system and so could we. The experience of these visits was extremely valuable in eliminating real or imagined hesitancies about particular systems. This became particularly critical later on when a group from one of the Task Forces revealed their convictions that one system being considered was not able to function in a complex University environment. Members of the Task Forces could not deny that their associates had seen a university being run with a particular vendor's software, despite their personal reservations about the package.

Throughout the selection process, there was some suspicion, occasionally voiced, that Bachich and Hester had made a vendor decision themselves and were simply using the Task Forces for self-justification. The limitations placed on scope, particularly "evaluate and recommend but don't select" heightened this suspicion.

The selection was not predetermined, and a great challenge was to convey this to the Task Force members. Had a decision been reached up front and forced on the users. it would have been impossible to implement the systems effectively, and the true management change desired would have been lost for another decade. The Task Forces were the main vehicle for the University middle management community to take "ownership" of the vendor selection. The four stages used were drafting the requirements checklists, meeting and discussing issues with the vendors, openly calling counterparts at user institutions, and the site visits. All four stages were necessary to obtain the personal and organizational commitments without which our plans would have failed.

Elliott Haugen started in August 1984 as the University's new Executive Director of Computing and Information Systems. Haugen's arrival was well timed in that SLU was closing out the evaluation phase and was moving toward the implementation phase, a difficult psychological transition. That Haugen was not perceived as being aligned with one vendor or another was key to the overall conceptual transition from Computer Center-Owned software to User-Owned software and the concept of the Computer Center as a service bureau rather than a grantor/withholder of computer privileges. During the fall of 1984 a comprehensive report was given to the President. This report detailed the problems we were facing in both academic and administrative computing, the solutions to these problems, the need to renovate the computer center, and the need to develop a micro-computer capacity. Haugen joined in on the drafting of specific plans and budgets.

October, November, and December were used to bring together all of the pieces of our plan. We blended the findings of the Task Forces, weighing the advantages of purchasing single systems from different vendors versus purchasing all systems from a single vendor. We reviewed the selection process with all of the Task Forces and chose the software vendor, selected a hardware vendor, negotiated prices, financial terms and delivery schedules. The culmination of these efforts was to submit on December 20, 1984 the final recommendations to the President. This report detailed the specific actions over the three year period of our plan including new one time only cost as well as annual recurring costs. In this report we specifically recommended that we should upgrade our current Honeywell DPS 8/44 to a DPS 8/49 and improve access for computing resources to academic users, purchase a separate computer for administrative use and purchase new administrative application systems. It was essential that a separate mainframe be available for administrative use at SLU. It would allow for better management of our computer resource, and we would not be put in the position of deciding between the academic user and the administrative user. Our overall plan called for expending an estimated $2.0 million over a 2½ year period. Included in the recommendations was a major increase in support for academic computing resources. We felt it important that we balance the investment we were about to recommend in administrative computing with a corresponding investment in academic computing. New positions were approved in our Computer Center including an Associate Director for Academic Computing and staff consultants for micros and statistical analysis. We purchased several micros and installed a program to allow micros to be purchased and financed through the University for all faculty and staff. Although the cost was relatively small for the enhancements in academic computing compared to what we expected to spend in administrative computing, the results and the reactions from the faculty were most gratifying and helped us immeasurably in implementing our plan for administrative computing. Approval for our overall plan was requested by January 1985.

We now knew what software was needed and what hardware it ran on and an estimate of what the cost would be. The overall strategy was in place and attention focused on selling the recommended course of action to, and securing funding from, the President and the Board of Trustees. During this time some additional field work took place to bring University executives up to date on both applications and hardware/systems software options. Serious price negotiations and financing were pursued and a successful arrangement was agreed to with the vendors and the University.

The third week of January, 1985, brought Trustee approval -- only 10 months since we initiated the process. We had decided to purchase all of the administrative application systems from Information Associates, Inc. We placed orders for the entire Series Z System from IAI including the Financial Records System (FRS), Human Resource System (HRS), Student Information System (SIS), and their Alumni/Development System (ADS). This software was to run on Digital Equipment Corporation hardware. We placed orders to purchase a DEC VAX 785 system and to cluster it with our existing VAX 750 computer.

The Series Z system together with the DEC hardware afforded the University a unique opportunity. It would permit us to install systems that crossed departmental lines and different areas of responsibilities with a common set of principles, parameters and definitions that forced us into fundamentally changing the way we did business. This is exactly what we wanted to do!

Hester was asked to serve as the overall implementation coordinator at the end of January. Space was set aside in the main administration building consisting of two small offices, four project rooms, and a training room. A full-time secretary was detailed to the project along with a 5520 workstation and printer, a coffee machine, and a refrigerator. Eight terminals and a printer were installed in the training room along with audio-visual aids. Each office and project room was equipped with one or more terminals. A Project Team was established for each of the first three packages to be installed: accounting, personnel and development. (Work on the student systems was postponed until substantial completion of the other systems because of staffing issues, unfamiliarity with hardware and software, and the need to keep the risk of failure within tolerable limits.) Project Leaders were selected: The Associate Controller, the Director of Personnel and the Internal Auditor. Each was assigned to the project 85% to 100% of their time and moved to office space on the project floor in the Administration Building. The most senior Computer Center analyst in each project area was assigned to the Team and moved to the project floor. A backup Data Processing staff member was also assigned to the Team, but remained officed in the Computer Center.

As Coordinator, Hester was to manage the interfaces between each of the Project Teams; among the Teams and the software vendor; the Computer Center (as the "computing" vendor); certain "Project" resources (such as word processing, forms design, documentation tracking, the Training Room, and the coffee machine); and the Vice President (as the vendor of executive decisions).

SLU considered the Coordinator role as particularly critical for attempting simultaneous systems installation, to avoid contention for precious resources and to avoid ill-will. The Coordinator role was also seen as a way to concentrate and focus executive attention on the project and provide a mosaic of diverse institutional experience to aid the Teams in evaluating optional policies and practices. The use of an outside resource in this role provided not only experience and capabilities not available among incumbent personnel, but also a "neutral" communications point where institutional personnel could discuss problems in a fashion that was not normally possible. An external consultant can also serve as a powerful force for change, not burdened with current practices or organizational boundaries. Outside persons are not seen as competing for jobs or as judgmental, controlling salary increases, promotions and working conditions. It is easier for an external consultant to determine the true status of a project or task or to find out about a trouble spot in a timely manner or to suggest new practices and policies. Further, the University is not faced with the dilemma of what to do with the person when the project is completed.

The role of the Project Leader was to organize the specific tasks to be accomplished, assign these tasks to project personnel, and monitor task completions. The Leader was also envisioned as the point-person on internal staffing/psychological implementation issues, but with the understanding that any issue of resources for implementations (versus continued operation) would flow through the Coordinator. The Project Leader was expected to have the key continuing role in the operation of the system (as part of the move to User-Owned-Systems) and in its continued maturization and enhancement, and hence was to master the software.

The role of the Senior Analyst was to help the Team understand the current systems and data file and the capacity of the new software. "Programming", including interfaces and conversion, was to be referred by the Analyst back to the Computer Center where the overall workload could be balanced. Responsibility for maintaining current systems was also left in the Computer Center. The second DP staff member on each Team was to receive complete implementation training so that there would be full backup during the implementation process and during future operations. Referring all programming requests back to the Computer Center minimized bottlenecks, gave everyone some sense of being involved in the major University undertaking, and assured that every programmer and analyst had some exposure to the vendor's code and documentation. The Senior Analysts met weekly (as the Technical Advisory Group) with the Executive Director, the head of Systems Programming and the head of conversion efforts to share experiences.

The responsibility of the Project Team was to master the software as delivered, recommend any programming changes, set definable parameters (such as the chart of accounts or available fringe benefit options) to SLU values, and train the institutional staff to use the resulting product. The Teams were specifically instructed to make absolute minimum modifications to the software packages and were told that changing institutional practice was to be preferred. A headline in the University paper about that time read "Bachich Says 'No More Business as Usual'."

The responsibility of the Computer Center was to install all of the new computer and telecommunications equipment; master the systems software; get the new applications packages running; design some security scheme; and do all the work on old systems, conversion, and interfaces. And to accomplish all of this while the building was being renovated around them, including two days in March when there was no roof.

Advisory groups were established from a broad range of users including business managers from 8-10 academic departments at all three campuses and all affected administrative departments. These groups were to act as a two-way communication channel between the Project Team and the real world, and to comment on forms, report formats, policy changes, training plans, and the like.

The computer tapes and manuals arrived the second week of February, 1985, less than a year after discussions on acquiring new systems began. The training/test version of the accounting system was working the next day. April, May and June were very busy months. In mid-June, the chart of accounts was completed (including the creation of "sub-departments" in the Medical School) and loaded; the vendor file was moved; the budget was moved and amended to match the greatly expanded departmental discretion in the use of object codes; all "transaction" users of the system were trained; and departmental and grants administrators began their training.

All data elements to be shared with other systems were negotiated and fixed across systems. Operating-system-level and application-level security were in place, and organizational-level security was being tested.

On Friday, June 28, between 10:30 a.m. and noon, the pre-production files were connected to the production copy of the software. Unfortunately, the primary power cable to the Main Campus had exploded at some time the night before and the backup cable had exploded at 9:30 a.m. Because the Computer Center was connected to a separate powerline, the hardware kept running. At 10:30 a.m., the University closed the Main Campus: it was dark, hot, the phones didn't work and none of the users could access the shiny new production system!

On Tuesday, July 2, the new accounting system was in full use for daily transactions and budget control. On July 8, the first full cycle of daily maintenance and update was run and accounts payable checks were written. Only eight modifications were made to the basic system: three were lifted verbatim from the vendor's manuals, one (check printing format) is described in those manuals, and the other four relate to object code budgeting discretion and organizational-level security and required roughly three weeks of top-level analysis and coding.

In early September (with the prior year's audit almost completed) all monthly processes were run to produce ledger sheets and departmental reports. A "menu" facility was developed to allow the Associate Controller to run any of various voucher processing, check writing, and reporting cycles from his office without any involvement of programming staff. The October ledger sheets were run by the 10th of November. All data entry is via terminals in the accounting and budgeting offices. Pre-encumbrance is performed on-line at "Commitment Offices" on each of the three campuses.

In July the new alumni and development system was loaded with 102,000 files of alumni and friends, with all names and addresses converted to mixed-case. All open pledges were placed on the files and linked to the new accounting system, any payments on those open pledges have been credited, and all name and address maintenance is being performed on the new system. In August, all June graduates were added to the files, payments were processed on-line in real-time, and acknowledgement letters were produced by query-language extract and download to a hard-disk word processing unit.

The payroll/personnel system implementation heated up during the Fall when a number of policy issues were settled, firm deadlines were set, and announcements were made in the University newspaper. Three thousand employees are being converted from a monthly payroll to join two thousand currently on the bi-weekly payroll. All deductions have been prorated and all fringe benefits converted to an advance deduction. Vacation and sick leave eligibility have been standardized. Two classes of employees have been dropped and a new administrative/professional/technical class created.

Surveys were conducted to establish bi-weekly rates of pay, labor distribution, vacation accruals, sick leave accruals, FTE, and personal demographics. All departments have been trained in timekeeping procedures and all transaction departments have had extensive training. November is a parallel month with the entering of new, converted, and updating information serving as final training for key operational personnel. There were 7,251 employees on the file on December 1.

After five tapes and an arm's length of excuses, the bank has accepted and certified a direct deposit tape on December 4. They had changed tape formats several months before, but not notified SLU.

The first new time reporting period is December 1-14. The direct deposit tape will be sent to the bank by noon on December 18 and checks will be delivered December 20. Then 15 people get their first weekend off in five weeks.

There were only a few changes to the vanilla version of payroll/personnel. The two serious changes related to calculation of life insurance and the University's share of TIAA, including instances where external pay (VA, etc.) was included in retirement calculations. The other changes were print formats on various forms, and splitting one screen between Payroll and Personnel.

In early December, [illegible] issues remain open. Applicant Processing has not been addressed. The [illegible]ing of 1500 (unpaid) Adjunct Faculty is not settled. Calculating and feeding payroll encumbrances into the accounting system awaits development of the 1987 budget using the personnel system's capacity. The CWSP interface with Financial Aids is manual. But W-2's for all 1985 employees will come from the new system.

Implementation of the four student systems will begin after New Year's, when things have calmed down a bit and the programming staff has a chance to rest. In nine month's time the equivalent of three to five years work has been accomplished; a week's sleep is deserved.

The day to-day stress of the implementation process, particularly as the "drop-dead" date neared and many people were required to work 60-80 hour weeks, has underlined the importance of the evaluation process conducted last summer. Every key actor in the implementation was deeply involved in drafting the Requirements Checklist, meeting with the vendors, and making site visits. When times are really tough, the camaraderie of the visits or the specific gains detailed for the new system by the individual him - or herself remains a key tool for motivating overworked people to stay another hour or two.

In summary, the path chosen by Bachich for revolutionizing SLU's management has compressed the entire software procurement and installation process into less time than often is spent just in preparing an RFP. In the process, the use of an external coordinator/change agent has provided a very broad base of fundamental change and formed the structure for continued enhancement. Thus, the benefit stream begins a full year or more earlier than might have been expected when the decision to make a change was made. And delivering the benefit stream was the rational for pursuing new systems in the first place. If the University can continue the simultaneous systems implementation plan without driving everyone in the institution stark-raving mad, SLU will have completed in less than three years what might have been a decade-long undertaking using the traditional decision-making approach. Nobody cares intrinsically about the details of selection or implementation -- institutional managers want results; the sooner, the better. In the case of Saint Louis University, sooner was mandatory.

A CENTRALIZED APPROACH TO DISTRIBUTED PROCESSING: ECONOMIES OF THE EIGHTIES

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Abstract

In the past thirty years, there has been remarkable changes in computing technology, end-user skills, and the role that information plays in higher education management. In an article for the 1984 Cause Conference, the authors examined the primary results of these changes and the effects on administrative computing architectures, especially for multi-campus universities. Several options were identified for institutions that wanted to incorporate these developments into an existing administrative system. The current paper examines these alternatives as reflected in a particular institution and describes the challenging approach taken to distributed computing at the University of Colorado.

Three functions are being enhanced at the university: central resources, end-user application environments, and communication between the two foci. Given the historical evolution of computing in the CU system, the university has identified a set of critical core systems which, for reasons of consistency or economy, should be maintained at the central administrative computing agency. AT the same time, diversity of campus missions and local needs of limited scope suggest the need for a coherent and productive end-user development facility. As a result, the university is crafting an architecture that seeks to distribute centralized data in a meaningful and secure way. This paper will discuss both design and implementation issues and suggests extensions of this computing enviroment in the future.

1. BACKGROUND

The University of Colorado is comprised of four campuses which are located in Boulder, Colorado Springs, and Denver (a general campus and a health sciences center). The Boulder campus is the oldest and largest campus with 20,000 FTE students. The Colorado Springs and Denver campuses have grown rapidly in the last few years to a total of over 10,000 FTE in 1985. Each campus has a Chancellor who serves as the chief academic and administrative officer and the system is headed by the President. The Board of Regents is comprised of nine elected members. The combined annual budget of the campuses is over $500 million for the current fiscal year.

Administrative computing support for the campuses and the central administration has historically been provided by a central facility and staff. Campus computing facilities vary in size, generally consisting of some number of VAX-class systems and have primarily provided academic computing support. (The Health Sciences Center is the exception with an academic facility of Tandem and DEC equipment and an administrative facility which uses IBM-compatible equipment.) Local campus support for administrative computing has been limited to interaction with institution-wide systems operated at the central facility and development of small, special-purpose systems to meet unique local processing requirements.

Applications developed and operated at the central facility have traditionally been batch oriented although there are a number of systems which are entirely on-line or which support on-line inquiry. Emphasis is on the continued development of on-line, database oriented systems using the Cullinet database management software acquired a few years ago. Systems analyst/programmer staff at the central facility has not grown for several years. About 25-30% of the available staff are devoted to maintenance. A major project to implement a new student information system is underway with completion scheduled for mid-1987. This system (like all future multi-campus systems) will operate primarily at the central facility using Cullinet's IDMS database software.

The University made the decision several years ago to move toward a wider distribution of administrative computing support and access to centralized data bases. This decision was a result of the increasing maturity and growth of the campuses as well as the evolution of computing technology. A number of preliminary actions were necessary to create the infrastructure required to implement this new architecture. Both computing and disk storage capacity were added at the central facility, an operating system conversion was completed, and the conversion of the administrative computing network to support IBM's SNA was undertaken.

An interesting issue which emerges from efforts to distribute administrative processing and data access concerns the extent to which the organization of administrative computing capability reflects the organization of the institution. This issue can be more easily resolved, of course, if the institutional organization and related issues of campus or departmental autonomy have been resolved. However, when these issues are unresolved and demand for improved access and service could be met through distribution of computing capabilities, objective evaluation of interesting options can become difficult.

2. EVALUATION CRITERIA FOR INFORMATION ARCHITECTURES

In a large multicampus university, trying to maximize the institutional good is a difficult process, if only because university diversity creates orthogonal goals. Nonetheless, there are a number of criteria to evaluate the success of an institutional administrative computing architecture. These fall roughly into two categories:

Financial Costs - It is obviously desirable to have cost-effective solutions. However, the time frame over which to evaluate relative financial costs is difficult to specify, especially in rapidly changing technology. Moreover, different architectures may have different useful lifetimes, making the traditional comparative cost-benefit analysis more complicated. The differing financial resources of various campuses or departments reduces the importance of minimizing the overall institutional cost; a flexible architecture that tailors expenses (and computing resources) to the levels of individual units may be well worth a higher institutional expense. In essence, the three E's are valuable - economics, enhancements, and exposures.

The **economics** of the architecture include the full end-to-end costs of delivering information, including acquisition of hardware and software, the cost of hardware maintenance, staff support costs, and application development expense. A major shift is occurring in the relative cost ratios of the above factors. Hardware acquisition and maintenance costs continue to decrease rapidly. Conversely, the complexity of our software systems has risen. Application development is now becoming the predominate cost. If application maintenance costs are included, the weight of this factor is magnified.

Enhancement refers to the hardware upgrade path possibilities. There are two basic classes of upgrades: system swap and system augmentation. Until recently, swapping a system out for a larger compatible one was the norm. Now however, there are alternatives based on addition of processors or networked systems. These approaches can preserve capital and offer hardware redundancy. For augmentation to work, the result must be seamless to the user; a common computing environment needs to run across the multiple devices. The marginal cost curve for adding another user is also an important consideration - the smoother the curve, the less the stress in an architecture. Stairstep curves tend to require difficult decisions more often.

Exposure refers to the risks associated with an architecture - the useful lifetime of the system and the fortunes of the chosen technology and vendors. In the current market, vendors face a multitude of challenges, ranging from staying in business to continuing to upgrade their products. Withall, exposure is generally being lessened, due to increased standardization. For example, vendors using common operating systems can utilize third-party applications, and the newer hardware has a modular design.

Stress Costs - Financial cost is only one way to measure the effectiveness of an informational architecture. A number of other important factors can be grouped together as "stress costs." These include the following:

Distress levels - There are stress points in any information architecture, where personnel are called upon to do tasks they prefer not to do (e.g. maintenance activities by end-users, end-user support by technical systems analysts). It is clearly desirable to minimize these points. For example distributed computing facility maintenance by a central organization has been successful because the insulation of the end-user from the distress of computer maintenance.

Inaccurate or incomplete information - Obviously, such failures on the part of an information system can cause financial, stress and morale consequences.

Difficulty of generating information - Such systems wind up with excessive staff, cumbersome access and data paths, and an inability to respond quickly to changing institutional needs.

Inflexible architectures - Rapid changes in technology and end-user needs imply that information systems need to be able to evolve and modify over time.

The relative importance of the above concerns varies greatly among institutions. In all events, it is desirable to have institutional consensus on the assignment of weights.

3. DESIGN ISSUES FOR DISTRIBUTED ARCHITECTURES

The eighties are establishing a new and widespread information architecture, one of networks of component systems, with flexible interconnect layers glueing the users and components together. The fundamental design decisions concern hardware, software, interconnects, and user roles:

Hardware - The hardware legacy from the seventies includes an embedded base of mainframes and attached terminals. In this decade, there has been rapid deployment of large number of PCs and departmental resources such as minicomputers. The several factors driving such trends are anticipated to continue over the next few years. The challenge is to develop architectures that can accomodate such a variety of equipment, and allow for the incremental upgrade of subsystems as needs (and funding) change. This suggests working with networks of known components, where classes of machines or interconnects can be built or modified in response to trends and needs.

Software - Most institutions now have a mix of older applications hard-coded around unstructured data sets, and newer systems built on database packages. The information flow between old and new tends to consist of series of "kludges". Again, the ability to upgrade software subsystems without extensive recoding of the special interfaces is desirable. Moreover, the archtiecture should permit ad hoc reporting without major effort. Lastly, in a distributed environment the data tends to be more important than the software; there must be provisions for the smooth flow of data between systems and users.

Interconnects - In a networked, hierarchical approach, the interconnections (both physical and logical) are the critical glue to make the end product usable. It is increasingly clear that single keyboarding is highly desirable and a single machine is insufficient. Thus the interconnects must provide three functions: (1) to switch, with appropriate speeds, any keyboard to an often heterogenous set of machines; (2) to connect these host machines with high-speed computer communications; and (3) to provide software for all higher-level functions, including terminal emulation, network file services, and applications such as electronic mail between these heterogenous systems. Given the diversity of hardware and operating systems on most university campuses, the task is obviously difficult.

End-User Issues - Different information architectures place varying responsibilities on the end-user. Those responsibilities can include: end-user programming requirements; system responsiveness to end-user needs; operational difficulty (e.g. ease of use, management responsibility for local systems, etc.) It is important to note the variation in computer skills among end-users. A rough division into end-user GCD's (greater campus developers) and LCD's (lowest common denominators) is being acknowledged by departments in their trend towards identifying resident experts to write local programs to be operated by the LCDs. It is important to define the expected users and uses of the systems. Both the central sites and the end-users need to be aware of their committments in the architecture.

4. IMPLEMENTATION ISSUES, REVISITED

Implementation refers to the acquisition and operation of the architectural design. In many instances, the design assumes some unique components, but there will usually be major items that are not specifically identified until implementation. There are several observations about implementation that warrant discussion.

Hardware - It remains desirable to minimize the diversity of campus administrative hardware. Regularity and redundancy make the challenges tractable and the solutions reliable, especially for universities with limited resources. It is helpful to build systems out of known components familiar to the university and often such architectures prove more maintainable than turnkey solutions. With the advent of VLSI technology, specialized machines such as database engines will be installed for processing efficiency.

Software - Our previous paper (1984 CAUSE National Conference Proceedings) discussed some of the basic implementation decisions about software and data. In addition to those generic concerns that characterize any software environment, there are several issues specific to distributed systems. In particular, software support, data management and user training are fundamental to the success of the approach. Software support should be both horizontal (i.e. standardized for the more widespread applications) and vertical (integration of the packages commonly used). Such support is necessary for easy data movement. Data management is necessary to avoid the dangers of redundant and stale data. Data management need also deal with security. User training is too often unpleasant for both trainer and end-user; perhaps this explains the frequent avoidance of the activity.

Interconnects - There are three general classes of physical interfaces: manual e.g. the trusty RS232 switch box), switched (eg. a data switch or PBX) and networked (e.g. Ethernet or token ring). Selection among these choices are constrained by physical limits such as bandwidth and driving distance and logical limits such as need for emulation and dynamic routing.

For the upper layers of the interconnect, a variety of services can be provided. At a minimum, two functions should be implemented: remote logins (with or without emulation) and file transfers (with error detection). Other activities such as electronic mail and file service are, of course, highly desirable. (It should be noted that mail can exist even without the more basic functions.)

Remote Logins - A decade ago, there was little hope of connecting divergent hardware together. Now, there is a wide variety of methods ranging from protocol converters thru intelligent switches to transport services on the hosts. The point chosen for emulation is quite strategic and can effect security and economic realms.

File Transfers - Some mechanism for file transfer is usually provided. If traffic is infrequent and only ASCII, then a simple program on the local workstation can provide capture and transmit utilities. In the broader case, the protocols need to offer error checking and binary transfers.

These issues can be illustrated in examining the possible ways to hook up a local workstation to both a departmental mini and a campus central site. The simplest method is to run multiple cables to a local switchbox. The cost of separate protocol converters suggests that a more effective architecture could be based around a general intelligent switch available on a single cable to the desktop. Unfortunately, heterogenous computing environments have wider needs than current switches can provide, although both digital PBX's and new cluster controllers are offering new possibilities. File transfers through such switched systems tend to be relatively slow and not robust. A third architecture, most appropriate when all workstations have local processing power, is the networked model. Remote logins and file transfers can be performed by all hosts operating a common protocol, such as TCP/IP or Kermit. Of all the choices, the networked option offers greatest speed and accuracy as well as the potential for connecting heterogenous computing environments. The major drawbacks to networks has been cost and difficulty of integration, but the technical maturing of the market has been quick. It is likely that the inherent flexibility and power of this architecture will prove increasingly attractive.

End-user issues - There may be choices about where to provide services such as emulation, security and applications. In general it is desirable to handle emulation close to the desktop, since the local host's power is available during remote logins. Security issues are more difficult, especially in networks. Control of physical devices is no longer possible. XXXXXXXXXXXXX Placement of applications is also important in distributed architectures. User-developed applications tend to reside on departmental machines, but such utilities may pass into the "campus public domain" and move for efficiency to a centralized system. The operation of electronic mail in particular is significant, since both security and reliability are critical for effective use. While this suggests a single large machine provide the campus service, e-mail, like other forms of mail, are best delivered right to the doorstep, i.e. the machine one uses most frequently. Now emerging are systems that combine the two approaches and download mail automatically from a central system to the local host at user login.

5. THE APPROACH AT CU

The approach being taken at the University of Colorado seeks to protect the University's investment in computing facilities, workstations, and application software while extending and enhancing the availability of computing capability at the workstation level.

Multi-campus and University-wide applications will continue to be developed and operated at the central facility. Central databases will contain the official data of the University and will be updated and maintained by the central application systems.

Subsets and copies of central databases will be downloaded to campus facilities for local analysis and reporting using standard software tools. These campus databases will be accessed by individual workstations as well as by departmental computers which may also provide local office automation support, device sharing, workstation clustering, terminal emulation and interconnection with other computers.

Access to the central databases will also be provided to individual workstations and departmental computers where necessary. This will be needed by central offices which must deal with consolidations of data from one or more campuses and by campus offices requiring access to data or other facilities not available at the campus.

The underlying goal is to provide the best computing environment at each of the four levels, allowing users to select the tools most appropriate to a particular task. It becomes immediately obvious that each user must have ready access to any computing facility in the University. While it is possible to structure computing environment that generally provides the capability that most users need, to do so implies that someone other than the individual user will make the decision about what is adequate or appropriate. When any kind of computing support was too expensive for the individual user or department, a generally satisfactory solution was acceptable. Now, however, hardware and software can be provided or enhanced in increments far below those required to upgrade the large, central facility. As a result, users expect (and deserve) ready access to the data and analytical tools which they require to perform their primary responsibilities.

Computing equipment available for administrative support includes IBM, DEC, and Prime. Given financial constraints, it is impractical to replace these devices. Even if funds wer available, the time, effort, and expense associated with retraining would be significant. Furthermore, one must assume that these brands were chosen for particular characteristics which met local needs. The task facing us then is to provide effective interconnections between and among these devices and the workstations and departmental systems.

The central facility use IBM compatible equipment and represents the largest investment in equipment, software, and staff. Cullinet's IDMS was selected as the database system to be used for all central administrative applications. The Health Sciences Center also operates an IBM compatible system for administrative applications which support its health care mission. IDMS is also used at this facility.

A new student information system is currently being implemented using IDMS and related software tools including ADS/O (Application Development System/Online). Plans for migration of older applications to the IDMS environment are being developed.

Campus facilities use DEC and Prime equipment to provide support for unique local applications, data analysis, and reporting. Evaluations of software to provide data access and analysis are currently underway. The goal of the evaluations is to select a single system which will be used by all campuses for local application development and for access to the local copies of central databases. Ideally, this same system will be used on the departmental systems. The central facility will develop an interface between the central databases and the campus environments. Support for this new software will be provided by the central facility as well as the campus computing organizations.

Evaluation of similar software for use on individual workstations is also planned, again with the goal of identifying a single package which will be supported by the central facility as well as the campus facilities. Interfaces between the central and campus facilities will be developed and supported as well. This approach to standardization by providing support for a limited array of packages appears to be the most reasonable way to avoid the proliferation of user-selected packages.

The critical capability to interconnect individual workstations with the entire community of administrative computing resources is still in the exploratory stages. There do not appear to be any technical obstacles which would prevent the interconnections from being made, however, it is not yet clear how much effort will be required to provide them in a straightforward and effective manner.

PROJECT PLANNING: A ROAD MAP FOR SUCCESS

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ABSTRACT

Project planning is the most detailed level of planning that is done in many data processing organizations. The use of a systems development methodology can give project managers the edge in planning and controlling an applications project. This paper discusses the University of Miami's experience with Arthur Andersen's information systems methodology, METHOD/1.

PROJECT PLANNING: A ROAD MAP FOR SUCCESS

Planning is generally recognized as an indispensible tool to effective management. In most organizations, however, it is rarely given the attention that it deserves. If performed at all, it is often done in a haphazard and informal manner.

In data processing organizations, planning may be neglected to such a degree that the management of the organization is forced to react rather than follow through with well thought out plans. Data processing organizations, as with all organizations, should view planning as a necessary prerequisite to achievement.

There is no single correct approach to planning. Rather, each organization must develop its own repertoire of planning techniques which will work well within the context of the organization and its management. [1]

There are three levels of planning which must take place in an organization for the effort to be fully effective. They are: strategic, tactical, and operational. Strategic planning answers questions regarding what the organization will become. It is via strategic planning that the goals of the organization are set, including organization's purpose and mission.

Tactical planning answers the question of what the organization must do to reach the goals which were set in strategic planning. This phase of planning establishes the objectives which translate the organizations mission and goals into concrete terms.

The third level, operational planning, determines what the organization must do now, in the short run. Operational planning specifies what tasks must be incorporated into daily operations to carry out the plans of the strategic level.

These levels of planning move from the probabilistic, uncertain, and conceptual in strategic planning to dealing with real people and real things on the operational level. In addition, the information which organizations must use to formulate plans is the least reliable for strategic planning but becomes increasingly more accurate as the plans progress through the tactical and operational levels. The importance of the decisions, which an organization must make when planning, are inversely related to the reliability of the information on which

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1. Arnold E. Ditri, John C. Shaw, and William Atkins, _Managing the EDP Function_, (New York: McGraw Hill, 1971), pp. 14-15.

they are based.

Planning, however, is not limited to the development of strategic, tactical, and operational plans. Once these plans have been developed, they must be implemented and monitored. Monitoring of plans requires feedback so that actual progress can be evaluated against the strategic and tactical plans. When a problem occurs, it will usually first appear at the operational level. It is very likely, however, that the root of the problem can be traced to the tactical or (most probably) the strategic level of planning, or lack thereof. Frequently resisted and disliked, planning involves abstract thinking and change which is unfamiliar and repugnant to many.

This paper discusses the lowest level of operational planning as practiced within Information Systems, Planning, and Institutional Research (ISPIR) at the University of Miami. For us, project planning is one of the most detailed levels of operational planning.

Modern day organizations are not static. As the organization expands, so must the information systems which support it expand. We recognize three stages of the information system life cycle. The first stage, planning, is where the need for a new system is identified and a conceptual model of the new system is developed. Stage two is the development process where the system is designed coded and tested and implemented. The final stage is the ongoing operation and maintenance of the installed system where problems are corrected and or enhancements are made as the information needs of the organization change. A system remains in this stage of the life cycle until it is abandoned or replaced.

Building an application system is analogous to building a house. In building a house, the customer describes his "dream" house to the architect who, after verifying the artist's rendering, draws the blueprints. The contractor then builds the house according to these plans. Upon completion of the house, the customer moves into the house and over the years does routine maintenance and remodeling to the structure as his needs change. Likewise, in building an information system, the user defines his information system requirements to the analyst. The analyst, in turn designs the system. Upon completion of the design, the project team transforms the design into programmed, tested, and documented modules and helps the organization convert information and start using the new system.

No matter what application is being developed, the process of planning, designing, developing and maintaining remains the same. The same tasks must be performed no matter what the application being developed. Standardizing the systems development life cycle allows organizations to develop quality systems faster and at a lower cost since proven techniques are used which allow them to avoid previously identified pitfalls. In addition, standardization of the tasks to be performed allows better management planning, control, and accountability.

The University of Miami selected Arthur Andersen's system development methodology, METHOD/1, as a comprehensive and structured approach to the system life cycle.

METHOD/1 consists of four phases. They are Information Planning (IP), Preliminary Systems Design (PSD), Systems Installation (SI), and Production Systems Support (PSS). Information Planning and Production Systems Support correspond to the planning and operating and maintaining phases of the systems development life cycle. METHOD/1 has divided the development part of the life cycle into Preliminary Systems Design and Systems Installation. Breaking the life cycle process into four units of work facilitates management control. At the end of each phase, reports are produced for management and users which will allow them to make an intelligent decision to proceed with the development based on increasingly more reliable costs estimates and system benefits.

The following is a discussion of each of the four phases of METHOD/1.

Information Planning describes the future system development needs of the organization as well as the personnel, facilities, and organization necessary to accommodate those needs. The objectives of the Information Planning phase follow.

- Relate the organization's objectives to its information needs

- Determine the effectiveness of information provided by the current systems

- Establish the hardware, software, personnel, and organizational strategies necessary to meet the organization's information needs

- Identify systems software projects and establish their priorities

- Obtain funding and management support to assure successful completion of the systems plan

The major deliverable of this phase is the Information Plan. It is a blueprint for the organization's future information systems activities. It should be linked tightly with the organization's strategic business plan and should help ensure that the activities of information systems help strengthen the organization's strategic direction. This phase relies on the input of many people in the organization. It is only through this input and the consensus of the organization will the Information Plan meet the needs of the organization.

There are five major segments in Information Planning. The first is Organization in which the Management Advisory Committee is formed and the project team is selected and trained. The most important segment in Information Planning is Information Needs. It is in this task that a clear definition is formulated of the information needs which are the most critical to the institutional objectives. This definition of needs is the basis for later identification of the types of information systems necessary for effective operation of the organization. In the Application Strategy and the Implementation Strategy segments the application systems and their priorities are identified. The Management Review and Approval segment presents the findings and recommendations of the Information Planning phase to the Management Advisory Committee which makes a decision on whether to proceed with the plan.

A decision to proceed with the Information Plan initiates the Preliminary Systems Design phase on a project by project basis according to the priorities established in the plan. The purpose of this phase is to determine the structure of the systems identified in the planning phase and obtain management approval and commitment to the proposed system. The objectives sought in this design phase are listed below.

- Identify all information needs for the subject application system

- Develop the system design and identify the associated costs of installation and operation, benefits of the new system, people and hardware resources required, and the schedule of system implementation

- Obtain the commitment to the proposed system of all management personnel

- Identify and implement the managerial and organizational structures necessary for the successful implementation of the system

The major segments in the Preliminary Systems Design Phase are Organization, Functional and Technical Specifications, Cost/Benefit Analysis, and Management Review and Approval. The objectives of the Organization segment are to select a sound project team, work program and project standards and to reaffirm senior management support. Functional and Technical Specifications is composed of four subsegments. In User Requirements, user functional requirements and information needs of the new system are specified in detail. When the requirements are complete, User Design is undertaken. Here all business events, resulting transactions, and the results of the events are identified. It is in User Design that all reports, CRT screens, and system processes are functionally specified. The Technical Design and Technical Support subsegments are then performed to the level of detail that the documentation can describe how the system will work, the analysts are satisfied that the system will work, the installation effort can be estimated, the testing and conversion can be planned, and the costs and time required to install, implement, and operate the new system can be estimated. The Cost/Benefit Analysis segment requires that the benefits and estimated costs of the installation and ongoing operation be evaluated. It is from this evaluation that a recommendation for management to proceed or not with the system is made. The management recommendation should take into consideration the policy considerations and the organizational impact of the recommended approach as well as the tangible and intangible benefits and costs. The final phase of the Preliminary Systems Design is Management Review and Approval where senior management support and approval to proceed with the installation effort is requested.

The second part of the development portion of the systems development life cycle is the Systems Installation phase. The goal of this phase is the successful installation of the system. In addition to the development of the modules required to implement the system's functional requirements, this phase also requires the development of user and operational procedures, training of the users, and acceptance of the system by the users and operations. The objectives of the work performed in this phase are itemized below.

- Produce accurate and reliable computer programs
- Establish and document the procedures required to operate the system
- Prepare the physical environment necessary to install the system

- Train personnel to use the system
- Implement the system
- Establish the organizational structures to ensure the successful ongoing operation of the system

The Systems Installation Phase involves the most significant amount of work in the development of the entire system. The segments of work consist of Organization where again the appropriate project team is selected to implement the system. Following the organization segment is Detailed Design in which the system design is completed and documented in detail and the program specs are prepared. After the completion of the design and specs, the costs estimates are reviewed and reconfirmed. Programming represents a major portion of the entire Systems Installation effort. Included in this segment are coding, testing, debugging, and documenting all programming work units. At the same time that the programming segment is underway, the User Procedures Development segment is being performed where the procedures that specify how to use and operate the system are developed and documented. The procedures detail the manual activities that must be performed by both the users and operations personnel in conjunction with the use of the system. Simultaneous with the work being performed in the Programming segment is the Conversion Preparation segment. In this segment, plans and preparations are made for a smooth systems test and conversion. Upon completion of the previous three segments, the Systems Test segment is initiated. The systems test is conducted by systems, operations and user personnel and is divided into the tasks of integration and user testing. The Conversion segment is the most important segment in Systems Installation. Its main objectives are to install the new system and to provide an environment which will ensure the continued successful use of the system. Once the system is installed, the Post Conversion Review segment is performed. This review is made to determine whether the system is meeting its stated objectives and if not determine corrective action which can be taken.

The final phase of METHOD/1 is the Production Systems Support phase. It commences upon acceptance of the system by the users and continues until the system is replaced or abandoned. Its goal is to provide for planning, executing, monitoring, evaluating and controlling the system maintenance which takes place. Objectives of production systems support follow.

- Implement system changes to programs and manual procedures with minimal disruption to the users

- Perform only maintenance activities which support the organization's business needs
- Ensure that production systems operate efficiently and are easily modified.

Production Systems Support consists of segments for Performance Tracking, Request Classification, Change Analysis, Systems Modifications, and Implementation. Performance Tracking is the ongoing evaluation of the performance of the system against the performance criteria developed during the Preliminary Systems Design phase. Request Classification fulfills the need to measure and control the maintenance backlog. The Change Analysis segment provides information on the magnitude of the installation effort required to implement a system modification or enhancement. In the Systems Modifications segment, changes to the system are actually performed and implemented in the Installation segment.

Each phase of METHOD/1 produces various outputs which are used as inputs to the next phase. In Information Planning, the Information Plan is produced along with a Project Definition Report for each system slated for development in the Information Plan. The system Project Definition Report is used as input to the Preliminary Systems Design phase. At the end of the PSD phase, Functional Specifications, Technical Specifications, and a PSD Management Report are produced. The Functional Specifications Report describes to the user in non technical terminology what the system will do and how it will work. The Technical Specifications Report is used to communicate to Information Systems technical management the technical design of the system. The PSD Management Report, a summary of the Functional and Technical Reports plus the economics and the Installation plan, is used in conjunction with the other two reports by management in making a decision to proceed with the Systems Installation. The project team in Systems Installation uses the Technical Specifications Report as input. Major products of the Systems Installation phase are the fully tested programs, system and program documentation, user procedures, and training manuals. These materials are used by personnel in the Production Systems Support phase when corrections and enhancements must by made to the production system. The Production Systems Support phase produces fully tested program modifications and updated system and program documentation which in turn can be used in a subsequent Information Planning phase when the system is replaced.

The four phases of METHOD/1 along with their deliverables give management the opportunity to review the feasibility of proceeding to the next phase. These reviews also allow management to make their decisions based on more reliable cost and time estimates.

Quality in the development of software systems is the responsibility of both management and staff alike. METHOD/1 requires quality assurance checkpoints at strategic points in the development process which allow management to ensure that a high quality system is being developed. The objectives of the checkpoints are to assist project personnel in development of a superior product and to give management a formalized manner for monitoring quality. [2]

The University of Miami acquired METHOD/1 two and one half years ago when it decided to replace its aging batch systems using a modern data base technology. A team of twelve professionals used the methodology in the Information Planning phase to develop the Long Range Information Systems Plan (LRISP) for administrative systems. The plan called for the development of over forty administrative systems in a period of approximately seven years. The first six projects to be undertaken used the Preliminary Systems Design and the Systems Installation phases of METHOD/1 with very few alterations. By April 1986, five systems will have been installed in a data base environment.

The the use of the methodology in its entirety with the first six projects has given us insight into the inter-workings of METHOD/1. The project managers have become very familiar with the tasks to be performed and their supporting documentation. METHOD/1 is a complete methodology which can be used from the smallest to the most complex projects. Being such, it must leave no stone unturned in its approach to systems development. However it is felt that with the type of projects which are currently planned in LRISP, some alterations should be made to streamline the process. These recommendations are:

- Reduce the Project Definition and Planning Segment of Information Planning to only those subsegments which are necessary to confirm the scope of the application system and plan the Preliminary System Design phase. The required subsegments are Survey of Information Needs, Develop Conceptual Design, and Plan Organize and Staff Functional Design.

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2. Arthur Andersen & Co, 'METHOD/1 Training,' pp. 6-50.

- The Preliminary Systems Design Phase should be divided into two phases. The new phases will be Functional Design and Technical Design with a Management Review and Approval segment at the end of each phase. It is felt that sufficient information will be available at the end of Functional Design to make a fairly accurate estimate of the cost and time duration for the remainder of the system project. This gives management an opportunity to evaluate the cost and time implications of proceeding with the project and to make a decision early if it is deemed necessary to discontinue an application project or cut the scope. This is done in order to yield the best possible information for decision making with the least dollar investment.

- In general, eliminate the Hardware and Systems Software segments since both the hardware and systems software for most projects are a given at the University of Miami. (Although special environments, i.e. microcomputers, etc., may require this segment.)

- The identification of the performance, security, and control requirements should be done in the Technical design phase as this seems to depend to a great extert on the technical design of the system.

Using a methodology for applications system development can be compared to using a road map to plan a driving trip across the United States. There are many routes which can be taken to get from Miami to Seattle but the driver who embarks on the trip without an itinerary may encounter dead end roads and unpaved highways in his cross country journey. A similar thing can happen in the development of applications systems. The use of a systems development methodology is clearly a road map for success in the development of applications systems. The methodology, however, should not be used like a cookbook. Rather it should be customized to fit the organization and the particular application project.

Track III
Special Environments

Co-Coordinators:

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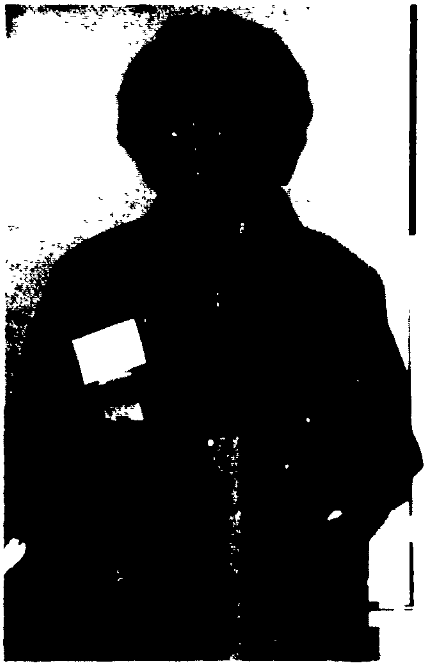

Callie Coaxum
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"USING IDMS IN A MULTI-CAMPUS ENVIRONMENT"

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New York City Technical College is part of the 18 campus City University of New York (CUNY). All of the CUNY campuses and the CUNY central office have installed Cullinet's Integrated Database Management System (IDMS) on their computers. Systems are being developed at CUNY central for use on their computer and on the computers at the individual campuses. In addition, systems are being developed by the individual campus computer centers.

How is the role of an individual campus computer center defined in such an environment? This paper will show what we at NYCTC believe that role to be. We will describe in detail the problems of dealing with systems development projects in such an environment. We will describe our current project of taking an IDMS student record system from another CUNY campus, Hunter College, and installing it at our college.

New York City Technical College is one of the 18 campuses of the City University of New York. Being part of a multi-campus system presents certain unique problems not faced by single campus systems. CUNY has for several years been involved in writing central computer systems. All are being written in IDMS. CUNY's plan is to run some systems at the central CUNY computer center and others on the local compus machines.

What is the role of a local campus computer center in such an environment? We clearly have to learn IDMS, a very complex system, in order to support the systems running on the local machines and, to be in a position to obtain information from the central computer. This paper will give a brief history of what CUNY has been and will be doing. It will outline the role we have defined for our computer center and how, through development of systems not included in CUNY centrals' plans, we are training our staff in IDMS. Included is our development of an admissions recruitment system in IDMS.

NYCTC has had an online student registration system for the past ten years. It is written in APL and runs at the CUNY central site. CUNY central provides many advantages for us:

* We have no operating system locally
* CUNY's computers are used for production and system development
* CUNY's systems programmers and operations are available to us
* Our computer center runs one shift, 8 am to 5 pm

Typically, jobs are submitted daily at 5 pm and are run overnight. When finished, the jobs spool down to our disk. The next morning our operator releases the print jobs. Despite these advantages, both our vice president and computer center director felt it would be to our advantage to have control over our own environment since CUNY central is no longer actively supporting APL.

Our initial plan for independence from CUNY included purchasing an IBM 4361, installing a new operating system (DOS), and using IDMS on our local computer. We also planned an eventual changeover to CUNY's student information system when it was completed. Since delivery was not expected for a year, it gave us time to reorganize our shop.

We had the standard shop (CHART A). The opportunity came to hire two new people, one as a replacement for a programmer who had recently left. We hired a person who was working as an assistant DBA and who had some IDMS experience, as well as a programmer/analyst with database, but not IDMS, experience. Currently we are recruiting for a DOS operations person. Deciding not to educate the new people in our current systems, we pushed them off into the future. They formed the basis of an IDMS team (CHART B).

CHART A

Computer Center Organization Chart Before IDMS

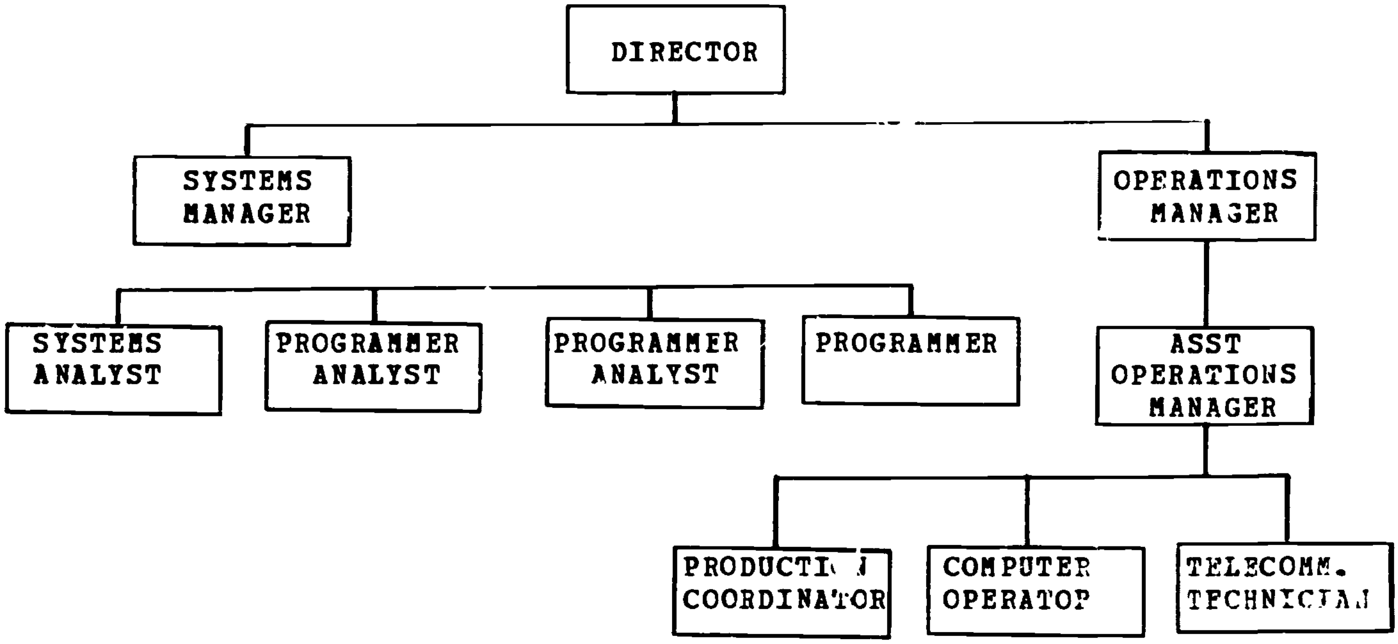
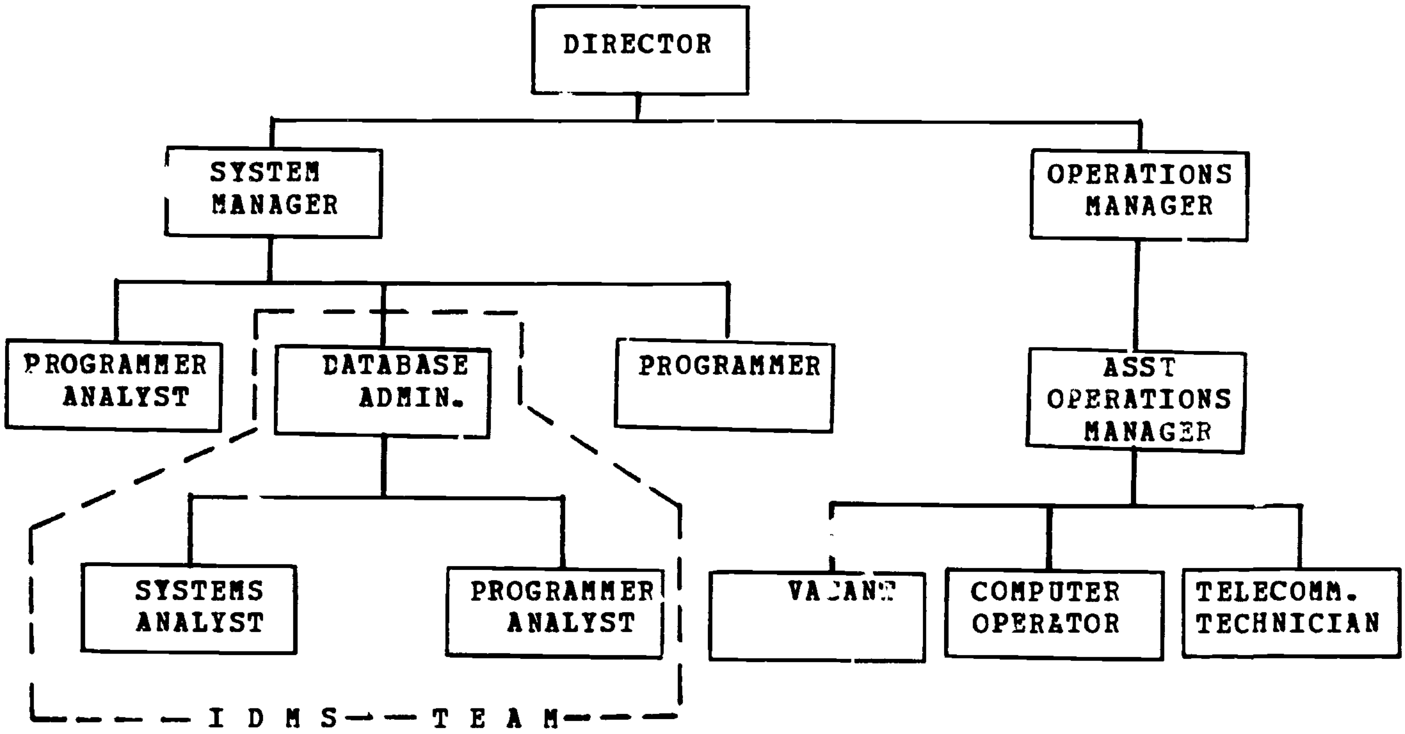


CHART B

Computer Center Organization Chart After IDMS



With no specific project to work on, the IDMS team was sent to IDMS school. Our search for IDMS project led us to an Admissions Recruitment System (ARS) for two reasons. First,it gave us the opportunity to develop an IDMS project completely, from beginning to end. This would include bringing up a CV, developing a schema, creating a dictionary, and using the IDMS retrieval language, CULPRIT, for reporting. Secondly, in a time of reduced enrollments, the ARS was seen as an important analytical tool.

Also we did not want to duplicate any of the efforts of CUNY central. CUNY had previously delivered a Financial Information System (since converted to IDMS), and were working on a City University Personnel System, as well as planning to begin work on a Student Information System. We had hopes of our Admissions Recruitment System eventually becoming a front end to CUNY's Student Information System.

During the final stages of testing, the Admissions Recruitment System was shelved in favor of a new project. Since it was now obvious that the CUNY Student Information System was in trouble, an early delivery was no longer a possibility. In trying to satisfy too many users, CUNY's project had ground to a halt. They are presently reorganizing for a second attempt. Reviewing our options, we decided to move ahead and build our own student system in IDMS.

The Hunter College student system was chosen since it was the actual framework of CUNY's student system. And besides, we had an excellent relationship with the Hunter people. An agreement was quickly worked out for their support and assistance in the conversion effort.

With little knowledge of the complexities of either IDMS or of the migration of IDMS from an OS to a DOS environment, we had some unrealistic expectations:

* We have bright people on our staff. Learning IDMS in a short amount of time, should be no problem.

* Aren't all operating systems basically the same? Moving from OS to DOS shouldn't be too difficult.

* To play it safe, we hired someone with knowlege of IDMS. He shouldn't have any trouble working his way thcugh DOS, despite the fact that he has an OS background.

And as the project began to move at a pace much slower than anticipated, we noticed the following:

* We weren't learning as fast as we thought we could.

- We felt we could buy experience. But consultants solve the immediate problem. Who solves tomorrow's and the next days'?
- DOS is quite different from OS. How do you migrate an OS database to an DOS machine without a systems programmer?
- We had second thoughts about the size of our computer. Would it be large enough to handle our student database?

Also, learning IDMS was costing us a fair amount of money.

NYCTC IDMS COST FOR FISCAL 84/85

IDMS COURSES (Minus 25% Educational Discount)	$11,500
MANUALS and DOCUMENTS	$ 1,572
CULLINET CONSULTING (One Day)	$ 750
OUTSIDE CONSULTING (Twenty-Five Days)	$ 6,500
CULLINET USER WEEK (Two People)	$ 2,300
USERS USER WEEK (Three People)	$ 3,600
TOTAL	$26,222

Since CUNY Central had purchased IDMS, our college received it free. Annually we pay $18,000 to CUNY central for IDMS support. Also, there was no charge for the Hunter College software. After a few months of struggling, we arrived at more conclusions:

1. IDMS, though one of the best database systems around, is extremely complicated with a tremendous learning curve.

2. Ten years of online experience had produced very sophisticated users who would have to be shown the advantages of a database system.

3. Unaware of the database advantages ourselves, but eager to learn, we developed new system and hardware plans. The extra hardware included more disk space for storage of the ten years worth of data, terminals, control units and printers.

Developing the system plan was difficult. We were not only using someone else's system, but pioneering the system development concept:

> Bring it up, use it, and then change it.

1. WE REALLY HAD NO CHOICE. There were other ways, but...

Our vice president wanted the college's student system rewritten in a database language. He asked that we use Hunter College's student system as a model. The VP's charge:

> Install Hunter on our computer, load the database with our student data and, if there's time, make changes to the system.

The builders of Hunter's system were hired as consultants to guide us through the development. Initially, they provided us with the system's 56 record layouts, one-line descriptions of the 730 data elements, a Bachman (schema) diagram and four books of program documentation.

2. FIRST THOUGHTS. We were guilty of some bad assumptions:

* A college is a college. How different can one college's student system be from another's?

* Once our users become aware of the new systems' benefits, they'll certainly embrace it.

* The Hunter consultants' experience will complement our lack of experience and provide us with all of the support we'll ever need.

* Installing the Hunter system should be easy, taking no more than 2-3 months.

Confidently, we tell the VP we'll have his system up in 3 months.

3. EARLY PROBLEMS. Immediately we encountered problems.

* The users are all too busy with their day-to-day problems to pay any serious attention to the future system. And, when they do manage a few minutes, they see only the negatives.

* Amazingly, the current system they're always complaining about now gives them everything they need, while the new one does not.

* Gradually the users begin asking us questions about the new system. Often we don't have the answers and their interest diminishes further. Other users continue to react with indifference, while a few actually threaten to "kill" the system.

* To make matters worse, an important user (a self-styled computer expert), takes on the task of organizing the user group. His inexperience and lack of proper focus tends to confuse the users.

* The consultant's documentation isn't as self-explanatory as we first thought. A great deal of time is spent getting answers to the simplest questions. Time is passing too quickly.

* When we need them most, the consultants aren't always available. They're busy with their own jobs, as well as contending with their own problems.

* All too swiftly the deadline approaches. Our level of confidence is dropping rapidly. When we mention our concerns to the VP, he is unconcerned, but asks for specifics. He doesn't seem to realize that we have no way of judging the magnitude of what has to be done. Accurately estimating time is out of the question. We can only concur with his request "Just give me Hunter unchanged. That doesn't seem so difficult."

4. EARLY STRATEGIES. ...starting to get on track.

* Time runs out. We confess our failure to the VP and, reluctantly he agrees to new deadlines:

  Three months to transfer the IDMS programs from Hunter to our computer, plus six months to convert our student data to the new database.

- * Despite the new deadline there is little time to rewrite old programs. The consultants suggest a database extract file. The extract would feed the old format into the old programs to produce the old output. This "backout" program saves us considerable time now. We may have regrets later.

- * The computer staff is split into two groups: the present and the future. To insure the deadline, we vow never to allow the future group to get involved in the current system's day-to-day problems. Surprisingly, it works.

- * Two months pass before the self-styled computer expert is shelved as user group leader. He's replaced by the newly-hired registrar and his computer-trained assistant. User activity begins to pick up.

- * With limited time and staff, it becomes apparent that we need the user group's assistance. They must perform the work that was traditionally ours, namely, systems analysis.

- * Out of desperation, we develop a scare tactic to insure the users cooperation. Our pitch goes something like this:

  > "The new system will be arriving soon. If you don't tell us how to change it, you'll be stuck using it the way it is! But if you learn it, and identify how you want it changed, we may be able to help you."

- * The computer people continue to walk the fine line between when and when not to answer user questions. Occasionally pleading ignorance, and referring them to their counterparts at Hunter, keeps the users doing computer work, the work of analyzing the new system.

- * Frequent review meetings are held, attended by both computer and user personnel, and moderated by the VP. This affords him the opportunity to publicly praise those who are cooperating and question those who aren't.

5. MOVING AHEAD. ...some progress is seen.

- * Working meetings of both user and computer personnel are scheduled to study, records, data elements and table codes in detail. Since both users and computer people are gathering information from different sources, the meetings are productive and everyone's understanding increases.

- * Documentation is developed to facilitate the individual users' private viewing of his segment. Screen layouts, record and data element descriptions, and lists of table codes from both systems, are available for comparison purposes. Also, Hunter's test database is made accessible via terminal.

- At a meeting of the college's cabinet (president, vps, deans, etc.), our VP has the users talk about their impressions of the new system. Most are positive, with the exception of a lone dissenter.

6. MORE PROBLEMS ARISE. ...we're moving too fast!

- The users begin to worry a little. They express concern over the decision to turn off the old system and turn on the new. Our VP seems to be assuming the "go, no-go" responsibility.
- The VP stands a good chance of having his way, since the college has a history of never uniting on anything. We panic at the thought of a premature changeover. Somehow things have to be slowed down.
- Someone suggests the concept of a parallel run. While no one knew the details of a parallel run, everyone, the VP included, thought it a sensible idea:

> ...you run the old and new systems simultaneously so as to verify that the outputs of both systems match.

- A parallel run task force is organized with the lone dissenter as chairperson.
- To lessen the possibility of anyone delaying the new systems' implementation, both minimum and maximum "success criteria" are requested in the charge to the group.

With the users now cooperating, things have been moving fairly smoothly. The system is being built incrementally, with the master course area as the starting point. The conversion specifications and programming have been completed and we're now loading the database with our course data. The course maintenance people will soon begin training in the use of the new system. And, since the lone dissenter has the responsibility for the financial area, that will be the next target for conversion.

CONCLUSION.

Our current schedule calls for completing the installation of the Hunter programs and analysis of the data elements by February 1986. We will parallel run the Summer 1986 registration to test the system. The parallel run will continue during the Fall 1986 registration so as to test the system under a full load of terminals as well as the more complex fall processing. The parallel run will be dropped by the end of 1986 or after the Spring 1987 registration and the "backout" program eliminated shortly thereafter. At that point we will be fully up on the Hunter system and will begin joint systems development of new projects with Hunter College.

"LONG-RANGE ACADEMIC COMPUTING: DEVELOPMENT AND IMPLEMENTATION AT A SMALL COLLEGE"

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The rapid growth of computer technology has forced colleges and universities to determine how computers can assist instructional delivery based on the effective utilization of current and projected resources. This article discusses the development and implementation of an academic computing plan for small colleges with enrollments of 2,500 or less. Long-range academic computing includes procedures for formulating institutional goals, determining financial requirements, designing the proposed system, and devising an implementation schedule. Other factors considered in this report relate to computer competency among faculty, staff, and students and the role of an Academic Computer Center in small colleges.

Introduction

Information technology and the rapid pace of technological innovation have forced many colleges and universities to examine the likely impact of computers and related technology on instructional programs. Although large universities are at the forefront of this activity, microcomputer technology has reached the top of most small college agendas as well.[1] Several factors tend to separate the two types of institutions, however, regarding the extent computers are actually interspersed throughout the curriculum. Among these are the recruitment of trained personnel and the acquisition of required hardware and software.[2] While the absence of trained personnel and lack of equipment may hamper the efforts of the smaller college, long-range planning may assist institutions in determining the effective utilization of resources in diminishing these shortcomings.[3]

The purpose of this article therefore is to present a systematic approach to developing an academic computing plan. Included also in the ongoing operational plan are the benefits of long-range planning in relationship to faculty, staff, and student development programs.

The Academic Computing Plan

A common interpretation of the overall concept of an academic computing plan is that it focuses significant attention on the utilization of computers in enhancing instructional programming. The purpose for developing the plan is to delineate the critical issues related to academic computing and to develop strategies for addressing these issues over a period of time. A systematic process, similar to the one described by Souder and Paz, can assist institutions in effecting a sound plan. They maintain that the sequence of activities in the development process can be classified traditionally as the Feasibility Study, the Design Phase, and the Implementation Phase.[4]

The Application Team Transfer (ATT) approach, developed by the IBM Corporation, has been use also by colleges and universities and is the genesis of the academic computing plan formulated at Winston-Salem State University. Although the process was modified to more accurately reflect the unique needs of the institution, the ATT approach has aided the University in identifying institutional goals, determining financial requirements, designing a proposed system, and devising an implementation schedule.

Institutional Goals Related to Academic Computing

The establishment of goals for academic computing is an important institutional activity since decisions about equipment, budgets, and strategies all emanate from goals that integrate well the institutional mission with those of academic computing.[5]

The organization of a special task force by the chief executive officer is the first consideration.[6] This group, comprised of administrators and educators within the institution (e.g., department heads and deans), is responsible for determining institutional goals based on information gathered during interviews with faculty from various disciplines, staff from support service areas, and representatives from business and industry. The process is illustrated by questions asked of individuals regarding the role of academic computing in their respective areas. Some specific examples of questions include:

1. What does academic computing mean?
2. Are computers currently being used? If so, how?
3. How many hours of computer time do you feel students require?
4. Who are the users of computers in your area? Who will be using them in the future?
5. What specific computer competencies (or skills) should students possess?
6. Who should be responsible for providing instruction in computer applications?
7. What should be the role of an academic computing center?
8. What kind of training would be appropriate for faculty and staff?
9. How should academic computing be administered campus-wide?

Answers to the questions posed by the task force, as well as recommendations and other pertinent information provided, are used subsequently to formulate institutional goals and to delineate the benefits of each goal. The Winston-Salem State University Task Force, for example, indicated that the goals established were designed primarily to enhance proficiency in computer usage by faculty and staff, assist students in developing better communication skills, and project the university as a viable institution in training individuals for computer-related careers. Closely related to these primary goals were those designed to enhance the computer science program and provide faculty training in the use of computers as an instructional delivery system in developmental skills courses.[7]

Determining Financial Requirements

Particular care should be exercised in identifying budgetary resources to support academic computing over the duration of the plan. Souder and Paz contend that funds should be distributed in at least four main categories: hardware, 30%; software, 30%; peripherals, 20%; and support activities, 20%.[8] The ATT approach emphasized the provision of funds based on the cost of individual workstations required for each area identified within institutional goals such as computer assisted instruction, computer literacy, instruction specific to disciplines, and faculty development activities.

Once funds are allocated, items to be purchased should be those identified previously in the plan. This action is designed to inhibit proliferation and encourage systematic acquisition of hardware and software. A procedure such as reviewing requisitions by an advisory committee can assist in this endeavor. Gillespie cautions that the dynamics of computers are such that the technology can quickly outdistance rigid plans.[9] It is therefore imperative that purchasing remain flexible to accommodate the necessary changes to the system.

Designing the System

The first step in designing the proposed system is to identify hardware, software and other technology required to accomplish institutional goals. The proposed system must complement the current system and aid in extending services currently available. The level of computing and the storage capacity required to maintain system integrity are important considerations in this regard.

A mainframe computer which can operate several independent units and support on-line, interactive computing or linkage with a network system which provides these services is essential. As the need for more complex programming becomes evident, the system should accommodate these changes without major equipment modifications. In addition, the number of workstations and the location of satellite laboratories should be included.

Implementation Schedule

The implementation schedule depicts the timetable in which acitivities associated with the plan will be accomplished and lists dates for periodic review of the plan. The schedule should relate activities to institutional policies, programming, budgets, and facilities along with projections of how these entities will impact on academic computing throughout the duration of the plan.

Training for Faculty and Staff

Faculty and staff training is an integral component of the academic computing plan and requires considerable attention. Barrow and Karris agree that there are actually four levels of faculty training: The first involves helping faculty to become aware of basic computer operations, the role of computers in society, and how to enter and retrieve data. The second level deals with evaluating and using software such as word processing programs, communicating with technical staff, and developing software with the aid of authoring programs. The third level allows faculty to become competent in computer programming provided most often through enrollment in a course, and the fourth level of training is designed to produce competent faculty for such programs as computer science and management information systems.[10] The best qualified personnel at the master's level are employed and provided financial assistance to pursue additional graduate study.[11]

A substantial portion of available faculty development funds should be directed toward computer-related professional activities. Seminars, workshops, and colloquia provided regularly allow faculty to explore the use of computers and ascertain how they can best be used to complement instruction. As a result, the institution benefits from highly trained faculty.

Computer Literacy Among Students

A definition of computer literacy for students should be included in the plan. Some may relate to students' experiences with the capabilities and limitations of computers. Others may relate to competencies in accessing computer-assisted instructional programs, supplemental instruction, or competencies endemic to an introductory or survey course.[12]

In a recent study conducted by Caporael, the researcher maintains that when computers are readily available, students learn to use them through continuous interaction and experimentation. Further, the social environment in which students operate is an important vehicle for computing activity, and even superficial projects can facilitate learning. Thus, some universities have mandated that each student own a microcomputer to insure the possible attainment of a considerable level of computer literacy.

Conclusion

In order to utilize computers effectively in the small college, it is necessary to develop a systematic and detailed plan. Five recommendations, addressed primarily to chief executive officers within small colleges, can summarize the points emphasized in this article and provide substantive direction with regard to developing an academic computing plan:

First, establish goals for academic computing. This is an important activity, since decisions about equipment, budgets, and strategies are all related to institutional goals. The participation of constituent groups will play an important role in the process of setting goals.

Second, determine financial requirements. What are the institution's current and projected resources? How will these resources be allocated? Such self-assessment is critical, a responsibility that can be shared by an advisory committee designed for this task and others.

Third, identify hardware, software, and other technology required to accomplish institutional goals. Who will review equipment and software acquisitions? How will the standards be established and audited? It is essential that the Academic Computing Plan specify this fundamental reexamination.

Fourth, devise an implementation schedule that includes services, communications, hardware acquisition or update, support and facilities. This schedule may serve as a convenient and useful guide for the progress and assessment of ongoing activities.

Fifth, provide appropriate faculty and staff training. What levels and types of training are necessary? What competencies are to be emphasized for student literacy and other skills?

A proper response to the foregoing important considerations will assist the small college in developing a viable Academic Computing Plan.

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How to Make a User Friendly

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Abstract

The implementation of new systems frequently means traumatic times for computer center staff and users alike. This is especially true when new systems are being developed for a system which covers a geographic area roughly one-third the size of the continental United States. This paper will describe the systems being developed at the University of Alaska and how one of its units, the University of Alaska-Fairbanks, has recognized the opportunity for several potential improvements including the opportunity to convert a deeply disappointed user community into a community of satisfied and friendly users.

How to Make a User Friendly

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Don Harris

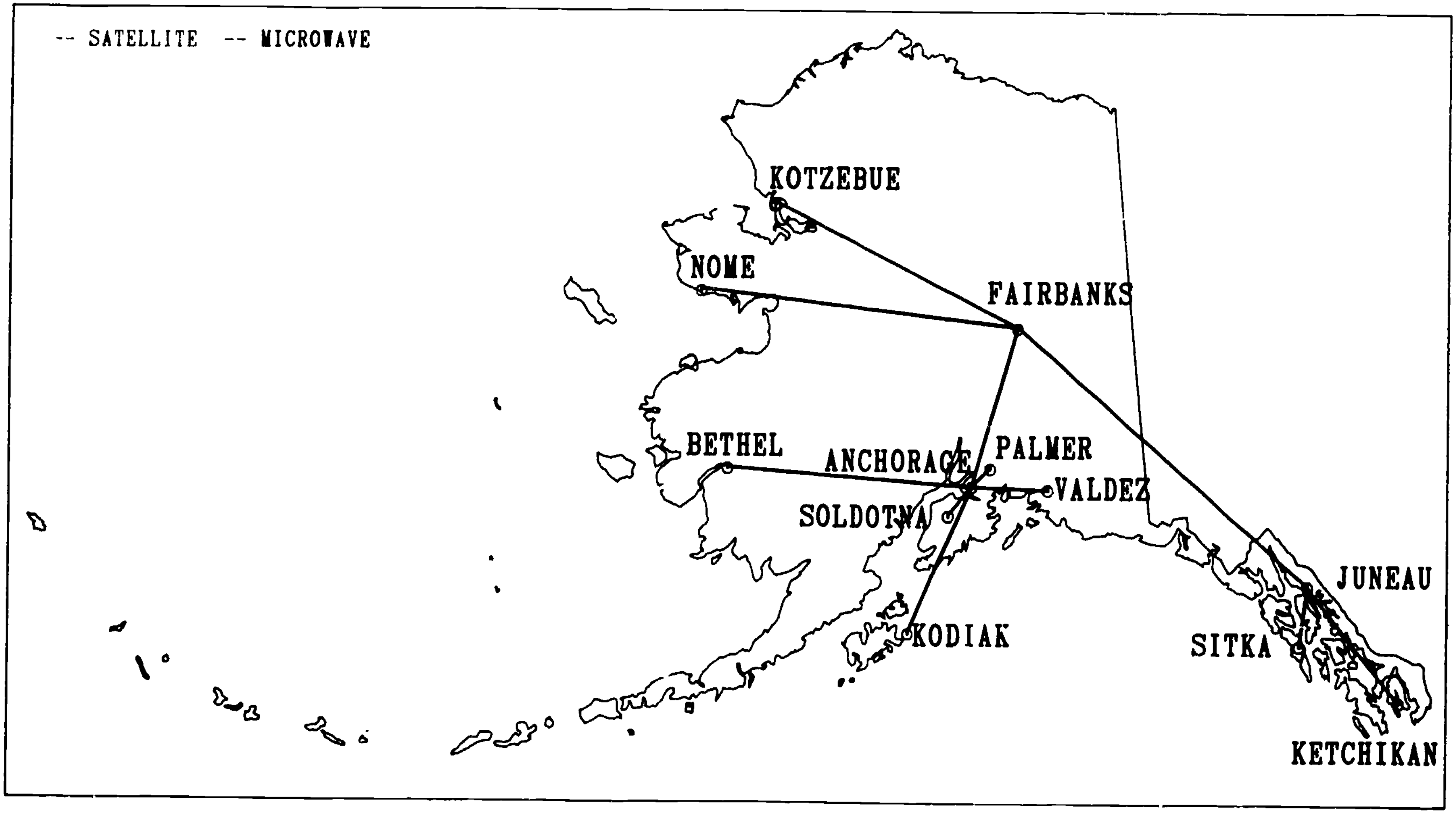
Historical Perspective. The University of Alaska was established as a land-grant college by an act of Congress in 1915. The college opened in 1922 and was located just outside the city of Fairbanks. Since that time, the University of Alaska System has grown to include three major campuses, eleven community colleges and numercus rural education centers. Most of this growth has taken place during the last decade and was supported by increased state revenues from oil and gas. The system is responsible for all public post-secondary education in Alaska and serves a population of nearly 600,000 distributed over 586,000 square miles. Each of the major units has a chief executive officer who reports to the President of the Statewide system. The Statewide system includes the University of Alaska Computer Network (UACN) which is responsible for providing all academic and administrative computing services.

Computing at UA. In the early 1970's computing at the University of Alaska was locally managed. From the late 70's to 1983, the network was managed by an outside contractor and in January of 1983, the University Statewide office assumed full responsibility for system management. Figure 1 shows the extensive nature of the network which is equipped with two DEC Vax 11/785's, a DEC Vax 11/780, an HP 3000 series 68, dual Honeywell 66/40's and a new IBM 4381-2 which will suport the new administrative computing system. Along with standard support for Academic and Administrative systems, UACN is responsible for:

5500 miles of long distance phone lines
598 computer ports on 6 computers
800 workstation parts
7000 user id's

The system experiences over 111,000 logons and 90,000 mail messages each month. Administrative computing suports Student, Human Resources and Financial systems in a batch environment. There are no facilities at the present time to support interactive administrative computing and this has led UACN to begin the development of new systems.

UNIVERSITY OF ALASKA COMPUTER NETWORK -- FAIRBANKS, ALASKA



New Systems. In the Summer of 1983, the University prepared an RFP designed to result in the selection of a new Student Information System (SIS), a new Human Resource Information System (HRIS) and the necessary hardware to support these as well as a Data Base Management System (DBS) and other "fourth generation" productivity tools. As a result of this process, Information Associates software was selected for SIS and HRIS while Cullinet's IDMS was chosen to provide data base management. These products will be implemented on the IBM 4381-2 which was installed in the Fall of 1984. We expect the new systems to be available in 1987, and to aid in the process, a Systems Implementation and Project Management Methodology was adopted. The basic elements of these are shown in figures 2 and 3.

During the selection and implementation process, several areas of concern have been identified by UACN:

Implementation Issues

1. The requirement that a single system serve the needs of such a diverse organization has forced an implementation structure which might lead to questions of "who is in charge?" and "who is responsible?"

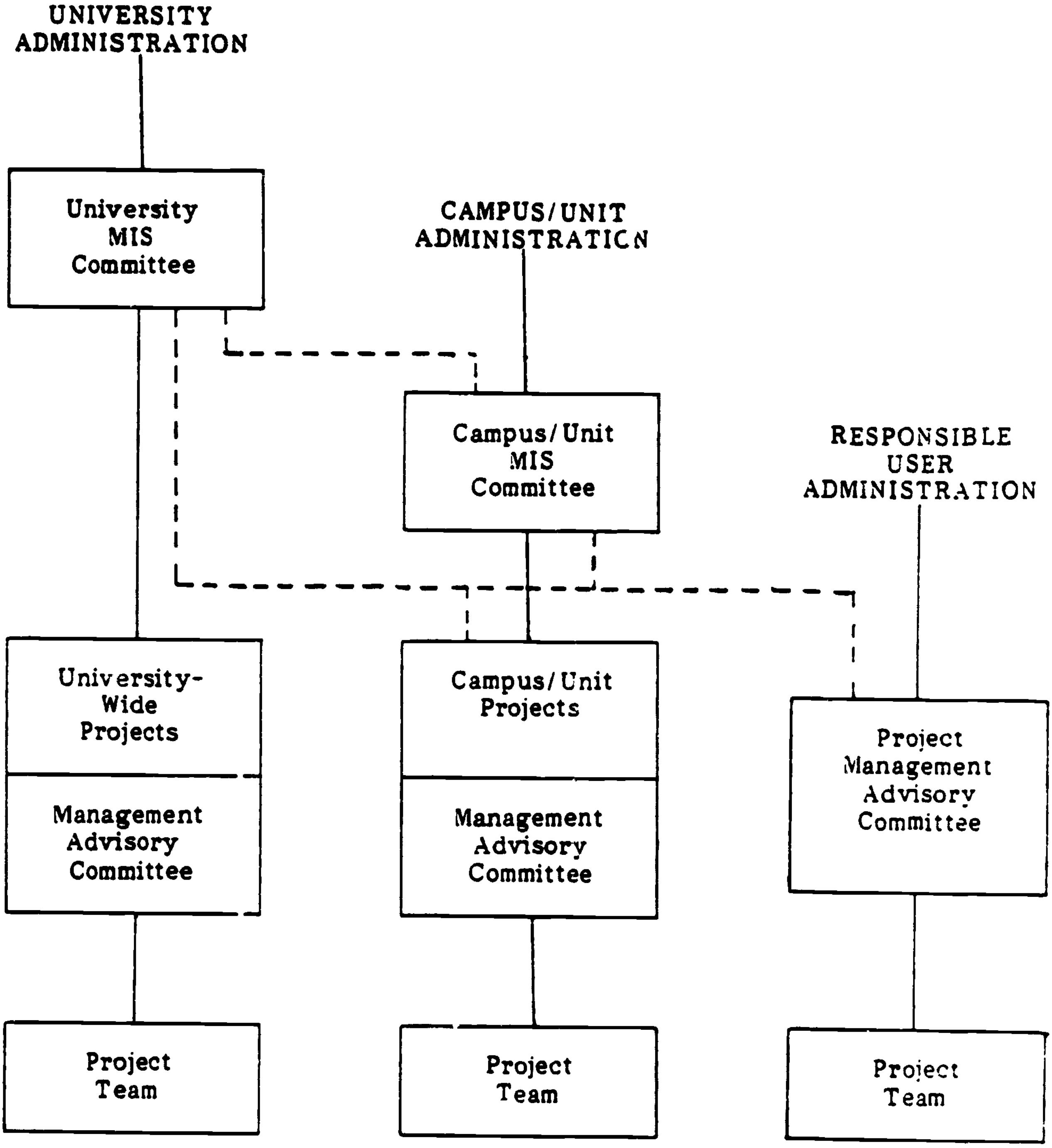
2. The computer center staff has difficulty seeing decisions made on a functional rather than a technical basis, but recognizes that both views must be surfaced and reconciled. This will require very close working relationships with the user community.

Training Issues

1. User's are anxious to begin training but regardless of how "user friendly" fourth generation tools are claimed to be, they are still new, and in the words of Fleit and Whiteside ([3], page 11) "Programming, even in a fourth generation command language, is still programming and more difficult than we've been lead to believe."

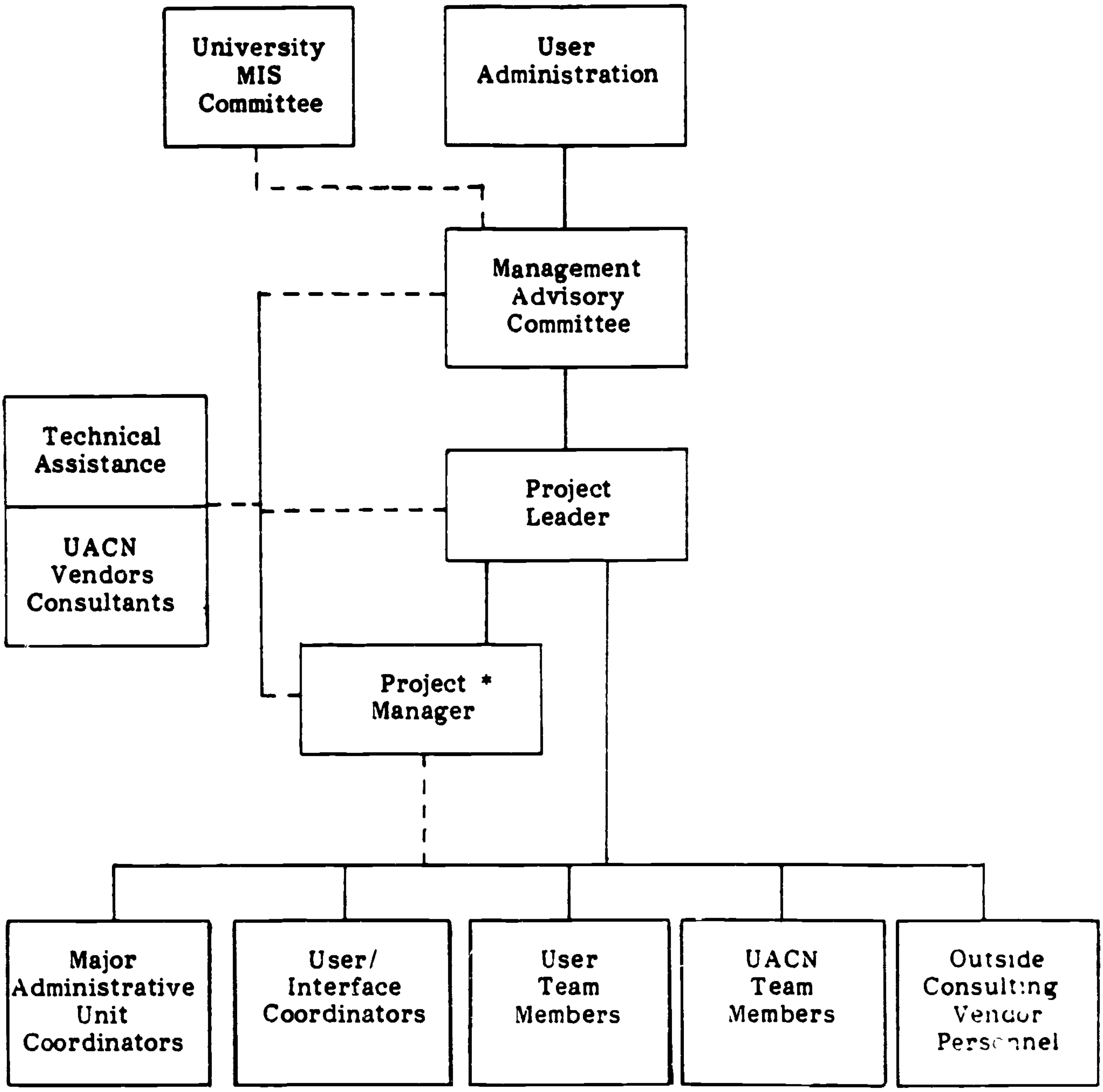
UNIVERSITY OF ALASKA

Information Systems Organization Structure



UNIVERSITY OF ALASKA

Information Systems Project Organization



*On small-to-medium projects, the project leader will function as the project manager with technical assistance from UACN.

2. Early training might be wasted if users cannot immediately apply what they have learned. In the current schedule, the time period between training and implementation is too long.

User Support Issues

1. UACN staff are themselves learning new systems and there is insufficien time available for supporting both current and new systems within the network let alone providing complete training for widely diversified and geographically remote sets of users.

2. The individual units of the University are not organized to provide their own support.

3. Systems implementation and development may be negatively impacted as the University of Alaska enters a period of stable or declining budgets.

User Perception Issues

1. The diversity of the University's structure is reflected in the diversity of its users. There are few who understand what on-line systems in the UA environment can actually provide. Many users have high expectations and little experience in the difficulties of managing a system as a finite, shared resource.

2. Users see UACN staff as management rather than as service oriented. This perception, based on resource limitations and lack of inter-unit awareness of needs, is likely to continue and might be exacerbated when problem resolution in the new system takes longer than users think it should in an on-line environment.

In order to help resolve these issues and engender a feeling of involvement and pride in the ownership of the new systems, UACN has recommended and is encouraging the development of Information Centers at each of the University's units. The Information Centers are to be staffed and administered by the local units with support from UACN throuogh a newly established User Services function. The remainder of this paper will show how the University of Alaska-Fairbanks (UAF) is responding to these challenges.

One Unit's Perspecive. UAF is the most complex unit of the Alaska system. It enrolls nearly 5,000 students in seven schools and colleges and supports 5 research institutes. One would expect a campus of such complexity to have a well-established administrative computing organization but, possibly because computer services have been a statewide function, no such organization exists. This, together with user's perceptions that UACN has been unresponsive to campus needs has resulted in a proliferation of departmentally maintained micro and mini systems (some of which are connected to UACN, but most of which are not). Table 1 shows the machines now being used in just 45 of the offices on campus and the varying configurations and software in use are just as mixed. An even more difficult problem is that the campus has no formal mechanisms of communication for dealing with systems, information, and data-flow problems. Discovering information is a happy accident rather than an expected event.

Table 1

Computers in use at UAF

Manufacturer	No. Used
Altos	1
Apple	14
CDC	1
Compag	5
Data General	1
DEC	2
Fujitsu	44
HP	15
Leading Edge	4
IBM Displaywriter	4
IBM PC	79
IBM XT	14

IBM S/34	1
Kaypro	5
NBI	2
Osborne	1
Vector	1
Wang	8
Xerox	1
Total	204*

* Only 45 of 60 UAF offices are represented in this table.

The decision to implement new systems has been welcomed by executive management as affording several opportunities:

1. To provide on-liine integrated systems with improvements in management information. For example, the current system has at least a three-week delay between the close of a semester and the availability of enrollment information.

2. To improve data management. Current policies and practices have encouraged offices to abondon the corporate files in favor of departmentally designed systems. These systems frequently contain important information but are held in incompatible forms or lack essential data necessary for incorporation.

3. To improve credibility with the legislature and other groups. Our "reactionary habit" of running about pell-mell gathering unrelated data from incompatible sources often results in contradictory and incomprehensible reports.

4. To organize the computer resources of the campus and improve their functionality and utilization with the potential of gaining increased management of information while controlling costs.

In preparing to take advantage of these opportunities, we have been guided by the acknowledged need for broad-based managemet involvement ([5], page 9). To encourage such involvement, groups at three levels of management have been formed and are encouraged to facilitate communications at each level as well as between levels. The groups defined for UAF are:

Level 1	The Systems Advisory Council - composed of the operating vice chancellors. The purpose is to set systems policy for UAF and resolve problems which cannot be resolved at other levels.
Level 2	The Management Information Systems Committee - composed of key members of the offices of Admissions and Records, Human Resources, Financial Accounting, and Planning. They meet weekly to "guarantee" that new systems will be integrated and provide for user needs.
Level 3	The Inter-office Communication Group - a broad-based representation of the UAF community. The group is helpful in identifying and solving operational problems and serves as an excellent communications vehicle.

These groups are in their early stages of development and will require time to become comfortable with helping to solve problems which are new to them. They will also need time to develop a new perspective for dealing with UACN in a different way. Eventually, these three groups will provide the primary communications "web-work" for policy and problem resolution at UAF.

The final element of our plan is the Information Center. Through discussions held at all three levels described above, the users have defined what the center will provide. It is not surprising that their needs have echoed what has been succintly phrased by Judith DiMarco ([1], page 6), "...the ability to locate, manipulate, and analyze the information they need." To facilitate these needs, the center will provide (1) micro-computer hardware and software evaluation, (2) micro maintenance support, (3) training in both micro and mainframe software and the interfaces between these system components, and (4) consulting with user offices to help resolve problems at the most appropriate system level. These are not new ideas, the functions are provided by most Information Centers. It is our hope that the philosophy of our center will make the bridge between "user friendly" software and "friendly users."

How to make a User Friendly. Our interpretation of the needs expressed by the UAF community has given us both an operating definition and a "spirit" for the Information Center. The Center will have a single purpose ... to help users transform data into information. We will accomplish this by providing the appropriate tools, training the users in their use, and, most of all, by listing.

While we know that technical skills are necessary for Information Center personnel, we believe that people skills are even more important. Thus, we intend to staff the center with people who...

1. Have a service orientation and the view that data is a resource belonging to the entire organization.
2. Can adopt the user's perspective of a problem while maintaining awareness of the impact information has on the University.
3. Have the ability to communicate at many levels of the organization both verbally and in writing.
4. Can anticipate user's needs through close communication and by possessing a broad understanding of the corporate files and the information flow within the organization.

It is our hope that, by providing formal channels of communication, on-going training which directly addresses user needs, and encouraging staff to listen and understand the users' problems we may create a "friendly user" atmosphere at UAF as well as develop "user friendly" systems.

Comment rom an Independent Observer. There are no easy answers to the issues facing the University of Alaska. The technical problems alone will be formidable but the most challenging problem will be to organize the various user groups so that they are able to interact and work together in the systems development process. The comments and suggestions which follow are offered as an aid in resolving these issues.

First, the questions of "Who is in charge?" and "Who is responsible?" must be resolved quickly. It would be prudent to bear in mind that users can claim ownership of a system only if they are in charge from development to daily operations. It is totally appropriate that UACN be concerned with the technical issues of implementation - but such issues must be resolved in light of the applications being addressed.

Second, the installation of a DBMS requires the careful constuction of a data dictionary. This is an excellent opportunity to begin training users in skills which they can immediately apply. In addition, proper training in basic systems analysis techniques will help solve the problems of individual data bases at least to the point of facilitating data compatibility, integrity, and reliability. Remember that individual data bases will not and should not go away - the proper training will help in their sharability.

Third, Information Centers provide valuable services but UACN should consider the possibility that this approach may tend to further alienate the user community through added organizational structure. Information Centers are an added dimension of systems, they should never be viewed as a replacement for a service oriented computer network organization.

Fourth, the apparent level of expectation UA users have for on-line systems is cause for concern. Moving from a batch environment to fourth generation tools is a very big step and users must be made aware of the limitations of the tools as well as guided in the identification of their responsibilities in the new environment. Given their lack of experience in developing traditional systems, they should move very slowly in developing fourth generation systems. It might be wise to begin with a smaller scale system so that users can be brought slowly into the process and have time to address their information needs after having benefit of experience and experimentation with the new tools.

Finally, it seems necessary for the University to take a hard look at its goals for new systems and adjust them so that time is provided for a spirit of cooperation to develop. Any system must realistically address the human factors including social interaction.

The University of Alaska has a long and difficult road ahead in bringing their computer-based systems to a stage of development in line with their goals. We hope these observations will be of some help and wish them the very best along their journey.

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PEER INVOLVEMENT IN THE FACULTY COMPUTER LITERACY PROCESS

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CASTLETON STATE COLLEGE
CASTLETON, VERMONT

Institutions of higher education have inherited large numbers of tenured faculty in the liberal arts from the 1960's and 70's. These people, as distinguised as they may be in their fields are, for the most part, computer illiterate. Through a somewhat painful evolution, Castleton State College has come upon a highly successful solution to this problem which is unique in its simplicity. Previous attempts at faculty education focused upon making the technology and learning opportunities conveniently available to the faculty but, lost sight of the psychological variables which served as impediments to participation in these programs.

Introduction

As is the case with most educational institutions Castleton State College is grappling with the problem of providing the institution with a "computer literate" administration, faculty and student body.

This paper deals with the various strategies which Castleton has used in the past three years to deal with the faculty computer literacy issue. It will not, however, address the difficult, if not impossible task of defining computer literacy. The expectation at this institution is that if faculty who have never utilized the computer before can understand the basic operation of the technology and become aware of the availability of various application packages, they will utilize the computer and will reach their own level of utilization and sophistication.

Background

Castleton State College is an accreditied, coeducational institution located in Southern Vermont. The student body is composed of 1400 full-time students and a full-time unionized faculty of 80. Castleton, the oldest of the five institutions which comprise the Vermont State College System, was originally founded in 1787.

This year the College's operating budget was barely $7.5 million. Tuition revenue provides two-thirds of that amount and state appropriations provide one-third. Vermont ranks 49th among the fifty states in terms of per student appropriations.

As recently as 1980 the institutions had only four computer terminals for student and faculty use. These terminals were linked via microwave to the Vermont State College DEC VAX 11/780 located in Waterbury, Vt., approximately 90 miles away. Through a series of grants and significant expenditures of institutional funds Castleton students and faculty currently have access to nearly 100 mainframe and microcomputer terminals. Approximately half of these workstations reside in the Academic Computing Center which is located in the college library. The Center is open 87 hours per week for student and faculty use. The remainder of the workstations are distributed throughout the campus's academic buildings and residence halls. The Academic Computing Center is staffed entirely by work-study student personnel. These students are characteristically Bachelor of Science in Computer Information Systems (CIS) majors. Castleton employs no full-time computer support personnel.

While predominantly a liberal arts institution, Castleton has seen a dramatic increase in students majoring in "career and professional" programs. One third of the undergraduate students major in Business Administration alone, and enrollment in the highly selective CIS program has grown to 60 students in the three years since its inception.

A computer literacy requirement was added to the core curriculum in 1982 to ensure that all students, regardless of major, would become "computer literate" during their freshman year. With over 50% of our students coming from secondary schools which provided for exposure to computer technology and 100% of our freshmen students taking the computer literacy core curriculum course, it became quickly obvious that the students were more "computer literate" than the faculty.

At the beginning of the faculty computer literacy project 60 of the 80 full-time faculty were considered illiterate in the area of computer technology. These 60 faculty were identified as the "target group" for the College's literacy project.

Institutional Constraints

While there are many models from which to copy, one learns quickly that the reason that one specific design works well for an institution was most likely because it fit well the existing resources and constraints of that institution. At Castleton approximately 60% of the faculty were tenured at the start of this project. For some faculty this stage is characterized by a "fallow" period marked, in part, by resistance to instructional change. As with most institutions Castleton finds its staffing out of balance with student demand. The effects of the 1960's and early 1970's have left Castleton with heavy tenure ratios and overstaffing in the liberal arts areas and relatively young, understaffed departments in the "career and professional" programs. It is often the case that the older tenured faculty working in the traditional liberal arts areas have difficulty seeing see how the computer can be applied to their tradition-bound discipline.

As stated earlier, state support for public higher education in the state of Vermont is meager at best. With minimal support from outside funding sources, faculty development monies are inadequate to support some of the more energetic programs that have been successful at other institutions. Castleton also lacks the administrative support personnel who are commonly relied on in many faculty computer literacy projects. As stated earlier the institution's Academic Computing Center is staffed entirely by undergraduate students. The State College System's computing facility, located approximately 90 miles away is managed under a contractual agreement with an independent management firm. While this firm does provide academic support for the member institutions there is presently only one full-time academic liason to serve all five colleges.

Finally, the faculty are unionized with workload and job responsibilities specifically detailed in the collective bargaining agreement. As such participation in any faculty development program would have to be completely voluntary.

To summarize, any successful computer literacy project at Castleton would have to utilize existing resources, be low cost, and completely voluntary on the part of the participants.

The Faculty Computer Literacy Projects

Attempt #1: Lunch Hour Workshops

In the Spring of 1984 a series of lunch hour workshops were scheduled. These workshops met once a week from 12:30 to 2:00 p.m. in the media room adjacent to the Academic Computing Center. This time period is one in the academic schedule when classes are not held so as to leave a time when faculty committees can meet. The seminars were headed by microcomputer sales representatives, knowledgeable faculty or administrators and the system academic support liason. The seminars were open to all faculty, staff and administrators. These seminars focused on equipment and software demonstrations as well as suggestions for computer applications in classroom management, test generation, report writing, research and skill drills for students. Attendance by the target group faculty at these seminars was disappointing, at best, averaging only four faculty members per session. Additionally the faculty who characteristically attended these sessions were those who were already considered computer literate. Only seven targeted faculty attended at least one session and only two faculty attended three or more. A survey was conducted to determine the reasons for the poor attendance pattern and the most commonly cited reason was lack of time. Many faculty were either involved in committee work, advising students, involved in their own research, or simply were not on campus that day. A survey of seminar attendees revealed that most of them desired direct hands-on experience with the computers and software packages.

Attempt #2: Computer Loan Program

Since the majority of the evaluation responses to the lunch-time seminar project dealt with the participant's desire to gain "hands on experience" in computer use, the "computer loan program" was instituted. This program allowed any faculty member to borrow a microcomputer during the summer of 1984 and the semester, winter, and spring breaks of the 1984-1985 academic year. Faculty participating in the program were provided with the necessary software, tutorials, and documentation. In addition each participant was given the telephone numbers, home and work, of four computer experienced faculty and administrators who volunteered to serve as resource persons for the participants. During the entire computer loan program period 14 faculty members took advantage of the offer. Unfortunately, only 7 of these 14 were members of the target group. A post project personal interview with each of the target group participants found that only three faculty had utilized the project's resources to the point where they had adequately mastered at least one application package and were using it in their research or classroom endeavors. The most commonly cited reason for not having adequately utilized the computers was frustration with "getting started" and "inability to understand the documentation." None of these four faculty utilized the resource people more than twice. When asked why the resource persons were not used more extensively to deal with their problems it became apparent that these faculty felt that their difficulties were due to a lack of technical or intellectual abilities on their part and felt embarrassed about asking basic questions.

Attempt #3: Peer Involvement Project

After analyzing the evaluation data from the first two faculty computer literacy projects and conducting numerous in-depth interviews with non-participants the following was determined:

- Most target faculty had a lack of understanding of computer applications relative to their personal or professional needs.
- Many felt that they did not possess the "ability" to utilize a computer.

- Many felt that with the other demands on their schedules they did not have the time, which most felt would be significant, to learn to use the computer.
- Many were hesitant to have their ignorance or lack of ability to learn the new technology exposed to students and administrators.
- They felt intimidated by "experts" who they felt spoke the foreign "computer tongue".

The peer involvement project was initially conducted during the summer (1985) to take advantage of the increased availability of faculty free time and also to incorporate individual faculty research projects in the process. Two "user-friendly" faculty were selected to serve as trainers in the workshops. These people were selected primarily for their interpersonal skills and background rather than technical expertise. One was a non-tenured assistant professor for the Computer Information Systems Department. The other was a tenured Associate Professor of Theater Arts. This second individual was a successful "graduate" of both the lunch-time seminars and the computer loan program. Both trainers were compensated the monetary equivalent of teachi- one adjunct course.

All targeted faculty members were contacted by mail and informed of the project. Additionall , most were personally encouraged to attend by the trainers. Participants were instructed to bring with them their current research projects as well as their grade book and two examinations from a course which they commonly teach. The target faculty were informed that the project was only available to faculty who were novice computer users. No staff, administration, or students would be included.

Additionally, they were assured that participation in the project was voluntary and would be held confidential.

The workshops were held for six hours per day on Monday and Wednesday for three weeks, lunch was provided. During these periods the Academic Computing Center was closed to everyone except the participants.

All workshops were designed so as to minimize the time spent on classroom lectures and maximize hands-on experiences with one on one support by the trainers. All practice exercises were performed on material which was relevant to the participants. Word-processing practice was performed on the participants' individual research, publication material, correspondence, classroom management material etc. Applications of databases, spreadsheets, and statistical packages were performed on the participants' actual research data, classroom management material, departmental budgets, etc. Each participant had his/her own terminal to practice on during the sessions and an attempt was made to group participants so that faculty with similar backgrounds had workstations near each other.

In addition a microcomputer was made available to each participant to take home. No specific out-of-class assignments were required however.

Every effort was made, especially in the early sessions, to simplify the learning process. Participants were provided with working disks and where necessary these disks contained pre-written command files to facilitate focus on the application itself. Simplified mini-documentation was written by the trainers. These documentations were written without jargon and limited to the most elemental operations so that the participant could, in a few brief pages, feel that the program was being "used".

The course schedule was deliberately left fluid to adapt to participant interests and difficulties. Generally, however, the first week was devoted to basic operation and care of the microcomputer and diskettes, as well as an introduction to word processing. Week two consisted of more advanced word processing, introduction to spreadsheets, databases, and statistical packages. After brief introductory exercises were performed on each of these application packages the participants were allowed to further practice on whichever of these packages was most applicable to his/her personal and professional needs.

Week three consisted of a general introduction to reading documentation, selecting software, mainframe operation and software, survey of available application software ar suggestions for coursework utilization of computer technology.

Evaluation

Of the 60 targeted faculty 17 signed up initially for the peer involvement project. One participant, feeling overwhelmed, left during the lunch break of the first day and did not return. The remaining 16 faculty completed the three week workshop series.

post- project evaluation identified that all participants were extremely satisfied with the content and structure of the project. Additionally all participants responded that they had recognized applications of computer technology for their personal and professional endeavors. Sixty percent of the project participants have incorporated the computer into their classroom work for the Fall 1985 semester or intended to do so in the Spring 1986. Finally, as was expected, these individuals are now available t serve as mentors and resource people for the remaining target group. As a result of its success the peer involvement project will be continued with minor modifications during the summer of 1986. It is also expected that this project will serve as the template for a similar project directed at administrative personnel.

Conclusion:

Previous attempts at computer literacy projects for faculty have focused upon content and resource availability and did not pay adequate attention to the psychological and behavorial variables that served to undermine them.

The main characteristics of the Peer Involvement Project which contributed to its success are:

-utilization of interpersonally skillful peer trainers.

-providing for immediate applicability of the technology to the participant.

-providing for a non-threatening environment.

-ensuring the homogeneity of the group.

-conducting the project at a time when the participants have fewer demands on their time.

Project Management: The User Perspective

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ABSTRACT

Coordinating a major statewide information system development effort for an education system comprised of unique four-year universities, community colleges, and an array of rural and distance delivery instructional components is a challenge. Compound it by making it the first development project for a centralized university computer center, by making the system being implemented a student information system running in the latest data base technology environment, by the existence of a complex university decision-making process due to a strong governance structure with strong tendencies toward campus autonomy and decentralized academic planning processes; by distributing these institutions as much as 2,000 miles from one another, and dependent on satellite relays for data transmission; and by making an implementation on an accelerated schedule in light of an eroding state revenue picture. Taken together, the constraints encountered by the student information system project at the University of Alaska forced the development of a non-traditional approach toward involving users from each campus in the system in all aspects of the systems development effort. Embracing this user perspective toward project management enhanced both the system design and campus commitment toward the development effort, established effective project team communication, and helped reduce the risk that non-data-processing tasks would end up on the project's critical time path and result in a delay in the implementation.

INTRODUCTION

The University of Alaska is a statewide system of public higher education. As Alaska's only public university, it is charged with providing for the postsecondary education needs of all Alaskans. Established as the land-grant institution for the State of Alaska in 1922 with a single governing board, the University of Alaska has grown into a series of higher education units which now includes three four-year universities, eleven community colleges, thirteen rural education centers, and a central system administration. While its roots go back nearly 70 years, today's University of Alaska is largely a product of public policy decisions made during the 1970s and 1980s. The sudden affluence of the State of Alaska in the last decade brought rapid growth to the University system, particularly in the number of campuses operating, in the instructional program depth, and in the magnitude of research and public service efforts. Due in part to this sudden affluence, the vast geographic area served, the diverse cultures this area encompasses, and Alaska's public policy of providing a high level of access to postsecondary education across the state, the administration of the University has evolved into a highly diverse structure.

During this period, a commitment was made to build a centralized state-of-the-art administrative data processing center and develop enhanced administrative systems that would meet the needs of users. Prior to this commitment, services were provided by a facilities management company. Only in the last three years has the University of Alaska taken over responsibility for computing. Thus, for the first time the University was embarking on a path of systems development with users in charge.

STATEMENT OF THE PROBLEM

The institutions of the University of Alaska system are markedly different in their goals, objectives, operational procedures, and information needs due in part to: 1) different educational orientations, 2) historical/political influences, 3) the markets they serve or intend to serve, 4) the number and background of their student enrollments, 5) the state of academic, administrative, and facilities development, and 6) staffing and funding variations. Community colleges having an open-door admissions policy and espousing the community college philosophy that are so small in size that many administrative functions, such as admissions and student records processing, are done in a statewide community college administration office. At the other end of the spectrum exist four-year research universities each with the autonomy to fashion the academic-related policies most appropriate for their institutional objectives, such as selective admissions policies, unique academic warning-probation-dismissal processes, course numbering schemes, and the definition of class contact hour. Some are are large enough to perform almost all administrative functions efficiently and effectively. The diversity within the system, particularly the academic policy and administrative procedure dimensions, required the building of a new statewide student information system to incorporate the varying needs of all campus users. The wealth of institution specific practical knowledge in the area of admissions, student registration, and student records existed only with campus users. For the new Student Information System (SIS) implementation project to succeed, some mechanism had to be created to facilitate users in becoming equal partners on the development team.

HOW THE UNIVERSITY IS APPROACHING THE PROBLEM

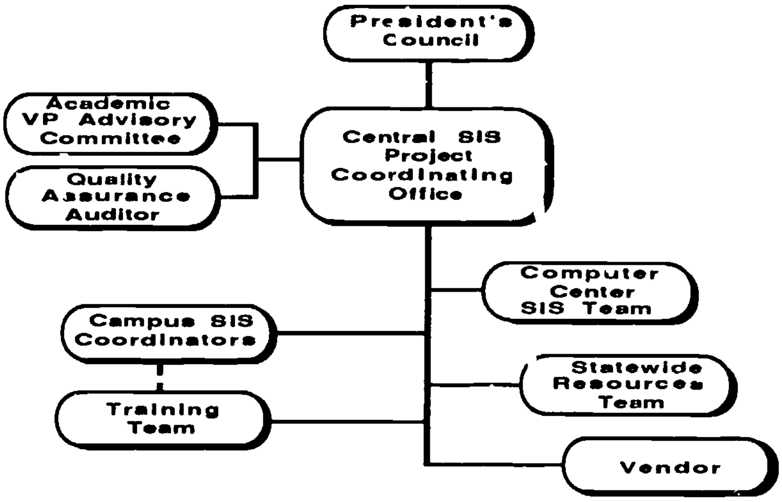
An Organization That Involves Users

Most data processing development projects have historically revolved around the computer centers and have been directed by technical staff. The users, historically, have avoided becoming involved in the mystique, terminologies and languages of computers, leaving this process to the data processing departments.

The University of Alaska (UA) is changing its system implementation philosophy by putting the responsibility where it more properly belongs - - - with the user. To accomplish this, UA has adapted an organizational structure for project development efforts that includes a management advisory committee (MAC), representatives from each major academic unit (MAU), a Training Team, various resources teams, and a Project Team. The MAC is comprised of top level administrators from each campus and are primarily the academic vice chancellors from throughout the system for SIS. The MAU committee members are the campus coordinators for the subject area being addressed by the project, from each of the units. The Training Team is composed of typical users from each of the units. The resource teams are members of the central administration responsible for the particular subject area being addressed, members of the computer center responsible for the actual construction, operation and maintenance of the information system, and representatives from the vendors involved. Lastly, the Project Team itself is composed of members of the user community addressed by the project subject area, and includes a Project Director who is responsible for the entire project and Project Leaders who are responsible for particular subject sub-areas.

The Student Information System project for the University of Alaska has developed this relationship and is moving ahead to implement a system recognizing the needs of users, balancing that with the technological capabilities that are available for solution to user requirements. During this ***transition*** to project management by users, it is important that users increasingly feel responsible for and direct the activities of the project. At the same time, it is important that data processing present a clear statement of alternatives and consequences from a technical standpoint so that decisions are made that consider all the trade-offs, both in system functionality and technical/cost impacts. The following chart, Figure1, illustrates the organizational structure for the SIS project at the University of Alaska.

FIGURE 1. PROJECT ORGANIZATION

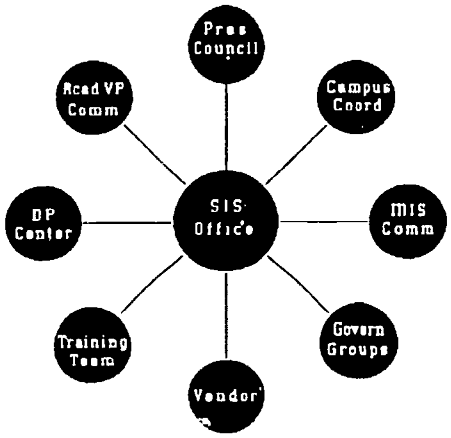


Decision Making Process

Because of the varied nature of the University and the involvement of multiple campuses, the decision making process can, and at times does, become complex and cumbersome. It is important to involve as many people as possible at the appropriate times to gain input and to assist reaching a decision. However, decisions still must be made and the old proverbial expression "being designed by a committee" can have its consequences in this structure as much as any other if not managed appropriately. It remains extremely important that decisions be reached in a timely, straightforward manner if the project is to be completed on time. In the implementation of the SIS project at the University of Alaska, this process has on occasion taken longer than desirable. On the other hand, the price of democracy must be paid in some time inefficiencies. It has been shown repeatedly throughout the implementation process that this price is worthwhile for the SIS project. It is necessary, however, to guard against letting it become a deterrent to getting the job done. This is being accomplished by setting deadlines and using automated project management techniques such as PERT and Gantt charts, so everyone knows who is dependent on whom. Within the organizational structure in place at UA, the actual decision making still must be made at the Project Director level with approval through the administrative channels. In Figure 2, the multiplicity of decision groups the Project Team must coordinate through indicates the degree to which this guarantees user review.

The management advisory committee (MAC) was established as an advisory committee to the Project Team; however, experience has indicated that management advisory committees, which consist of high level administrative staff, want to function periodically as the policy making and decision making body for the project. This has been useful except when that body does not feel it has the authority to set a particular policy before feedback from campus assemblies or campus chancellors which hampers agreement in a timely fashion. For the most part, the SIS MAC has struggled through some very difficult issues and has been able to resolve them in a reasonable timeframe. Some of the issues resolved consist of consolidated tuition structures, uniform grading policies, and campus-specific academic action calculations. In sum, the trick is in managing the project in a fashion that ensures adequate time is allotted to permit users to set the project direction thereby making the necessity of unilateral decisions by the Project Team rare at best.

FIGURE 2. COORDINATED DECISION GROUPS

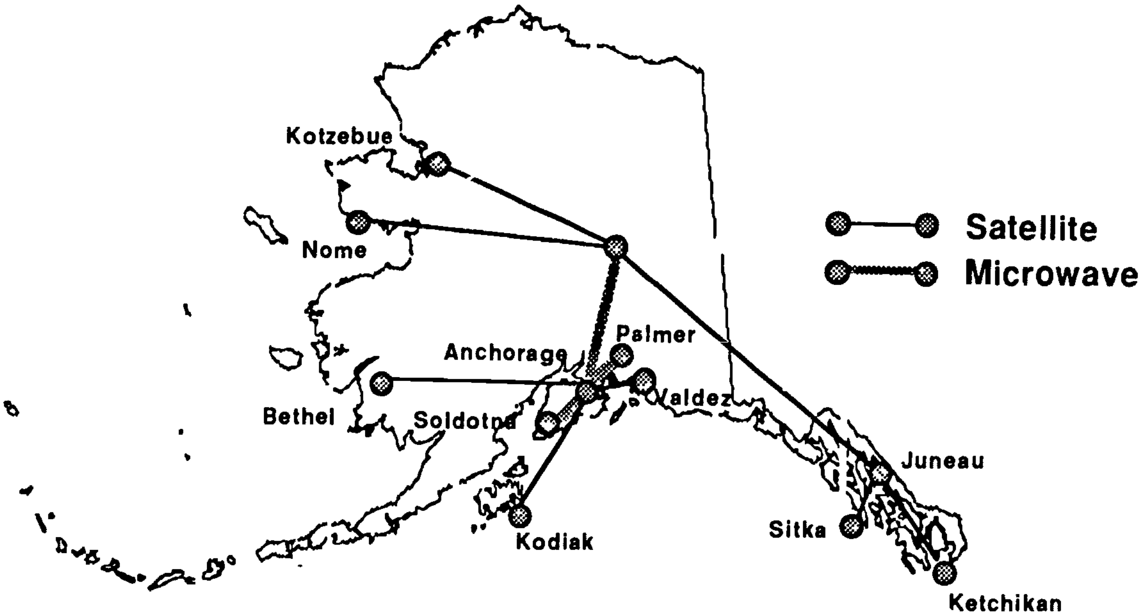


State-of-the-Science Technology

When the University of Alaska embarked on upgrading its administrative computing capabilities, it issued an RFP for a Student Information System (SIS) and a Human Resource System (HRS) with associated hardware. The results of the RFP were the selection of Information Associates' SIS and

HRS systems and an IBM 438l-2 mainframe. Also part of the process was to select programmer productivity tools and user support tools which would allow the users to perform much of their data processing functions without having to rely on the technical expertise of the programming staff. The hardware has been installed, as has the base system for SIS and HRS. The applications systems, before they can be put into production however, must be modified because of the unique requirements of the University of Alaska. This process is currently underway. The RFP process resulted in the use of personal computers as workstations in order to provide a backup capability in the event of a disruption in the communications network or in the Control processing unit. Figure 2 depicts the geographical size and extent to which the University is committed to providing computing throughout the state. It should also be noted that the University of Alaska Computer Network (UACN) provides for 5500 miles of long distance phone lines. Another purpose for the use of the PC's is to provide a micro to mainframe connection that will allow the downloading of information from the mainframe to microcomputers for data analysis.

FIGURE 3. UNIVERSITY OF ALASKA COMPUTER NETWORK



As part of the software that was obtained, Cullinet's IDMS Management System was purchased, along with the associated products for development. These will be used extensively for modifications as well as enhancements to the SIS package. It is anticipated that users will assume responsibility for many of the ad hoc reports, utilizing the query languages and 4th generation languages that are to be made available. As part of this, the University of Alaska is putting into place a support mechanism for training and assisting users in the application of these products.

Initial training sessions have thus far been conducted for the technical staff and a limited number of users. The training has been reasonably successful; however, it needs to be pointed out that training must be associated with using the product. Portions of the training were conducted without the availability of the software and much of that training was less effective than it would have been due to the lack of hands-on reinforcement.

Project Management as the Transition Key

The key to making a successful transition from DP managed development projects to user managed projects is effective project management which integrates the strengths of both the data processing professional and the functional user. At the University of Alaska, this process began with compiling the administrative systems RFP where both programming and campus administrative staff collaborated. The user role was continually expanded from bid finalist site visitations through the identification and prioritization of software modifications. The manner in which software modifications were identified, used to construct implementation alternatives, and how project tasks were communicated serves as a good example of how project management techniques can be used to integrate user and programmer.

In the spring of this year, University of Alaska campus chancellors requested that the SIS Office develop a number of system implementation alternatives that would clearly present the trade-offs for each alternative in terms of functionality, required resources, and full system live dates. The major objective was to try to find areas which could be changed in order to allow an accelerated implementation schedule ahead of the originally estimated Fall1987 date.

A four-phase process was followed to facilitate the completion of the analysis in the timeframe provided:

- **Phase I - Identify SIS Modifications**
  In order to understand the software product the University had bought in relation to possible modifications that might be needed, the SIS Training Team comprised of campus users had to first complete SIS training. A number of meetings with campus, data center, and IA personnel subsequent to the end of the training period produced a list of two dozen required modifications to the base SIS system.

- **Phase II - Write Modification Specifications and Prioritize**
  A six question format, which incorporated both technical and functional questions, was developed to organize modification specifications in a comparative manner. The questions were: 1) what would we like to do, 2) what does the current system(s) do in this regard, or how do we handle it now, 3) what does IA's SIS currently have, 4) what alternatives do we have to satisfy the need for this modification, 5) what are the pro's and con's of each alternative, and 6) what is the recommended alternative, particularly in relation to cost, time, and manual impacts. MODS ID Teams, teams comprised of one campus user and one programmer, were assigned to every modification and were charged with compiling responses to each of the six questions for their modification. The most difficult aspect of the questions centered on the validity of the time estimates to complete any particular modification. No satisfactory numerical process was found superior to a best guess approach utilizing experienced users and programmers. All modification six-question write-ups were then studied by campus and central office representatives prior to being prioritized as being either absolutely necessary before turning the system on or not.

- **Phase III - Construct Multiple Implementation Scenarios**
  Four base scenarios were developed by varying the following variables: 1) whether one or multiple data bases would be used, 2) whether one or several independent copies of the SIS software would be used, 3) the manner in which campus differentiation would be handled, and 4) whether or not a phased approach to adding software modifications would be used. PERT (Program Evaluation and Review Technique) models were developed based on the parameters imposed by each of the scenarios detailed as well as the modifications identified

by campus users. A minimum number of set dates were used, thereby preventing the introduction of an excessive degree of slack, or unproductive v.ua time into each model. The models were used to refine tasks and task dependencies within the SIS development and design process and to calculate both pilot campus and full system implementation live dates.

- **Phase IV - Rank Each Scenario in Relation to Impact Variables**
  The final phase included comparing the relative rating of each scenario in relation to the following eleven key impact variables: 1) separation of campus data, 2) centralized reporting, 3) campus reporting, 4) software maintenance, 5) standard data definitions, 6) data redundancy, 7) computer center hardware, space, and staffing, 8) campus staffing needs, 9) interfacing to other system, 10) time to implement, and 11) additional cost. Campus chancellors picked the scenario which mandated the use of one data base and one software copy which included only the modifications identified as being high and medium priority. The scenario chosen showed a Fall 1987 full system implementation date (Gaylord, Helmuth, & Newell, 1985, p. 192)

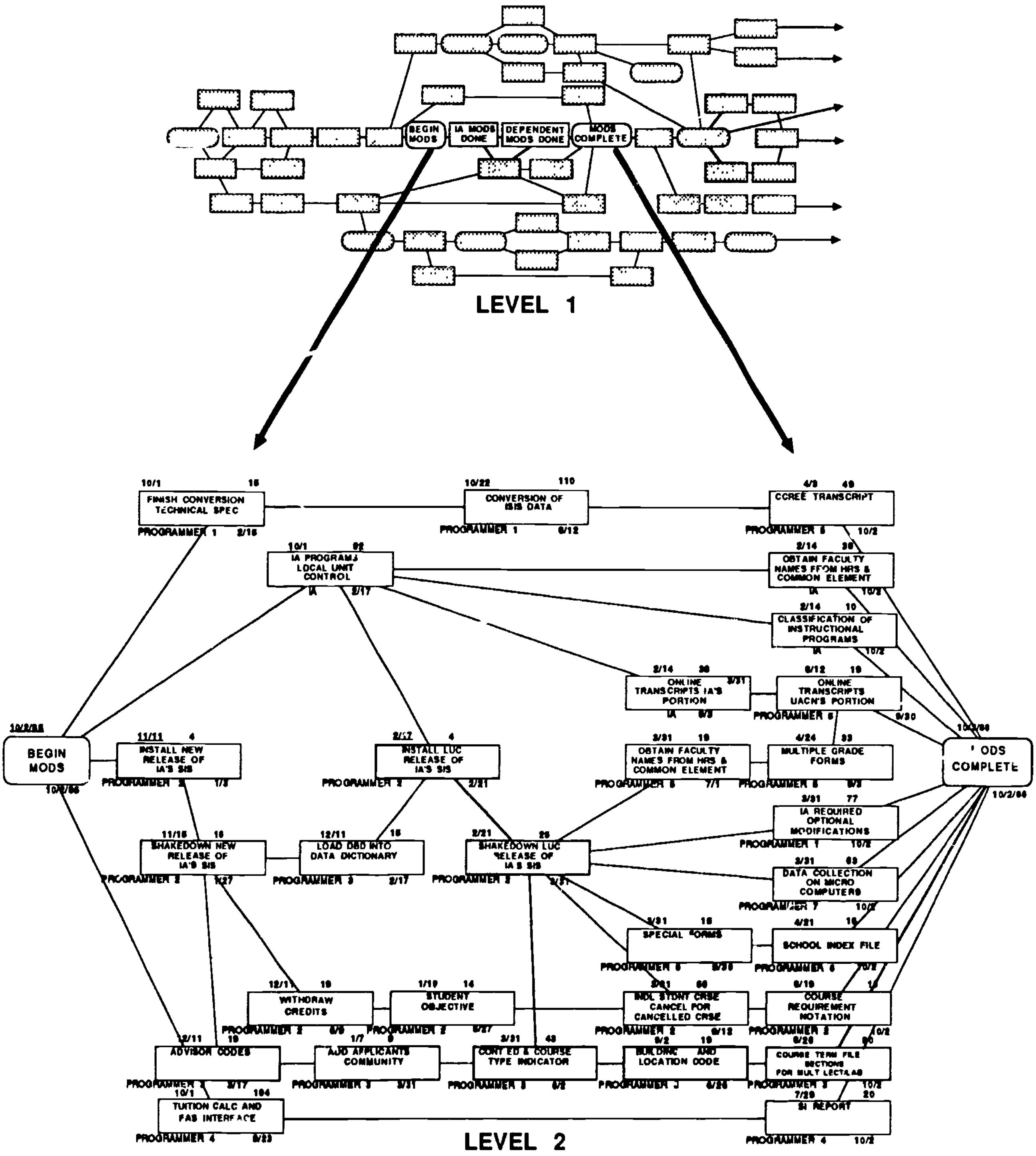
In each phase, campus users were either involved in assessing or designing functional system characteristics and modifications or in the final decisions concerning the project implementation schedule. The approval of the modifications and their descriptions also served as a first step in delimiting functional and technical modification specifications needed by the DP center and consequently helped save considerable time on these and succeeding tasks.

Once this implementation milestone was completed, project management techniques were also used to plan, communicate, organize, monitor, test alternatives, and assess project progress. Figure 4 is an example of how nested PERT charts were used to manage the project. On each task box, starting in the upper left hand corner, are displayed: 1) earliest start time, 2) the time duration in days required to complete the task, 3) latest completion time, and 4) resources assigned or required to complete the task. All PERT systems use a network to graphically portray the interrelationships among the tasks and milestones (key dates, meetings, events) of a project. The network representation of the project plan also shows all the precedence relationships regarding the order in which tasks must be performed (Hillier & Lieberman, 1974, pp. 230-241).

For the SIS project, three levels of PERT detail were designed with different user levels in mind. The first level, the overall project schedule comprised of the highest aggregation of tasks, was targeted primarily for executive administrators, particularly the academic vice chancellors that comprised the SIS management advisory committee, and their need to know the major project events. Tasks at Level 1 were assigned principally to the campus, the data center/IA, or the SIS Office. Level 2 schedules detailed major project tasks by campus and individuals within the data center and the SIS Office. These schedules were targeted primarily to assist campus SIS coordinators and programming managers with planning for major task deadlines. The most detailed chart, Level 3, listed tasks by individual breakdowns and was coupled with a tasklist, or Gantt chart of assignment descriptions, earliest task start dates, latest task end dates, and estimated task durations. These tasklists were used to structure actual daily work assignments for both users and programmers.

The use of PERT for constructing various levels of project planning, control, and scheduling for different degrees of user involvement has been invaluable for organizing the systems development project, testing alternative plans, revealing the overall dimensions and details of the plan, establishing well-understood management responsibilities, and identifying realistic expectations for the project. Taken together, the various levels of task descriptions functioned to provide a structured process in which to ensure maximum participation from and maximum communication to campus users around the

FIGURE 4. NESTED PERT CHARTS



state. The large investment in time and effort needed, paid off in the highest possible user - programmer integration.

SUMMARY AND CONCLUSIONS

The University of Alaska is committed to providing a Student Information System that meets the needs of all University users; to provide for convenient procedures for registering, tracking, and grading students, as well as accessing data to be analyzed for institutional research and planning purposes. To allow this to happen as effectively as possible, UA is adopting a new information systems implementation strategy that emphasizes user involvement. The results of this strategy are beginning to surface. As the SIS project develops, there is a more realistic recognition of the magnitude of the required tasks, rather than a crisis inspired discovery of the same. We attribute this increased user community consciousness to their involvement our strategy requires, and expect this heightened concern to be sustained over the length of the implementation project and beyond. We further expect much smoother progress than had we not gotten users so involved. For example, our revised project schedule, after more than a year into the project, calls for initial processing to occur one or two semesters earlier than was originally forecast. Moreover, we are experiencing greater user confidence in our end product and expect greater user satisfaction to continue through implementation.

The secret: instill a feeling of ownership on the part of the system's users by allowing users to control their destiny.

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Small College Computing on a Shoestring

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Special challenges face small poorly-funded colleges that strive to deliver quality academic computing services to faculty and students. The very successful evolution of computing at Castleton State College is detailed through a case study approach. A brief description of the College and its funding history precedes a discussion of: a) the financing of computer hardware purchases, b) the design of academic computing facilities, c) an effective, low cost model for the supervision and management of an academic computing center and d) other strategies for providing high-quality computing services on a "shoestring budget."

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INTRODUCTION

In the last decade, no curricular or methodological trend has so transformed America's colleges and universities as has the introduction of the computer and degree programs associated with it. The popularity of computing, in fact, as a subject for study and as a tool to be used in other, older disciplines, may be one of the few great common denominators of today's higher education scene. We might actually be hard pressed to find an institution that has not been touched in significant ways by the academic computing boom.

Yet, many institutions have had to fight for a seat on the computing bandwagon during a period when the economic realities of higher education have made it hard to find the funds for expensive additional equipment, personnel and programs. To make matters worse, the country's colleges and universities have had to leap into the computer age at a time when only a limited number of computing center managers were available, who often could set high salary requirements for those who wanted to purchase their services.

All things considered, then, we can be fairly certain that during the last decade many institutions--especially the smaller and/or poorer ones--have found it difficult to make the changes necessary to bring their institutions into the computer age. The purpose of this paper is to discuss how one impoverished, small rural college has met, on a shoestring budget, the challenges of introducing computing into the curriculum and the college as a whole.

The outline for this paper can be found in Figure 1. After describing briefly some of the salient features of Castleton State College and its funding history, attention will be given to the development of computing at Castleton since 1981, including some of the decisions that were made early on. Next, the design, organization and operation of Castleton's Academic Computing Center will be addressed. The Center may, in fact, provide some of the best examples of how Castleton has met the challenges of providing computing services when only a limited budget was available to support such services. Finally, a few issues still unresolved and some looming rather large on the horizon will be identified.

OVERVIEW OF CASTLETON STATE COLLEGE

Founded in 1787, Vermont's first college and the 18th oldest in the country, Castleton was never able to take advantage of its early start as so many of America's old and now great institutions have. Rather, for reasons that are not fully known, it remained a tiny, virtually unknown college, dedicated for most of its history to preparing Vermont school teachers. Eventually, starting around 1960, it undertook a process of deliberate change and grew in a mere ten years from 389 to 1200 students. During this same period, its degree offerings increased from one, namely, teacher training, to about thirty, including most of the traditional liberal arts disciplines.

Today Castleton has essentially the same thirty degree programs--only computing programming, computer information systems and one or two other programs have been added--and enrolls approximately 2100 students, 1400 full time and 700 part time. Most of its students are "first generation college," and the vast majority are enrolled in career-oriented majors like business administration, nursing, communications, education, criminal justice and social work.

Although Castleton remains one of the smallest state colleges in the country, it is big by Vermont standards; and many "Castleton watchers" maintain that this is one of the chief reasons why the institution is and has for some time been poorly funded relative to its smaller Vermont State Colleges (VSC) sister institutions.

In fact, all the Vermont State Colleges are poorly supported. Vermont ranks 49th among the states in public support for higher education, and the budgetary situation of the state colleges is worsened by the fact that Vermont allocates a disproportionately large share of its higher education dollars to a student grant program.

In addition, as was mentioned, because of its size, perhaps because of unfavorable political alliances or perhaps simply because of historical accident, Castleton is funded less well than its sister VSC institutions. Figure 2 reveals that, on a per capita basis, Castleton receives about $1000 less to educate each student than is true for the two other four-year VSC institutions.

Why have I gone into all this detail with respect to higher education funding in Vermont and at Castleton in particular? I did it to illustrate the background against which efforts to introduce academic computing must be considered. Castleton, and presumably many other institutions like it across the country, was quite strapped financially long before it became clear that to keep current, it would be necessary to spend additional hundreds of thousands of dollars of its precious fiscal resources on computing-related expenses.

COMPUTING AT CASTLETON

Castleton is a late arrival on the computing scene. Vermonters say with some pride that their state is at least five years behind national trends; and this seems, if anything, a conservative estimate of the typical lag time. As recently as 1981, Castleton had only three small machines--can you believe, "TRASH 80's"--on its own campus for academic computing.

Now, to be fair, it should be mentioned that since the early seventies a VSC system-owned Harris computer was housed at Castleton and available for use by all VSC institutions for both administrative and academic computing.

(The VSC system Harris computer was sold in 1979-80 and replaced by a Digital VAX system that was installed in a new central computer facility located adjacent to the VSC system office in Waterbury, Vermont.)

But by 1980, awareness of the need for additional computer hardware had grown, and the acquisition of computer equipment became a principal reason for applying for a U.S. Department of Education Title III grant.

Thank God for Grants!

Where would we be without grants? Given the extremely tight budgetary situation described earlier, it is quite possible that Castleton could never have come of age in computing at anything like a reasonable rate if the College had not obtained several important grants, especially its Title III grant.

Many institutions get grants, but few spend their grant dollars as wisely as they could. One of the lessons Castleton's administrators learned from observing the mistakes of other colleges was that it was seductively appealing but budgetarily dangerous to spend significant amounts of grant dollars on personnel and/or program-related encumbrances. Clearly, all grants disappear eventually, and most run out within a "quick-fix" year or two or three.

Castleton decided to make a concerted effort to avoid the temptation of requesting grant support for people and programs--which would most likely disappear and be missed when the grant ran out--and decided instead to seek grant support for the purchase of hardware and "durable goods" which could be used and employed for, hopefully, many years after the grant had expired.

Well, that is exactly what Castleton did, and between 1981 and 1985 the inventory of computer hardware at the College increased, roughly speaking, by a factor of forty or, to put it another way, 4000% , the vast majority of which was purchased with grant dollars.

Mainframe vs. Micros?

When the College decided to seek grant funds for computer hardware, it had to face the choice of many microcomputers or a single mainframe or mini-computer. I will be the first to admit that I do not know enough to participate for long in a discussion of this complex question. And the complexity of the issue is compounded by the fact that, in any given year, new technological breakthroughs and pricing developments may render last year's well-founded conclusions obsolete. But suffice it to say that we at Castleton went back and forth quite a few times on this one.

In the end, what we ended up doing was, I think, the right decision. Although our original grant proposal called for us to buy a mini-computer, between the writing of the proposal and the award of the grant, we decided we would be better off if we took our first long strides into the computer field with microcomputers. Our reasons were the following:

- from a certain point of view we would get "a bigger bang for our buck" or, at least, that many (albeit smaller and less powerful) machines spread visibly around the campus would raise the interest level of our faculty and students;
- having a computing program that was based on micros might allow us to cope more effectively with problems of maintenance, aging and obsolescence;
- some of our faculty already invested in academic computing were oriented to specific hardware and software the functions of which might not be available--or at least would be much more expensive--in the mini-computer we were contemplating;
- the prices of all computer hardware were dropping fast and, if we could postpone the purchase of a mini for a few years,

we would be able to get much more machine for our money at the time that we did make the purchase.

As it happened, our scheme seems to have worked well for Castleton. In the first few years of the grants we were able to receive, we purchased numerous micros of a variety of sorts and more recently added a VAX 11-750 mini-computer. Figure 3 shows the College's recent expenditures on computing hardware.

Centralized or Decentralized?

When it appeared likely that we would be getting the grant funds that would permit the purchase of a significant amount of computer hardware, we had to face the happy issue of where to put it. The three principal options seemed to be either 1) to centralize it in one large computing center, 2) to establish a series of smaller centers or labs in some of our major academic buildings or 3) to spread it quite fully around the campus.

While most faculty wanted the equipment available at their fingertips, a faculty/administrator committee recommended the centralized approach.

Their reasons were:

1) security; the more widely distributed the equipment was, the more difficult it would be to keep it secure;
2) access; recognizing that security was a concern and that the equipment should be monitored, the committee saw that, with limited resources, students would be provided far more hours of access if most or all of the equipment was located in one facility thereby permitting a single, rather modest, budget for monitor wages;
3) service to students; as with access, given the limitations of our budget, centralizing the equipment would make it much more affordable and thereby possible to provide trained tutors to assist users;
4) stimulation; the committee wisely foresaw that pulling together computer "jocks" into a single center would have a synergistic educational effect as students and faculty, working side by side, got interested in each other's projects and learned from their peers.

In fact, from the start, the model we developed called for locating some hardware outside the Center to create "teaching stations" in each of the major academic departments which provided extensive computer instruction, especially mathematics, business administration and education. In addition, as our inventory grew, we became more willing to develop "satellites" of the computing center, but the commitment to centralization as the dominant approach has worked well for us.

CASTLETON'S ACADEMIC COMPUTING CENTER

As was indicated earlier, it may well be that, from the point of view of "computing on a shoestring," Castleton's approach to establishing and running an academic computing center may be the most noteworthy of the projects about which I am able to report.

The data presented above clearly showed that Castleton was poorly supported. In terms of the support that was available for staff and administative services, in fact, Castleton has about half of what her also very poorly supported (by national standards) sister institutions have. Needless to say, therefore, that over the years, many of Castleton's administrators and staff have worn many hats as it became necessary to divide up numerous functions and responsibilities among an inadequately small number of administrative personnel.

It was a surprise to no one at Castleton, then, when, with the arrival of computing, the responsibility for the oversight of both academic and administrative computing was assigned to someone who already had a rather demanding full-time job, namely the Director of Financial Aid, who was named "computer liaison."

In addition to not being able to support a full-time "computer czar," it became necessary to find a low-cost way to staff the proposed academic computing center. The model that evolved was one that was based exclusively on the services of undergraduate students, all reporting, through a student director of the Academic Computing Center, to the College's Computer Liaison.

Choosing a Site

After the decision was made to centralize computing services rather than have them extensively de-centralized, key concerns to be addressed in identifying a site were security and access. In the end, it was determined that the College library, located close to the center of the campus, could be renovated to provide a safe and easily accessible facility. Since the library was already open and staffed eighty-seven hours a week, it would take minimal additional effort to make sure a computing center located there was open days, evenings and weekends.

In addition, because the College would be installing a large inventory of computer equipment in its academic computing center (ACC), it was comforting to know that the library had long been one of the very most secure buildings on the campus.

Supervision and Oversight

As was mentioned, Castleton's ACC is overseen by the Director of Financial Aid. Certainly, no organizational chart logic would have suggested this, but it came about at Castleton for three reasons: 1) the College could not afford to hire an additional administrator to supervise computing; therefore 2) someone already on the staff had to be found who could do it; and 3) given the need to find an existing administrator to assume the responsibility of overseeing computing, the Director of Financial Aid had both the ability and the inclination to take it on.

While this was clearly an example of "necessity being the mother of invention," it should also be mentioned that this kind of practice may be adviseable generally in organizations. The recently touted Theory Z concept of life-long employment, for example, suggests that much can be gained in terms of organizational continuity and effectiveness by finding ways to move successful employees around within the organization. Certainly, for the individual in question at Castleton and for many others, such a move can be a way of revitalizing one's career and opening up exciting new professional challenges.

ACC Organizational Structure

An organizational chart for the Academic Computing Center can be found in Figure 4. As is seen, the primary supervisor of the ACC Director is the College administrator in charge of computing, namely, the Director of Financial Aid. Secondarily, since the ACC is located in the Calvin Coolidge Library, the ACC Director also receives supervision on facilities-related matters from the College Librarian.

The ACC Director has two student assistants, one whose focus is the day-to-day operation of the Center, the other of whom is primarily concerned with the College's VAX 11-750 and with the interface between computing at the College and the services of the VSC central computer center in Waterbury, Vermont.

In addition to the student managers of the ACC, numerous other students provide valuable services at the Center in two different capacities. Approximately ten students are employed and trained to be Monitors whose function it is to control access, allocate computer time, distribute software, help students with hardware problems and oversee the proper use of all equipment and the Center as a whole. About seven students are hired, technically by the College's Tutoring Office, to serve as Counselors. These individuals provide free tutoring in course work related to computing and are available for help with programming problems and the proper use of software.

Other Staffing Considerations

As was mentioned earlier, the ACC is completely student-run. All individuals are paid at the current minimum wage rate which is charged either to the College's federal work study program (for students eligible for work study aid) or to College payroll.

Since the start of the ACC, the College has been extremely fortunate to have had very well qualified directors and assistant directors even through directors are only paid approximately $2000 for the academic year (for 20 hours work each week) and assistant directors only $1500 for the same thirty week period (15 hours per week). In addition, the director typically receives supplemental contracts for College vacations and the summer, resulting in a total compensation of still only $4500.

It may be no coincidence that all three directors have been what Castleton calls "non-trad" students, namely students older than the normal student age of 18 to 22. Directors have been as young as twenty-four and as old as thirty-two.

The Educational Technology and Academic Computing Committee (ETAC), a faculty/administrator committee, is responsible for making a recommendation to the computer liaison (Director of Financial Aid) as to its choice for ACC Director. Similarly, the ACC Director interviews and recommends (to the computer liaison) regarding the hiring of the assistant directors. Monitors are hired and supervised by the ACC Director; counselors are hired by the director of the College tutoring program.

Training

The search for the new director begins in mid-November each year. This permits selection by January and a full semester for training. Twice in the past, the director has been promoted from one of the assistant director slots and, typically, before that they served as a monitor; so that a director is likely to have had at least two years of association with the Center prior to stepping into the directorship.

The computer liaison and the outgoing director train the director-to-be. The director trains the assistant directors. The director and the assistant director also go through an eighty-hour videotape training program provided by Digital. In addition, the staff of the outside firm that manages the VSC central computer system also provides training to the ACC student managers.

Monitors are trained by the director in three sessions; the first of which is a general orientation to the ACC, its philosophy and services. The second and third training sessions tend to be hands-on introductions to a variety of equipment, functions and operations.

Other Issues

Needless to say, running an academic computing center with only part-time student employees who are paid minimum-wage salaries poses some significant and exciting challenges. The key, of course, is getting and keeping good people, and that seems to be mainly a matter of incentives and rewards.

For reasons that undoubtedly are not all known (and that may include a fair bit of luck), Castleton has been quite successful in attracting and motivating many very capable and deeply committed students. There is, in fact, a very positive and palpable esprit de corps among the ACC student staff. They take their work very seriously, clearly feel proud to be on the staff and, probably as a result, are often willing "to go the extra mile" for the Center.

It may well be that the past practice of promoting-from-within has enhanced morale in an important way. Certainly, the current strong esprit de corps could not have developed if the first few student managers had not been dedicated, high quality people who were excellent role models worthy of emulation. Clearly, many students enjoy tremendously the opportunity to have extensive access to some fairly sophisticated machinery. Others enjoy the respect, responsibility and autonomy.

Finally, it has undoubtedly helped the Center that virtually all of its student managers have been able to land, upon graduation, excellent jobs.

Another issue has to do with the challenge of supervising student managers--even those in their late twenties and early thirties--who have little or no managerial experience. Aside from choosing the directors wisely (from among the available pool) and attempting to build-in effective training experiences as they progress through the ranks, the success or failure of Castleton's student ACC directors ultimately rests on the contributions of one person, namely, their supervisor, the Director of Financial Aid.

Fortunately, this person has worked extensively and with great effect to transform relatively "green" students into computing managers in a remarkably short period of time. Although there will always be some truth to the old saw, "you get what you pay for" and, to be fair, there are problems that arise because of Castleton's "unprofessional" approach to computing management, the College gets a great deal more than its dollar's worth from the expenditure it makes on the ACC each year.

Lastly, we must mention that, institutional costs and benefits aside, Castleton's approach to the management of the ACC has had some outstandingly positive benefits for its students that could not be matched in a college program that enjoyed the luxury of professional computer management services.

UNRESOLVED OR PENDING ISSUES

As we look towards the future of computing at Castleton, some issues are clear:

- We must continue to develop the already well-established esprit de corps of the ACC staff. (The Director would like to outfit them in blazers!)
- Pressure for wordprocessing hardware and software (already extensively available in the ACC) mounts as growing numbers of students move to that mode for the typing of all of their papers.
- The College must consider again the role of satellite computer centers as some academic departments begin to "take off" into the computing stratosphere.
- The issue of networking, both among the various machines on campus and to machines off-campus, has become increasingly urgent.
- We must develop ways to give our students, especially our better students, experience with a broader variety of operating systems, especially UNIX and IBM's. Networking to off-campus hardware will probably be the best response to this need.

But other issues regarding the future remain cloudy:

- How long will our equipment be right for our needs?
- Will we be able to pay the bills of maintenance and equipment replacement without additional large grants?
- If the computer craze mushrooms further, can we continue to meet the computer needs of the campus through underpaid student labor?

Undoubtedly, many other questions will arise as we move eagerly towards our future in academic computing, but anxiety about what may come should not stop us from making the best of the present situation--even if we have to do that on a shoestring budget!

FIGURE 1

SMALL COLLEGE COMPUTING ON A SHOESTRING

OUTLINE

I Introduction
  - rationale for session
  - outline of session

II Overview of Castleton State College
  - brief description
  - "lean" budgetary conditions

III Computing at Castleton, 1981-present
  - use of grants to acquire equipment
  - mainframe vs. micros
  - academic computing - centralized or decentralized?

IV The Academic Computing Center (ACC) at the small college
  - choosing a site/location
  - issues of supervision and oversight
  - organizational structure of the ACC
  - staffing the ACC
  - training of student staff
  - educational support services for student users
  - the development of "satellites"

V Educational support services for faculty

VI Unresolved or pending issues
  - the demand for wordprocessing
  - maintenance, service costs
  - obsolescence
  - other

VII Feedback and open discussion among session participants

FIGURE 2

VSC BUDGET ANALYSIS DATA
FY1986 OPERATING BUDGET

	Castleton State College	Johnson State College	Lyndon State College	Vermont Technical College
<u>REVENUE COMPARISONS</u>				
TOTAL GENERAL OPERATIONS REVENUES	$7,301,895	$5,527,329	$5,354,290	$4,626,821
FULL-TIME EQUIVALENT STUDENTS	1,565	987	900	641
REVENUES PER FTE STUDENT	4,666	5,600	5,994	7,229
<u>EMPLOYEE DATA</u>				
NUMBER OF FTE ADMINISTRATORS AND STAFF	73.0	69.5	74.8	53.2
FTE STUDENTS PER FACULTY POSITIONS	13.6	13.9	12.7	10.0
FTE STUDENTS PER ADMINISTRATORS AND STAFF	21.4	14.2	12.0	12.0

FIGURE 3

CASTLETON STATE COLLEGE
ACADEMIC COMPUTING EQUIPMENT EXPENDITURES

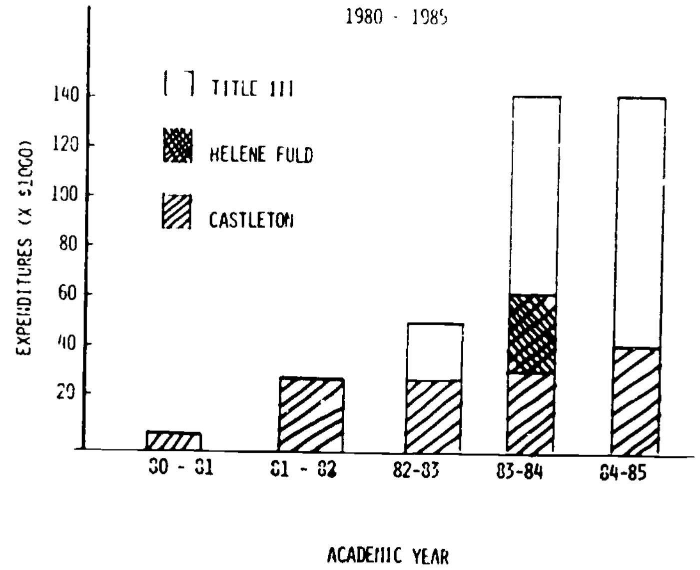
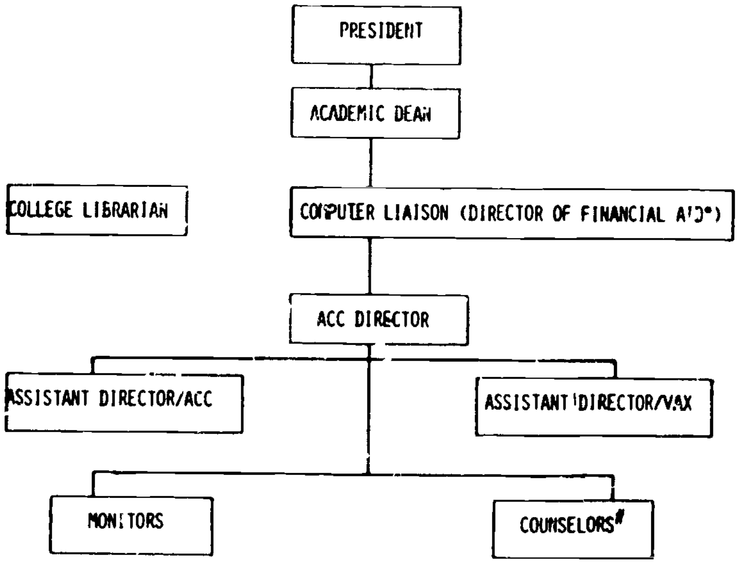


FIGURE 4
ACC ORGANIZATIONAL CHART
CASTLETON STATE COLLEGE



* NORMALLY REPORTS TO DEAN OF STUDENTS

\# ALSO SUPERVISED BY DIRECTOR OF TUTORING PROGRAM

COST REDUCTION THROUGH MINIMAL BIBLIOGRAPHIC INPUT

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ABSTRACT

There is available through various sources, Library Congress etc., a great deal of data about books. It is possible using traditional data processing techniques to decrease costs of information. The Librarians who select the books input a minimium amount of information about the book or better yet copy existing information. Programs can be written to gather information from other sources to expand and update the minimal level of information in the system to improve it`s quality. By using the computer rather than relatively more expensive library the Library Director is able to reallocate resources to other areas of the library.

INTRODUCTION

A library is traditionally defined as a collection of books. In the past several years the function of the library has been changing. Librarians now seem themselves in the information dissemination business. Any meeting of librarians is replete with references to Toffler's Third Wave and Nesbitt's Megatrends.

We in the computer business also see ourselves as being in the information business, but not in the same way librarians see themselves. I would like to look at the relationship of the library and its supporting computer organization. More specifically, I would like to look at how the computer center can enhance library effectiveness and the quality of the information the library prsents, at the same time saving money, using some rather traditional data processing methods.

WHY LIBRARY AUTOMATION?

Probably, the first question that needs to be addressed is why did libraries decide to automate in the first place? The two reasons which are the most commonly given are cost and improved information quality.

In pre-automation days the library paid a very high price for its manual operations. The cost of the books in the library was often outweighed by the cost of buying and processing the books into the collection. Perhaps the largets cost involved in processing a book into the collection is in cataloging a book and producing and filing the cards for the card catalog.

A manual, system by its very nature, requires a lot of paper to order and process books. Because of the number of books bought by a large library a lot of time and money would be spent in moving paper from one place to another. As we shall see a little later the amount of paper generated in the traditional, ordering and cataloging operation is quire large. Paper generally requires two things: people and space. Next to money, people and space are the two items that are in the shortest supply in any institution.

The acquisition and circulation of books are generally the two areas that computing people feel the most comfortable with therefore these are the areas which are done first. The similarities between a regular purchasing system and an acquisition system are great. The same degree of similarity exists between the standard inventory application and a library circulation system.

One of the biggest aids to the general public because of the computerized libraries is the quality of the data in the system has improved greatly. Since the advent of computers library the data is available to the public in much higher quality and much more rapidly available. The use of bibliographic cataloging utilities such as the On-line Computer Library Center (OCLC) has kargeky been responsible for this increased speed and accuracy. OCLC is a computer organization which allows its' members to catalog their holdings and at the same time use this data held at the center to generate catalog cards and receive, if desired, a tape copy of their transactions. This centralized cataloging serves two purposes: it is cheaper for the member to produce catalog cards and the information in the catalog becomes much more standard.

CURRENT OPERATING ENVIRONMENT

Currently, there is available to the average research library a great amount of data about books. This data comes from three major sources: the bibliographic utilities, the Library of Congress, and from commercial sources.

The bibliographic utilities are the cooperative companies such as OCLC which I mentioned earlier. They serve as repositories of data for their members to use. It has been said that companies like OCLC, Washington Library Network and the Research Libraries Information Network are doing an 18th century function with 20th century technology when they are producing catalog cards by computer.

The Library of Congress is the largest cataloger of books in the United States. They receive and do original cataloging for almost all books published in the United States. The Library of Congress makes available through the MARC subscription service their total cataloging output plus output of selected other cataloging organization who are area specialist such as Yale in Eastern European Languages. The cataloging data coming out of the Library of Congress is considered to be the standard for all cataloging done in this country. MARC data is also available for books in British and Canadian format.

There are a large number of commercial databases which do cataloging of bibliographic information. The databases offered by these companies generally deal with journal literature and do not constitute an addition to what is generally thought of as the card catalog of the research library. Many of the databases that are sold by these commercial organizations are in the public domain, these companies are offering access to these databases. The addition of serials information to the card catalog would be a great addition to the information available about a collection.

The advent of the online catalog has dramatically changed the demands put on bibliographic data in the past few years. Some of the old ideas about what was important about bibliographic data have had to change. The sequence of cards in the card cabinet was once considered very important. Now, in the days of the online catalog, there is essentially no sequence. Knowing the proper title or name of the author is not as important as it once was now that keyword sequence searches of the title are possible. There is now no such thing as the main entry with added entries, all entries can be considered to be main entries.

The question then becomes what is the most effective way to keep the library up to date informationally, in the most cost effective manner?

To find this answer we will look at three basic models of library operation. The first is the traditional paper based pre-automation system. The second model will be the post-automation system that is currently inplace in many libraries where there is little integration of computerized function. The third model will use the data that is available from outside sources too keep the data in the system up to date.

PAPER BASED SYSTEM

The paper based library is the traditional library prior to the introduction of automation. All work is done on paper and original cataloging is done for each book that is received by the library.

The flow of work through an acquisitions and cataloging system would look something like this. The person who is responsible for selecting books (called the bibliographer) determines which book he wishes to order. The bibliographer would fill out a multipart form listing the important information, author, title, about the book. This form would be sent to the Acquisitions Department. In Acquisitions the librarian would check the validity of the information about the book and make necessary corrections before the purchase order was sent out to the vendor. The order then could be filed in either of one of two ways, by vendor or by the date that then order was expected to be filled. The order by expected date of completion would allow for claiming of books that were not shipped to the library. The sequence by vendor would allow the Acquisitions department to quickly review the status of books in a particular department.

When a book is received the two copies of the order must be pulled and readied for payment. The books is then passed to the Cataloging Department. The Cataloging Department analyses the book and types the cards for the card catalog and the shelflist. Once the cards are typed they are filed in the card catalog and basically forgotten until the book is withdrawn from the library's collection.

The three biggest problems with the traditional paper model are: 1) the system is very labor intensive, 2) there tend to be great backlogs involved, and 3) it is difficult to tell what is happen to individual ordered items. At every step of there processing system there must be something done by a person, like typing, filing or collating etc. Because a human can only do so much work there is a tendency to have large backlogs in this type of system, if one person is absent the entire systems could become very bottlenecked. Finally, to make a report of which books have not be received from a given vendor yet would be a difficult undertaking as every order from the vendor would have to be gone through or a separate sequence of the file would have to be set up.

COMPUTERIZED DATABASE MODEL

The integrated database model is useful after the library is fully automated, but automation takes place on several different systems which do not talk to each other. This is generally the case with most libraries today. For the sake of the model we will assume that the library has an acquisitions system, a cataloging system through one of the bibliographic utilities and a circulation system installed.

The bibliographer would again decide on a book to acquire. He would then type in the desired book information into the computerized acquisitions system. The job of the acquisitions librarian is to still confirm the validity of the data. Once the validity of the data was correct the system would ready an order and the order would be sent out. There would be no need to file the order requests as they can be processed by the computer for claiming or other purposes.

When the book was received at the library the receiving clerk would look up the book on the acquisitions system and mark it as received. The computerized system would then generate all applicable payment information. The book would then be sent to the cataloging department.

The Cataloging Department would look for the book on the database of the bibliographic utility and request a copy of the data regarding the book be forwarded to the library. When the data is received from the bibliographic utility it would be entered into the cataloging system for use. Once the data has been entered into the database it can effectively be forgotten. Although it might be said that data in machine readable format is much easier to manipulate than data on paper.

The computerized model eliminates one of the difficulties of paper systems. Reports are telling the status of any of the data in the system are much easier to get because the data is available to the computer and therefore can be more easily reported. Secondly, the amount of physical work done by the staff is lessened because there is less time spent in things like filing and the generation of reports. The major point is that the quality of the data entered into the purchasing subsystem is not substantially better than the data that is entered into the manual system. It is this question of the quality of the data that the Early Data Entry model serves to address.

EARLY DATA ENTRY MODEL

The early data entry model is built around the idea of entering as much high quality data into the system as possible as soon as possible. This system takes advantage of the large amounts of data currently available to the library through the Library of Congress Subscription Service.

Data from the LC cataloging tapes is selected for entry into the system. The data is analyzed to insure it is in the language set, intellectual level and areas of interest collected by the library. The data that is selected is placed in a queue that is personalized by area of interest for a bibliographers expertise. The association between the record and the bibliographer can be made through the use of the LC call number which directly related the title and the subject of the book.

The bibliographer then browses through the pre-selected queue of books making buy no-buy decisions for given books, Ift the decision is not to buy the title information is discarded from the system. If the decisions is made to buy a book the data from the queue is used to build the order as the required information is already resident in the computer. This data is then sent to the Acquisitions Department for order processing.

In the Acquisitions Department the acquisitions librarian has little need to check out the information as it is already the highest, Library of Congress, quality available. At order time, the book is in effect cataloged. If the system in which the librarian is working is fully integrated when the book is ordered the information about the book is available on the online catalog. If it is available on the online catalog then it is available to all users of th system.

When the book is received, the notation of the fact can be made in the system. In most cases, there is no need to catalog the book again because the cataloging is done. For cases when the books needs to be cataloged, for back orders and the like, the cataloging procedures of the fully integrated model would be used. In the integrated model the circulation data is also available to the online catalog.

When a set of LC cataloging comes into the library it can be run against the data that is already in the system. This will allow the latest cataloging to be found. This late cataloging will then be placed in the system.

One of the major pluses of this type of system is all data coming into the system for the various sources can be used to upgrade the quality of the data already in the system. A hierarchy of cataloging quality could be set up so that the computer would tell which data to overlay with which data. If the University of Georgia cataloged a book and then the Library of Congress, at some later time, cataloged the same book the data from LC would be considered to be of better quality and should overlay the UGA cataloging. It is a common practice for publishers to catalog their books which are to be published in a procedure known as CIP (cataloging in publication). This information is found on the verso of the title page of almost all books. This data is known to be inaccurate, for example part of the proper form for the author is the birth date. It is surprising how many authors don't want their birth dates published. LC, generally, at sometime after publication updates the CIP data with their official cataloging. This system would allow the new data to come into the system as it became available.

This method either cuts to a considerable degree or eliminates the three problems cited above in the paper system. The amount of physical and intellectual work done by the library staff is greatly reduced because the computer is doing the majority of the work. The only backlog which would develop in this system is at the point of acquisitions processing if the acquisitions librarian were not able to carry out her function for some reason. Data about the data in the system is available as it is the computerized model above.

BENEFITS

There are four main benefits from the early data entry model. The data added into the system is of the highest quality as it is taken from the Library of Congress copy.

Secondly, data that is in the system is constantly being updated with higher quality data as it becomes available.

Thirdly, the cost center allocation of funds can be changed from technical services to other departments where needs exist. The use of computerized input frees up people and therefore funds because there is less manual work which must be done. Often this change would be to put more librarians into contact with the general public so they could use the library more effectively.

Finally, the patron is well served as information about the book is available sooner, from the time the book is ordered until the time when the book is withdrawn from the collection. This information is of the highest quality.

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SO NOW YOU'RE A TELECOMMUNICATIONS MANAGER

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Abstract: This paper provides a brief overview of the management and planning issues which confront higher education institutions in the area of telecommunications. It is aimed at information systems managers who have a technological orientation but may not be sensitive to the specific issues of telecommunications.

It includes a brief, high-level review of how recent legal and technological changes have affected telecommunications management. The focus is on management issues such as coordination, cost control, functionality, flexibility, and relationship between telecommunications and management information systems.

It concludes with a proposed action plan to assist an institution in reationalizing its telecommunications services.

So ... Now You're a
TELECOMMUNICATIONS MANAGER

To paraphrase Charles Dicken's description of the French Revolution, "It is the best of times; it is the worst of times." We who are involved in data processing and information systems have finally come to understand microcomputers and office automation. The democratization of computing has introduced a new dimension for our services -- the widespread sharing of data and its use for decisions at all levels. We now encourage decision support systems and "fourth-generation tools." The ancien règime of traditional data processing is dead.

But now we are asked to confront a new set of technological issues. Because of our successes in weathering the microcomputer revolution and a new respect for our technological wisdom, many institutions are now turning to their information systems professionals to help in understanding the new opportunities emerging in telecommunications. Many of us, either formally or informally, are becoming telecommunications managers.

Telecommunications is a new infrastructure that brings people together. It is as important to our society today as was the nineteenth-century railroad or as is today's interstate highway system. Organizations rely on information -- both information generated internally and information available from outside sources. Telecommunications has become a complex technology, driven by complex politics and influenced by complex policies and regulations.

Simply put, telecommunications involves the sharing of information over a distance. In addition to voice communications -- telephones -- it encompasses data communications, video (and radio) transmission, and image processing. Until recently, these have been supported separately. Telephones, xerographic equipment, TV antennas and cable systems, and data networks have rarely been coordinated or integrated.

Technological innovations and a new legal environment present new opportunities for increased effectiveness and efficiency in using information, but they also make it very confusing.

The Technology

This confusion is a major reason why many higher education executives are turning to their MIS managers for guidance in telecommunications. Data processing professionals are used to dealing with complex technological issues.

Some of us follow the new technology: fiber optics, Tl lines, PBXes (Private Branch Exchanges), satellites, microwave communications. We hear the debates over baseband vs. broadband networks, and probably are hopeful that the new advances in the use of twisted pair wire for high speed communications will minimize the need for extensive recabling of our campuses.

IBM's recent moves in networking give good insight into the problems facing the telecommunications manager. First IBM announces a "cabling system" which is incompatible with its own products, but which it says will be the backbone of IBM's future product strategy. This is a coax system, meeting different technical specifications than those used either in existing IBM coax-based products or in common third-party systems. Then IBM announces the PC-network, its flagship local area network. Of course, it is broadband system, using coax, but not compatible with the IBM Cabling System. And now it announces a token-ring network as the new product of choice.

Especially since deregulation, the number and scope of vendors has mushroomed. There are "full-service" vendors who will provide you with all information systems and telecommunications, neatly bundled. There are special service vendors; there are consultants; there are vendors with specialized products. Choosing vendors carefully is critical in high-tech areas, and the choices are not easy.

The Decisions

There are a lot of decisions to be made in telecommunications. Some are simple cost analysis questions: should the college buy or lease its telecommunications equipment.

Some have to do with whether the college should "go it on its own" or use a public service provider: Centrex or private switches. Just as we begin to believe that Centrex systems will give way to private exchanges, the Bell Operating Companies begin an aggressive campaign to make Centrex systems both cost effective and attractive.

Questions of technology are complex, and, surprisingly, often emotionally charged. Generally, except in areas dedicated to R&D, educational institutions should not be experimenters in technology, yet often the appeal of the new technologies, coupled with an institution's self-image as an innovator and leader, lead to daring experiments.

The technology of telecommunications is more complex and more esoteric than that of microcomputing. And the telecommunications manager has the added problem that the layman of 1985 is more aware of high tech than ever before in history. A few ads from ITT on fiber optics and the wonders it represents can lead a college president to decide that fiber optics will solve his telecommunications needs.

These kinds of decisions are not trivial -- we are talking big bucks. The average college in the United States spends between one-half and one percent of its total budget on telecommunications. This cost generally provides only basic service -- it supports telephones and computer terminals. The scope of service will increase dramatically over the next five years. Office automation will increase the volume of data exchanged and the number of access points; the increased use of graphics will expand the volume of data in each transaction; and the rise of video and image transferring will result in a qualitative leap in capacity requirements.

It is probably not unreasonable to project that the telecommunications requirements in our colleges and universities will increase five-fold in the next ten years. This does not mean, however, that telecommunications costs will increase five-fold.

Consultants to the Fortune 1000 companies maintain that, today, the average American business is spending nearly twice as much on telecommunications as it needs to. Most consultants feel that the implementation of sound business planning, properly selected equipment, and personnel efficiency measures can cut the current figure in half. And as technology continues to evolve, even greater efficiencies should result. It is not unreasonable to suppose that the greater telecommunications needs of the 1990s can be met with budgets that are not too dissimilar to today's budgets. But it will require work, leadership, wisdom, prudence, and good management.

Historically, data networks have been the province of data processing management and all other telecommunications has been handled by a separate office. But as access to computing becomes more widespread, and as the technologies supporting data communications and other telecommunications come together, the distinction between management information systems and telecommunications is rapidly disappearing. There is a now a "spectrum of technology." Where, for instance, does electronic mail fit into the traditional organizational structure? Electronic mail often is implemented on a mainframe or minicomputer -- traditional data processing activities -- but functionally more resembles telecommunications than computing. More and more, computing networks and telephones share facilities; the PBX is really a computer.

As the technology of telecommunications becomes more complex, and the scope of telecommunications expands, the management of telecommunications comes more and more to resemble the management of information systems. It is not necessary -- and often it is not organizationally appropriate -- to merge management of telecommunications with management of information systems. Nevertheless, the interdependence of the two requires increasingly tight coordination. There is a convergence of management. The "hi-tech management team" must support traditional data processing, telephones, electronic mail, office automation, video and image processing, and decision support. It is important to recognize that the use of communications lines for data exchange is different from the use of those same lines for voice. The telecommunications manager must increasingly come to understand data communications; and in today's sophisticated environment the telecommunications manager probably manages several computers.

The Danger Signals

How does your college measure up in telecommunications management? Maybe you think you're fine -- if so, great -- but, let me suggest some danger signals that indicate that your college may in fact lack good management and planning.

Obviously, the first is telecommunications systems which do not meet your needs. They cannot be expanded to add additional users; they cannot support required functions; or plans to expand functions are stymied by telecommunications support. These problems may be articulated in very specific terms: no additional trunks are available in the Science Building or the cost of a microcomputer lab is excessive because of the cabling costs for the local area network. Users complain because of extended downtime, and maintenance complains of high maintenance costs. Response times may be excessive. Dial tones may be slow and circuits noisy. Too often callers from the outside get busy signals or cannot reliably get messages to faculty members because phones ring in empty offices or at non-responsive "message centers."

Conversely, you may have under-utilized resources. While lack of capacity and resource is usually obvious -- users complain -- excessive capacity is often invisible. Nevertheless it costs. If you have distinct telephone and data networks, you may well have idle capacity that could be used more efficiently. Do you have enough WATS lines so that they can handle all the calls made at 1:00 when administrators return to their offices and all, simultaneously, decide to call their colleagues across the country? Perhaps you bought this excess capacity in anticipation of future growth. The danger is that by the time you need that excess capacity the technology will have evolved or your needs will have changed.

The telecommunications function within your college should have high visibility. It is a major expense, and an area that will change dramatically over the next few years. Major decisions will be made, either through conscious action or through inaction. Priorities for telecommunications should be a function of institutional needs, not local ambitions. The decisions will affect the fundamental way the institution administers itself and even will permeate the educational process itself. Previously, institutions had little control over the costs for telephone systems, and the costs for data communications were not substantial; now institutional decisions on functionality, systems, and vendors can result in savings of millions of dollars over a few years. If these decisions are left to low echelon managers, often with little technical savvy, the college runs a grave risk.

There are several hallmarks of good management. There should be sufficient capacity and appropriate functionality. Clear management reports should indicate performance levels, costs, and usage statistics. An effective plan should be based on an analysis of current capacity and a detailed assessment of future needs. Telecommunications requirements should be an integral part of institutional planning. Information systems plans and telecommunications plans must go hand-in-hand.

Surprisingly, even with relatively simple telecommunications systems there may be significant hidden costs. Telephone circuit installation costs may may come from departmental budgets rather than the central telecommunications budget. Local area networks and data communications for departmental computers rarely show up as a telecommunications cost -- and personnel costs for supporting data networks may be buried in departmental budgets as well as the budget for computing services. Cabling is probably done by facilities, and equipment may be procured from operating funds or even supplies budgets.

As telecommunications technology advances, the college needs some one or some group who keeps informed and is able to make technical judgments. You undoubtedly have specialists with expertise in specific areas but perhaps lack a technical specialist to provide consultation to management. Technical expertise is increasingly important as telecommunications functions grow and as options expand.

Telecommunications for an institution must be viewed as a global, strategic issue. Dealing with vendors, for instance, is becoming increasingly complicated. Not only are there more vendors out there, but the systems being offered are more complex. Multi-vendor environments are becoming increasingly common, and with them comes the requirement for more expertise in understanding how different products relate and how to establish performance criteria. Someone needs to understand the entire telecommunications system, for the entire institution, in order to make the most intelligent decisions regarding specific applications for specific users. In a well-managed telecommunications function, there is a central office to handle vendor relations.

Telecommunications is sophisticated stuff. Properly made, a procurement decision involves evaluating the need, identifying all suitable products, developing selection criteria, performing a financial analysis of return on investment, preparing an RFP, evaluating vendors and their ability to service the equipment, supervising installation, etc. These are not tasks for amateurs, no matter how well-informed they may be. And even if there are professionals within user departments to perform these activities, decisions cannot be made in isolation. New systems must be compatible with existing systems, and management should be alert for ways to share resources. Decentralized management can lead to duplication and costly attempts to interface products with different technologies and from different vendors.

It is obviously one thing to lay out the possible problems with your current telecommunications management. It is quite another to tell you how to solve them. It would be an oversimplification to suggest that there is one ideal answer to fit every college and university. Institutional preferences for centralized versus decentralized operation, existing organizational structures, size, magnitude and types of telecommunications requirements -- all of these are major factors in developing an appropriate telecommunications function. But I can suggest a few ideal guidelines.

As with computing, it is important to establish fundamental criteria to be used in evaluating a technology, a project, or a system. No matter how appealing a technical solution may be, it should not be implemented unless it serves the functional needs of the institution. There are four criteria to keep in mind:

o	Effectiveness:	Doing the right thing
o	Efficiency:	Doing the thing right
o	Volume:	Getting the most out with the least in
o	Value:	Progress towards objectives

Every purchase of telecommunications equipment and service, and every decision that bears on telecommunications in any way, must be evaluated as a business decision. There must be reporting and planning processes that ensure a business approach.

For effective, efficient, valuable telecommunications, the institution must have a coherent investment policy based on careful analysis of needs, adequate planning, building upon institutional strategic plans, clear priorities, and effective coordination. These are the hallmark of a sound telecommunications organization, just as they are the hallmark of a sound management information systems organization.

Developing the Business Plan

In the corporate world, any operational function as important as telecommunications would be guided by a formal business plan. This plan indicates the basic goals and objectives to be achieved, the strategy to be followed, the organization, the resources required (and revenues generated), and the criteria to be used to evaluate effectiveness. I think we all recognize that higher education must be administered as a business, and telecommunications in higher education is just as viable a candidate for business planning as in business. There are several overriding issues which should be included in the Telecommunications Business Plan.

No progress in telecommunications can be accomplished without first establishing an institutional commitment to effective telecommunications. Institutional commitment begins at the top. Senior management must become involved. One possible way to develop an effective institutional commitment is to establish a Telecommunications Task Force made up of senior deans and chaired by the Vice President of Information Systems or the Vice President of Administration. Perhaps another vice president or two should also be included. This Task Force should include technical experts and representatives of user groups. The committee should be constituted in such a way that the members include technical savvy but are not committed to incumbent technology. The issue is to meet current and project needs, not to continue current practices.

Another way to achieve an institutional commitment is to hire a consultant who reports to the President or a senior vice president to review the institution's telecommunications needs and systems. Many institutions feel that the objectivity of an outsider is worth the investment. If you already have an experienced telecommunications expert within your organization with a broad view of institutional operations, he or she can be the focal point for the process. The who is less important than the what.

In any event, an institutional-wide review of telecommunications may well encounter resistance. There are probably several local telecommunications projects already in place -- local minicomputer systems and local area networks; perhaps even a telephone switch -- and their managers will be strongly committed to these operations. An institutional review of telecommunications represents a threat, perceived equally strongly by those whose operations have been working effectively as by those who have developed inefficient management empires. But strong and supportive senior management involvement can simultaneously highlight the importance of this review process and ease understandable tensions among telecommunications personnel.

The objectives of this review are to identify all telecommunications functions, to evaluate costs and performance, effectiveness, staffing, etc., and to develop a comprehensive plan for future expansion and capital investment. Inventory current activities, systems, and needs. The first step in such a review is to inventory all existing telecommunications and systems, even those not supported by advanced technology. This will involve reviewing phone call records and bills, data networks, communications traffic volume, performance reports, man-hours reported in support of telecommunications, etc Even if the institution currently uses Centrex, a surprising amount of data can be collected and analyzed from data tapes which can be provided by the telephone company which details each call made.

The entire communications structure within the institution must be reviewed. A realistic and accurate assessment includes not only electronic telecommunications but communications of all types. There may well be areas lacking electronic communications which ought to be supported by technology. Changes in the regulatory climate and technological innovation have had a profound affect on office operations, data sharing, and computing. Offices which physically exchange data by diskette or paper must be evaluated as part of the communications review.

As a part of this review process, look for redundant communication networks where multiple circuits run along parallel paths or where two or more systems provide similar, or identical, services. Look for idle or underutilized resources, phone lines or computers that are operating well below capacity for no apparent reason. Look for old technologies that might be candidates for enhancement or upgrade to ensure that you are getting the best performance for your dollar.

Establish the total bill for telecommunications, including dollars spent in specific user areas which users may be reluctant to acknowledge. That physics lab with the sophisticated local network cannot be ignored any more than the bookstore computing system or the automated library network. You cannot make accurate evaluations for cost/benefits without complete information.

After completing the review of current activities, systems, and needs, reassess them in terms of current technology. Be careful in this review to not be taken with the glamor of new technology for itself. Except in its specific research context, higher education institutions should not typically be in the forefront of experimentation. Few colleges or universities have an R&D budget in terms of their own operation. Keep the actual needs of your institution always in mind. Do not choose fiber optics unless it is really what is needed to meet institutional objectives. Keep in mind, however, the overall direction of the technology. Centrex may appear less expensive today than a private branch exchange, but analysis of future costs and expected reliability may well suggest that investment in one or more switches is justified.

After these inventories and assessments, the task force or the consultant or the designated telecommunications manager, in conjunction with the telecommunications experts, must work closely with the institutional strategic planning team. Telecommunications planning, like information systems planning, cannot work independently of strategic planning. It is not uncommon to discover during a review of institutional needs for information systems and telecommunications that the institutional strategic plan is inadequate. The role of computing in instruction, especially, is often ill-defined; and that role has profound impact on both information systems planning and costs, and on telecommunications activities. If the college plans a widespread, integrated office automation environment, with powerful decision support systems, it must prepare for it in the telecommunications plan.

A good technique for getting the telecommunications function organized is to develop a short-term telecommunications improvement plan, a stabilization plan, if you will. Determine an interim organization for the telecommunications function, and decide who will be assigned to it and where it will report. This may require adding new personnel or reassigning personnel. If the institution lacks qualified technical personnel, it is especially important to get started quickly because finding and/or training technical people is a long process.

This short-term plan should focus on service problem -- pain points within the organization. This may include both inadequate service to users and high costs which can be quickly reduced. It is probable that a good inventory of current activities revealed areas of concern, areas with excessive downtime or inadequate capacity. Addressing these concerns, while reducing costs, will gain quick credibility for the project. Usually, a little good management coupled with senior-level commitment can make significant progress in six months, and will convince doubters of both the degree of institutional commitment and the worth of the process.

It is important during these first months to identify goals which can be met and to establish credibility. Keep commitments within reason. Identify clearly what goals will be met publicize the successes. A part of this short-term telecommunications improvement program is to develop a long-term plan. This plan should address goals and objectives, priorities, organization, time-lines, strategies, and resource requirements. This short-term program should be a model for the on-going activity. Success in the short-term plan is the best groundwork for long-term success; but problems in the short-term mean problems in the long-term.

Implementing the Organization

The final step in the Telecommunications Project is establishing and implementing an ongoing organization to support and manage telecommunications. The Task Force, or a senior management figure who has been given responsibility, should prepare recommendations for a long-term management organization for telecommunications. Part of the task is to establish good rapport with all user areas, and the long-term management structure must fit both the institutional culture and ensure high user confidence. The long-term management structure for telecommunications should reflect strong central control or support substantial departmental autonomy as appropriate. But I strongly advise that decision process for telecommunications reside in a single group with the resources, authority, and expertise to make them.

The ideal telecommunications organization is centralized. All telecommunications issues should be handled in one office, and these issues include planning, engineering, performance, operations, maintenance, and procurement for both telephones and data communications. In addition, it has top-level visibility ideally with a direct reporting relationship to senior institutional management. Telecommunications is a critical and expensive business. There must be a good on-going planning process, and management and budget controls to ensure that decisions are made and implemented in a cost-effective manner. The telecommunications office must not only handle the day-to-day mechanics of running your systems and switches and networks, it must also provide a support structure for the entire institution's communications purchases.

This management structure (Telecommunications Department is a good working name) should have responsibility for planning, for implementation, and for operation of all institutional telecommunications. It should be headed by a Manager of Telecommunications who should be a senior person within your institution, on a par with the Manager of Information Systems, reporting to a Vice President. During the start-up phase, particularly if the institution expects to make a heavy capital investment, this manager might report even directly to the President of the College. The key is to ensure that the telecommunications function reports at a high enough level to receive the visibility and support it needs from senior management.
The individual serving as Manager must be thoroughly knowledgeable of telecommunications technology. But she or he must be far more than a technician. The Manager serves as part of the institutional planning team, and must be involved in making and implementing college policy. There are very few trained telecommunications managers around -- hence the job often falls to the Manager of Information Systems. This is fine, as long as the Information Systems people recognize that Telecommunications is more than Data Communications and give it the prestige and weight it deserves. I recommend that, even if a common person serves as both managers, the telecommunications department remain distinct from the information systems department.

The Telecommunications Department handles all maintenance, operations, and engineering for telecommunications. It provides technical support for all telecommunications, including preparing specifications and configurations, managing acquisitions and systems implementation, and providing operational support and maintenance. In addition, it should provide regular reports to users on performance and administrative reports as they are needed for planning, cost evaluation, and chargebacks and budgeting.

There must be on-going long-range planning processes to ensure that telecommunications services meet future needs. A regular cost/benefit evaluation process, technology assessments, a futures planning function to anticipate new needs and new products, and regularly updated capacity plans are the essential elements.

There should also be a mechanisms for monitoring performance and costs of telecommunications and for reporting relevant information to user departments and to senior management. Telecommunications is no different from any other business function; without good controls there is no way of evaluating effectiveness and improving efficiency.

Most importantly, the Telecommunications Services Department must be prepared to provide effective user liaison, working with users to resolve problems, to prepare feasibility studies for enhancements and new applications, and to assist the users in all phases of planning and operation. All the control mechanisms and management structures in the world can be rendered ineffective by a lack of cooperation. This user liaison function will be especially critical with information systems personnel, both administrative and academic. There can be no faster way to vitiate the effectiveness of the Telecommunications Services Department than to have the instructors and researchers using computing frustrated because of non-responsive attitudes. Despite the obvious overlap, or more likely because of it, computing people often have the greatest distrust of telecommunications people.

Building on the Telecommunications Organization

Telecommunications is expensive. A higher educational institution can easily spend one percent of its total budget on telecommunications -- this can amount to millions of dollars in the larger universities. But deregulation has opened the door for a very interesting possibility for financing the institution's telecommunications bill. Think about your institution, its physical layout and clienteles, and its place in the larger community. You have new opportunities to plug into national networks, to take advantage of consortia developing TV courses, and to get closer to your sister institutions in your city and state.

Colleges and universities which provide dormitory housing for students or staff can now provide telecommunications services for their residents. Simply put, it means that the university can become the telephone company for the people living in university housing. Obviously there is extra cost in wiring the dormitories and providing service, but charges to students can help pay off both the incremental additional costs and some of the initial capital outlay for campus switches and systems.

As you confront the issues of telecommunications, and the need for telecommunications planning, you will quickly realize that the best time to prepare the physical plant for telecommunications is when it is built, or remodeled. You should never let any building renovation project occur without a thorough review of your telecommunications capabilities and plans.

Especially when buildings are being remodeled, consider integrating voice, data, video, and image data. Security systems, fire detection systems, and energy management systems are all part of the school's telecommunications activities. Consider creating what are often called "Smart Buildings" which come equipped with cabling for all telecommunications functions.

Summary

In the near future, most traditional directors of Management Information Systems will be required to become deeply involved in telecommunications, and often will be expected to provide the same leadership and management that they have traditional provided in data processing. You cannot get started too early. Whatever the organizational and political environments which prevail within your organization, I strongly urge you to go back to your schools and begin to address your telecommunications. Meet with appropriate management; assume the role of telecommunications manager or meet with her; begin identifying current problems; and begin planning.

TELECOMMUNICATIONS AT A TWO-YEAR COLLEGE

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Mount Royal College

Abstract: Up until a year ago telecommunications at Mount Royal College consisted of the usual telephone service plus a relatively small number of asynchronous terminals being connected directly to mainframe computers.

The situation has changed dramatically because of new telecommunications requirements such as:

*a major expansion project that will double the physical size of the College;
*the creation of other teaching locations within the city that are distant from the main campus:
*the cooperative development and delivery of CML/CAI programs by the province's colleges using telecommunication facilities;
*the need to link the province's colleges for the purposes of exchanging messages and files;
*the growing tendency for staff and faculty to work out of their homes; and
*the increasing need to interconnect on-campus micros.

This paper describes the College's response to the above sudden increase in telecommunications requirements. Specific topics covered include: (1) a summary of the telecommunications service requirements; (2) an evaluation of the available technologies and alternatives to meet these requirements; (3) the basic design/selection decisions; and (4) a description of the work done to date, the lessons learned, and the work remaining.

1.) INTRODUCTION

Mount Royal College (MRC) is a 2 year post-secondary institution in Calgary, Alberta The city's population is about 630.000. and in addition to MRC, there is a University and an Institution of Technology serving a total population base of about 1 million

At present the College has approximately 4500 FTE students To allow for added emphasis on Technology and Community Services there is a $60 million expansion program underway. This should nearly double the student population by 1988-89. and presents major challenges and opportunities

One of the major challenges has been the development of a comprehensive communication strategy To understand the scope and the nature of the challenge it is best to look at **FIG. 1** which shows the MRC network" in 1984-85 At that time, the "network" consisted of very little more than a number of terminals connected directly to two mainframes via a front-end switch (PACX) As a result of new program initiatives the College was soon faced with the requirement to provide communication services in the following key areas

- Linking of personal computers (PC) within classrooms and across the campus
- Connecting distant terminals to the mainframe, that were no longer within the range of direct wiring
- Providing links to other towns/cities for the purpose of remote course delivery (CML-type)
- Connecting on-campus facilities and users to a newly established consortium dedicated to the development of computer assisted learning and located at a distant point in Calgary
- Providing access to the main campus' computing facilities from the recently established Downtown Campus
- Providing specific technical direction to the architects working on the College expansion Since the expansion also incorporates major renovations, a comprehensive networking strategy and plan had to be developed that would facilitate the introduction of new technologies throughout the entire College for many years to come
- Providing electronic mail and messaging services between Mount Royal and other post-secondary educational institutions in the city, in the province, in Canada and on the international scene
- Linking mainframe computers at high speeds o Providing off-site back-up for the increasing number of on-line systems via communication facilities
- Providing easy access to public data bases

The requirements for new services have been and are occurring at a very rapid rate We have had to find an orderly and effective way of moving from a very primitive to an up-to-date and sophisticated communication environment very quickly

The purpose of this paper is to describe what we did and why, in order to meet the above challenges It concentrates on design issues, alternate technologies, management issues, and on installation specifics Hopefully, it will assist people and institutions currently traveling a similar path, and also those who are yet to consider these issues.

2.) WHY A NETWORKING STRATEGY?

The main reasons for regarding **communications/networking strategy** absolutely critical to attaining College objectives are

- Easy and effective access for students/staff/faculty to computing and communications services is (and will increasingly become) essential The network is the means of delivering such services
- The ability for staff/students/faculty to communicate electronically within the campus, the city, the province, the nation and the world is also becoming an increasingly necessary part of being able to do a good job. The network is the means of providing such a capability
- The growing decentralization of computing facilities at the College makes the ability to interconnect users, and to exchange data between computers more and more essential The network provides such a capability.
- The networking strategy defines the nature of the cabling plant in a building Once the wires are embedded in the structure, changes and additions are very costly Hence it is desirable to design a cabling plant that will serve the College well even in the face of technological changes over the years.
- The data and information available from our computers attain their true value, when they are shared, transmitted, exchanged or conveyed. Without a communication network that would not be possible
- Without a communications strategy, the increasing demand for communications services may be fulfilled by the future implementation of incompatible devices, services, and networks Any opportunity to eventually integrate voice, data and video services would be lost, and major inefficiencies would result

3.) FUNCTIONAL REQUIREMENTS

Although the primary and most pressing needs were initially to provide effective communication services within the main campus, it did not take very long to realize that external communications needs had to be considered at the same time We needed a complete solution One that provided for present and future needs, one that could eventually provide data, voice and video services in an integrated form We wanted to cover a range of distances (from very short to very long) with our network The existing investment in communications facilities had to be protected We were hoping to use identical software/user interface at all levels (from classroom to international networks) We wanted to ensure conformance to ISO standards as a means of protecting the future of a potentially very large investment

As a first step in the study, the functional requirements were expressed in user or application oriented terms The emphasis was on data communications, since a good voice network was already in place The result was the list below

- Asynchronous terminal (i e VT100-type) access to mainframes, minis and micros for timesharing services
- Electronic Mail Service within the campus and to other post-secondary institutions
- CML/CAI and graphics development on mainframes and download to micros
- File exchange between micros and mainframes, and between micros and micros
- Easy access to common software (wherever located) in timesharing mode (Spreadsheet, WP, Statistics)
- Word and text processing
- Access to transaction driven administrative applications
- Remote course delivery (CML/CAI) via links to external networks
- Printer, disk, and other resource sharing
- Public DB' access
- Access to computers of other institutions and organizations via packet switched external data communication services
- Connection(1)of·
  - Mainframes and minis (at high speeds)
  - Micros and micro-nets to mainframes and each other
  - Dissimilar micros to mainframes and each other
  - Dissimilar mainframes to each other
  - Terminals (synch and asynch.) to mainframes and minis
  - Off-campus, city sites to mainframes and minis
  - Common wide area networks (SNA, DATAPAC/INSTITUTIONS, DATABANKS)
  - Devices operating at different speeds
  - Terminals, micros to shared printers, disks etc.
  - Modem pools (dial-in/out service)
  - Intelligent copiers
- Delivery of computing/communication services to every office, classroom, and study area
- Provision of a data-link to SL/1 voice PBX
- Provision of accounting, traffic monitoring, usage statistics, and troubleshooting information
  - Protection of sensitive data
  - Voice communication between on-campus users, and voice links to most locations in the world
- Dictation
- Teleconferencing
- Facsimile transmission/reception
- Attachment of RS232 compatible devices
- Provision for a minimum 200% growth in traffic and the number of workstations
- Accommodation of concurrent users, who may be working with several applications simultaneously
  - Ability to run common PC software on the local portion of the network

(1) All 'Connections imply file exchange/sharing initially, and program-to-program communication later (interoperability not just physical connection)

4.) KEY ASSUMPTIONS

It became evident early in the study that we would have to deal with a number of uncertainties, such as the nature of the use of the network, and the impact of new technological developments during the next 5 to 20 years To deal with them, the following working assumptions were made

- The planning period is 3 to 5 years for the initial installation Beyond that there will be a need for reengineering, which should be facilitated by building in flexibility now
- The communication network will be required to serve one main geographical location with links to satellite locations during the planning period.
- There will be one computer centre for large, mainframe equipment Mini and micro computers may be located as appropriate High speed interconnections of all computers will be essential
- Audio, video and data traffic will be handled by separate networks during the planning period Therefore, users may have to work with several terminals (one for each type of traffic)
- The source of audio and video input will be other than the computing network (e g library)
- Access to outside services, data bases, other organizations and institutions will be essential
- The network will be constructed to permit easy and free access for all faculty, staff and students to all of the services
- The network will be under single, unified management, and will conform to accepted international standards
- Only proven and existing technology will be used
- The present SL-1 PBX will be retained for handling voice communications (it may be expanded in size)
- Since future requirements are hard to predict flexibility, and adaptability are critical, and will be provided for wherever possible

5.) CONCEPTUAL DESIGN

We hoped to design a network that would be gracefully upgradable throughout the life of the new buildings. Here gracefully means the ability to adapt and to accommodate changes in size, technology etc., and the ability to provide satisfactory return on investment for each generation of installed components. Thus the network was designed for maximum flexibility, but also for sharing, coordination and effective management

The objectives were to permit every workstation/user free and easy access to all of the network's services at any time, and to permit the addition of new services at minimum additional cost Consequently, the network was designed to accommodate

- Volume increases (more terminals, more locations, more computers, more traffic, higher speeds etc)
- New devices (new terminals, computers, networks different traffic types etc)
- New functions (voice/data integration, program-to-program communication, document/file exchange, dictation, teleconferencing, intelligent copiers etc)
- Incorporation of video (and broadband) technology
- Incorporation of emerging international standards - Relocation of users/workstations
- Organizational changes
- Etc

This will be accomplished by

- installing a common backbone or main network
- prewiring every office, classroom, study area etc. for all three major service types
- allowing for 200% growth in size, speed and volume
- using international standard hardware interfaces to devices, networks, computers etc
- dealing with a vendor committed to providing international standard software
- selecting a technology that allows incremental or gradual growth
- building in "hooks" or "bridges" to potential future functions/applications
- setting the objective of network-independence (i e. applications that do not depend on specific features of the network)
- using identical software and hardware regardless of the size of the network (classroom, building, campus)
- building-in provisions for isolating network segments from each other for purposes of traffic management and security
- selecting a technology that provides proven "gateways" to other networks
- delivering high, CPU-level speeds to every work location
- allowing for a variety of transmission media (coax, fiber optics, twisted pair)

- permitting the connection of devices based on diverse technologies
- selecting a proven technology, supported by a well established vendor who can be relied upon to remain at the forefront of technology

As will be shown in section (6), the alternate approaches considered were
- INTEGRATED VOICE/DATA SWITCH (IVDS)
- DATA SWITCH (DS)
- LOCAL AREA NETWORK (LAN)

The baseboard LAN approach was selected, with the understanding that it would be gradually upgraded to broadband, following 5 (or more) years of operation As shown in FIG 3, the chosen architecture consists of several carefully linked networks in recognition of the variety of needs to be served There is a central, main network or backbone, servicing most of the on-campus users There are specialized subnetworks servicing special users (e g PCs, CAD/CAM etc) The voice network remains as in FIG. 1 and is not shown here Finally, there are a variety of "gateways" linking the College network to a variety of external locations and network architectures Other design features, with special emphasis on flexibility, are summarized below

- FIG 1 depicts the present communication network at the College FIG 3 shows the conceptual design for the proposed network It consists of a main network" or "backbone' to which a practically unlimited number and type of devices and subnetworks may be interfaced
- To extend the length of the network and to cover additional locations, one network segment may be connected to another via transceivers and repeaters
- Devices of established types may be added or relocated incrementally, by simply plugging" into the backbone at the appropriate spot (accomplished by wiring all offices, classrooms, study spaces etc for data, voice and video service)
- New, as yet unknown, devices, will be accommodated if they confirm to 'ISO'-standards and a soon as the vendor provides the necessary interfaces. The fact that the vendor has already interfaced a wide variety of devices, and that it is committed to ISO standards gives the College reasonable assurance
- New types of functions (e g, video) require new cabling (e g broadband) which would replace or be in addition to the "backbone' Bridges" allow for the gradual introduction of such new services, without disrupting the existing network Bridges' also serve to isolate segments, thereby increasing privacy and traffic handling capacity
- Increased speed and traffic requirements must be accommodated by the built-in spare capacity of the backbone. Bridges can also be used to increase the traffic handling capacity The maximum capacity of the network depends on the way the connected devices are used However, based on laboratory measurements, the proposed network should support 1500 - 2000 devices of the present types without degradation in service levels
- Connection to new external networks is accomplished by the use of 'gateways" The key ones of which are already available Any new ones will depend on the vendor's commitment to providing full support for ISO-standards
- The proposed network is uniform and modular in construction This permits identical structure and components to be used at the individual office, the classroom, the building or inter-building levels
- The following is a summary of the key technical characteristics of the proposed network
  - Maximum transmission speed = 10 Mbps
  - Maximum length of one segment = 500 m
  - Maximum number of nodes per segment = 100
  - Maximum number of nodes per network = 1024
  - Number of devices per node = 8 - 16
  - Maximum distance between end points = 2 8 km
  - Maximum speed, with 100 devices active concurrently, = 2 to 4 Mbps

It is difficult to describe the many other design considerations with going into a lot more technical detail The next section summarizes our view of the alternatives, and thus provides further insight into the key design decisions

6). ALTERNATIVES

Two of the alternatives to the recommended strategy have to do with the use of different technologies Others concern changes in scale or vendor and are not discussed here

6.1 INTEGRATED VOICE/DATA SWITCH (IVDS)

This is a sophisticated PBX designed to connect, switch, route etc messages, both, in the form of data and in the form of voice While this technology may well become desirable in the longer term (i e 5 - 10 years), it is not the best solution for the College, because

- it is just emerging from the research stages and doesn t have a long track record

- it has a relatively higher "per connection" cost
- its transmission speed is limited and is not suitable for CPU-to-CPU traffic
    - it requires a separate physical path (or pair of wires) to connect each individual device to the IVDS This often results in a large, complex and hard-to-maintain wiring-plant
- it is controlled by a single, central processor where failure can bring the entire network to a halt
- it would duplicate the functions of the SL/1N voice PBX, to which the College is committed for at least 5 years
- it often doesn't permit data and voice over the same wires, which can double the size of the wiring plant. When there is a single pair of wires, the system cannot receive multiple source signals (e.g data, voice, video) simultaneously
- it provides a physical path between connected points, but does not provide the key user services such as file transfer, remote data access, program-to-program communication

6.2 DATA SWITCH

This is a specialized PBX, designed to switch, connect, route etc data messages only It is the least costly solution for the moment, it is also well proven, and has a speed that is higher than that of the IVDS.

It does require a separate pair of wires for each device or connection, and is based on a centrally controlled design. Most importantly, it provides the physical connecting path, but typically lacks the software based user services, the integration with the user's application software It conforms least to international standards, and is less open-ended It is an acceptable short-term solution

A summary of our view of the characteristics of the three competing technologies is given in Table 1

7.) PHYSICAL DESIGN

The conceptual design of FIG. 3 has to be converted into a practical, physical network This section deals with the installation and implementation considerations The following two diagrams give an overview:

FIG 4 Representation of the conceptual design in physical implementation terms

FIG 6 A pictorial overview of the types, the locations and interconnection of equipment in the building.

Given the above installation outline, the following are specific construction/installation details that we asked the architects and engineers to consider:

- Every location (offices, classrooms, laboratories, study areas etc) should be wired for all three services (data, audio and video)
- In addition to horizontal ductwork, vertical cable risers should be placed between floors at strategic locations.
- Workstation locations should be equipped with connectors to handle all types of traffic (audio, video, data)
- Major horizontal and vertical ductwork should be
    - highly accessible
    - as straight as possible
    - large enough to accommodate cabling for all three types of traffic (6" x 9 trays are adequate)
- Conduits to work locations should, as a minimum, accommodate coaxial cable and up to three twisted pair for each user These requirements increase for other areas such as classrooms, study areas, laboratories, etc, in proportion to the number of users located there
- For large open areas which may be used as study locations, as well as certain large enclosed areas (laboratories, etc.), in-floor ductwork should be installed This will give students the potential of "plugging in" computer based equipment wherever, and whenever, necessary
- Special rooms or "wiring closets" should be located at strategic locations to contain wiring panels and specialized communication devices.
- Closets should be at the intersection of vertical and horizontal ducts, and should be located centrally for the area they are servicing
- Closets must be easily accessible (and the equipment within them must also be easily accessible) as they will be a high centre of continuing activity (servicing, new installations, etc)
- The environment (temperature and humidity) of closets must accommodate sensitive electrical equipment (110V; 100 Watts, 60 HZ; 100 BTU/M)
- Electrical supply to these closets must meet standard specifications for computer equipment (e g isolated ground, etc.)
- Closets should be large enough to accommodate a mixture of
- wiring terminator fixtures,
- controllers for terminal clusters or local area networks,
    - equipment for communication "nodes",

  - specialized, distributed mini-computers, and
  - shared devices for micro- processors interconnected through local area networks (e g drives)
- The "wiring closets" should house connecting and/or switching equipment for all types of traffic (i e data/audio/video)
- There should be at least one "wiring closet" or "node" for each wing of the new building
- Conduit(s) should be provided for an increasing number of incoming data and voice lines near the Computer Centre and PBX-room respectively
- When planning coaxial cable routing, the manufacturer's minimum bend radius (typically 8") should be taken into account
- The network-earth-reference point should be clearly identified The maximum length of the earthwing conductor is typically 45-50 feet
- The coaxial cable may be teflon coated or standard PVC, depending on local building code
- The length of cable between the coax tap point and the device being connected (i e concentrator) is usually limited (150'), and should be considered when designing the physical layout of wiring closets

8.) CONCLUSIONS

We have found that a comprehensive and flexible communications strategy is essential

Once the requirements are expressed in functional, application oriented terms the alternate technologies should be assessed LAN vs IVDS vs DS approaches deserve careful consideration Beyond selection of a strategic approach, the other popular technical questions (e g topology, media) did not seem to matter as much This was especially so, because we decided that there were overwhelming advantages to maintaining a clean and uniform software interface to our present computing environment The other key decision was to call for ISO compatibility Having made these decisions, we could focus our energies on the installation issues In that respect we are still learning, but feel that the concepts of wiring closets, and of prewiring every location for all three major service types were particularly important.

At this point in time, we have connected to other colleges using the public packet switched networks We have installed classroom networks for PC(s) and have tested leased line services to satellite campuses. We are about to link up with BITNET The wiring of the new buildings, the installation of the wiring closets, the completion of the linking of the mainframes etc is still to come

We have learned a lot We think we have made the right decisions, but only the first months of full use of the network will be able to provide the answer Performance, network management, functionality, flexibility etc. have yet to be fully examined through actual operating experience

TABLE 1
THE COMPETING TECHNOLOGIES

	LAN	IVDS	DS
• Transmission Medium Coax,	Twisted pair, fiber	Twisted pair	Twisted pair
• Topology	Bus,tree,ring	Star	Star
• Rated Speed (MBPS)	10	0 064-1 5	1 5
• Switching Technique	Packet	Circuit	Circuit
• Network Control	Distributed	Centralized	Centralized
• Throughput	Function of no of users	Function of switch	Function of switch
• Access Control	1	3	3
• Compatibility with ISO	3	1	1
• Network size	2	3	3
• Computing and User interface	3	1	1
• Incremental expansion	2	2	2
• Support for foreign services, networks	3	1	1
• Cost/connection (Canadian $)	800	1500 - 2000	500 - 600
• Flexibility, Adaptability	3	2	1

NOTE: In several categories above, a numerical rating is used to express our assessment On this scale (3) is best, (2) is medium and (1) is weakest

PRESENT NETWORK

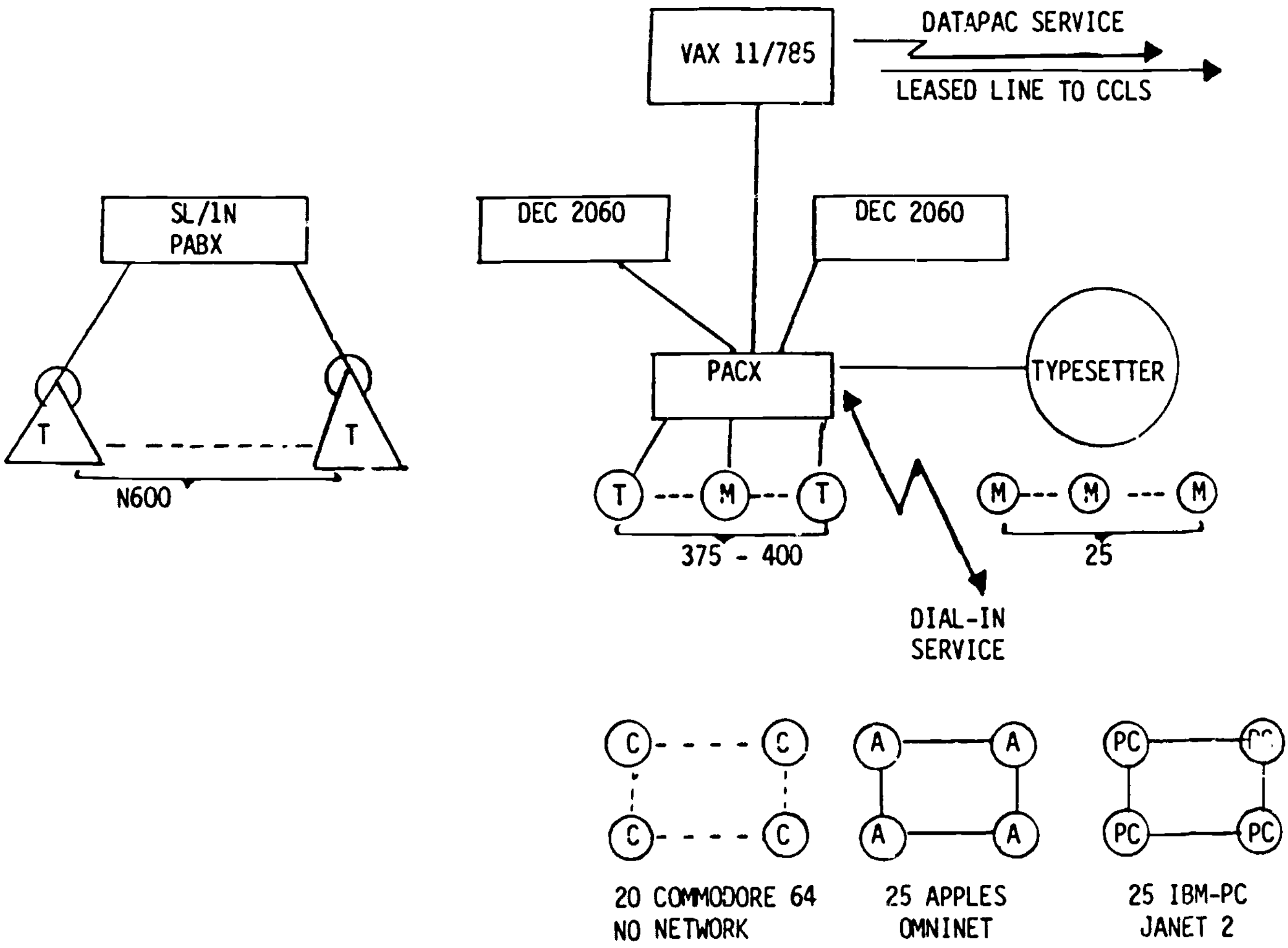


FIG. 1

LEGEND:

MF	MAINFRAME (OR MINI)	B	BUS INTERFACE UNIT
T	TELEPHONE	PR	SHARED PRINTERS
T	TERMINAL	D	SHARED DISKS
M	MICRO OR WP		
A	APPLE		
PC	IBM-PC		
C	COMMODORE-64		
	NETWORK OR SUB-NETWORK		

PLANNED NETWORK

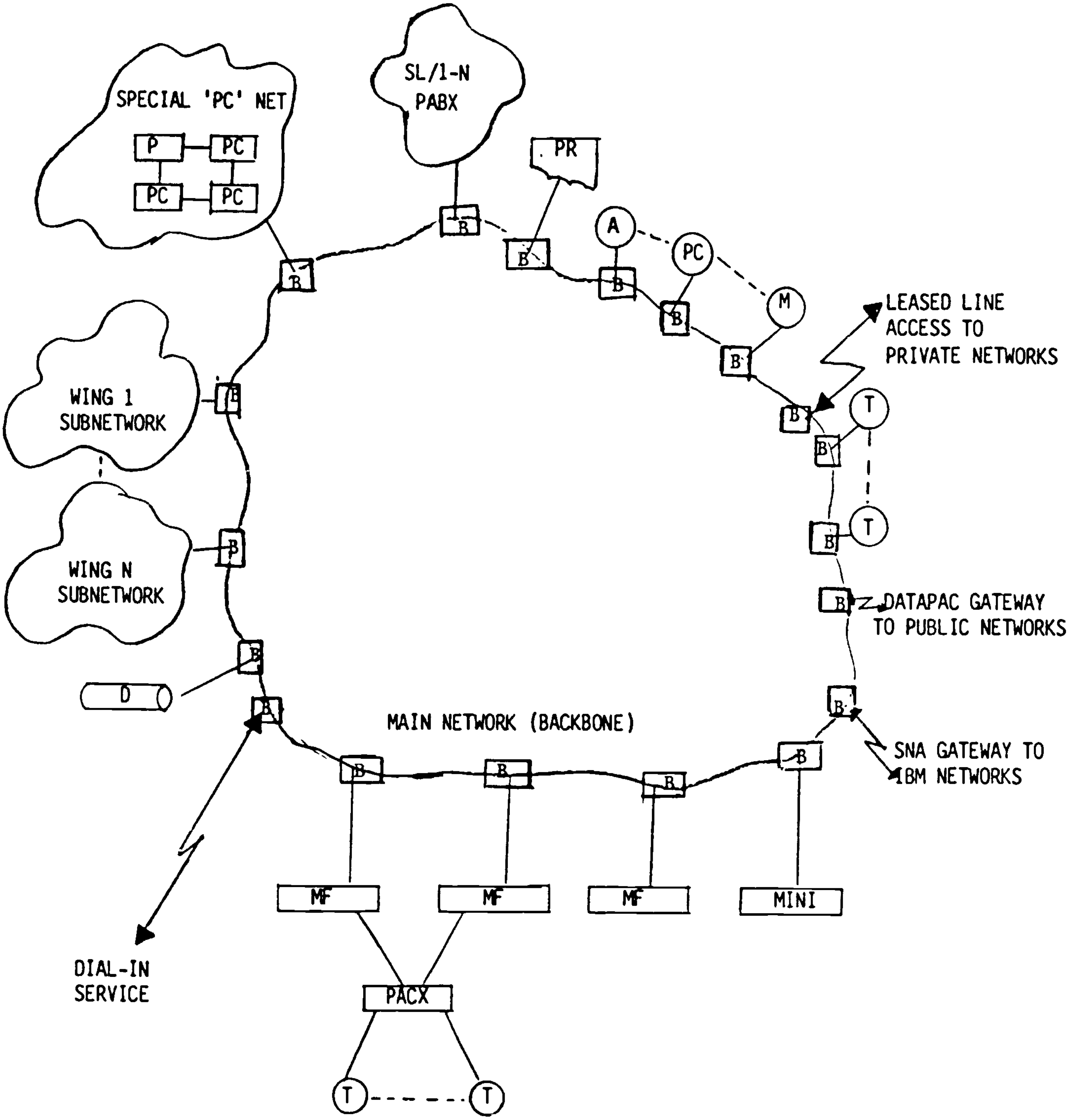


FIG 3

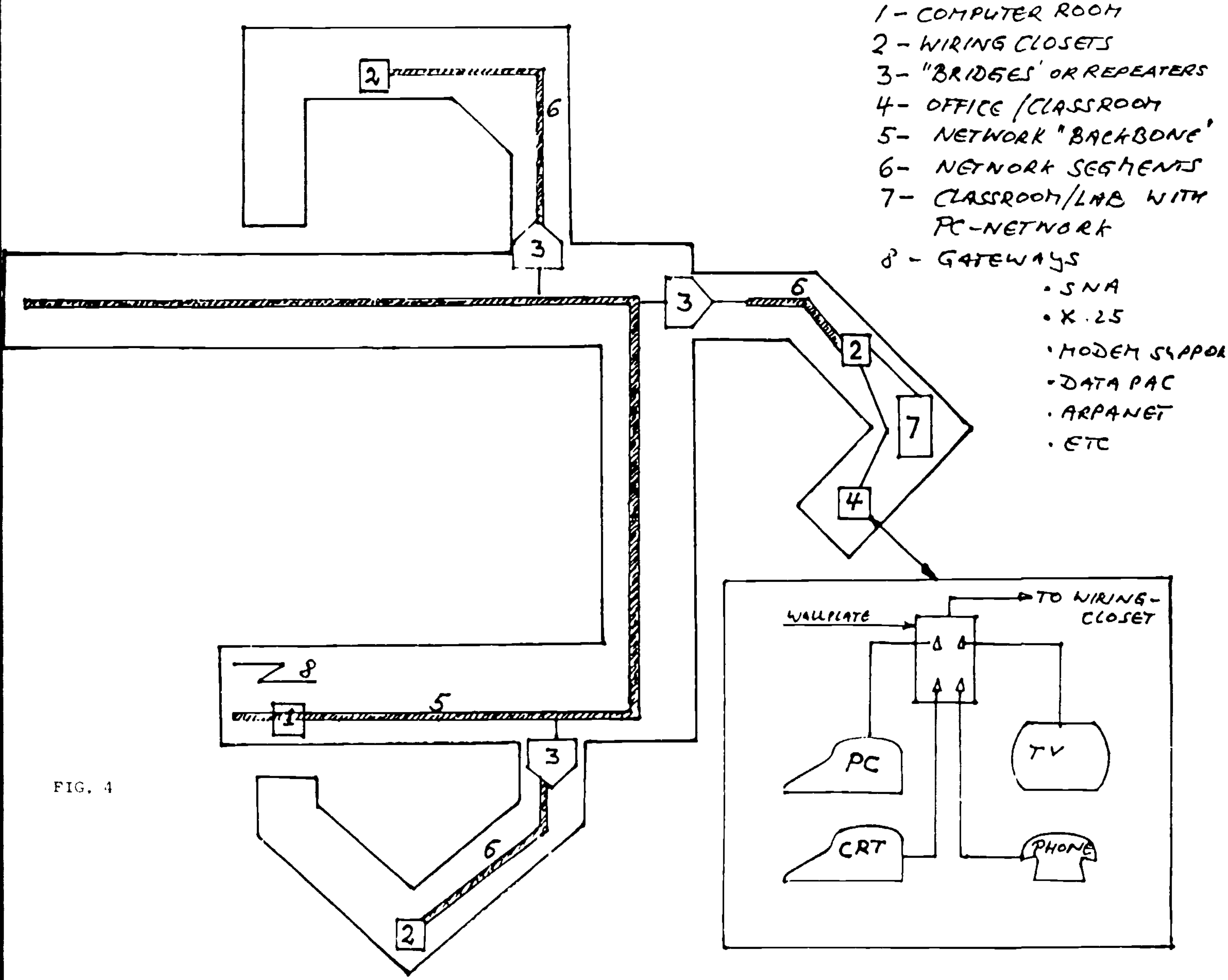

1 - COMPUTER ROOM
2 - WIRING CLOSETS
3 - "BRIDGES" OR REPEATERS
4 - OFFICE / CLASSROOM
5 - NETWORK "BACKBONE"
6 - NETWORK SEGMENTS
7 - CLASSROOM/LAB WITH PC-NETWORK
8 - GATEWAYS
• SNA
• X.25
• MODEM SUPPOR
• DATA PAC
• ARPANET
• ETC
2
6
3
3
6
2
7
4
8
1
5
3
6
2
TO WIRING-CLOSET
WALLPLATE
PC
TV
CRT
PHONE

FIG. 4

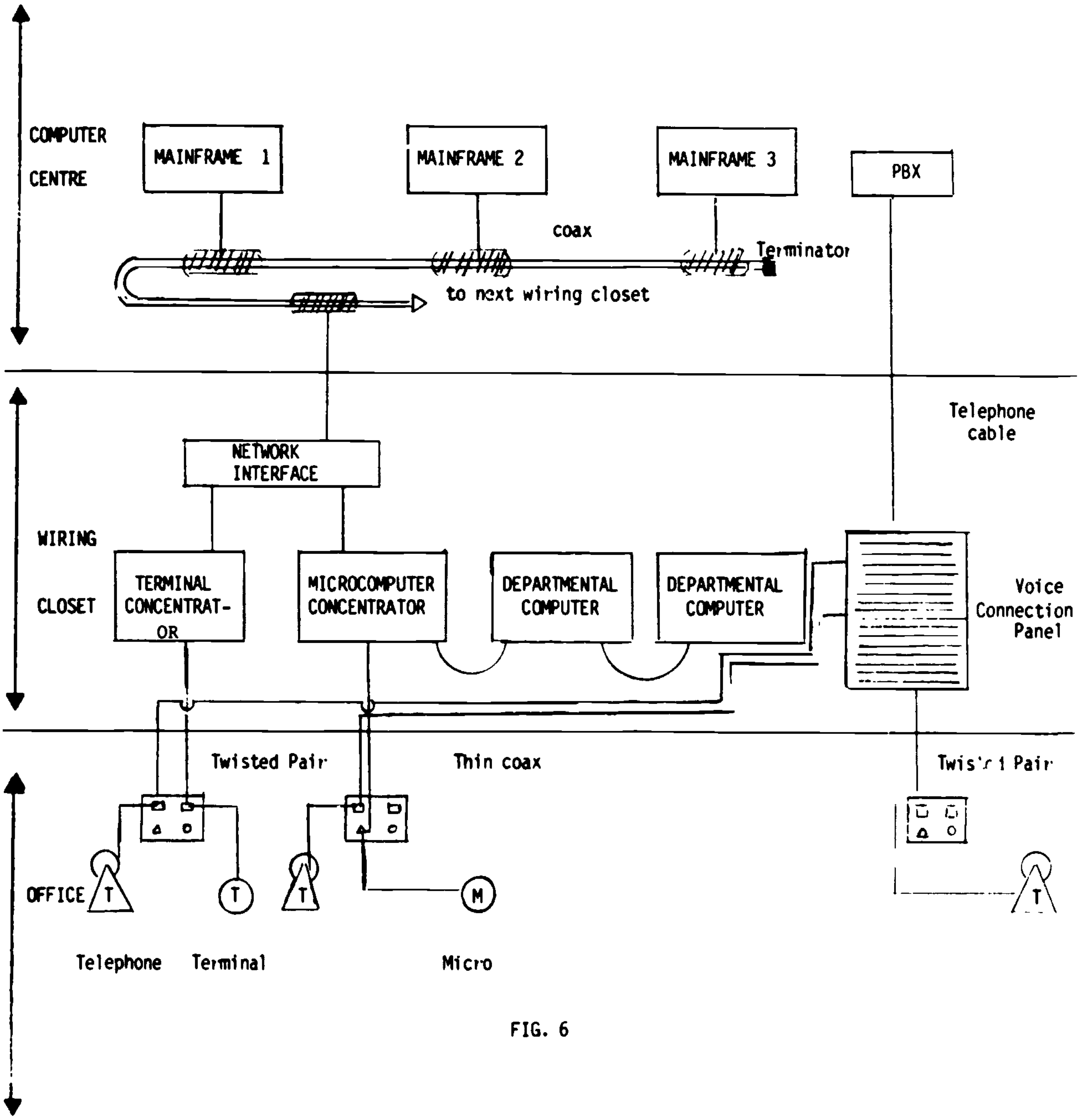

COMPUTER
CENTRE
MAINFRAME 1
MAINFRAME 2
MAINFRAME 3
PBX
coax
Terminator
to next wiring closet
Telephone
cable
NETWORK
INTERFACE
WIRING
CLOSET
TERMINAL
CONCENTRAT-
OR
MICROCOMPUTER
CONCENTRATOR
DEPARTMENTAL
COMPUTER
DEPARTMENTAL
COMPUTER
Voice
Connection
Panel
Twisted Pair
Thin coax
Twisted Pair
OFFICE
T
T
T
M
T
Telephone
Terminal
Micro

FIG. 6

INTEGRATED VOICE/DATA NETWORKING
THE DATA PERSPECTIVE

Stephen J Patrick

UNIVERSITY OF WISCONSIN - STEVENS POINT

Stevens Point
Wisconsin

There are three data communications factors at an educational institution that make data communication difficult: computing is decentralized, the campus has diverse computing hardware, and there is not a large budget to accomplish data communications.

The University of Wisconsin - Stevens Point installed an integrated voice/data communication system. The Information Systems Network (AT&T's local area network offering) will meet our current data communication needs, and will provide the backbone for future growth.

INTEGRATED VOICE/DATA NETWORKING
UNIVERSITY OF WISCONSIN - STEVENS POINT
THE DATA PERSPECTIVE

Stephen J Patrick

BACKGROUND

The University of Wisconsin - Stevens Point (UWSP) began looking for a campus wide data communication system over three years ago (1982). Our early research concentrated on traditional local area network products. We discovered that the cost of implementing any campus wide network would be far more than the University could afford. The cost of the network would exceed the cost of all the devices on the network. This was not considered a viable alternative.

During this same period another group was exploring the feasibility of purchasing a voice PBX to replace Centrex service. Early in 1984 the campus made a decision to combine the two needs, the University would issue a request for proposals (RFP) for an integrated voice/data communication system. The RFP was issued in July of 1984. In December the campus selected AT&T as the vendor, a System 85 PBX for voice service, and the Information Systems Network (ISN) for data service.

The purpose of this paper is to describe the data portion of our integrated communications system. The paper will describe the data communication needs of UWSP, the ISN as a data network, and examine the cost of the ISN.

DATA COMMUNICATION NEEDS AT UWSP

There are three data communications factors at UWSP that make data communication difficult. These factors are common to most educational institutions: computing is decentralized, the campus has diverse computing hardware, and there is not a large budget available to accomplish data communications.

DECENTRALIZED COMPUTING

A campus environment is very different from a business situation. In a business the "boss" can make a decision on computing standards and practices. This is not possible in an academic environment. Decision making in an institution of higher education is much more distributed than in a business. As a result there is little control over who is purchasing computer equipment, and the purpose of that acquisition.

In an academic environment decentralized computing works very well. Individual users have control over the resources they need, and they are the most qualified to determine the proper solution for their needs. This makes the computer communication situation much more difficult to manage. The environment is not stable and must be flexible enough to meet changing needs.

DIVERSE COMPUTING HARDWARE

One of the goals of academic institutions is the creation of knowledge. Faculty members in both instructional, and research endeavors do not want to be restricted to a single computer vendor, or architecture. Even in administration computing research and experimentation is tolerated. In this environment, each computing decision is an independent decision. This results in a wide variety of computing hardware that do not communicate well together. Each computer vendor has its own communication protocols and would like to force all users of that computer to follow abide by the vendors rules.

Ideally the computer network would be the bridge between incompatible hardware. The network should function as the translating device to remove the complexity of communicating from the end users.

SMALL BUDGET

For many years the real funding available per student has generally been decreasing (at least it has at UWSP). The institution does not have the freedom of making a capital investment in a computer network unless the benefits are large. The cost of the network must be fully justified, and must not be out of proportion to the cost of the equipment that it is connecting. An objective of UWSP is to have data communications costs at the same order of magnitude as voice communications. In other words the data communications bill to the end user would be close to the telephone bill.

The ISN provided the best solution to the three problems described in this section. The ISN provides a mechanism of connecting all the computers at UWSP for an average cost of $500 per connection. This was by far our lowest cost alternative while providing a high service level.

DESCRIPTION OF THE ISN

The easiest way to conceptually understand the ISN is to examine the design goal of the ISN. The principle design goal of the ISN is to provide universal data service. The role of the ISN is to give computer users the same kind of service that voice telephone service provides.

Within universal data service are four design concepts: (1) to provide a means of interconnecting diverse computing hardware, (2) to provide fast data transport, (3) to provide user friendly procedures, and (4) to be able to add equipment without service disruptions. Each of these concepts will be examined in detail.

At this time there are two types of local networks; networks that provide numerous services in a homogeneous environment, and networks that provide a more limited service level in a heterogeneous environment. Examples of the homogeneous networks include personal computer networks such as 3Com that allow personal computers to share resources (fixed disk drives, printers, etc). The ISN is the second type of network. Services initially are limited to basic communications, but the reach is much broader. The ultimate realization of this goal would be the ability to attach any computing device to the network and allow it to communicate with any other device on campus. As time passes and advances are made in the ISN the level of services provided by the ISN should approach the services that homogeneous networks can provide.

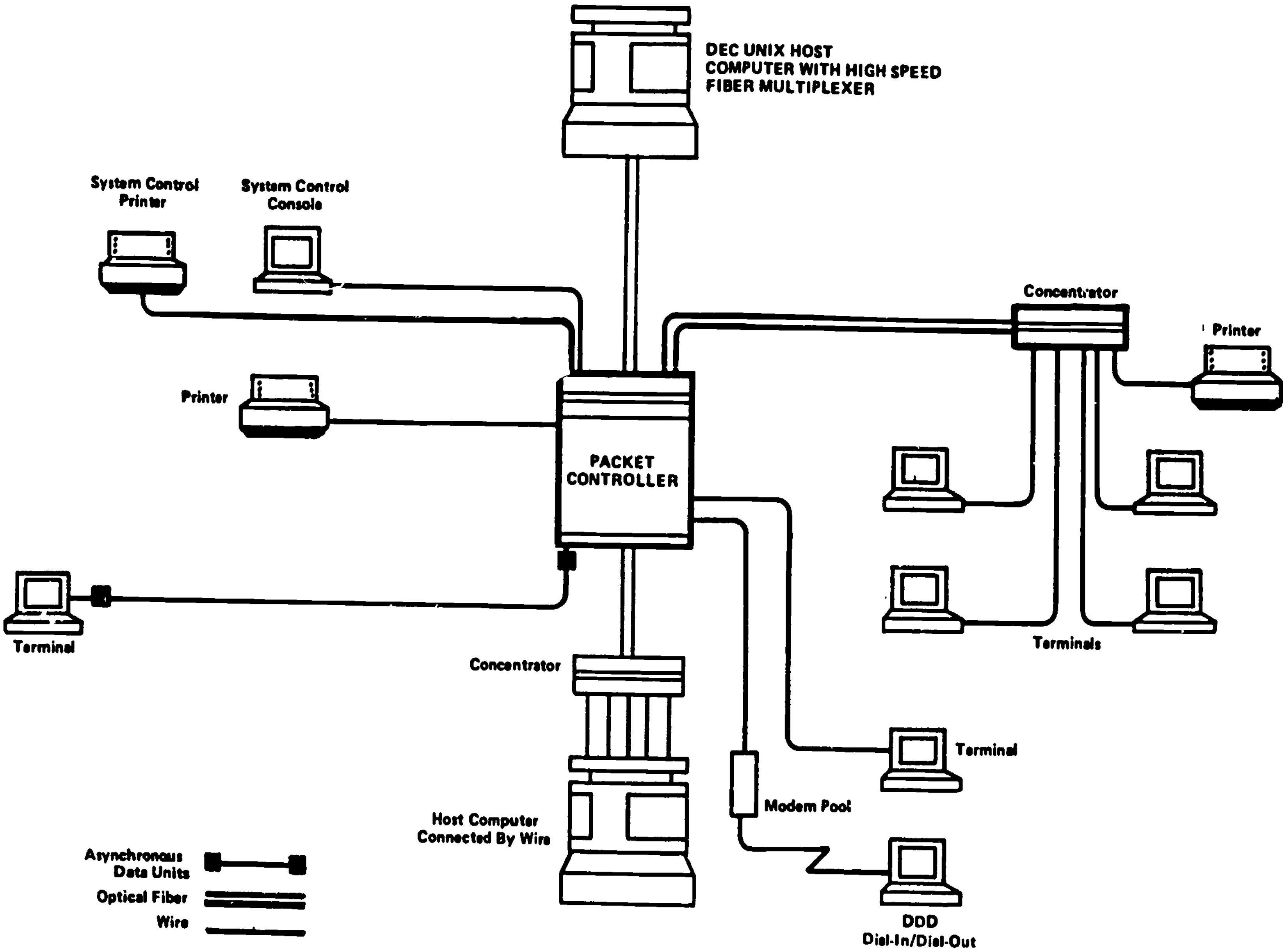
Fast data transport is an essential component of local area networking. The speed required will increase geometrically as the capabilities of computers increase. Terminal emulation applications function well at speeds of 9600 bits per second (Bps). File sharing applications require speeds in the range of a million Bps.

The system should be easy to use if it is to succeed in a non technical environment. Computer users at UWSP are no longer restricted to programmers, scientists, and data entry clerks. Individuals with non-technical backgrounds are using computers in their daily jobs. The users need to communicate with different computers. The system must be straight forward and easy to use if is to succeed with these users.

A dynamic environment will require numerous additions, and changes as the system grows. The system should allow for configuration changes without disrupting service. In some mainframe computer networks it is necessary to bring the data communication system down to change the network configuration. This will not be acceptable in an environment with thousands of users resulting in daily configuration changes.

ISN Components

The ISN's topology is a hierarchical star. This is the same topology as the voice PBX. This allows us to install the wiring


DEC UNIX HOST
COMPUTER WITH HIGH SPEED
FIBER MULTIPLEXER
System Control Printer
System Control Console
Concentrator
Printer
Printer
PACKET CONTROLLER
Terminal
Terminals
Concentrator
Terminal
Modem Pool
Host Computer Connected By Wire
DDD
Dial-In/Dial-Out
Asynchronous Data Units
Optical Fiber
Wire

for the ISN at the same time as the PBX resulting in a low cost cable plant (incrementally for the data network). Both the PBX and the ISN will share fiber optic backbone cables that go to each building on campus.

In the center of the network is the packet controller. The packet controller is the brains of the ISN. It routes all messages between network users. A packet controller can theoretically accommodate as many as 1,920 devices. Multiple packet controllers can be linked together extending the size of the network.

Concentrators are connected to the packet controller by fiber optic cable. There are two strands of fiber linking each concentrator to the packet controller, one strand for each direction of the communication. The role of the concentrator is to extend high speed data capability to the users location. Each building (floor) will have a concentrator. The users in the building will be connected to the concentrator by the premises wiring.

Inside the packet controller and the concentrators are interface modules that connect end users to the ISN. These modules are interchangeable, and can be placed in either the packet controller, or concentrators. At this time there are two basic types of interface modules; Fiber Interface Modules (FIM) that connect concentrators and host computers with fiber optic cable, and Asynchronous Interface Modules (AIM) which are used to connect up to RS232 devices to the ISN. When an end user is within 250 feet of the AIM board, and the data device is not sharing telephone wire with an analog telephone, the user can be connected directly to the AIM board. When the users is over 250 feet from the concentrator, or the user is sharing telephone wire with analog telephones an Asynchronous Data Unit (ADU) is required. The ADU allows RS232 communication to share cable with analog telephones and extends the distance allowed to 5,000 feet between the end user and the AIM board (at 9600 Bits per second). ADU's can be avoided if digital telephones are used, of if 8 pairs of wire are pulled to each telephone jack.

Computer hosts can be connected either to a concentrator, or to the packet controller with either ordinary twisted pair wire, or fiber optic cable. An AT&T 3B20, or a DEC VAX running System 5 UNIX can be connected to the ISN with a fiber optic connection. This will allow the computer to have up to 120 simultaneous conversations with ISN users. At this time other host computers are connected to the ISN through twisted pair wire, a twisted pair wire will have to be used for each port on the host computer.

End users will normally be connected through the wall phone jack to the ISN. The building telephone wire contains wire that can be used to connect to the ISN. When the wiring is installed for the PBX the customer has the option of having 4 or 8 pair of wire installed at each jack. With 8 pair of wire there will be a separate data jack for ISN users. In this case the user simply plugs his computer into that jack. With 4 pairs of twisted pair wire, analog telephones require 2 pairs of wire. A data device would use an ADU which would use the remaining two pairs of wire at that telephone jack.

ISN Protocol

The ISN connects computing devices with virtual circuits. The ISN uses time division multiplexing to connect up to 1920 devices. The ISN can support up to 1200 virtual circuits at any one time.

At this time devices are connected to the ISN with EIA RS232C interfaces, and direct fiber optic interfaces (to host computers). In the near future the system will support CSMA/CD, X.25, synchronous IBM 3270 protocols. AT&T's philosophy to develop an new connection protocol is to develop an interface board that attaches to the ISN in either the concentrator or the packet controller. The interface board will translate the external protocol to the ISN's internal protocol. This implies that major changes can be made to services to users without requiring changes to the functioning of the ISN itself.

The system supports both switched and permanent virtual circuits. To use a switched circuit the end user will "call" the destination computer. If a line is free, the ISN will establish the circuit. The end user devices begin communicating. A permanent virtual circuit is a circuit that always connects two devices. This would be useful for connecting real time monitoring devices, point of sale devices, or host computers. Permanent virtual circuits are defined by the system administrator and once defined always connect the two devices.

The AIM board will assemble transmitted data into 16 byte packets. If a delay between bytes of 4 milliseconds occurs the AIM board will send a partial packet. For terminal users a packet will be sent for each key typed on the terminal. Once constructed, the ISN will sent each packet to the destination.

Inside the ISN node (and each concentrator) are three short buses. There is a transmit bus, a receive bus, and a contention bus. The ISN uses the contention bus to determine who uses the next transmit cycle on the transmit bus. This results in a collision free protocol. In a loaded environment the ISN will be delivering its fully rated capacity.

The contention bus is short enough that a single bit can be detected by all contenders before any contenders can send the next bit signal. When an ISN module has data to send it builds a unique contention code based on priority, and the stations address. During the contention cycle for each bit period, a module is either sending a bit or listening for a bit. If a module hears a bit when it is not sending, it is out voted and drops out of contention until the next contention period. This results in one and only one winner. At the end of the contention period the winner sends its packet on the transmit bus, while sending the next contention code(if it has more data to send). If a module looses the contention it sets a high order priority bit for the next contention period. In a loaded environment transmission occurs in a round robin fashion. Each device transmits a 16 byte packet each round. Users do not loose service level based on low addresses.

When the packet reaches the ISN processor. The processor replaces the source address with the destination address and sends the message on the receive bus. The proper module will pull the message off the receive bus and send it to the proper concentrator.

The ISN can deliver 48,000 packets per minute. Each packet is 180 bits long. The rated capacity of the ISN is obtained by multiplying the size of a packet by the rate of delivery. This results in a rated capacity of 8.64 Mbps. The usable capacity is somewhat less because a portion of the packet is control information. The usable packet size is actually 16 bytes resulting in a packet size of 128 user bits and a usable capacity of 6.144 Mbps. The ISN's perfect scheduling protocol provides an excellent level of service up to network saturation.

END USER PROCEDURES

If a user wants to communicate with a computer on campus he/she would dial the computers number (or name) through the keyboard. The ISN will establish a conversation between the user and the other computer. The ISN allows hunt groups to be set up. Using a hunt group associates all the computer ports on a host computer with a single "phone" number. The ISN provides a number of important services to aid in the communication. The ISN handles the differences between different computers communication parameters. The ISN will adjust for different speeds, parity, stop bits, etc. This means that the end user does not need to know that there are technical differences between the computers he/she wishes to communicate with.

FUTURE DEVELOPMENTS

A key future development of the ISN is the addition of services to the network users. AT&T has announced STARLAN, a 1 million bit per second local area network. STARLAN is a CSMA/CD network designed to provide all the functionality of a high service homogeneous local area network. When STARLAN is interfaced to the ISN, users will have the services of homogeneous local area network and the connectivity of the ISN. STARLAN will also further multiplex host terminal communications. Host computers on STARLAN can be contacted by terminals on the ISN.

STARLAN will interface the ISN through a STARLAN Interface Module (SLIM). There are two types of SLIM boards. There is a bridge SLIM board which will give provide the ability to connect up to 10 disjoint STARLAN's into a single network. There is also an interconnect SLIM board which will allow stations on STARLAN and stations on the ISN to communicate.

A high priority need of AT&T is to interface the ISN with the IBM world. This will be done through a synchronous interface. With the synchronous interface a 3278 device is connected to the ISN. The ISN is connected to a cluster controller next to an IBM host. The ISN will allow the terminal user to switch select IBM hosts, and will allow better utilization of cluster controllers. In the non-ISN environment an IBM large system will need a cluster controller port for each terminal. With the ISN the system will only needs enough ports to support the peak load.

High speed fiber optic computer interfaces will give large computers the ability to move large amounts of data quickly and easily. This will make distributed computing in an administrative environment easier to implement.

COST

With any project the magnitude of a campus wide communication network, cost is a critical factor. We had the advantage of installing the ISN while installing a PBX. The AT&T Universal Wiring Plan brings the cost of the cable plant for the ISN to a incidental cost. The incremental cost of the cable plant and the ISN processor was less than $100,000 out of a 1.3 million dollar project. Once the wiring and the packet switch are in place the incremental cost of the ISN is about $500 per station. This cost includes all ISN hardware but does not include end user connection equipment and assumes that the cable plant does not require changes. A station can be added anywhere on campus easily. A computer, or terminal can be added to the ISN through the nearest telephone wall jack. This can be done for a modest incremental cost without affecting the service of other ISN users. At no time must we splice into existing wiring, or cut off service to an existing current user.

PROBLEMS ENCOUNTERED

The ISN and AT&T are not perfect. We did encounter problems with the ISN and it's installation. These problems normally occur with any significant undertaking. The purpose of this section of the paper is to give you the opportunity of benefiting from our experience.

Our greatest problem was the installation of the network. The original contract called for the installation to be completed by the first week in August. The actual installation was not completed until Thanksgiving. At the time of our installation ISN parts were in short supply. We did not receive delivery until after the cutover of the voice PBX. Unfortunately, once the voice PBX was completed the throng of AT&T installation people left. We were left with local installation people that were experienced in voice telephone service, but did not have a data communication background. We provided an on-the-job training service to the AT&T installation crew. The installation crew also did not have any data communication test equipment to tell if the connections were working once they had been installed. We loaned the installation crew a Compaq computer to give them the ability to test each RS232 connection as it was being installed. The next installation of an ISN in our area will be quite a bit smoother. The AT&T personnel are quality individuals who can do the job if given proper equipment and training, in our case they were provided with neither.

We also had some difficulties attaching host computers to the networks. This problem occurred because of a misunderstanding of the scope of the installation. We expected AT&T to provide a full service installation. We wanted AT&T to be responsible for finding out how to connect our IBM, Burroughs, Sperry, and Digital computers. AT&T expected us to provide that expertise. This led to a bit of a conflict because the terms of the installation were not clearly indicated in the contract.

There were a couple of minor technical problems with the ISN. Some of these problems have nothing to do with the ISN itself but relate to the difficulty of the communication problem. We would like to use a single terminal emulator to communicate with all our computers. It is difficult to do this because of the special needs of the different host computers. Also, different host computers handle echoing of characters differently. Some computers will echo each character back to the terminal. Other computers will not echo to the terminal. The end user would have to be able to adjust to the different echo cases as they occur. Host echoing shows the ISN at it's least efficient moment. A packet containing a single keystroke is sent from the terminal to the host computer. The host computer replies with another packet back to the terminal. Two 16 bit packets are used for a single character resulting in 97% waste.

The final area of concern is the fact that the installation and maintenance of the ISN is going to cost more than it could have if we had implemented our voice phone system differently. This is a case of trading current cost savings for future expansion costs. We installed an analog phone system with four pairs of wire to each phone jack. Four pairs of wire is not enough to support both data and voice service effectively. AT&T technical people now recommend eight pair of wire to each jack. Another area of cost savings were the cross connect blocks. AT&T installed the old fashion punch down cross connect blocks. These blocks are meant to support permanent circuits and are not designed to facilitate change and growth. Modern patch cord cross connect blocks would allow local administration of moves and changes with minimally skilled personnel. The punch down cross connect blocks will be much more difficult to maintain. The impact of these two short term cost savings is that the incremental cost of an ISN connection is $500 instead of $300. The total economic analysis depends on the expected number of data connections compared to the short term savings realized. At the time we signed the contract we were unaware of this condition and did not perform this analysis. We may have made the right decision, but if we did it was accidental.

CONCLUSION

The ISN is succeeding at solving the three data communications problems at UWSP. The ISN is a wide area local area network that supports distributed computing.

The campus wide fiber optic backbone and the design of the ISN place no restrictions on the location of computers. A computer can be placed anywhere on campus and be accessed from any place on campus.

The ISN can support many different computing hardware environments. The ISN is the common denominator to UWSP computing. The ISN provides a connection to nearly all computing vendors equipment and operating systems.

The ISN is an affordable solution. In our case we installed the ISN backbone for a small incremental cost. Our growth will be affordable because we will be adding to the ISN in low cost increments. The incremental cost is now $500 per ISN connection. This cost is considered low cost because it is approximately 20% of the end users hardware cost. I expect this cost to decrease as the ISN reaches mass distribution. We are recovering this cost through end user charges.

TELECOMMUNICATIONS AS THE FOUNDATION FOR COMPUTING AND COMMUNICATION AT UW-STEVENS POINT)

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ABSTRACT

The University of Wisconsin at Stevens Point is embracing the philosophy of user driven computing advocated by James Martin and others. One of the keys to the new environment was accomplished through the replacement of the traditional telephone and computing delivery systems with an integrated voice and data system that facilitates distributed computer applications.

The telecommunications system, installed in August of 1985, features a fiber optic backbone for voice, data, and possible future video requirements. The focus on this presentation is on what we learned from the acquisition process with the belief that our experience can benefit others.

INTRODUCTION

The University of Wisconsin Stevens Point is one of thirteen four year campuses making up the University of Wisconsin System, which also includes 14 two-year campuses. UW-SP is located in Central Wisconsin and serves approximately 9500 students.

STATEMENT OF THE PROBLEM

Telephone costs for Wisconsin Bell's 15 year old 701 Centrex increased by 20% per year for the period 1979 to 1984. The cost to move or install a six button telephone had increased to as much as $350 per phone. The old stepper technology of the 701 was so primitive that it was necessary to call the switchboard just to transfer a call! Our voice system was expensive and obsolete.

Also, we had few phones in our residence halls and wished to provide both voice and data communications in each of our 1950 rooms. Due to the work of Judy Halterman at Tulane, we had also learned about "do it yourself" student long distance and wished to provide a similar service for our students. We concluded that it might even be possible to reduce costs for the entire campus because of the efficiencies of using WATS lines during the day for administrative calls and at night for student calls. This is because the cost per minute billed decreases as the usage is increased on WATS lines.

We also had unsatisfied data communications and computing needs. The campus had received a Title III grant from the "Feds" to advance computing in general and data communications in particular. This grant plus the approval of a new Computer Informations Systems Major caused an increased need for more and diverse computers on campus and a way to communicate with all of them. The problem was to combine our voice and data communications needs in order to obtain an integrated approach that also gives us a least cost solution.

EVENTS LEADING TO THE RFP

Several unsuccessful attempts (politics played a major role) were made to update the telephone system prior to the 1984 - '85 effort being reported on here. Each of those false starts made a contribution to the development of the finally successful request for proposal. The Computing Department was reorganized to combine the telecommunications and computing professionals under the Director of General Services. This encouraged a UNIFIED VIEW OF COMPUTING AND COMMUNICATIONS--an important contributing factor.

We obtained a University of Vermont RFP at CAUSE-83 which gave us a tremendous boost over previous attempts at Request for Proposals.

SPECIFIC SYSTEM REQUIREMENTS PLACED IN THE RFP

At the urging of a University friend, Dennis Fuller, REA Telephone Engineer, we stated a strong preference for a fiber optic "backbone" that would have the added capacity to handle the increased data communication load projected. Due to its high bandwidth, fiber optics´ cable is also capable of transmitting video signals. We asked the vendors to also propose how video signals might be transmitted in the voice/data system they proposed.

We wanted each telephone station to have the ability to have an easy, cheap data connection. We projected 200 data connections at cut-over to the new phone system growing to 2500 stations in five years. Also, we had several recent successful applications to user driven, distributed computing, and began to conclude that this approach should be expanded. To do so, our existing and all future computers would need to be connected to the same network. Some method of protocol conversion would need to be provided to allow a PC to connect and communicate with our Sperry, IBM, DEC, AT&T, and Burroughs computers.

We structured our RFP so as to allow vendors to propose either student long distance services or equipment. We stated simple, functional goals and left it to the vendors to state how they would accomplish them.

Our final RFP looked like a 112 page "wish list" that asked for the kind of environment we wanted to be in for voice, data, and video.

PROPOSAL EVALUATION

Worth stressing was our use of off-campus people in the evaluation process. The Telcom Manager for Sentry Insurance (Carol Schulfer) and the owner of a nearby independent telephone company (Dwight Bowden) provided great insight while evaluating the 10 proposals received. Two consultants were also employed but sparingly.

We formed five subcommittees: Data/Video, Voice Functionality, Service, Finance, and Student Long Distance. All subcommittees were assigned the specific areas of the RFP response to evaluate except the Finance Committee. (See Exhibit 1) The Finance Committee´s responsibility was to build a seven year, net present value cost model for each proposal.

The cost components used in the cost model were:

1. Original purchase price of voice and data systems.
2. Interest costs to finance the investment.
3. Seven years maintenance including annual increases.
4. Seven years of projected moves, changes, and additions.
5. Seven years operational costs for running the telephone system.
6. Seven years cost of WATS and Central Office trunks.

The cost model was written in "Symphony" and run on a PC. Because of all the cost data and the point catagories that needed to be kept organized, the program proved very helpful.

Each proposal was evaluated by the subcommittees according to their area of expertise and to a specified point scale (See Exhibit 2). For example, the Voice Subcommittee evaluated the voice features of each proposal and assigned up to a maximum of 30,000 points to each proposal. All subcommittees evaluated the "System Design, Control Technology and Capacity" aspects of each proposal and assigned points.

Since we had both a cost and benefit number, the cost/benefit technique could be used to evaluate each proposal. While Intecom ranked highest in points (167,290/200,000), the seven year cost was also the highest (4.99 million). AT&T´s System 85 for voice and its complimentary product, the ISN, ranked second in points (150,575/200,000) but had the lowest seven year cost at $2,849,839. The resultant cost/benefit figure was $18.93/point - the lowest of any proposal. It should be noted that Centrex ranked second to last due to the lack of integration of data costing $900,000 more than the lowest cost AT&T proposal. (See Exhibit 3 for details).

APPROVAL PROCESS

Two approvals were required (the UW Board of Regents and the Wisconsin Department of Administration) prior to contract approval. Because of political clout of Wisconsin Bell, this could have been a very sticky matter. It was a relatively uneventful process for us, however, because of the outstanding political preparation done by our top management and the extent of the cost savings over Centrex.

INSTALLATION

The workload aspects of the process are summarized by Exhibit 4. The workload of implementating a PBX and data system should not be taken lightly. If a campus is not willing to make the committment to invest enough people for implementation, problems can result.

OBSERVATIONS - WHAT WE LEARNED

Probably the most interesting fact we learned was that mixing voice and data in the same PBX was not cost effective. No matter whose PBX you buy, it cost a substantial premium to add data over voice ($1400 for an AT&T System 85). The approach of using spare voice wiring but running data separately is much more cost effective. The basic voice station cost us $457 per line. An ISN connection is about $500 and easily made at any station without rewiring.

We found that using extra telephone wiring for data was far cheaper than having a separate network of coaxial cable dedicated just to computing. The "moves and changes" problem with a separate network are difficult and expensive.

Our insistence on fiber optics proved fortuitous. While the other vendors stumbled over themselves trying to "do something" with fiber optics, AT&T provided us a 96 strand fiber backbone at a lower cost than the conventional copper backbones proposed by others.

We ended up contracting with a regional Wisconsin carrier, (Schneider Communications - Green Bay, WI) for providing us with a student long distance bill. We charge the students the same long distance rates as Wisconsin Bell. We leased WATS lines and set up a student accounts receivable on an IBM-XT to handle past due bills. Thus far, we are not making much over our costs, but we expect to eventually as we learn how to optimize our WATS and private line mix.

By installing a PBX we are saving our campus money (nearly $1,000,000 in voice over the next seven years). We calculate that we will save $600 every time a data connection is made on the ISN versus our prior coaxial cable technique which cost $1000 per connection. Since we plan on connecting 2,000 stations to the ISN over the next five years, we should experience another one million dollars in "cost avoidance".

The reorganization that combined Computing and Telecommunications into one organization also played heavily in a successful outcome. We suggest that other campuses consider such a step.

The video communications proposals received were disappointing. AT&T had a prototype video PBX using one fiber optic strand per connection. The rest of the vendors offered nothing. As of November 1984, when we were evaluating proposals, CATV was still the only viable method of distributing full motion video. We felt that this may change and opted to do nothing with video - for the time being.

CONCLUSION

In conclusion, we would leave the following message:

1. Don´t waste time and consulting dollars writing a technical specification for a Voice & Data System. Write a "wish list" in the form of a RFP.

2. Get help from writing and evaluating your RFP from experience Telecommunications practicioners from local government or industry.

3. Build a staff organization that has the authority to make comprehensive data and voice decisions. Be sure to staff properly for the increased workload.

By approaching our voice and data problems from an integrated point of view, you can save your campus money. Perhaps it´s time you consider making Telecommunications the foundation of your computing system and services.

EXHIBIT 1 EVALUATION SUBCOMMITTEES

1. DATA/VIDEO
    - A. DATA FUNCTIONALITY
    - B. LAN AVAILABILITY
2. VOICE – VOICE FUNCTIONALITY
3. SERVICE
    - A. INSTALL PROCEDURES
    - B. MAINTENANCE
    - C. MOVES AND CHANGES
4. ALL SUBCOMMITTEES
    - A. SYSTEM DESIGN
    - B. CONTROL TECH AND CAPACITY
    - C. SYSTEM RELIABILITY
    - D. DISTRIBUTION SYSTEM
5. FINANCE – COST MODEL
6. LONG DISTANCE – REVENUE/COST MODEL

EXHIBIT 2 EVALUATION COMPONENTS

1. SYSTEM DESIGN, CONTROL TECHNOLOGY & CAPACITY	15%	30,000
2. SYSTEM RELIABILITY	20%	40,000
3. VOICE FUNCTIONALITY	15%	30,000
4. DATA FUNCTIONALITY	10%	20,000
5. LAN AVAILABILITY	10%	20,000
6. DISTRIBUTION SYSTEM	10%	20,000
7. INSTALLATION PROCESS	10%	20,000
8. MAINTENANCE	5%	10,000
9. MOVES AND CHANGES	5%	10,000
TOTAL SYSTEM	100%	200,000

EXHIBIT 3 SUMMARY OF PROPOSALS

		FUNCTION.	COST PER
	7 YR.COST	CAP.RAT.	FUNC.PT.
AT&T	$2,849,839	150,575	$18.93
SYS.85/ISN			
INTECOMM	$4,993,845	167,290	$29.45
IBX S/80			
WI BELL	$3,686,019	111,400	$33.09
NEAX 2400			
GTE	$3,738,868	110,100	$33.96
NEAX 2400			
TELCOM N.	$3,899,418	113,000	$34.51
SL-1			
WI BELL	$3,722,495	104,300	$35.69
SL-1			
NORSTAN	$4,197,621	113,700	$36.92
CBXII			
CENTRAL ST.	$4,079,461	97,500	$41.84
SL-1			
WI BELL	$3,784,063	87,200	$43.40
CENTREX			
CENTURY TEL	$4,809,438	99,700	$48.24
SL-1			

EXHIBIT 4 WORKLOAD ASPECTS

PRE CUT (APRIL – JULY)	
A. DIRECTOR OF GEN.SERV.	0.75
B. TELCOM MANAGER	1.25
C. STATION REVIEWS	3.00
D. SPECIAL STUDIES	0.25
E. DATA MANAGER	0.50
F. PHYSICAL PLANT	2.00
TOTAL	5.75
CUT (AUGUST)	
ALL OF THE ABOVE PLUS 20 STUDENTS TO CHECK OUT PHONES	
POST CUT (AUGUST – OCTOBER)	
A. DIRECTOR OF GEN.SERV.	0.25
B. TELCOM MANAGER	0.99
C. STUDENT LONG DIST.	1.75
D. TERMINAL CHANGE	0.50
E. SWITCHBOARD (unchanged)	1.00
F. ISN MANAGER	0.50
TOTAL	4.74

AN APPROACH TO INTEGRATED NETWORKS

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This paper describes a strategy for integrated data and voice networks that is being implemented at The University of Michigan. It also discusses the myths and realities of the term "integrated" networks. These networks often use multi technologies, multi vendors and multi transmission media that will be fused into a single integrated network. Transmission media include twisted pair wire, coaxial cable , fiber optics and microwave. Vendors usually include many of the leading players in the communications, data processing, computing and information technology. Technologies can include voice, data, images and graphs, processed and communicated in real or delayed time. We at The University of Michigan are attempting to bring order out of this often disjoint chaos.

WHAT IS INTEGRATION

Integrated networks are currently the "fashionable" networks. They are thought to be good and every one needs one, but often those believing and professing this "network integration ethic" fail to see what the phrase "integrated networks" really means.

Integration can take several forms including common wiring schemes, common terminal equipment, common transmission system or common switching systems. The hoped for result is the minimization of constant moves and changes of the associated continual constant plant construction, the elimination of the need for multiple terminals or workstations on the same desk and to provide consistent user interface all around the network.

The ultimate goal is a fully integrated information and communication system which integrates voice, data, text, graphics and images. This system would then process, store, retrieve and move all messages, pictures, words, and data whether spoken, written, typed or drawn in real and/or deferred time. We should not lose sight of these goals, as it is easy to become enamored with glamorous technology for its own sake. By keeping in mind the reasons why we are trying to develop and implement integrated networks we can have an easier time sorting through what often looks like baffling and confusing technology.

TOPOLOGY OF THE UNIVERSITY

The main Ann Arbor, Michigan campus of The University of Michigan consists of four disjointed campuses: North, Main or Central, Medical and South. These span approximately a 2 by 7 mile area, along with several outlying University "pockets". In addition there is a campus forty-five miles to the north in Flint, Michigan, and another one 25 miles to the east in Dearborn. The voice and data network activities described in this paper are to work in an integrated manner across all of these campuses.

EXISTING NETWORKS IN PLACE

There are many independent and semi-independent networks at The University of Michigan. Many of these are interconnected in various ways. These range from large, University-wide networks, to small localized networks.

The largest of these networks is UMNet, which is a campus-wide packet switching network using technology developed at the University of Michigan for the Merit Computing Network, a state-wide network with major hosts at the University of Michigan, Michigan State University, Wayne State University, Oakland University and Western Michigan University. There are over 5000 terminals and micro computers attached to, or dialing into UMNet from various locations. The largest of the hosts on the network are the University's Academic Computing Center's Amdahl mainframes which run the interactive Michigan Terminal System (MTS). These systems also control UMNet.

There are a number of other hosts on UMNet including several departmental Digital VAX and Prime computers, as well as a link into the University's Administrative Network. Attachments are also being installed to a super computer consortium to which the University belongs, as well as a satellite link to the National Center for Atmospheric Research's high speed network. UNnet also provides gateways to ARPA net, TYMNET, TELNET, AUTONET, and DATA-PACK.

The Administrative Data and Office Systems networks include a large data processing center providing mainframe data processing on an IBM computer and office systems with Wang Laboratories OIS, VS and PC systems. There are over 1,100 Wang workstations and 40 processors, and over 600 IBM 3270 type of terminals, remote terminals, and work stations and personal computers asynchronously attached via protocol converters.

Networks at the University Medical Center include a patient care network, a laboratory data network, an office network and a Medical School Administrative network. The Patient Care Network is an IBM based network using the IBM cabling plan with shielded twisted pair cable and also a Series One for protocol conversion for asynchronous attachment. The Hospital laboratory and research network is a large, asynchronous based network, that uses a TRW designed broadband network that supports a large Applitek UNILAN local area network for over 1,000 asynchronous attachments initially. This broadband cable also supports a Wang office network and will have a high speed Ethernet; and the Medical School Administrative network, which is a WangNet.

Networks at the College of Engineering include several large Appollo Domain Networks interconnected over a campus wide WangNet broadband network, and several large PC, CAD/CAM and Ethernet networks. These are all all interfaced to UMNet. This is also a major locus of advanced communications and network research.

There are also various other small and medium sized networks using a variety of technology at such units as the School of Business and the Institute for Social Research. These all seem to have a predominant need to communicate within their own groups, with an occasional need to access others elsewhere on campus, and occasionally off campus.

NETWORK AREA OF COVERAGE

The physical architectures of networks may be classified according to the area covered. These would begin with those limited to a building's floor, then a building, small clusters of buildings, campuses, metropolitan areas and finally wide area networks.

Floor distributed networks - Distances of up to 400 to 500 feet. These tend to be high speed and use twisted pair, coaxial cable or in the case of open office landscaping, infrared light. Some of the initial high speed twisted pair offerings of vendors like IBM and AT&T were in this range.

Building - Distances of 500 to 1,000 feet, similar to floor networks. Twisted pair offerings by IBM and AT&T are moving rapidly in this direction.

Cluster of buildings - 2,000 to 4,000 feet. These have tended to be coaxial cable based with star architecture, but several vendors including Northern Telecom are supporting high speed (1 to 2.5 megabit speeds) on unshielded twisted pair.

Campus - Distances of 1 to 10 miles. This is the realm of the coaxial cable LANs (Local Area Networks) with an increasing use of fiber optics as well as many low speed twisted pair LANs and data switch networks. These distances are also suitable for low speed, low power, microwave links.

Metropolitan - Distances of five to ten miles. This is the part of the network world that the local telephone operating companies, and some cable TV franchises see as their own. Telephone local loops have been the mainstay, while data over voice networks, where low speed data (usually 4,800 to 9,600 bits per second) may share the same wires at the local telephone loops, combined with packet switched and data switched networks, are coming into play. Broadband networks, especially circuit switched and token ring are also starting to be used, and fiber optics and cellular radio are in the wings.

Wide Area - The long distance carriers, satellites, microwave and value added packet networks roam this domain. Speeds have been creeping up from 9,600 bits per second to 56,000 bits per second, and now extended 1.5 million bit per second networks are beginning to become common.

REVIEW OF TRANSMISSION MEDIA

Twisted pair technology is currently used for telephone systems, campus, metro and even wide area networks. This cable is tried and true and quite reliable. It is bulky however, when large amounts of data must be transferred or for multiple concurrent uses due to the limited bandwidth of the cable. Using twisted pair with current technology one may send 1,200 to 2,400 bits per second maximum of asynchronous data and 2,400 to 9,600 for synchronous data depending on the condition of the lines. Digital techniques are capable of driving twisted pair at up to 56,000 bits per second, and this is becoming more common. A number of vendors have announced networks in the building and cluster of buildings distance. These networks have speeds of 1 to 2.5 million bits, with some products even approaching the 4.5 million bit per second range for building distance.

Microwave technology is limited because of the scarcity of spectrum availability, therefore bandwidth is severely limited. Costs are not too high for campus or metro distance for up to a few million bits per second with line of sight low power equipment, but longer haul and higher power equipment is quite expensive. Moreover this technology appears most suitable where narrow pipelines are found where data and and/or voice can be concentrated over these links.

Fiber optics has an extremely high bandwidth but is quite expensive at the present time. Since splices are especially expensive and time consuming it would appear that fiber optics makes the most sense between high traffic locations with minimal branching. This technology is rapidly developing, however, and campus size networks are almost feasible at this time.

Broadband coaxial cable technology is capable of handling medium to high speed data with current technology. It is quite possible to obtain up to 400 to 450 megahertz of bandwidth on a single cable. The use of already available components from the cable TV industry and the ability to easily find trained people who have had experience in the cable industry has caused this technology to become popular for large building networks, clusters of buildings and campus networks. The cost of an entire campus trunk, however can be approached by the costs of full distribution throughout a cluster of buildings. For this reason broadband for a large campus must be used more for trunking and be supplemented with lower cost distribution within buildings.

CONFIGURATION FOR THE UNIVERSITY of MICHIGAN.

Broadband Systems - The University has installed four University-wide coaxial cables. These consist of a trunk that includes a dual cable WangNet system, a single cable mid-split network and a spare cable for future use. These cables cover all areas of the Ann Arbor Campus, including the North, South, Medical and Main Campuses which, though close, are geographically separated by at least a mile or mile and a half. The distance is about seven miles in length and two miles in width, with an additional one and a half mile spur to the Michigan Media Center across Ann Arbor. The paths include four branches on Main Campus through the steam tunnel system and express runs to the North and South Campus via ducts under the City of Ann Arbor streets, and the distribution via University ducts.

Building distribution is minimized because the within building data wire (described later) will normally collect data. Only specialized applications such as video or special purpose networks will require actual distribution.

The initial use of the cables is as follows:

Mid Split Single Cable - This cable will initially support UMNet. This network technology will form the initial backbone for most university computing. This network will initially use point-to-point radio frequency modems, running at 56000 bits per second, to connect its network nodes. We also anticipate some administrative traffic on this network, probably using multidrop radio frequency modems. The rest of this mid-split network is unallocated. The allocated portion currently comprises only one TV channel (6 megahertz) in each direction out of a total of 400 megahertz. We are actively moving to the use of an IEE 802.3 Ethernet type network, 802.4 token ring or some other high speed architecture for high speed shared channel connection of UMNet.

Dual Cable WangNet - Allocation includes:

Wang network services - This supports file transfer, logical or virtual terminal attachment between Wang systems, document sharing, and resource sharing. It will also be used for remote administration of Wang systems and problem solving counseling from a central location to various remote Wang systems.

Wang peripherals attachment service - This service allows specially equipped Wang workstations to directly attach to the cable; or more generally a cluster of Wang peripheral equipment and workstations to attach to the network via network multiplexors which are capable of concentrating up to eight such devices to the network. There will be both global peripherals bands as well as diplexable peripherals bands, that allow use of a given channel within a given geographical distribution.

Video services - Seven video channels will be available for occasional use of point-to-point or broadcast via cable video when needed for University events or instructional use.

Data Services - Modems and shared use local area networks have also been selected. Wang modems for up to 56,000 bits per second will be used for remote job entry controllers, 3270 controllers, Wang emulators running both remote job entry and 3270 protocols, and protocol converters for traffic that is directed towards the administrative computer and UMNet. Fairchild Tl 1.5 million bit per second modems are used for linking Appollo networks. We are also considering the use of an Applitek UNILAN network as we see a market develop.

Microwave - The microwave communication is used to link the Main Campus in Ann Arbor with campuses in Flint, Michigan and Dearborn, Michigan. A digital microwave system will carry both voice and data.

Fiber Optics - The fiber optic system is used to connect the North Campus to the Main Campus and the Medical Campus, the Medical Campus to the Main Campus, and the Main Campus to the South Campus. Multi-strand single-mode fiber is utilized in these links.

Twisted Pair - The final media, that of twisted pair, will be the real workhorse of the system. It will handle all of the linkages between individual phone outlets and data and voice concentration points. There will be voice concentration points located at Flint and Dearborn as well as the North, South, and Medical campuses and several other wire concentration points, which will all link to the main switch at the School of Education Building over the previously mentioned fiber optics system.

There is a dual modular jack at each telephone outlet with one data jack and one voice jack. The voice jack has two wire pairs that run directly to the nearest switch site. The data jack has two wire pairs that run to the the basement of each building. Each jack has a third pair which terminates in the telephone closet to be used for power or other special purposes. Between building distribution will consist of about 150% of initial voice needs, allowing for some data on the between building wire as well as for growth. The building data wiring will normally be connected to a network concentrator device that in turn will use one of the other media, depending on the location.

OTHER TECHNOLOGY STATUS- The University's search for a new telephone system resulted in the selection of an SL-100 digital PBX system from the Northern Telecom Corporation that is being installed by Centel Business Systems. Centel is an independent telephone operating company as well as installer of large PBX systems. The fiber optics, microwave, and twisted pair systems described earlier, along with extensions to the WangNet, are being installed as part of this project. Installation has begun and will be completed in phases by mid 1986.

The building wire plan has already been installed in the School of Business where the data wire concentrates three buildings in a computing room. It is used to connect mainly Buroughs B25 microcomputers, along with Apples and IBM PCs, to UMNet concentrators. Develcon line drivers are used for this connection.

Also completed is the new University Hospital where over a thousand data circuits are used to connect to Applitek network interface units using Telebyte line drivers. The Applitek NIUs in turn connect to the TRW broadband. The hospital is also using 2500 outlets wired with IBM shielded wire, for 3270s and asynchronous work stations. The IBM wires connect to

Interactive Systems multiplexors, while the asynchronous workstations connect to the Applitek network.

Another data network that this project makes available is the Data Path Units offered by Northern Telecom, Inc.. These units allow switched digital communications of up to 19,200 bits per second asynchronous, and 56,000 bits per second synchronous within the SL-100 PBX. These data path units also interface to modem pools for inbound and outbound off net communications. We are considering the use of Northern Telecom's Computer PBX Interface (CPI) to connect the SL-100 to the Wang systems and UMNet.

We have also installed a Northern Telecom Meridian DV-1 system that uses 2.5 megabit transmission over twisted pair, and are beginning to plan for its use as well as developing interfaces under a research agreement with Northern Telecom. At the same time we are beginning to review several other high speed Local Area Networks (LANs) that can use our building wiring, and anticipate some building or building cluster LAN prototypes by this summer (1986). The next task will provide logical and physical connectivity between these LANs.

LOGICAL NETWORK INTERCONNECTIONS

We have several internal projects underway to bridge the various networks together. These include several using X.25, IBMs SNA and the TCP/IP protocols that are becoming so popular throughout the academic community. There are also other higher level gateways being developed, already in place or planned. These should be able to at least perform file transfer, document exchange and message system interconnections. We are also attempting to put together other cooperative development projects with various vendors that are currently serving the University as well as other vendors. Some examples of possible vendor cooperative projects include Appollo Computing Inc., Wang Laboratories, Inc., Northern Telecom-Bell, Northern Research, Apple Computers, AT&T, XEROX and Concord Data.

CONCLUSION

The combination of all of these modes of operation thus could provide an optimum use of each of the media where they are most cost effective. The microwave systems cover the long distance hauls between the campuses located in different cities. A fiber optic link is used between high data concentration points with high inter-location traffic, but with narrow pipelines because of some geographical dispersion. The broadband cable is used for a geographically dispersed local area with heavy data traffic as likely to go between any given location as any other. The twisted pair follows various star network configurations. All will blend in, then, to the broadband network.

The internal wiring will initially be driven at 19,200 bits per second on the twisted pair for asynchronous data and 56,000 bits per second for synchronous data. We fully anticipate, however, that as technology progresses we should be able to drive the same twisted pair at speeds of one and one half to two and one half million bits per second. We are actively involved in efforts to find high speed switching capabilities that can handle this kind of data both in small nodes within buildings as well as in larger nodes at our campus concentration point.

This architecture will support several, large, campus-wide networks as well as many smaller ones. These networks will all be tied together via various gateways, protocol converters or bridges. We look forward to developing additional gateways in cooperation with various vendors. We are also looking towards dedicated processors that could interface to most of the voice and data networks, and perform much of this gateway processing. This could prove to be a more manageable way to handle these gateways than the network-by-network pair-wise approach. Indeed we have found that this network-by-network pair-wise approach takes a large, continual and expanding amount of resources, to the point where our progress has been greatly inhibited.

We hope to utilize this network within our University environment, not only in our day-to-day operations for teaching, research, and administration, but also as a laboratory or test setting for joint development projects between communication and information processing systems vendors and the University. The result should be to better develop the use of these multi-media networks for the mutual benefit of the University and the vendors.

Through all of these developments, however, it is critical that we do not lose sight of our overall goal, the creation of truly integrated information systems. Technology has a way of catching the imagination, and we should use this spark to help give us momentum, and enable us to use technology in ways that benefit us. We should be cautious, however, that we do not let technology lead us for its own sake.

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THE SEMI-PLANNED LAN:
REFLECTIONS ON PROTOTYPING A LOCAL AREA NETWORK

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ABSTRACT

Eighteen months ago, San Francisco State University , like many other institutions, had several frustrated administrative computer users who were looking for some relief from a backlog of application requests and saturated computers shared between the administrative and academic community. Five administrative user departments discovered during cafeteria conversations that they had common requirements for office automation and data manipulation which could be addressed with microcomputers. However, each user's application had data storage requirements that would necessitate hard disks with each PC.

Computing Services assumed the role of facilitator suggesting a shared mass storage pilot project. We agreed that we would not study the project to death, but simply select a LAN vendor, install a fileserver, string a few cables to a few PC's, and see what happened. There were hundreds of variables we could have pondered for months (i.e. security, training, software availability, cost/benefit, etc.) but we chose to only semi-plan (prototype?) the project.

This paper will present the results of the semi-planned pilot LAN project at SFSU (a smashing success), indicate the current growth status, and discuss the semi-planned future of the LAN. Management tips will be given for those institutions who wish to get a LAN up fast.

THE SEMI-PLANNED LAN: REFLECTIONS ON PROTOTYPING A LOCAL AREA NETWORK

Background

The California State University is the largest statewide system of higher education in the USA. Nineteen campuses spread across the state offer undergraduate, graduate, and a few joint doctoral degrees to over 316,000 students. About 17,000 faculty teach in the 1500 bachelor's and master's degree programs offered by the CSU in over 200 subject areas.

San Francisco State University is the fourth largest institution in the CSU with about 25,000 headcount students (18,000 FTES) and 1,400 faculty. Located in the "City by the Bay," SFSU does not compete with our two well known neighboring institutions because our missions are different. The University of California, Berkeley and Stanford University emphasize graduate education and research, whereas the CSU emphasis is on teaching and other scholarly activities.

The Director of Computing Services at SFSU reports to the President and is responsible for all instructional and administrative computing as well as data communications. Assisting the Director are three Associate Directors: Instructional Computing, Operations, and Information Systems. The campus mainframe is a Control Data Corporation Cyber. Other DEC and Prime minicomputers as well as a variety of microcomputers supplement the mainframe. The nineteen campuses and the Chancellor's Office are linked by an X.25 statewide network.

Data communications on campus is by a twisted pair cable plant. Four 3Com within building local area networks are in place. These are soon to be connected to a campus broadband loop. This is the story of how we got into the first local area network.

Information Technology Status Summary

Administrative and instructional users at each CSU campus share a CDC Cyber mainframe. At SFSU, the Cyber 730 is accessed by 121 instructional users and 55 adminstrative transaction terminals. There is no data base software and little in the way of fourth generation productivity tools. Response time is very bad at peak periods. Most adminstrative applications are batched through a production control office.

The situation described above is perfect for predicting a backlog of application requests in the administrative area since there are no provisions for end-user computing, end-user control of data, or end-user submission of jobs. Given this scenario, one would not be surprised to have found many frustrated users on the campus two years ago.

Some immediate needs

Campus long range objectives which included end-user computing and office automation were established after reviewing the long list of needs. As you know, the planning and implementation schedules in a large multicampus system take forever. However, there appeared that there might be an easy and quickly implemented solution to one set of needs which had a common thread running through them. In addition to end-user computing and office automation, this particular group of needs included elements of decision support tools and electronic mail.

Five adminstrative areas on campus had the following requirements:

Admissions and Records - Provide high quality and timely responses to prospective students' inquiries.

Academic Affairs - Prepare the University Bulletin for computerized typesetting and provide spreadsheet capability for trend analysis and forecasting.

Public Affairs - Prepare press releases and selected mailings.

Extended Education - Provide office automation and record keeping unique to a self-supporting operation.

Computing Services - Replace card punch data entry with key-to-disk technology.

The five areas were in need of some immediate relief and were actively seeking solutions to these and related problems.

How do you spell r-e-l-i-e-f ?

It was pretty obvious that most of these needs could be met with a personal computer solution. Yet the data storage requirements for each area would dictate a hard disk for each PC. At this point, Computing Services assumed the role of facilitator and suggested a shared mass storage solution. We proposed a pilot local area network featuring centralized mass storage and backup. We hoped that there would be some additional benefits of shared software and multiple user access to files.

To make the project happen quickly, we established some informal ground rules. We would not study the project to death. We would select one vendor, install the system, form a user's group, and see what happened. The users would evaluate and select the software. Computing Services would offer some training on the use of the LAN and the user group would hopefully offer peer training based on the "emerging expert syndrome."

We felt the pilot project was low-risk in nature in that if the LAN component was a failure, the PC's were still usable. Computing Services purchased the LAN components with the idea of charging the respective users for the portion of the disk space which they used.

With this semi-planned approach, off we went into the land of prototyping known as The Promised LAN.

Which Vendor ?

The first step in our P-LAN called for the selection of a vendor with an available product (as opposed to an announced product). A representative group from the five administrative areas began a review of the literature, conversations with the experts, and scheduled some visits to installed sites. We only had about two months to complete the selection and issue a purchase order before the end of the fiscal year.

Four different vendors were considered: Corvus, Davong, 3Com, and Nestar. The gambling element in our decision was second guessing which network would become a standard or at least be around in five years. The 3Com Etherseries was finally selected on the following points: ease of central management; storage capacity; expandability; conformity to the Ethernet standard; and vendor proximity (for quick service). After furious negotiations, the price was finally right.

Installation

Our own three person technical support team began removing dropped ceilings, drilling holes, manufacturing connection boxes, and pulling cable. As each IBM PC arrived, it was fitted with a network adapter card to permit high speed communication to the central file server. The server itself came with a 36 megabyte disk drive and a cartridge tape backup. Account volumes and passwords were issued to the users.

When the dust finally settled, the five administrative user areas took the big leap and found themselves staring into the face of the future. Short of breaking a champagne bottle over the nearest workstation (we could not afford the bubbly), the right buttons were pushed and the rest is history. The users were corralled and led, and finally crossed over into the Promised LAN. The project costs including server, typical workstation, and disk usage charges are shown in Table 1.

What training?

With the exception of a couple of training sessions on DOS and the network, the users were on there own. Some inquisitive users read the manuals, experimented, and became network experts. Others provided political and financial leadership. Clerical staff members began

Table 1

SAN FRANCISCO STATE UNIVERSITY LOCAL AREA NETWORK COSTS

CENTRAL STARTUP COSTS	
Initial Equipment:	
3Com 3Server (36 mb)	$6,000
Cartridge Tape Backup	2,600
Cartridge Tapes (100 @ $21)	2,100
3Server Network Software	1,500
	12,200
Expansion Equipment:	
3Server Expansion Disk(36 mb)	3,000
	$15,200*
PER STATION COSTS	
Basic Workstation:	
IBM PC w/640 kb,dual floppy, & monochrome monitor	2,500
Etherlink Network Adaptor, cables, & installation	550
	$ 3,050
Options:	
Color monitor (additional $)	300
Dot matrix printer	900
Letter Quality Printer	1,800
Laser Printer	5,000

ANNUAL MAINTENANCE (est.)	
Central Server & Tape	$1,000
Basic Workstation	250

*Computing Services purchased the central server startup equipment and recharges users $40/megabyte/month based on their usage of the shared mass storage device.

NOTE: These "ball park" prices do not include any user application software.

evaluating word processing and spreadsheet software. A grassroots users group emerged for the purpose of sharing knowledge and providing future guidance to the project. The users group experience was successful because the very people who were making the rules were the ones who were playing the game.

A steering committee from the campus users group then helped to establish the Bay Area 3Com Users group. The purpose of this group is to share concerns and successes among major Etherseries users in the greater San Francisco Bay Area. In addition, this group has made suggestions and applied subtle pressure on the 3Com Corporation which has resulted in the implementation of several of the group's suggestions.

So who won?

At this point in the short life of the project, it appears that each of the units has achieved at least one of its initial objectives. Computing Services has replaced card punch data entry with key-to-disk technology using a software package called RADAR on the LAN. Extended Education has developed a faculty payroll data base. Academic Services is making use of data bases and spread sheets which enhance their day-to-day decision making and forecasting activities. Academic Affairs now has the University Bulletin on the network and Public Affairs has the much needed increase in their word processing capabilities. At this time, Admissions and Records has not found off-the-shelf software to implement their Advanced Standing Evaluation system, nor have they been willing to write their own software. However, A & R is making use of the office automation available via the LAN.

Some new players

The first pilot Administrative Local Area Network (ALAN) has gone through a metamorphosis. The initial reaction of some of the units that were approached to participate was sometimes a polite "No" often coupled with a prediction of failure. A few months later, those same units were knocking down the door to get on the network.

At present there are two other networks on campus and another underway. One of the other networks is for administrative use in the Library. The other network in place is the result of a joint venture between the School of Business and the Division of Extended Education; the first provided the space and the latter provided the funds. This instructional lab features 50 IBM PC's without disk drives connected to three 3Com servers, two tape drives, and five dot matrix printers.

The network that is being implemented is in the School of Creative Arts. This 3Com based network will link Apple Macintosh computers together to support administrative and facility use applications.

A major expansion to the initial ALAN occurred when the units reporting to the Vice President for Administration (Budget, Accounting, Business Affairs, Personnel, and Payroll) joined the network. We simply added in another server (for storage and security reasons), strung some additional cable, and welcomed them to the network which is now up to about 50 workstations.

Where to we go from here?

With all of this success under our belts, where do we go from here? First, we continue with the users group as the focal point and clearing house for ideas and directions. That group has identified the eternal search for multi-user, LAN-based software with site licensing as its primary on-going objective.

Secondly, we are looking to expand our intrabuilding networks with print servers for more access to draft, letter quality, and laser printers. Thirdly, we seek network communication servers to link the intrabuilding LAN's with a campus broadband network. Our fourth objective, then, is to expand our window to the world with communication links to statewide, nationwide, and worldwide public and private networks. The illustration on the next page is about as close as we ever got in our semi-planning to schematically diagramming our pilot LAN project and its future interfaces.

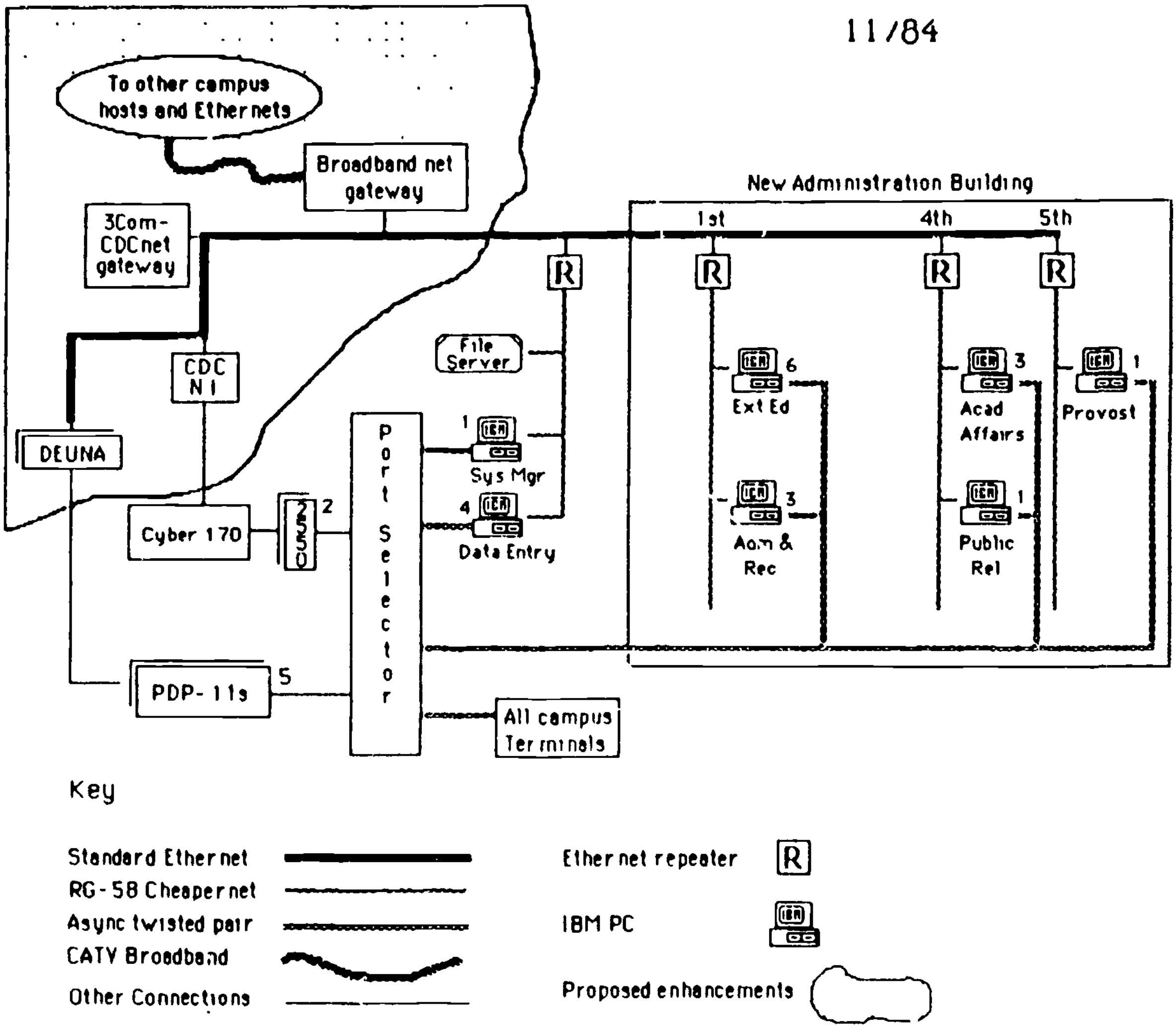
Conclusion

Eighteen months ago, a group of campus associates found some commonality in their attempts to deal with problems related to office automation and the ability to get work done with the help of information technology. A LAN pilot project was chosen as the common denominator solution. Steps were taken to minimize potential loses and increase benefits via shared mass storage and volume workstation purchases.

But the most important decision was to keep the concept of a pilot project with informal planning as the guiding light for the project. Hindsight indicates that only by keeping the nature of the users group and its steering committee informal were we able to shorten the time between decision making and implementation. We created an environment of some seasoned users and potential new users who were able to ask the right questions. We experimented on a small scale and were able to share the results with other interested parties. We created a level of interest among computer users never seen before outside of Computing Services. We generated an excitement of participation in a cutting-edge endeavor. And we did it all in a relaxed, friendly, semi-planned manner.

In closing, the last page of this paper offers some management tips for those who may wish to get a LAN installed quickly. We remind you that the key to end-user satisfaction in this as in all projects is end-user involvement.

SFSU Administrative Ethernet System



LAN MANAGEMENT TIPS: Some Dos & Don'ts

1. DO a little planning but not too much.
2. DO pick a pilot site (office) with some enthusiastic employees who like change and gadgetry.
3. DO pick a LAN vendor with a track record of post-sales support.
4. DO simple applications first... get some success stories under your belt.
5. DO double the amount of mass storage you think you'll need.
6. DO have one person designated as the resident guru.
7. DO arrange for spare parts and a standby file server.
8. DO plenty of cable drops up front.
9. DO acquire a laser page printer ... WOW.
10. DON'T buy any PC's with less than 640k memory.
11. DON'T expect to find a plethor of multiuser software available...yet.

Source: John True
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CAUSE '85 (December 1985)

Track V

Microcomputer Issues and Applications

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"IMPLEMENTING MICROCOMPUTERS IN ACADEMIC DEPARTMENTS: CHANGING THE FACE OF ACADEMIC AND ADMINISTRATIVE LIFE AT THE UNIVERSITY OF CALIFORNIA, SANTA BARBARA"

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Abstract

Descriptive review of how the Provost's Office of the College of Letters and Science at UC Santa Barbara installed 275 microcomputers in 34 academic departments during the past 18 months. The goals of the installation were to 1) enhance faculty productivity by increasing access to computing; and 2) enhance administrative support to chairpersons and faculty by automating recordkeeping and word processing at the departmental level. The paper discusses the process of implementing microcomputers including development of a decentralized computing philosophy, the decision to utilize microcomputers, the phased implementation of hardware, and provision of user support services. The paper also presents ten consequences or observations of the implementation process which should benefit other institutions considering the implementation of microcomputers in academic departments.

INTRODUCTION

The intent of this paper is to present a descriptive review of how the Provost's Office of the College of Letters and Science at the University of California, Santa Barbara (UCSB) implemented 275 microcomputers in 34 academic departments during the 18 month period from July 1984 through December 1985. Included is a discussion of the process by which the College assessed department needs, selected appropriate vendors, planned for phased distribution, installed hardware and software, and handled on-going user support; as well as a discussion of the major consequences accompanying the implementation. The paper refers to both academic computing and administrative computing in academic departments. For purposes of definition, academic computing is viewed as those computing activities undertaken by faculty in support of instruction or research, while administrative computing is viewed as those computing activities undertaken by staff to provide automated logistical support to faculty at the departmental level.

This discussion focuses exclusively on academic departments within a medium-sized public research university, and the process of implementing microcomputers to enhance academic and administrative computing in academic departments. It is beyond the scope of this paper to review the nature of academic departments as unique organizational units within an institutional setting, but it is important to remember that the governance structure and operational aspects of academic departments differ considerably from other non-academic units. Consequently, the experiences of the College of Letters and Science at UCSB are best generalized to large schools and colleges in other universities, and not to other non-academic segments of institutions.

THE PROCESS OF IMPLEMENTING MICROCOMPUTERS

Computing Philosophy of the College

A predominant feature of the University of California system is decentralized decision-making and responsibility, particularly as it pertains to the academic areas of each campus. This emphasis on decentralization began to strongly influence campus computing resources at UCSB around 1980 when it became apparent that the cost of computer hardware was steadily decreasing while the availability of computer hardware was steadily increasing. As noted by John W. McCredie in Campus Computing Strategies (1983), UCSB's experience was not unique in this regard. Universities everywhere were participating in the "new wave" of integrated low-cost computing and communication technologies, as evidenced by the "spread of mini- and microcomputers into every area of higher education" (pg. 4). Moreover, McCredie noted that "the rapid development and spread of microcomputers was accelerating the decentralization of computing resources on campuses" (pg. 8).

The combination of a general decentralized management philosophy for academic units at UCSB coupled with the changing face of computer technology led to a Collegewide policy encouraging decentralized computing. The immediate result was that the Provost's Office assumed broad responsibilities for coordinating academic and administrative computing within the College. Initial efforts included the distribution of stand-alone word processing systems to academic departments in the 1982/83 academic year, and the hiring of an independent consultant to assess the administrative computing needs of academic departments in the Spring of 1983. The distribution of word processing systems was handled in an ad hoc fashion, lacking sufficient coordination, although it did stimulate faculty and staff to think more creatively about computing applications. It was soon apparent that more intensive planning was necessary, and the results of the independent consultant's review of administrative computing needs in a dozen departments underscored this theme. The consultant's review included faculty and staff comments on a wide spectrum of issues, with four factors consistently repeated regarding academic and administrative computing in departments:

Computing Concerns of Academic Departments

1) Increasing demand for low-cost computing
2) Increasing demand for greater access to computing for academic and administrative work
3) Increasing dissatisfaction with existing centralized computing services
4) Increasing interest in minicomputer and microcomputer applications

On the basis of this input from faculty and staff in Letters and Science departments coupled with a realization that centralized mainframe computing services could not satisfy departmental needs, the Provost's Office adopted a formal philosophy encouraging the implementation of stand-alone computing wherever possible. This philosophy was not limited to microcomputers, as a number of departments eventually purchased minicomputers for various instruction and research projects. However, the implementation of minicomputers involved eight machines and is a separate subject beyond the scope of this paper.

The Decision to Use Microcomputers

Behind the decision to emphasize decentralized stand-alone computing for departments was the very real need to rapidly expand the basic computing capacity available to academic departments so as to satisfy two goals: 1) enhance faculty productivity by increasing access to computing; and 2) enhance administrative support to chairpersons and faculty by automating recordkeeping and word processing at the departmental level. Related to the first goal was a basic belief that increases in faculty computer literacy would ultimately lead to increases in student computer literacy, as faculty would apply their research experiences with computing to the classroom.

With these goals in mind, the College continued to utilize the services of an independent consultant to evaluate stand-alone computing alternatives for administrative computing, and surveyed faculty concerning preferences for academic computing. Provost's Office staff visited five other University of California campuses in the Fall of 1983 to assess comparable approaches to enhancing computing in academic departments. On the basis of combined input from these various sources, the College decided to implement microcomputers because of a number of clear advantages of this technology in addressing the computing needs of 34 Letters and Science departments:

<u>Advantages of Microcomputers for Departments</u>

*Adaptable to large/small environments
*Ease of operation
*Expandable
*Local control of systems
*Low-cost start-up
*Multiple applications and uses
*Networking capabilities
*Portable
*Real-time processing
*Shared use

The next question was to determine which microcomputer to purchase for academic departments. The Provost's Office decision to select International Business Machines, Inc. (IBM) was based on three key factors. First, IBM was a large established company with a proven track record of support for universities plus a stable prospectus for the future. The College had confidence that IBM would still be around five years down the road. Second, the existing and future product development plans for the IBM Personal Computer (PC) provided desired expandability and adaptability without compromising the critical need for standardization. Equipment standardization was viewed as essential in order to promote shared use, simplify installation and maintenance, and streamline software development and training. Moreover, the IBM PC also offered tremendous potential for both academic and administrative uses through varying hardware configurations such as the PC/XT and PC/AT. Third, a very important factor was price. IBM entered into an agreement with the University of California providing substantial purchase discounts, including a 37% price reduction on bulk purchases of 50 or more PC's plus any necessary peripherals and software. In addition, IBM offered loaner equipment through their Educational

Development Program, by which the campus could receive PC's free-of-charge for six months and then purchase some or all of the loaned hardware and software at the end of this period at a 43% price reduction.

Phased Implementation of Microcomputers

The College developed a flexible implementation plan for purchasing, testing, and installing the 275 PC's in the eighteen month period from July 1984 through December 1985. The plan itself did not consist of a single document, but rather was the product of simultaneous efforts aimed at expanding available academic and administrative computing. Hence, there was no specific target number of PC's to be distributed, just the general objective of increasing microcomputing capacity in every department in order to accomplish the following: 1) provide "PC's on Wheels" in each department whereby faculty could share mobile PC's for word processing purposes to aid in preparation of initial drafts of papers, proposals, course materials, correspondence and other items; 2) provide specially configured PC's, PC/XT's, or PC/AT's for faculty to use in data analysis and problem solving in their research or for curriculum development in instruction; and 3) provide improved administrative computing support to faculty at the departmental level through development of an Automated Recordkeeping System to assist with resource management and real-time bookkeeping, plus automation of department office functions such as word processing.

The basic theme underlying these three objectives was to help automate a wide range of tasks previously done manually by both faculty and staff. The first two objectives satisfied instruction and research needs and were classified as academic computing, while the third objective was classified as administrative computing. A survey in November 1985 revealed the following utilization patterns of the 275 PC's for academic and administrative computing:

Utilization of PC's

Purpose	Qty	%
Academic Computing	176	64
Administrative Computing	69	25
Combined Use	30	11
Totals	275	100

Distribution of the PC's was accomplished in three six-month phases: Phase I, July 1984 through December 1984; Phase II, January 1985 through June 1985; and Phase III, July 1985 through December 1985. Distribution by academic department is presented in Table I on page 10, and indicates that 221 or 80% of the microcomputers were PC's, 43 or 16% were PC/XT's, and 11 or 4%

were PC/AT's. The Collegewide distribution by phase is presented below:

Phased Distribution of PC's

Phase	Qty	%
Phase I (7/84 - 12/84)	63	23
Phase II (1/85 - 6/85)	128	47
Phase III (7/85 - 12/85)	84	30
Totals	275	100

The actual purchase of the 275 PC's was handled one of two ways. Either the Provost's Office sponsored the PC purchase (through the IBM Educational Development Program, a bulk purchase arrangement, or as part of the distribution of administrative computing systems) or the department purchased the PC (using allocated equipment funds, extramural contract and grant funds, or overhead funds). The Provost's Office directly purchased 192 PC's or 69% of the total, including 55 loaner PC's as part of IBM's Educational Development Program, and departments directly purchased 83 PC's or 31% of the total.

Providing User Support Services

In order to help administer the distribution of PC's to departments, as well as to consult on hardware and software and implement appropriate administrative systems, the Provost's Office created a support staff group entitled Administrative Computing Services (ACS). By the fall of 1985, ACS had evolved into a cohesive unit of five full-time data processing professionals providing user support services to academic departments. Three staff were charged with the task of developing and maintaining a series of Automated Resource Management Systems throughout the College, including various automated recordkeeping modules (accounting system, recharge system, storeroom inventory control system), faculty and staff provision control systems, and budget tracking systems. The remaining two staff were responsible for direct user support including selection, testing and installation of hardware and software, coordinating insurance coverage, providing user training, evaluating peripherals and software, and negotiating maintenance agreements.

ACS staff remain active in administrative systems development for Letters and Science departments using programming languages such as COBOL, D-BASEIII, FOCUS, and PASCAL. ACS staff maintain a working knowledge of Displaywrite III, Microsoft Word, Word Perfect, and Word Star, so as to help advise and train faculty and staff interested in using word processing software. They have also negotiated a low-cost maintenance agreement for the College with Computerland. By conducting an initial diagnostic evaluation and arranging for a single pick-up location for PC's in need of repair, per hour maintenance costs were considerably less than those offered by other vendors, including IBM.

ACS functioned strictly in a support capacity vis-a-vis departments, with an agenda dictated by departmental needs as articulated by faculty and staff. Choices between competing needs, particularly in the area of administrative systems development, were made by the Provost in consultation with departments. ACS staff responded to problems and inquiries within the established limitations requiring standardization in hardware and software. Fortunately, there was considerable flexibility in attempting to respond to departmental needs, since most software products were IBM PC compatible, and most applications could operate on an IBM PC, PC/XT, or PC/AT.

CONSEQUENCES OF IMPLEMENTING MICROCOMPUTERS

As with any significant organizational change, the mass distribution of such a large number of microcomputers in a relatively short time span impacted departmental lifestyles. A number of unforeseen consequences occurred, although the overall reaction of faculty and staff across disciplines was generally favorable. Below is a review of the more significant consequences which might be relevant to other institutions seeking to implement microcomputers in academic departments. The order does not reflect any ranking or level of significance.

Computer Literacy Enhanced Productivity

A very positive outcome from the distribution of microcomputers was a marked increase in productivity by both faculty and staff in departments. Faculty using PC's for initial preparation of text and proposals were enthusiastic about the gains in their personal productivity as writing is easier and quicker. Staff using PC's for recordkeeping and word processing found they accomplished more in less time, and that revisions and updates did not create the emotional turmoil that once seriously impacted clerical staff morale. Faculty also found that their ability to experiment with computing for various instructional and research purposes was enhanced through microcomputers due to reduced costs and ease of operation.

Standardization Was A Two-Edged Sword

The decision to standardize microcomputer hardware throughout the College was basically a mixed blessing. On the one hand, standardization was a positive factor in simplifying testing, installation, and maintenance of hardware, and in streamlining software development and training. This was especially true in administrative systems development, where staff user groups were formed to help design initial systems and to facilitate training. On the other hand, standardization was a negative factor to many faculty because it was limiting. Faculty were generally accustomed to freedom of choice, and there was some resistance to distribution of a single product. Some faculty were reluctant to learn a new system if they had used different hardware or software before, others mistrusted IBM and questioned its corporate motives, while still others expressed considerable computer expertise (both real and imaginary) and complained that the IBM PC was improperly suited for their work. Ultimately, these faculty concerns really reflected a broader interest in control over academic decision making, especially in areas of new technology with such enormous potential for changing the academic workplace.

PC's Facilitated Faculty Independence

The advantages of microcomputers, as previously discussed, afforded a form of technology best-suited to faculty behavior because of features such as portability, expandability, and a stand-alone operating system. In essence, the PC represented a technological extension in computing of how faculty view themselves within the academic organization: decentralized and fully independent. Hence, PC's facilitated the natural independence and creativity of faculty in conducting their teaching and research.

Real-Time Computing Changed Expectations

A fundamental change brought about by the implementation of microcomputers into academic departments was the advent of real-time computing. The presence of real-time computing altered the demands for information and faculty expectations of turn-around time on work assignments. Staff who previously functioned simply as clerks or secretaries found themselves being asked more questions and given more work. In administrative computing systems, staff had access to real-time financial and personnel data so as to better serve faculty needs. While some staff reacted to this change with great enthusiasm, others were threatened and confused by the loss of a "time lag" in the preparation and recording of transactions. Suddenly, errors were handled by official correcting entries into systems, instead of merely being erased or replaced as with manual or batch systems.

User Support Was Necessary But Expensive

Not surprisingly, quality user support was necessary for the mass distribution of microcomputers to be successful. Without the presence of full-time ACS staff to oversee ordering, testing, installation, maintenance, and training activities, the mass distribution of PC's would have been unsuccessful. Moreover, ACS staff maintained cooperative working relationships with a variety of faculty and staff (all with differing levels of computer expertise) and responded well to the difficult task of advocating certain solutions to microcomputer problems while leaving the actual decision making up to individual users. Quality user support was also quite expensive because it was so labor intensive. Each new installation added a multiplier effect to user support costs which were often unaffected by economies of scale. Although standardization and mass distribution had the advantage of reducing hardware acquisition costs and fostering lower group rates for maintenance and insurance, it had the disadvantage of increasing personnel costs due to the need for one-on-one consultation and user training. User support became even more expensive when administrative systems software was developed and required maintenance and periodic updating.

PC's Became Status Symbols

A completely unforeseen consequence of the phased distribution of PC's was that the College created a new "status symbol" for faculty and staff. While the Provost's Office believed that the distribution would more than satisfy demand, in reality it established a new measure of institutional prestige. Everyone wanted their own PC on their desk in their office. Faculty and staff with PC's had new stature; those without PC's did not. The result was a predictable outcome from the laws of economics: PC's became highly valued and scarce, hence demand for PC's increased dramatically. With roughly 530 permanent tenure-track faculty, 140 temporary faculty, and 250 permanent staff in Letters and Science departments, a very large (but perhaps artificial) demand remains for PC's.

Shared Use By Faculty Was Ineffective

Related to the creation of the PC as a "status symbol" was the failure of the "PC's on Wheels" approach to work effectively in departments. The assumption that faculty would share the use of PC's ignored a basic principle of human behavior: "possession is nine-tenths of the law". The idea of implementing mobile PC's was a well-intentioned attempt to recognize that faculty prefer to work in their offices (at all hours of the day and night) rather than to share a microcomputer facility within the department. However, once individual faculty moved a shared PC to their office, it usually became their PC and was not available for use elsewhere. The few departments that established a microcomputer room to house their PC's fared better with shared use since faculty and staff could only use the hardware and software in a single location. Complications over shared use also occurred with printers. The College had planned to provide one printer for every six mobile PC's, but 108 printers have been distributed for the 275 PC's, creating a ratio of one printer for every three PC's, or twice as many as originally anticipated.

Centralized Computing Was Adversely Affected

Although it is not the focus of this paper to review the pros and cons of centralized computing services, the decentralized computing philosophy of the College and the decision to implement microcomputers in academic departments impacted the centralized computing services at UCSB in a number of significant ways. First, the costs of central mainframe computing continued to increase as academics redirected their computing business to departmental minicomputers and microcomputers. The fixed costs of centralized computing remained constant even though the number of users declined. Second, central computing services evolved into basically an administrative computing center concerned with large systems such as payroll and student registration. Hence, central computing staff were not as actively involved in mainstream activities and developments with academic computing. Third, adversarial feelings emerged on campus between those advocating mainframe computing versus those advocating microcomputing. However, the real issue was not technology-centered, but resource-centered. The distribution of PC's represented part of the continuing decentralization of resources and computing business away from a single centralized mainframe computing service.

Interdepartmental Communication Was Improved

A small but clearly tangible consequence of implementing such a large number of PC's was improved communications and a closer working relationship between the Provost's Office and departments, as well as between departments themselves. There was greater understanding of shared needs and problems, and departments consistently voiced a belief that the Provost's Office placed departmental computing needs first and advocated for solutions to those needs. Departments also actively sought advice and counsel from other departments on computing and other issues, which was a positive change from only a few years ago.

The Benefits Exceeded the Costs

Lastly, in evaluating the experience of the College of Letters and Science at UCSB with implementing 275 IBM PC's in 34 academic departments, it was clear that the benefits exceeded the costs. The phased distribution of microcomputers accomplished the goals it was intended to accomplish: 1) faculty productivity was enhanced through increased access to computing; and 2) administrative support to faculty at the departmental level was enhanced by automating recordkeeping and word processing. No other computing approach could have reached so many individuals in such a short period of time with such positive results. This is not to diminish the problems or unforeseen consequences, but rather acknowledges the general success of the phased distribution from an overall perspective. It also recognizes that the idea was not to avoid costs, but to dramatically enhance computing capacity at the operational level in an academic department.

TABLE I

DISTRIBUTION OF IBM PERSONAL COMPUTERS BY ACADEMIC DEPARTMENT

COLLEGE OF LETTERS AND SCIENCE - UC SANTA BARBARA

DEPARTMENT	PC	PC/XT	PC/AT	TOTAL	%
Anthropology	8	1	1	10	3.6
Art History	2	0	0	2	0.7
Art Museum	0	0	0	0	0.0
Art Studio	2	0	0	2	0.7
Biological Sciences	27	2	1	30	10.9
Black Studies	2	0	0	2	0.7
Chemistry	6	3	0	9	3.3
Chicano Studies	2	0	0	2	0.7
Classics	3	0	0	3	1.1
Communications Studies	6	1	0	7	2.5
Dramatic Art	3	1	0	4	1.5
Economics	9	3	3	15	5.5
English	12	2	0	14	5.1
Environmental Studies	6	2	0	8	2.9
Film Studies	1	0	0	1	0.4
French/Italian	8	0	0	8	2.9
Geography	4	6	2	12	4.4
Geological Sciences	13	2	1	16	5.8
German/Slavic	8	1	0	9	3.3
History	11	0	0	11	4.0
Linguistics	3	0	0	3	1.1
Mathematics	2	1	0	3	1.1
Military Science	1	0	0	1	0.4
Music	2	1	0	3	1.1
Philosophy	7	0	0	7	2.5
Physics	7	5	0	12	4.4
Political Science	9	2	0	11	4.0
Psychology	16	2	1	19	6.9
Religious Studies	6	0	0	6	2.2
Sociology	18	5	2	25	9.1
Spanish/Portuguese	8	0	0	8	2.9
Speech	8	0	0	8	2.9
Statistics	0	2	0	2	0.7
Vivarium	1	1	0	2	0.7
TOTALS	221	43	11	275	100.0

-Totals reflect Personal Computers distributed from July 1, 1984 through December 1, 1985.

-Distribution Percentages: PCs - 80%, XTs - 16%, ATs - 4%.

CREATION OF AN ON-LINE PC BASED INFORMATION CENTER

Presented to

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CREATION OF AN ON-LINE PC BASED INFORMATION CENTER

Charles W. Burmeister, Ph.D.

On-line PC based information centers have been established in key administrative areas to support Decision Support Systems, Executive Support Systems, and Office Automation. The concept consists of the intelligent integration of five facets of recent converging technologies. The powerful microcomputer provides the computer hardware within the administrative area. User friendly software systems, such as Lotus 1-2-3, for the microcomputer provide the user with friendly tools eliminating the need for programming personnel as facilitators. The microcomputer is linked to the mainframe computer system by use of a software and hardware link, micro to mainframe link, creating an environment where users can work efficiently on either system. The mainframe becomes for the most part the information utility or database. Information gateways have been developed to provide easy access to the database. All aspects of creation of the centers will be presented along with the experiences of users, the benefits received by users, the impact upon the college administration, the evaluation of the long term potential, and a look at the future role of on-line PC based information centers in institutional information strategies.

CREATION OF AN ON-LINE PC BASED INFORMATION CENTER

INTRODUCTION.

On-line PC based information centers have been established in key administrative areas to support Decision Support Systems, Executive Support Systems, and Office Automation. The concept consists of the intelligent integration of five facets of recent converging technologies. The powerful microcomputer provides the computer hardware within the administrative area. User friendly software systems, such as LOTUS 1-2-3 (tM), for the microcomputer provide the user with friendly tools eliminating the need for programming personnel as facilitators. The microcomputer is linked to the mainframe computer system by use of a software and hardware link, micro-to-mainframe link, creating an environment where users can work efficiently on either system. The mainframe becomes for the most part the information utility or data base. Information gateways have been developed to provide easy access to the data base. All aspects of creation of the centers will be presented along with the experiences of users, the benefits received by users, the impact upon the college administration, the evaluation of the long term potential, and a look at the future role of on-line PC based information centers in institutional information strategies.

To provide for continuity of thought, the following is the sequence of subjects that will be discussed. The college environment will be described along with the associated problems and opportunities; the opportunity provided by the converging of technologies; a brief background of these technologies, inherent problems, and the necessary support organization; the implementation that is underway of these technologies including the impact, observations, and extensions; and finally, a look at future possibilities.

THE COLLEGE ENVIRONMENT

The Alamo Community College District consists of three community colleges, San Antonio College, St. Philip's College, and Palo Alto College, with a total enrollment (head count) of about 28,000 students. Classes are offered at the three college sites and at four other centers. Personnel consists of approximately 750 full time faculty, 60 administrators, and 450 professional and classified staff.

Computer resources consist of two IBM 4341 computers, one IBM 4331 computer, 175 administrative video display terminals, 325 instructional video display terminals, and numerous other peripheral equipment located at seven distinct sites. A SNA/SDLC data communications software system is used to communicate among all the systems.

Over 150 micro computers of various makes are installed in instructional laboratories. In 1985 the first wave of PC's were being purchased by administrators. Very few were connected to the mainframe and, in most cases, only a few were being used effectively. Personnel were, in most cases, eager and enthusiastic, but without clear direction and knowledge of how to proceed to make effective use of PC's in the administrative environment. Two were being used in standalone spreadsheet applications with the others being used mostly for word processing.

Information centers have been maintained for use by all personnel at three locations. Use of these centers by individual personnel has been very low. However, requests for over 2000 production jobs and management reports are received monthly and processed by production analysts.

It was in this environment that we set out to create on-line PC based information centers in key administrative areas to support Decision Support Systems, Executive Support Systems, and Office Automation. The project is currently underway.

INFORMATION STRATEGY.

Due to converging, available technologies the opportunity for an integrated information system is feasible. All individual elements exist or are in the process of being developed. These include the following.

1. Personal computers exist in sufficient numbers, power, and diversity to provide for standalone computing capabilities and flexibility. By a recent forecast,it was noted that almost ten million workers have personal computers available with the number increasing at approximately 15% per year. The sheer performance of the hardware is tremendous and has been doubling every three to four years.

2. Extensive user friendly software for use on the personal computers is available and is designed for the non-technical user. Most of the software is inexpensive.

3. Student, personnel, and financial data bases exist and are maintained on the institutional mainframe computer systems.

4. Communication hardware is available making it possible for personal computers to link with the mainframe computer systems.

5. Software is currently being developed to provide for an effective link of the data bases to the personal computer system.

The effective integration of these elements creates the exciting possibility of an integrated information system encompassing the mainframe data bases and the personal computer. The key is the software system creating an effective micro-mainframe link. Due to the recent emergence of this technology, these systems will be discussed in some detail in the next section.

MICRO-TO-MAINFRAME LINK.

Most of the available systems to connect a PC to a mainframe are referred to ; micro-mainframe links. These cover a spectrum of possibilities from a simple modem to access the mainframe to complex software systems where the hardware connection is assumed. For reference, we will assume an IBM 33XX or 43XX mainframe environment with its related complexities. Typically users use an emulation board to make the PC's look like a 3270 family of terminals. In this mode, the PC can be "hot switched" back and forth from a 3270 terminal mode to a standalone microcomput allowing for independent dual operation. This is convenient but is only a small step toward a "partnership" operation.

The goal is to "link" by means of software the data bases residing on the mainframe computer to the data base of the personal comput . It is essential to provide the data to the personal computer in a format that is conveniently usable by the various user friendly PC software systems. There are a number of fferent methods to accomplish this which the following.

1. The Brute Force Method. The simple, primitive approach is to capture the needed data from a mainframe computer report and key the necessary elements into the PC. This approach is obviously not imaginative, but it works. However, one can list many negative facets which rule this approach out except for the very unusual, single exception use. It is equally obvious that this is not a software link.

2. The Extract Method. By using a direct link from a micro program to a mainframe data base or file, this allows a PC end user to make a request from within a specific micro program to a particular data base on the mainframe. The mainframe data base is often a subset or extract of the more general institutional database. The file that is downloaded must be staged or formatted for use with a particular micro application.

3. Application Oriented Links. This method allows the user to access and transfer data which is then converted into a particular format for a specific micro application. The user makes a request at the micro level which is then transferred into a mainframe server. The mainframe server interprets the request and retrieves the data. It then sends it through a communication line to a file on the micro where it can be transferred into a specific application at the micro level. When the user is finished with the data,

he reverses the process to return the data to the mainframe data base.

4. Data Management Links. Generic links are those which can access a variety of mainframe data bases or applications and can download those data into any of a variety of popular PC programs, including spreadsheet, word processing, and data management applications. Generic links may depend on the implementation of a vendor oriented prerequisite, for example, a particular mainframe data base management system or language, to serve as a catalyst for the linking process. Generic links typically provide the broadest range of linking possibilities within an organization.

The above groupings implies a certain amount of stability in the market place. This is not the case. Rapid changes are occurring. There are new product announcements almost weekly A recent issue of Computer Decisions lists products ranging in price from a few hundred to fifty thousand dollars. During this period, it is essential that the buyer, you and I, be careful and plan any investment carefully.

On the other hand, the good news is that convenient access and integration of the institutional data bases into the PC environment is doable today for a price. By exercising intelligence, the price is reasonable. When the third generation software systems arrive, data on the mainframe will be available to a PC application by a simple push of a button. It extends the power and opportunities of the end user making the creation of on-line PC based information centers a very reasonable and achievable goal.

There are two concerns or pitfalls that should be briefly considered. These include the matter of data security and data integrity.

Data Integrity. Most MIS managers will immediately express more concern about the potential problems of data security than data integrity. In the educational environment, the matter of data integrity may be the greater problem. If users are given convenient access to the mainframe data bases, users will be sharing and using data in a variety of new and different ways. Overly creative users will put data to uses for which it was never intended. There are several categories of data usage that signal potential problems including multiple purposes, mixed time frames, big categories/small analysis misunderstood definitions, and institutional vs. private data. If we can be alert to these uses, we will be able to develop more effective systems and procedures.

Data Security. At a basic level, security problems engendered by micro-to-mainframe links fall into classes defined by the extreme difficulty of controlling access to the network, the transportability of information within a network, the nature of the way in which users are accustomed to interacting with their PC's and t e fact that who has responsibility over the PC end of the link may not be well defined.

One trap that must be avoided is the tendency of concerned MIS managers to overreact and to impose excessive security procedures- a "let's protect everything" and therefore do nothing reaction.

Data should be classified on the basis of its sensitivity, and the degree to which it needs to be shared within the organization. Data that isn't that sensitive should simple be ignored and make easily accessible. Data that is sensitive and needs to be widely shared poses the greatest risk and, so, should be protected first.

It is clear that once sensitive, confidential files are downloaded to a PC security of that data must rest with the end user. As central MIS management, we are the keeper or custodian of the data. As custodian we must sit with the local users and make sure they are aware of their responsibilities toward maintaining security. Security effective becomes a distributed function which is possibly a horrible thought to many MIS managers. Fortunately in the education environment most data does not fall into the highly confidential classification.

IMPLEMENTATION.

With a general idea of the opportunity, we set out to implement the concept within our general environment that was outlined above. The software link Tempus Link had been purchased for the possibilities it presented for use of the mainframe disk system for storage of PC disk files. Several administrators were purchasing PC's without a clear understanding of the use that was going to be make of the little guys. After several sessions of seeking user participation and understanding, the project was underway.

What has evolved over the months is a clearer understanding of the concept and the opportunity . I have referred to this as the concept redefined. Keep in mind the prime purpose was to create an on-line PC based information center. This might also be referred to as a distributed information center concept.

In the concept redefined, the following criteria were developed as guide lines.

1. The ultimate system would have to be simple if the desired extensive impact within ACCD community college environment was to be achieved.

2. The ultimate system, at least from a first generation concept, would have to be inexpensive. It would have to be developed with computer and personnel resources already in place or approved for expenditure in the 85-86 budget.

3. The system would have to be doable now with current levels of technology. This could not be a long term seven year project with benefits promised down the road. The doable now criterion mean that the technology could not be at the leading edge, but with an effective lag period built

in.

4. As a basic premise, available technology would be utilized and reinvention of the wheel would not be considered.

5. The impact of the system would have to be measurable and real. The system would have to provide for an enhanced and improved performance of administrators as well as professional growth of the administrators who participated.

6. The system would have to provide for the real possibility of an reduction of the central processing load. The computer power sitting on all those desks would be put to work for important functions other than word processing.

7. The system would have to provide for an effective distribution of the information center function with enhanced and increased functionally.

8. The system would have to provide for the opportunity to develop a professional partnership with users. The computer professional would provide the computer expertise and the end user would begin providing a professional end user responsibility.

9. Due to limited available computer personnel resources and the size of ACCD, the ultimate system would have to provide for well thought out standardization in order to provide adequate flexibility and and end user opportunity.

All of these factors were not part of the original planning but represented our general philosophy and evolved as the project was implemented.

The college environment being more static in structure and information needs allows an effective implementation within these constraints. A high technology growth company moving in the fast lane would require much greater opportunity and flexibility to meet its ever changing information needs.

Information in the college environment centers around students, personnel, and finance. The management information needs relative to students relate to needs relative to specific student records which is provided via CICS and to summary information. This is fortunate since the number of individual student records would make most systems unwieldy.

Operation. The various specific elements of the implementation within ACCD are discussed below. There is not a clear order of presentation.

1. A IBM 3278 emulation board is used in IBM PC's and XT's to provide for the emulation of a 3278 terminal. This allows for hardware connection to the mainframe and provides

the opportunity to "hot switch" back and forth between PC and mainframe operation.

2. LOTUS 1-2-3 and dBase III, and others, are used on the PC as user friendly applications which the end user can easily put to effective use.

3. Tempus Link, a micro-mainframe software link, is available to assist in convenient access to mainframe data. In addition, the software that comes with the 3278 emulator is available. We have developed to techniques to operate effectively using LOTUS 1-2-3 with either system. The latter is the most economical although not quite as convenient.

4. A complete summary of all student data is maintained on the mainframe data base. A CMS file for each semester is available and is as it exists at the state recording date.

5. Complete data is also available in a CMS file on the mainframe for all active personnel. This file is updated on a daily basis and is date stamped.

6. Financial data and aspects related to it will be provided during the first quarter of 86.

7. A personnel data base model and student data base model allowing for enrollment projections using LOTUS 1-2-3 are provided to each user. After the user is comfortable in use of the model provided, they are encouraged to make modifications to meet their precise needs.

8. None of the data provided represents confidential information in this environment. Personnel salaries are included and could be a problem in some institutions. However, password security is required to access the files and is provided only to administrators who qualify. The end user is instructed to maintain reasonable security and erase them when completed.

9. When a user desires to work with the student or personnel data base, the appropriated files are downloaded into Lotus 1-2-3 in the proper format for LOTUS 1-2-3. The end user is then free to use available user friendly software to perform in a convenient and time effective manner whatever application is necessary to achieve the desired results including graphics, spreadsheet, or data base management.

10. The appropriate files as indicated in items 4, 5, and 6 above are maintained by production control on the mainframe. Requests for creation of special file formats are processed by production control. These are useful for departmental uses and other special applications.

SUPPORT ORGANIZATION.

Support provided the end user consists of an expanded training program to include all the necessary technical background areas, consultation, operational support as indicated above, programming and design of various models, and promotion of the concept. These are the usual necessary components of a support organization. IBM has a series of new publications dealing directly with support of end user computing that are excellent. See G520-4233 and G320-0736.

EXPERIENCE AND EVALUATION.

The purpose of this undertaking was to integrate the PC into the information network and to have positive, measurable impact upon administration performance. This broad goal is being met with the following specific points being addressed.

1. The PC's that were purchased or being purchased for undefined purposes were given a specific use and placed into use.

2. In the process of determination of what information was needed by various administrative positions and when it is needed, many administrators gained a better understanding of there responsibilities and how their performance could possibly be improved.

3. Individual administrators have experienced professional growth due their increased competence in use of the tools of computer technology.

4. The possibility of a professional partnership is becoming a possibility. Longer term this impact could become very great.

5. The concept of a distributed information center is becoming a reality. The end user is able to more flexibly and conveniently to meet the individual needs as opposed to a straight request to production control.

6. It is too early to experience any decline in use of the mainframe resource. For the most part more users have been brought into the system and more diverse things are taking place which is healthy.

7. We have shown that an expensive software link is nice but is not necessary to implement the full concept. In addition, in the education environment data base management software link may not be necessary.

8. Neither data security or data integrity poses a particular problem in the manner that the concept is operating.

Our evaluation has been positive and it has been a meaningful experience. We expect that as the development effort grows the extensiveness of the impact will become even greater.

FUTURE OPPORTUNITIES.

Technology in this area will increase rapidly and will enhance the great opportunities that exist. Since the software that is available is in an extremely dynamic state, it is probably wise to wait until a software standard emerges before making an investment. There is, however, adequate software available with assurance that a standard is coming. Thus implementation of the concept can be undertaken at this time.

The integration of the powerful PC into the total information network provides the end user with great opportunities for effective and full utilization. It will become essential and common place in most organizations.

MICROCOMPUTERS IN HIGHER EDUCATION ADMINISTRATION:
CURRENT ISSUES AND PLANNING

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The role of microcomputers in college and university administrations is investigated through a survey of a sample of public and independent California institutions. Microcomputer policies, standards, issues, and problems are explored and analyzed for trends. The survey assesses the scope of microcomputer use as well as current plans for expanding the use of micros. The issues that ought to be addressed in planning for this inevitably growing trend are identified and discussed.

Objectives

A major objective of the study was to systematically unearth the approaches used by (and useful to) higher education administrators in planning for the smooth integration of microcomputers into administrative functions and processes. Also, the types of issues administrators considered in developing plans for acquiring and implementing microcomputer systems and solutions, and the types of applications utilized were determined. This study was designed to support planning, policy making, and decision making efforts. A critical question faced by many university administrators willingly or unwillingly is, "What is the appropriate role of the microcomputer in university administration?" The study seeks to provide guidance in answering this question.

Review

In the short span of five years, microcomputers have already established a significant presence in the "toolkits" of education administrators. The many uses such as office automation tools and database management systems are described elsewhere (Spuck and Atkinson, 1983), and others still (Brown, 1983; Brown and Droegemueller, 1983) address more specifically the decision support systems role of microcomputers. They argue that decision support applications through software tools like spreadsheets, computer graphics, and database management systems are particularly suited for increasing administrative productivity. These tools augment the more traditional but time saving office automation tools like wordprocessing, task management, and calendar scheduling. Electronic mail is another time saving communications aid that is mentioned.

Just as it is not likely that microcomputers will replace instructors in the classroom (Chapman 1985), micros probably will not be replacing any staff or administrators. Rather, they will be used as a productivity tool and will refocus managerial efforts to include new tasks. There are signs that higher education managers and administrators are already changing the way they do business. Some industry leaders are predicting "a time in the not too distant future when the micro, or whatever they are called, will be a necessary tool of the dean, business manager or president" (Evans and Coffey, 1984: p. 20). The proliferation of microcomputers in higher education has been so widespread that some universities have even institutionalized the process: For example, according to Gale (1983), Cornell University reorganized its computing services to not only include the three traditional subdivisions -- systems and operations, administrative computing, and instructional computing -- but to include a fourth subdivision, "Decentralized Computing" to deal expressly with the problems, issues, policies, and opportunities associated with the new ubiquitous presence of micros on the campus.

But the challenges of the transition to the new micro technology are not easily answered by a simple reorganization of services: in 1983 this very issue (i.e. the growth of micros), was the "hot" topic of the CAUSE National Conference, where a forum was held entitled "Micros on Campus: Policy Issues." Here, issues like maintenance demands, hardware and software procural standards and policy, user training, self help, and linking through networks surfaced. The issues surfaced as more of a knee jerk reaction to a rising tide than through a strategically planned approach toward shepherding in the new technology.

One writer (Emery 1984), on the other hand, provides more planning and policy guidance by assessing the trends, their implications and by suggesting some reasonable planning assumptions. Particularly helpful are his economic insights about deceptive, low unit prices which add up as large numbers of units are purchased and realistic "full" costing including peripherals, software, maintenance, technical support, etc. More important, however, is the wholistic discussion of strategic positioning (i.e. technological leader, early follower or casual follower) and the checklist of issues in strategic planning for information tecnnology.

Significant among issues is the networking issue associated with linking micros to each other and to other, larger resource machines. That micros will communicate is not a given; while some of the communications problems have been solved, machine incompatibility and lack of communications protocol standards leave much to be desired. Brooks and Creutz (1984) discuss the need and the current difficilties. While not a reality today, a network of linked micros is thought by some (Harris, 1983) to be the next significant step in improving college computing. Even some of the major players are banking on the importance of networking: "An Apple spokeswoman said that ... it had jumped at the chance to work with Pacific Bell because Apple believed communications will be the driing application for getting more computers into the home" (Weber, 1985).

While previous literature on microcomputers in higher education administration identifies the important issues, the prespective taken is usually based on a single or small group colleges of universities experiences. The current study broadens the perspective by sampling the experiences of administrators across both public and private colleges and universities in California.

Methods and Data Sources

The method employed combined several data gathering efforts. First, a computerized search of the literature uncovered specific planning efforts in higher education institutions. These studies were reviewed with the objective of identifying the planning models and approaches utilized, the issues dealt with by planners, and the outcomes in terms of recommended directions. The important issues were molded into questions for an interview/survey instrument (see Appendix A). Next, the study utilized a telephone survey of 22 California postsecondary institutions to gather data regarding philosophy, campus policy, procedures, and problems. Institutions were selected by size and type and control including 15 public and 7 independent institutions. For the most part, computer center directors or assistant directors were interviewed. In two cases microcomputer specialists were questioned.

Interviewers probed respondents for detail regarding the history, implementation and effectiveness of campus policies and procedures. Data were coded by the authors and analyzed statistically using SPSS (Nie, 1975).

Findings

The 22 campuses interviewed had a total of 1,029 administrative microcomputers currently in use and planned the acquisition of 559 more next year, representing a 54 percent annual growth rate. The campuses ranged in size from 1,000 to 35,000 students (averaging 15,256) and currently used between 0 and 200 microcomputers (averaging 49) and planned for the purchase of 0 to 200 (averaging 29) next year.

A total of 33.3 percent of the responding institutions had formal written policies governing the acquisition and use of administrative microcomputers 23.8 percent, reported having informal policies as 38.1 percent had no policy at all. Two respondents declined to answer or did not know.

Ten institutions had policies that specified manufacturers, two campuses limited the selection of hardware, and seven had no policy. There was no significant correlation between having a policy governing the acquisition of microcomputers and specifying or limiting the selection of hardware. For example, of the seven campuses having formal written policies governing the acquisition and use of micros, three had policies specifying hardware manufacturer, one limited the selection and three allowed complete user discretion.

Wordprocessing was the most popular use with 89.5 percent of those responding placing it first. Spreadsheet applications were a clear second, database programs a clear third, telecommunications, graphics and electronic mail were a close fourth, fifth and sixth with integrated software seventh.

Microcomputer Use	Rank
Wordprocessing	1
Spreadsheet	2

Database	3
Telecommunications	4
Graphics	5
Flectronic Mail	6
Integrated Software	7

Only four of the institutions surveyed had a centralized software library. Ten institutions reported that they share software informally between offices. Seventeen institutions reported that they allow users to select software.

Fourteen institutions, 73.7 percent of those responding to the question, indicated that they provided a microcomputer training program to administrative personnel. Among the fourteen institutional traing programs identified, one was operated by administrative personnee, 10 were operated by computer center personnel and one relied on auto tutorial programs.

Ten institutions networked microcomputers -- only four reported that they had problems linking microcomputers.

The fourteen institutions estimating administrative microcomputer expenditures, said they spent $2,270,000 on administrative microcomputers this year. Spending for new micros amounted to approximately seven percent of the computing budget at the three campuses within the survey where total budgets were given.

The computer centers of 81.3 percent of the responding campuses provide machine service directly while 53.3 percent purchased service contracts. Only 29.4 percent budgeted administrative microcomputer service through the computer center while 70.6 percent budgeted service through each individual department.

Institutions responding to the survey indicated they expected on average a 35 percent discount on equipment and 78.9 percent indicated they purchased from local vendors.

Discussion

While many institutions had developed and were implementing microcomputing plans, the formal planning process was much more apt to cover larger mainframe and minicomputer networks than to plan explicitly for the microcomputing environment within administration. A few institutions, such as Carnegie Mellon (not surveyed), have developed long-range plans centering around networked microcomputers. In the current study, the following arguments were articulated as reasons for establishing a formalized process and written philosophy;

- the lack of standards produced chaotic purchasing leading to problems with networking, machine maintenance and user training,
- larger volume buying resulted in higher savings, better vendor relations and better user support,
- acquiring "pools of similar equipment" provided backup in the event of breakdown,
- equipment maintainence, service and user training could be funded and managed centrally providing faster more effective support,
- the software support base tended to be larger providing greater user satisfaction and productivity.

Several institutions recognized the chaotic proliferation of microcomputers in higher education administration. One solution was to identify regional computing needs for mini computer applications which, when properly configured, can be more cost effective and provide lower cost workstations compared with micros. But the most predominate institutional response was to establish a "support incentive standard", that is to recommend hardware standards (brands) and to support only the recommended brands with training, maintenance, network links, and purchasing discount incentives. While alternative brands of micros were allowed, the lack of support provided a significant disincentive for users to "stray" from the pack.

One of the major benefits of the study effort was the identification of issues that require attention if a planning effort for micros is to be both realistic and successful. Issues identified by a number of institutions as needing consideration include: 1. developing policies and standards for hardware and software acquisition, support, and maintenance; 2. selecting systems to readily meet telecommunications needs; 3. determining cost effective maintenance options; and finally, 4. providing for effective user training and support (including software support).

The importance of this paper is that it surveys higher education institutions on planning microcomputing environments to indicate current trends and uses, and identifies important issues that need to be addressed. In short, the paper serves as a primer for educational planners addressing the role of the microcomputer in the work place.

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APPENDIX A

SURVEY OF MICROCOMPUTERS

(Circle all that apply and fill in blanks)

1. Campus___________________________Contact______________

2. Campus Size - # of Students____________________________

3. Number of Administrative Micros not in place______________
   Planned for next year_________________________________

4. Does your institution have a philosophy governing the aquisition, use and applications of microcomputers within the administrative framework? Is it written? or informal?

   a) 1) yes, written
      2) yes, informal
      3) no
      4) other____

5. Does university policy specify

   a) Manufacturer?
      1) yes, which ones______________________________
      2) no
      3) selection limited
   b) Configuration e.g. DD, memory, etc...
   c) Software?
   d) Other?

6. What are the uses of microcomputers in your administration? Can you estimate:

   The percent of total use in the following areas:
   a) word processing ____________________
   b) spread sheet ____________________
   c) graphics ____________________
   d) telecommunications ____________________
   e) integrated software ____________________
   f) electronic mail ____________________
   g) other ____________________

7. Do you network your microcomputers?

   a) 1) no
      2) yes
   b) If so how
      1) LAN
      2) Through mainframes using telecommunications software
      3) Modems
      4) other

8. Does your university have a centralized administrative software library?

    1) yes
    2) no

9. Do you share software informally between offices?

    1) yes
    2) no

10. Does each user of office acquire and maintain their own software inventory?

    1) yes
    2) no

11. Does your institutional administration offer a formal microcomputer training program?

    a) 1) no
        2) yes
    b) If yes it is run by
        1) administrative personnel
        2) computer center personnel
        3) vendor
        4) tutorial
        5) other

12. Regarding purchasing microcomputers

    a) Do you buy under state contract?
        1) yes
        2) no
    b) Do you buy from local vendors?
        1) yes
        2) no
    c) What % discounts from vendors do you expect?____________
    d) Is software included?________________________________
    e) What is your Microcomputer Budget for new machines this year?________________________________

13. Regarding Service

    a) Who handles the service on your equipment?
    b) Have you purchased service contracts on your micros?
    c) Who pays for service?

14. What are some of the problems your organization has encountered in acquiring and using microcomputers in your organization?

    a) Is software piracy a problem? How is it handled?
    b) Is utilization of micros good or do they sit idle in some offices?
    c) Is linking a problem?
    d) Is enforcing standards a problem?

Other Comments ____

ORGANIZING TO SUPPORT THE MASSES: A UNIFIED APPROACH

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ABSTRACT

This paper will review the decision to reorganize academic and administration microcomputer support in an institution with over one thousand microcomputers into a unified department. A brief summary of the evolution of the growth in the number of micros and variety of use will be followed by a discussion of the various strategies for reorganization which were considered.

The focus is on the structure that we adopted, the reasons for this action, what the reaction has been, the mistakes that we have made at various stages of the support activity and how we intend to cope with growth in the number of micros from 1,200 in 1985 to 2,500 in 1986 to 4,000 in 1987.

In 1982, Bentley College which is the seventh largest undergraduate college of business in the United States, decided to make a radical change in the way it provided computing resources to its clientele. Up until this time, computer service was provided by one central DEC10 mainframe and it was decided to provide a more decentralized environment by acquiring the first three of what subsequently was to be five PR1ME computers. In addition, in order to provide alternative computing resources, the first 100 Apple+ microcomputers were acquired for academic use. These were placed in a new micro lab and were issued to the faculty and these complemented the 200 terminals that were hooked up to the PR1ME's for academic users. At this time, administrative users did not have access to microcomputers and were using one of the PR1ME with approximately 85 terminals.

During 1983, administrative users began to discover micro-computers with the acquisition of 2 Apple III micros and the subsequent acquisition of a few IBM PC's. These systems were acquired quite independently of the Computer Center and therefore were left to their own devices for instructional as well as service support. Another complicating factor was the acquisition of ten PR1ME Producer100 workstations for an office automation pilot test. These micros used a different word processor and they were using Multiplan and we were using VisiCalc in the academic area.

With the introduction of the Apples and IBM PC's, an entirely new dimension of computer support had to be provided and a staff built up to offer seminars, private tutorials, and other faculty and student support. The organization which was established in early 1983 to support the microcomputer and other activities falling under the aegis of Information Services is depicted in Attachment A. You will note that there are microcomputer consultants in both the Academic Computer User Service area and the Administrative Systems group. This necessarily resulted in a duplication of training and support efforts as well as expertise on such items as VisiCalc, and word processing which were software components used by both the administrative and the academic users.

This organization was reasonably effective as long as we were dealing with a few hundred users of microcomputers and when the occasion arose we would offer a seminar and somehow make it possible for administrators to sit in on an academic seminar. However, it quickly became obvious that it was going to be inadequate to support the several thousand micro users that were on the horizon.

A major decision was made in 1983 which was to affect the environment in which we operated as well as the organizational requirements to support this environment. This was the development and publication of the academic computing goals in January of 1983 which served as a policy statement that heralded the College's total commitment to computing. These goals which were issued by the Academic Computer User Planning Committee chaired by the Dean were as follows:

1. All Bentley College Bachelor of Science and Master degree candidates will be computer literate.

2. The Computer Information Systems Department will offer programs in information systems and computer science that are nationally recognized for the expertise of their graduates.

3. Computer applications will be integrated across the curriculum in appropriate disciplines and courses so that individuals in majors from departments other than CIS will be at the forefront of computer applications in their field and will be sought by employers for this characteristic.

4. The college will offer credit and non-credit computer programs as appropriate for such audiences as executives, high school teachers, children, small business people and others seeking a level of computer knowledge.

5. All Bentley faculty will be computer literate and able to employ the computer in their courses, where appropriate, within four years.

6. Relevant faculty research will be supported on campus or through time-sharing off campus.

7. The college will support a computing utility that includes mainframes as well as various microcomputers with stand-alone and on-line mainframe access capability.

8. The college will provide for the sale of microcomputers to faculty, staff, and students.

It seemed clear from these objectives that we would be dealing with a mass of computer users and that virtually every faculty member and student as well as many staff people would have microcomputers. They would be used as stand-alone units and to access time-sharing computers where centralized databases would reside. Thus, it would not suffice to have individuals who solely understood micros and associated software. We would also require an understanding of the administrative and academic data bases with which the micros would interface.

There were a number of problems with the old organization and these were exacerbated by the decision in 1984 to acquire the first 300 Hewlett-Packard microcomputers for student(200) and faculty use(100). What is most significant about this action is that it required a complete change in the knowledge of the support personnel from that of an Apple environment to one where they would have to support the MSDOS operating system and new applications software. In this case we were moving from Visicalc to LOTUS and from ScreenWriter/Supertext to MemoMaker and WordStar. In addition, much of the course specifies software such as Accounting Plus, an audit package and others would have to be evaluated and replaced.

The summer of 1984 was a tumultuous time mainly due to the retraining of the professional staff as well as the 80 or 90 student lab consultants who were supporting Apples and terminal instruction. They had become adept at supporting Apple's but from this point forward they would be supporting the MSDOS micros. Thus, we had to re-train returning and new student assistants and introduce a new generation of hardware and software. Suffice it to say that we did not allow enough time for this activity and we learned that we needed additional professional staff trained and available to lead the part-time student assistants.

In the fall of 1984 we had established two new labs with 100 Hewlett-Packard 150 micros and we conducted a pilot test of 15% of the freshman class who were equipped with portable microcomputers. These 115 students would utilize the portable in three courses during each of their freshman semesters. These were the Computer Information Systems course, the Accounting course and the English course. It is important to note that while students were equipped with portable computers for the first time, the Accounting and CIS course had previously been offered to freshmen and it was only the English course that was using the computer for the first time. The College had an eight year growth pattern of use of computers and at the beginning of 1984 we had over 200 of our 600 course sections across various disciplines utilizing computers in one form or another in the classroom and for assignments.

In view of what was a mass migration to micros in 1984, it became evident that we wo ld have to develop new modes of instruction and that we would have to establish a critical mass of microcomputer support professionals who had considerable overlap with the administrative systems personnel as well as the academic computer consultants. It would simplify matters if in fact all one had to know was micros but the implications of down-loading administrative data to micro-computers and the subsequent micro update and uploading of information gathered on micros describes a job description which is far more complex than simply knowing about microcomputers. Unfortunately, many people involved in microcomputers do not have that perspective and one virtually has to train the staff to develop such as generalist view of information processing. This is rather difficult since many micro support personnel have not had a traditional computer education.

In 1985 a decision was made to establish a separate microcomputer support group out of the academic computer user service area in order to better support all of the constituencies that were utilizing micros on campus. The remaining people in the academic group who supported labs and faculty computer support primarily in the research area were housed under a new Director of Research and Instructional Computer Support. The microcomputer group were placed under the direction of a Director of Microcomputer Support as depicted in Attachment B. As of this writing the organization is really too new to evaluate but it is clear that we have begun to break down the barriers of communication that existed when administrative people were reluctant to call the academic people for support.

The objectives of the microcomputer support group were as follows:

- Develop policies for Evaluation and Acquisition
- Develop Standards for Data Administration & Exchange & Software Usage
- Acquire Hardware for Faculty, Students and Staff
- Acquire Software from Publishers, Vendors & Public Domain
- Train Faculty, Students,and Administrators
- Develop a network of micros and mainframes
- Combine support activities of micros and O/A
- Provide Download/Upload Capability to our PR1ME systems
- Provide Common Tools -- WordPerfect, LOTUS, Revalation

Some of the preceding objectives are very global in nature and will require considerable time to develop. Those which seem most difficult to accomplish are the establishment of policies and standards for microcomputer evaluation, acquisition and use although we have made considerable progress in this area and we do have a set of policies which have been developed.

Throughout this three year period, there were a number of situations that developed at our institution that might benefit other colleges that have a rapid proliferation of micros. Some of these are identified below and the important lesson that we learned is that policies and procedures should be developed in advance to deal with these situations rather than simply reacting to them as they occur.

The first situation that presented itself was the "jumping on the bandwagon" phenomena. The micro is the newest device on campus and whether or not it is suited to a given application everyone wants to use it. As a consequence, individuals requesting micros are loathe to have you evaluate the purpose for which they intend to use it. Perhaps more important is what happens when they find that the micro simply cannot do what they had intended. At this point they have time invested and whether it makes sense or not they may not want to switch back to using a mainframe. The consequences are requests for software and data bases that simply are not suited for micro application.

Pursuing the data base theme, in a business institution such as ours we have assembled a number of financial data bases(CITIBASE, CRSP, HUGE, COMPUSTAT...) and software packages which use these financial data bases(IFPS, EXPRESS, IMSL, SPSS...) These are large multi-tape data bases which do not lend themselves to being downloaded to micros except in their smallest extracted forms. The key word in this situation is that controls have to be established and the usage and extraction of information from these financial data bases has to be closely monitored to determine whether this is indeed a micro application.

A significant external factor affecting micro acquisition and use is the software policies established by third party vendors and the licensing issues associated with this acquisition and use. While some vendors are flexible in providing site licenses and text publishers are adopting software workbooks complete with diskettes, the large successful software houses such as LOTUS do not have the same flexible pricing when one is dealing in literally thousands of copies of a piece of software. Consequently, when a major decision to acquire a software package, which is utilized by a large number of students or staff, is made. One has to make a commitment to that software for a long period of time. Faculty in particular do not like to be constrained by this type of decision since they wish to be using the latest version of software or the latest software package, for that matter. This creates an almost untenable situation of forcing the cost of software onto the students. It is bad enough to have to do this for several courses during a students career but to have them acquire two, three or four different word processors in their four year career somehow seems ludicrous. It is incumbent on us to protect their, as well as the College's, investment in software which is acquired.

As a direct result of this type of policy, we have adopted the concept of a supported software list. This in itself is viewed as an unnecessary constraint by faculty but it seems to be the only sane approach to staffing for supporting the thousands of different software packages which are in the marketplace. We will acquire an examination copy of a piece of software to determine if it might be useful in a classroom setting. However, the cost effectiveness of that software has to be evaluated by the college steering committee on computing matters prior to acquiring multiple copies. Thus, a software package does not find its way to the supported software list unless the college has made a commitment to acquire multiple copies for lab utilization or for distribution to or purchase by students.

Another problem which is paramount in the administrative area but also finds application as regards students is whether or not one makes available all of the features of a given package to a specific user. Of necessity, in administrative systems, some individuals are restricted to the query commands of the reporting system but others also have access to the update commands. Such is also the case with micro-based software since one needs to evaluate the features of the package prior to unleashing it on an unsuspecting user. Acquiring and distributing software which is too complex for a user or allows them to compromise the integrity of the college's databases will do more to discourage the user than not acquiring the software in the first place.

The advent of micros brings the concept of data administration full circle. From the early days when we were trying to provide a central data base and allow users to access that data base, we now have a situation where we will have an almost totally distributed environment where data exists in many locations. This makes the concept of data independency difficult to obtain and the exercise of the database administration function difficult at best to perform. The opportunities for data redundancy will multiply almost geometrically with the expansion of the number of micros and the attempts to control access to information as well as update will be resisted. This problem should not dissuade us from attempting to enforce the data administration function. In fact, I would argue that the concept of a centralized dictionary that is controlled in an active sense by a computer which monitors activity across the network of microcomputers is even more critical to data administration than it was when we had centralized data bases. While software is not readily available to perform this function, it should signal the necessity for development of such "traffic cop: DBA computers" to continually audit the existence of data items on microcomputers which are extent throughout the campus and to redress issues of data redundancy when they are encountered.

This level of complexity raises the issue of how and where to capture the network definition of the existence of microcomputers. Clearly, it is not enough to have a DBA computer functioning by itself. It must be working in conjunction with a network management computer which provides access from micro to micro throughout the system and can identify users who move their micros from node to node. Again, software developments and technology do not seem to have resolved this issue. The network management software that exists with the major vendors has not advanced to this level of the ISO model where we have transparency or inter-connectivity at the application layer. However, in order to achieve the management of micros on campus, we clearly must move to that type of system. It is just not enough to have one vendor's computer talk to themselves over WangNet or DECNet, or PR1MENET. We must strive for a network above the computers that provides node to node communication in a user transparent form.

Another major problem with the introduction of micros is that policies must be established for acquisition of hardware and software. Left to thier own devices everyone wants a complete workstation. It is not enough to have dual floppies and 256K of RAM. One can easily make a case that at least one-half megabyte is required and to have a computer without a hard disk is dysfunctional. Similarly, one can make a case for acquiring a complete library of software for each faculty or administrator. While this makes sense from the individual's perspective, a college or university could easily go bankrupt acquiring the full complement of software for everyone on campus. Clearly, policies must be established and published in order that people will not inundate the center with requests for h dware and software that simply cannot be acted upon. The Computer Center must be taken out of the middle of this situation and it must be made clear what the procedures are for acquisition.

Having said all of this, I must come back to reality and suggest that whatever policies are established and whatever standards and procedures are created, there will be a continual attempt to ignore policies. Users will perform end-runs around procedures and completely disregard standards. Maintaining policies and standards requires eternal vigilance and, while exceptions must be made, it should be remembered that what one is trying to accomplish is to maintain the integrity of the campus-wide computer environment. To ignore established procedures only to get a given faculty, or staff member off of one's back is not in the best interest of the institution and should be discouraged.

One of the major problems with the introduction of micros as related to administrative systems, is the opportunity that is created for ignoring the college-wide priority setting mechanisms for the development of administrative systems. If a use can't get a given system or sub-system developed, it is a simple matter to go to the information center or the microcomputer support group and request that a package be evaluated and in this way the user may be implementing a system that the college wishes not to implement. It is one thing to be able to put in a system because there isn't enough manpower in the administrative systems group but it is quite another to install a system that a college wishes not to install.

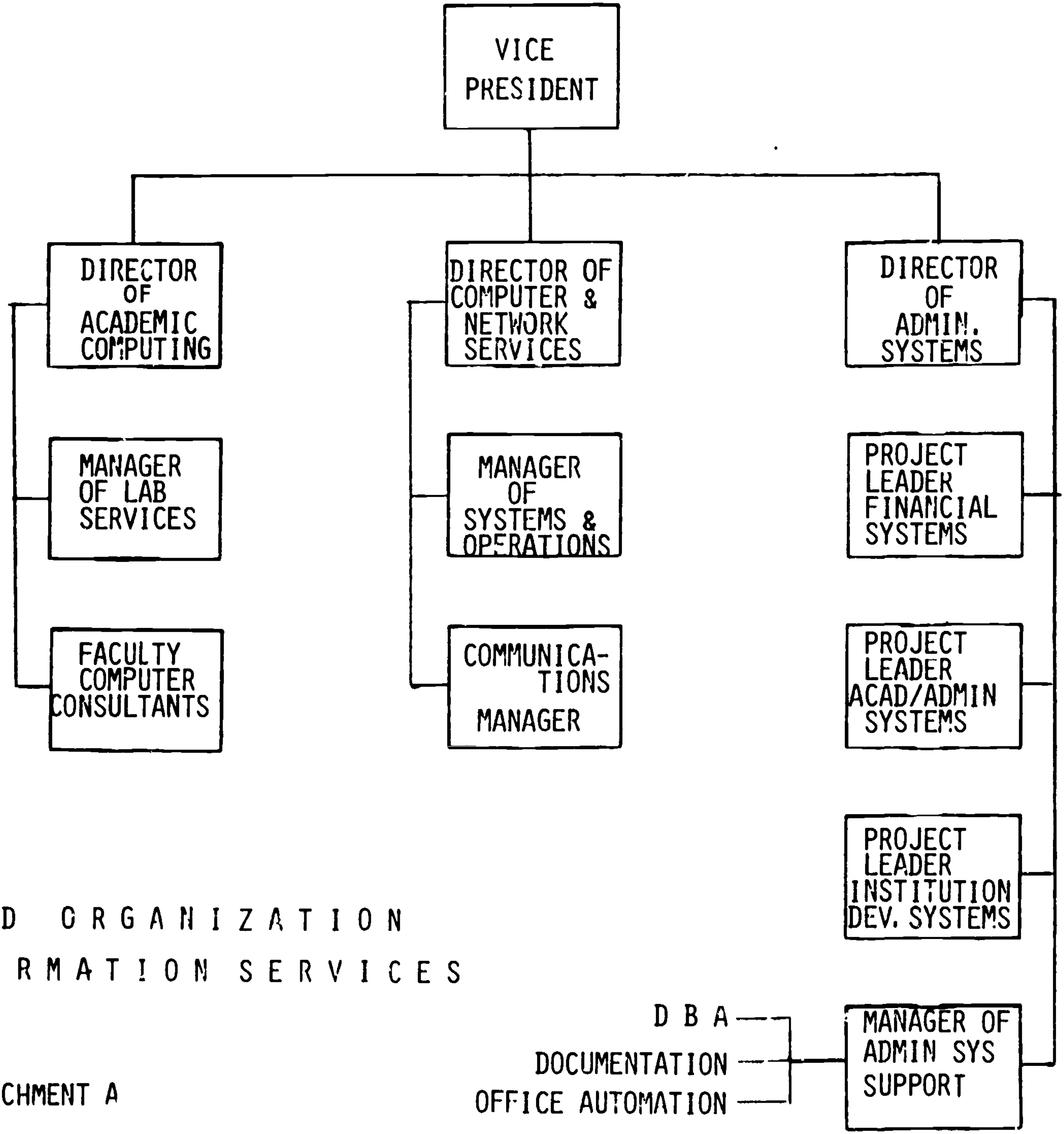
Throughout this period of micro proliferation on campus where we have seen the number of microcomputers increase from the first 100 Apples to nearly 1,400 micros during the fall of 1985, we have seen an evolution of the introductory micro workshops to increase levels of sophistication. This is testimony to the increased computer literacy on the part of our faculty to the point where we are now employing the term "computer fluency" to characterize the level of literacy that they have achieved. The important point about this software evolution is that it is a never ending story and the minute that one feels that they have their arms around the problem the faculty or some other group will come up with the new cure-all software package that absolutely must be used. Thus, the microcomputer support issue is really somewhat akin to dancing on hot coals and it is not an occupation for those who are wedded to a given software package or given approach to using microcomputers.

Supporting microcomputers will continue to be an area of continual change thus making the establishment of standards more complex than anything we have experienced before. This is primarily due to the decentralization of the activities which are performed on micros. It is one thing to control the activities of someone tethered to a mainframe via some communications cord and have all of their activities on the dumb terminal monitored. It is quite another matter to control not only the activities of the micro which are connected to the mainframe but those activities which are totally independent and distributed.

In closing, I might note that it may seem that this entire approach to supporting microcomputers has been altogether too reactive since we did not have a grand plan in advance and merely adjusted the organization to deal with the situation. This is quite true, and in large measure we adjusted to deal with a problem that arose but we have not been without our successes in any case. Some of the more notable successes that we have had are as follows:

- We handled distribution of 1,000 micros without incident.
- The faculty has moved from literacy to competency.
- Course integration has met our expectations.
- Student literacy accomplished.
- Administrative training started but progress is slow.
- Handle software evaluation efficiently.
- Enthusiasm for new applications is at fever pitch.
- Several instructional modes have flourished.
- Walk-in information center activity is very high.

Finally, the objective of this paper was to offer some guidelines to college's that might be venturing into this mine field of ever-changing technology of hardware and software and, hopefully, some light has been shed on this timely and perplexing issue.

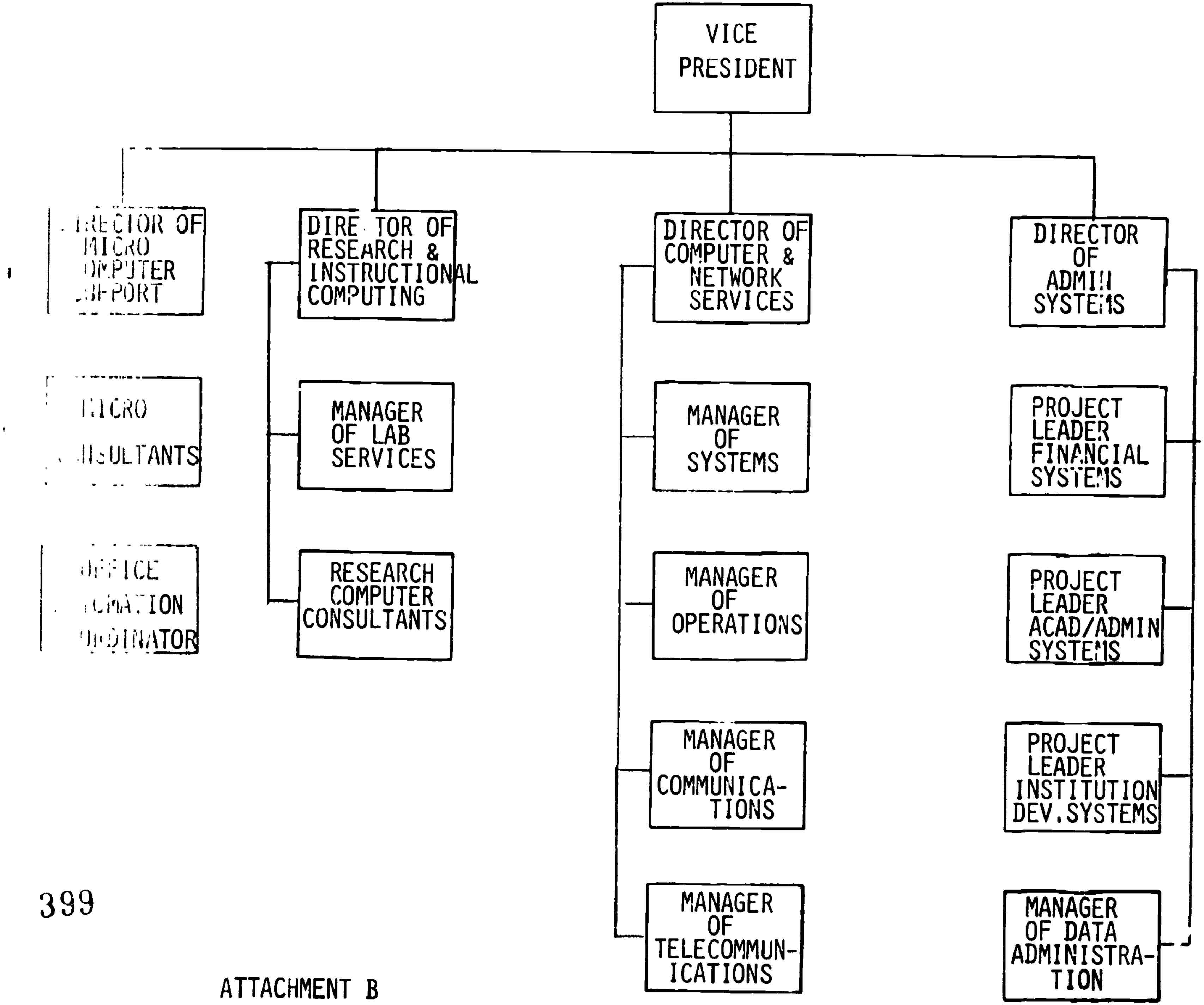


OLD ORGANIZATION

INFORMATION SERVICES

ATTACHMENT A

NEW ORGANIZATION
INFORMATION SERVICES



ATTACHMENT B

Network Alternatives for an Office Information System Using Desktop Computers

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New York, N.Y.

ABSTRACT

This paper describes a methodology for designing and evaluating networks to connect desktop computers to form an office information system. The nature of the problem is discussed, the major alternatives are identified, and the selection of appropriate network models are explained. The models are then used as guides in order to evaluate current offerings of the different types of alternatives. Finally, Hunter's direction is described in the context that has been established. The Hunter system entails several hundred microcomputers linked to an IBM mainframe running a major Data Base Manager, with the same micros also linked in an office automation system. The integration of these two environments, at the user interface, is a primary goal of the design.

This paper addresses a rather broad subject that could easily occupy the entire Proceedings. Therefore the emphasis will be upon how to think about the problem of choosing a network to connect desktop computers to form an Office Information System (OIS). The way to think about this problem is through the vehicle of a network model which can provide a basis for comparing the alternatives. Various possible models already exist and the proper one can be chosen by considering the nature of the network problem and the alternatives available for solution. By comparing the alternatives on the basis of a reasonable model, a choice can be made that meets the underlying objectives. Accordingly, this paper will be divided into four sections:

1. *The Nature of the Problem*
2. *The Major Alternatives*
3. *Network Models*
4. *Configurations.*

1.THE NATURE OF THE PROBLEM

The environment that we find ourselves in is illustrated by the drawing on page 12. Everyone (or so it seems) on campus has a micro and is "doing their own thing" while we are high upon the cliff trying to get an overview. This situation has come about through a combination of opportunities and difficulties. The opportunities are related to the introduction of desktop computers with the attendant increase in computer literacy and usage. A rapid increase in user involvement has moved from standalone applications such as word processing and financial modeling to a desire to communicate with mainframe data bases and to use the information therein to develop personal data bases and custom reports.

The difficulties are those that we're all familiar with by now. Administrative support demands continually outstrip the resources available to meet those demands. This is not just a manifestation of Parkinson's Law but reflects a reasonable request on the part of a user who knows that he can do certain things for himself rather that wait for his turn in the queue.

Thus the requirement for campus communications in order to facilitate the sharing of information will only grow. The problem then is to assure a healthy growth which means growing in that way which makes the networked desktop computer more effective than the standalone desktop. This can be done by defining objectives and choosing networks which have the chance of allowing those objectives to be reached. An important point to be made is that the subject being addressed is information sharing not resource sharing. The interconnection of a half-dozen PCs with a shared resource such as a laser printer or a file-server, is easily solved with many Local Area Network(LAN) offerings. The more difficult problem, which is really the one that must be solved to meet user expectations, is how to provide a general-purpose communications interface for the typical desktop computer user.

What is the nature of this communications interface? It is diagrammed on page 13. Here we have a desktop computer whose screen is a "window" that looks upon a world of office system tools. These include access to institutional data bases, personal data bases and external systems in a consistent way. End user languages are available through the same window for query, data reduction, data manipulation, simulation and modeling. Report generation of all kinds, electronic mail and other office tools(word processing, calendaring,etc.) would also be available in the same manner.

The nature of this interface should be one that decouples the user from any considerations of where these tools are or how to get to them. Furthermore, moving from one domain to another should be accomplished seamlessly from both a control and data transfer viewpoint. The shell in the diagram labelled,"packaging,service and networking" is intended to represent the part of the system that implements this interface. If the system depicted in the diagram were confined to a single computer then the shell could exclude networking. However, since the tools described are distributed over many computers, the networking will directly impact the user interface. In fact, since the system is distributed, this "packaging, service, and networking shell" will also be distributed and the question of how to distribute these functions is essentially the same as that of how to design a network architecture.

One last point concerns the need for an integrated approach to the communication of information. Is it necessary to be able to handle text, graphics, data, voice and image all through the same medium? Something called the "Compound Electronic Document" is illustrated on page 14. This concept which incorporates all five types of information into one document has received a great deal of attention by all of the major players in this arena. IBM, Wang, DEC and AT&T have all considered this approach to integration as a strong possibility for future office systems.

2.THE MAJOR ALTERNATIVES

There are three major approaches that can be characterized as mainframe-based, single office-engine and multiple office-engine. Naturally, many combinations of these three types are possible and desirable. However an understanding of the network needs of each type will facilitiate combining them. It's probably obvious that network complexity increases as we move from mainframe to single-engine to multiple-engine. We will see why this is so when we consider network architecture. In this section, we'll describe the three types and some current implementations.

Mainframe Based

The schematic on page 15 gives the shape of this alternative using the most popular mainframe architecture- IBM. This is *a diagram supplied by IBM with the intention of showing the great variety of solutions that they offer. Indeed, there are many interesting new products shown: a token ring LAN for PCs, ASCII terminals connected through a PBX (CBX in Rolm language), new protocol converters (3708/3710) and twisted-pair connection to a 3274. However, from an Office Systems viewpoint all paths lead to a mainframe running PROFS or DISOSS. Furthermore, these paths must go through a traffic cop called a 3725 communications controller. Office tools are obtained through the PROFS/DISOSS software which can only run on mainframes. To further complicate things PROFS can only run under the VM operating system and DISOSS only under the MVS operating system. Neither PROFS nor DISOSS provides a complete set of office tools. Both packages are needed- yet the only way that they can operate together is with a brand new "Bridge" between them.*

What all this means is that the IBM mainframe solution is still not a distributed intelligence solution. The concept behind the architecture is still essentially one of dumb terminals connected to mainframes. IBM was late in providing standalone word processing for the PC and the diagram on page 15 still emphasizes word processing on the mainframes(DW 370). New approaches are being introduced to allow for greater use of the distributed computer power inherent in the desktop computers. These include software such as Topview to provide the seamless interface we discussed earlier and concepts such as LU 6.2, an enhancement of IBM's System Network Architecture(SNA), that moves away from the tyranny of the mainframe. These newer ideas will be discussed later in this article.

Single-Engine

This approach which is depicted on page 16 has been advanced by the minicomputer vendors(DEC, Wang, Data General). All office system functions are removed from the mainframe and placed in a mini with appropriate software(such as DEC's All-In-One). It is this combination of a mini with office software that we're calling an office systems engine. Individual PCs can access the engine or a mainframe through the use of a PBX or a LAN. Remote PCs can have the same capabilities as local PCs by using multiplexers or gateways to connect to the local PBX/LAN.

Many systems of this sort have been installed with varying degrees of success as measured by user acceptance. The question to be answered here is what functions must be provided by the various components(engine, PBX, PC) in order to realize the system described on page 13.

Multiple-Engine

This alternative, as shown on page 17, is an extension of the single-engine concept. This is a solution that many have referred to as "departmental computers". The idea is that a hierarchy of computing is established and just as individuals have their own desktop computers, departments have their own engine. All information flow within a department can then stay within the departmental engine. The new requirement that is introduced by this alternative is the need for appropriate networking between the departmental engines. There are some sophisticated requirements needed for this configuration such as the need to be able to connect any two users by reference to a simple name and to update this information without having to regenerate the system. In order to have a successful multiple-engine installation, each department must be able to operate it's engine without needing any system programmer assistance. This is not an easy requirement to meet.

These three alternatives, as well as the area of PBX vs. LAN is where choices must be made and to help us in choosing, a network architecture or model is needed.

3.NETWORK MODELS

The first thing to say about any architecture is what are it's objectives. As stated above, the over-all objective here is to provide a basis for Office Information Systems with a very strong user orientation. Therefore I offer five primary objectives with an explanation as to why each is of primary importance.

Standard, Open, Consistent Interfaces

Since the subject is the networking of a multitude of programmable computers, we are faced with defining how these ever-changing stations can talk to each other. It follows that the interfaces between these computers must observe certain standards or rules. Furthermore these standards must be known to everyone, in sufficient detail, so that all players in the networking game can conform to the rules. These rules or standards must also have a consistency of design and direction so that all players have the possibility of aiming in the right direction as they make changes to their individual programs. Few would argue with this objective but might, instead, question the possibility of achieving it. In fact, a great deal of work has been done in this area and the pace of activity is increasing. Many companies have promulgated their own set of interfaces: IBM has their SNA, DEC has their DNA and Xerox their XNS. These are all complete network architectures. The International Standards Organization (ISO) and the American National Standards Institute (ANSI) have developed standards for the lower levels of network architecture. The ANSI standards are being done in conjunction with the Institute of Electrical and Electronics Engineers (IEEE) and their work is usually referred to as ANSI/IEEE Project 802 because those are the first three numbers of the standards. A major new initiative *in this area has been started by eighteen companies who have formed the Corporation for Open Systems. The purpose of this not-for-profit corporation is to speed the adoption of networking standards. IBM has been invited to join the effort but it's not yet clear what their position will be with respect to this corporation.*

Integration

The second objective is to provide for the integration of the various types of information such as voice, data and video. This has to be an objective because the big guys (IBM and AT&T) are very interested. Therefore we all must be interested even if we don't quite know what to make of it. The primary manifestations of this goal are the composite document discussed earlier and the desire to use high bandwidth links based upon fiber-optic technology.

Distributed Intelligence

This objective is there to make explicit the requirement that any network that we configure should anticipate the wide use of distributed intelligence. In other words, the workstations are anticipated to be microcomputers that will only become more powerful and will exhibit insatiable appetites for data and communications.

Flexibility

This means an architecture that is easy to understand and easy to modify. We must try to prevent the network from becoming a new bottleneck.

Risk Management

The last objective has to do with "staying alive". Networking is a new, volatile area with all of the attendant risks for failure. Vendor credibility is difficult to ascertain for the newer firms. An adherence to a widely used architecture is one way to provide the flexibility to substitute one vendor for another.

Two issues which are not primary objectives are efficiency and absolute reliability. Efficiency is of less importance because of the growing power of desktop computers. A good deal of this power will be used to provide the "seamless interface" that was described earlier. The efficiency of the desktop computer software should be sacrificed towards making the user more efficient. Reliability, while important, is not of much use unless accompanied by graceful failure and speedy repair.

These objectives can be achieved by modelling a network through the use of the standards that have been mentioned. The way in which this is done is indicated in on page 18. Here we see depicted a local area network connecting several PCs and a laser printer. The layered box connecting each unit to the wire indicates the seven basic tasks that are defined by the OSI model as necessary before communications can take place on a *network. Messages pass from the sender through each of the seven layers and onto the network. They then travel back up through the layers to the recipient. The function of each layer is described in the upper right-hand corner of the diagram. Each layer on the sender's side communicates with it's counterpart on the receiver's side. This "peer-interaction" allows for a modular approach to the communications functions. The table on page 19 gives several versions of this layering of the communications protocols. There are four versions described including the OSI model already shown in the previous diagram.*

We can see how these models differ by comparing their layers. SNA's layer 3 (path control) incorporates the same functions as OSI's layers 3(network) & 4(transport). However 3COM uses the Xerox protocol called XNS which performs the same functions as SNA's third layer. An interesting approach by 3COM is the lumping together of the upper layers into single pieces of software called Ethermail, Etherprint and Ethershare. Their reason for doing this is to reduce the overhead involved when moving between layers. It seems clear that, if we were trying to use 3COM's LAN to hook up DEC computers and terminals, it would be essential to understand how to align the layers of the two models being used.

To help gain a better understanding of this layered protocols concept, consider the figure on page 20 which shows the internal workings of the SNA model. The algorithm is that as data moves down through the layers, headers are added at each level until finally, a BLU(basic link unit) is formed. This BLU is what is placed on the physical media and is received at some other node. Then as the data moves upwards through the layers, the headers corresponding to each layer are utilized to invoke the appropriate actions at each layer. An exploded view of the BLU is given at the bottom of this figure. This is the format for SDLC (synchronous data link control), which is the data link protocol for SNA. This protocol consists of a link header(LH) and a link trailer(LT). Sandwiched between these is the PIU (path information unit) which contains the Request/Response unit plus all of the headers from the higher layers.These Request/Response Units are the units of information that the application layers deliver to or receive from the network.

One further structure must be understood in order to complete this very basic description of network models. This is the Session. While SNA does not define a session layer as in OSI and DNA, it does define a session as a virtual circuit that is established between two Logical Units(LUs). The figure on page 21 indicates what is meant by an LU. IMS, CICS, and JES2 are all examples of LUs which can be "masters" and control a virtual circuit. DW, 3270, and S/38 are examples of "slaves" which can be at the other end of a virtual circuit. The virtual circuit is a path through the transport network which is established by the master and maintained until the master de-establishes the path. In SNA, this transport network consists of the lowest three layers. Establishing a path through the transport network means *navigating through a good deal of hardware and software as can be seen from this figure.*

It only remains to try to establish a basic network model that will provide us a good chance at meeting the objectives stated and will also conform to the standards that have already been set in place. For this purpose, the figure on page 22 is offered. The Basic Network Model depicted splits the seven-layer cake into a three-part sandwich. On one side of this sandwich is the transport network which consists of the lowest four layers of the OSI world (or 3 in SNA). Here is where all of the current questions of LAN vs. PBX, baseband vs. broadband, coax vs. twisted-pair, and so on are addressed. The other side of the sandwich is the application program (layers 6 & 7)and the middle is the session which is OSI layer 5. This middle of the sandwich is also where the SNA logical unit (LU) resides. A virtual circuit is maintained, between sessions, through the transport network. The session layer is must mediate between the application program and the transport network in order to resolve the conflicting requirements of useability on the one side and efficiency on the other. To complete the model, the requirement that any session can be a master should be included. This model is now where current standards are heading and, in fact, is the equivalent of the latest SNA standard for a logical unit--LU 6.2.

How does this basic network model meet the objectives? First, with regard to standard, open, consistent interfaces, this model is consistent with existing standards and tends to simplify compliance by relegating the complexities of the transport network to specialists. Openess is achieved by having customizers able to concentrate on one interface, that of the program call to the session. The objectives of integration and flexibility are achieved by simplifying the number of interfaces for the system implementer. However, the detailed layers are retained so that new layers can be substituted in the transport network and so that the presentation layer can be used to customize user interfaces. Distributed intelligence is supported by all of these networking standards but the ability to configure any node as a master facilitates distribution. The reason for this is that with this ability, any node can communicate to any other without involving a central processor. The last objective of risk management is handled by aligning with an overall direction that IBM is moving towards while retaining the details of the layers so that most standards can be incorporated.

4. CONFIGURATIONS

This section will discuss configurations in terms of the models already described and the directions in which those models are evolving. To begin with, consider the two session interfaces in the figure on page 22. The interface to the transport network must move towards efficient use of the network which means fewer, more powerful commands. On the other side, the program call interface, because it is a local processor function, can use many, simple commands. The evolution of these *interfaces is, of course, driven by what is happening on their respective sides of the networking world.*

The transport network is being collapsed into fewer layers in newer implementations. This involves minimum risk since standards in this area are well advanced. However, the presentation and application layers, on the other side, are in a state of great developement. Here is where the newer IBM developements such as Document Content Architecture(DCA), Document Interface Architecture(DIA) and SNA Distribution Services(SNADS) are to be found. Here, also is where the seamless interface pictured on page 13 must be created.

Another issue of great concern in discussing configurations is Network Control. Control facilities must be made available and utilized through a session manager. These facilities fall into the following major categories.

Connectivity- The ability to add or subtract nodes and links to the network, to determine the status of these nodes and links and to do this without interrupting operations. This last requirement is a difficult one that many vendors cannot meet.

Directory- The ability to access any node by name. Knowing which nodes are active and gracefully handling the transition from active to inactive and vice-versa is a sophisticated capability worth having.

Route Selection- The ability to have alternate virtual circuits between sessions.

Session Modes- The ability to specify different modes based upon a combination of security levels, priorties, and service classes.

Data Transport- The ability to make tradeoffs between transmission and control efficiencies by specifying error rate and flow control parameters.

Consider page 23 which describes examples of the primary alternatives for configuring mainframe-based systems. These alternatives are: IBM, a Data Base Manager and a Translator. IBM's approach has been confusing because while they have emphasized centalized applications driving dumb terminals, there was no centralized office solution. Electronic Mail through PROFS runs in the VM world, document integration through DISOSS runs in the MVS world and departmental systems are inadequate. However, things are changing: a bridge between PROFS and DISOSS has been announced, LU 6.2 has been delivered and IBM is striving mightily to bring a departmental system to fruition. Nevertheless, the need to operate both a VM and MVS environment, in order to have a complete office solution may remain for some time.

An example of the Data Base Manager approach is Cullinet's Information DataBase(IDB). This is a new product which allows for a high degree of integration between Cullinet's data base manager (IDMS) and the PC. This is an easy short term path for Cullinet users. It is a centralized approach which provides for a high level of integration between the PC and the mainframe with an easy interface for the user.

The Translator alternate is exemplified by Integrated

Technologies software product- Softswitch. This software allows revisable-form translation between several of the major W/P vendors and also provides some of the integrated filing features found in Cullinet's IDB solution. However the capabilities are limited to W/P products and the addition of new vendors seems to be a major problem. Softswitch has recently been announced for the DEC Vax computers. This offers the interesting possibility of using DEC as departmental machines and tying them to IBM mainframes with Softswitch.

The state of the Single-Engine world is summarized by the figure on page 24. Each of the major minicomputer vendors (DEC, HP, DG, Wang) offers a viable, well integrated solution in this area. Furthermore, they all offer strong networking capabilities to tie together multiple minis in a coordinated way with many of the Network Control features mentioned previously. They are also able to integrate IBM PCs. However none of these vendors has a solution that is as well integrated as Cullinet's. However, not only is Cullinet a centralized, IBM mainframe solution but also Cullinet's network capabilities are very limited.

The choices in the Multiple-Engine case are those indicated on page 25. It is here that the models discussed before are most valuable. In order to compare categories and vendors within each category, a standard functional model should be used. Using the Basic Network Model as a guide, some observations can be made about these choices. A network of minicomputers will provide the most functionality, the best integration, the best network control and, unfortunately, the highest cost. The model will be well realized, particularly if the vendor's own microcomputers are used. Sophisticated software is available for both the transport network and the applications areas.

The LAN can be used simply to provide the transport network for minis, in which case it's cost must be added to the minis. However, if the intent is to build a network only with LANs and their associated servers and gateways, then it is likely that what will be available is an efficient transport network. There will be weak capabilities in integrated applications and network control. This is primarily due to the immaturity of the use of LANs as anything other than a transport network. Furthermore, large LAN structures especially those with gateways present formidable control problems. If the physical link is a broadband one such as Wangnet, these control problems are further complicated.

The PBX is actually not a solution to the multiple-engine configuration problem by itself. The PBX can only provide a transport network which has limited functionality. However, it does offer a low risk solution because it is easily managed and it's technology is well understood. In fact, it doesn't even provide the entire transport network but only the bottom three layers of the OSI model. A basic communications software package must be at each node in order to create the fourth layer. In some cases, this software is supplied and integrated by the PBX vendor.

Given the current situation, and our environment at Hunter, *we have decided to take the direction that is shown on page 26. We must first of all provide for integration with our current Cullinet environment on an IBM 4341 which links us to the larger CUNY network. This is provided by having the capability for any PC to dial a port on a Protocol Converter which then makes the PC look like a 3270 to the IBM Mainframe. A Data PBX is used to provide this dial-up link from anywhere on our main campus. This allows us to make use of the extensive twisted-pair wiring plant that is already installed. Furthermore. we can now access an Office Engine through the same mechanism and also provide the same functions to desktop computers at other campuses through remote Data PBXs that are linked to the main Data PBX. LANs can still be used for small work groups and linked to the main PBX through modems attached to the LAN.*

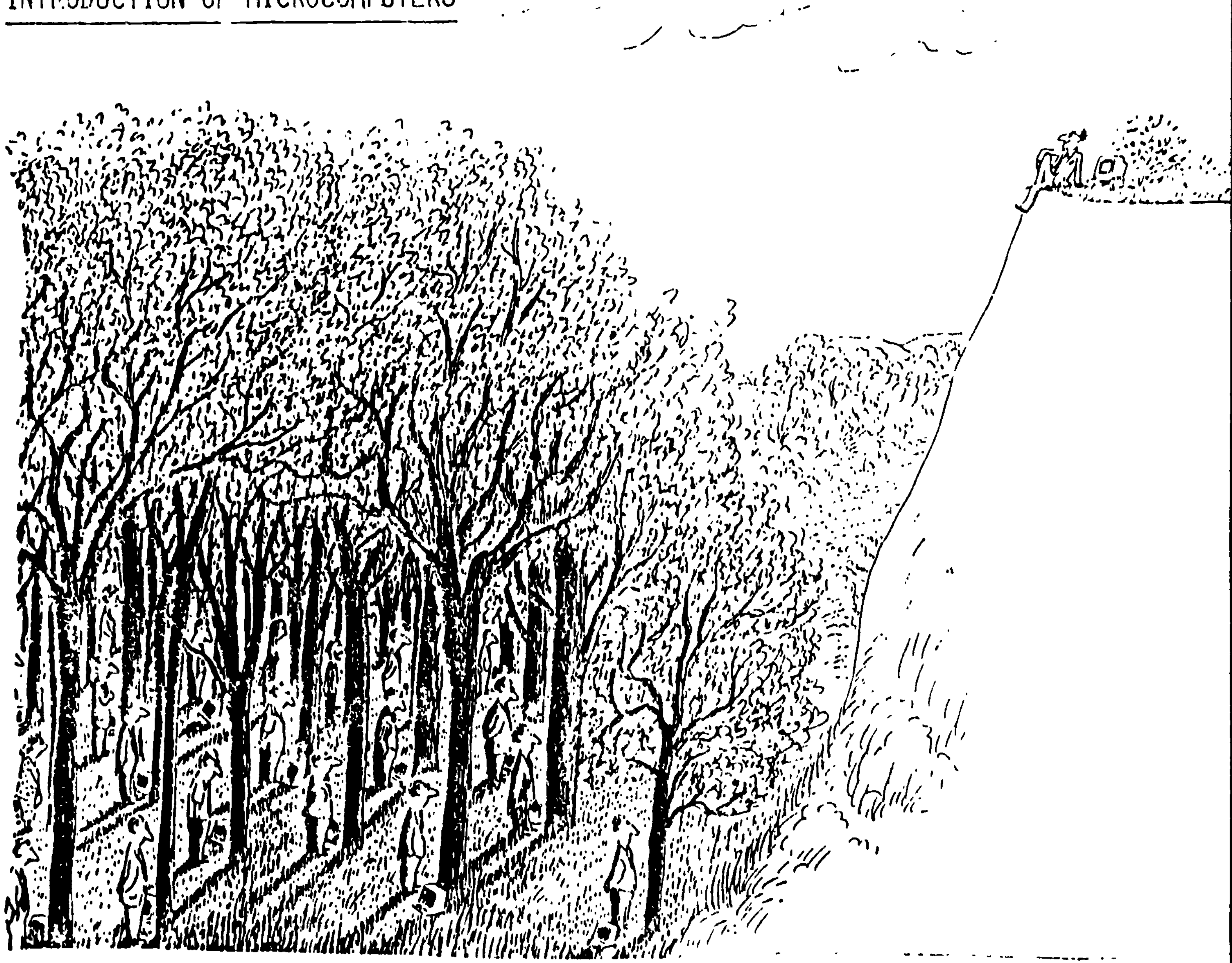
The problem of integrating the applications in the PC must be solved by custom software which must also create the "seamless interface" described earlier. We chose to implement the office functions in an engine that is separate from the mainframe because of cost considerations. The overhead to serve many workstations, from an IBM mainframe that is also doing many other things, is too high. In addition, expanding an Office Engine is much less costly than expanding a mainframe. If communications efficiency between the engine and the mainframe becomes a problem, then a link can be connected between the two of them. Large data transfers between the engine and the mainframe can then be invoked from a PC, but the actual transfer can take place directly.

The models that have been discussed allow us to clearly identify the distribution of functions needed. For example, the Data PBXs provide the first three layers of the transport network, and the fourth layer plus session control must be supplied at each end. The interaction between the presentation layers at the nodes is where compatibility must be achieved. This means that it must be possible to identify this layer in the Office Engine and in the Cullinet data base world and to interface with those layers from the equivalent place in the PC. The achievement of this structure will facilitate reaching the desired objectives.

A new approach, illustrated on page 27, has appeared on the scene. Essentially it combines most of the features of the Data PBX, the Office Engine, and the Protocol Converter into one box called a Network Server. In addition, many features of the Cullinet IDB and Softswitch are also provided. The Banyan Network Server actually handles many different types of transport network models and can be attached to several different types of host computers. These Network Servers can also be connected to form wide area nets. In an environment where many different workstations exist and the desire is to link them all together, this may be the only solution. However, this is a very new direction, offered by very young companies and therefore accompanied by high risk.

In summary, the best that can be achieved is to set whatever is done in a framework that is consistent with those standards that exist. That way there is, at least, the hope of accomodating future changes.

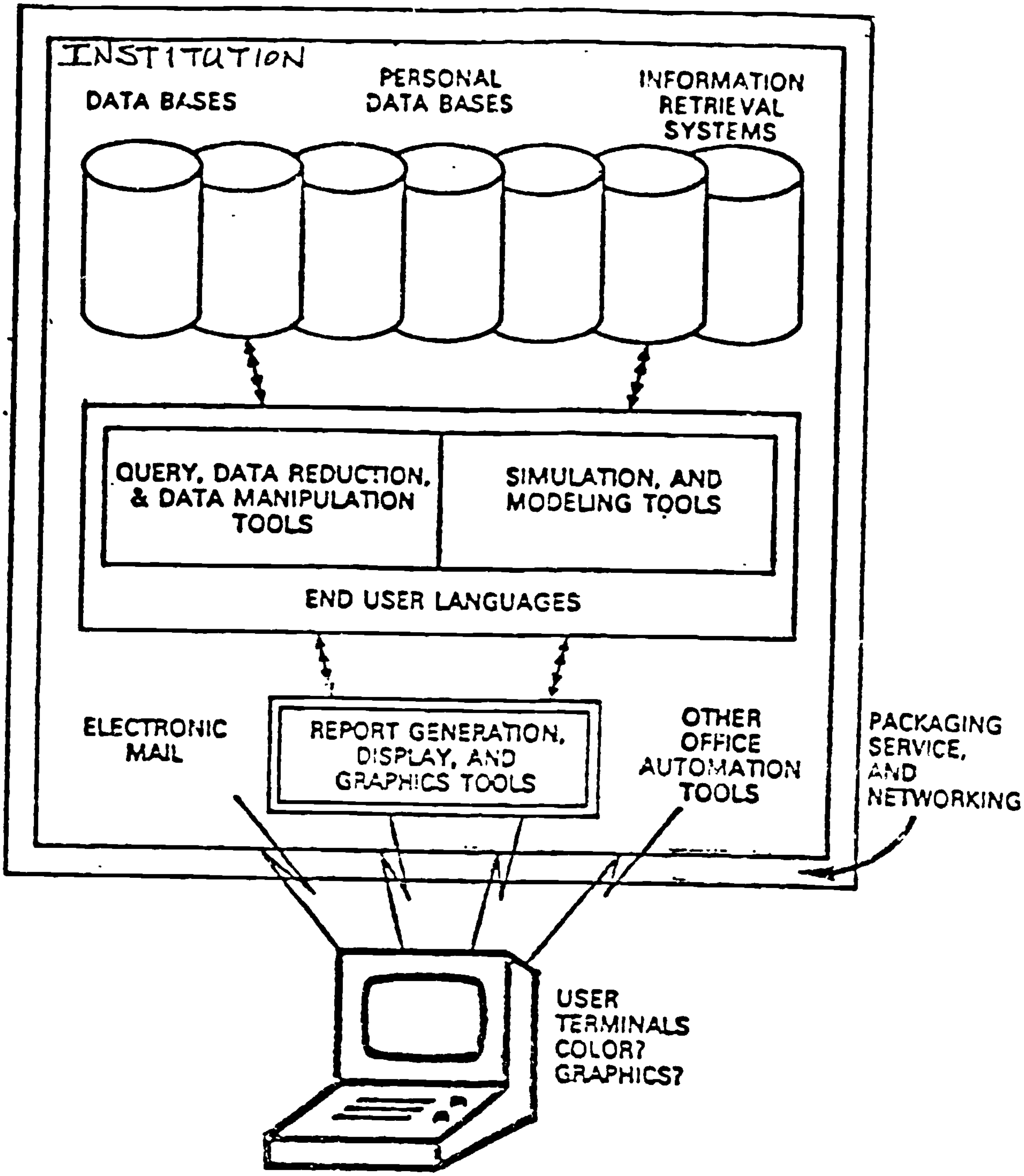
INTRODUCTION OF MICROCOMPUTERS



NATURE OF THE PROBLEM

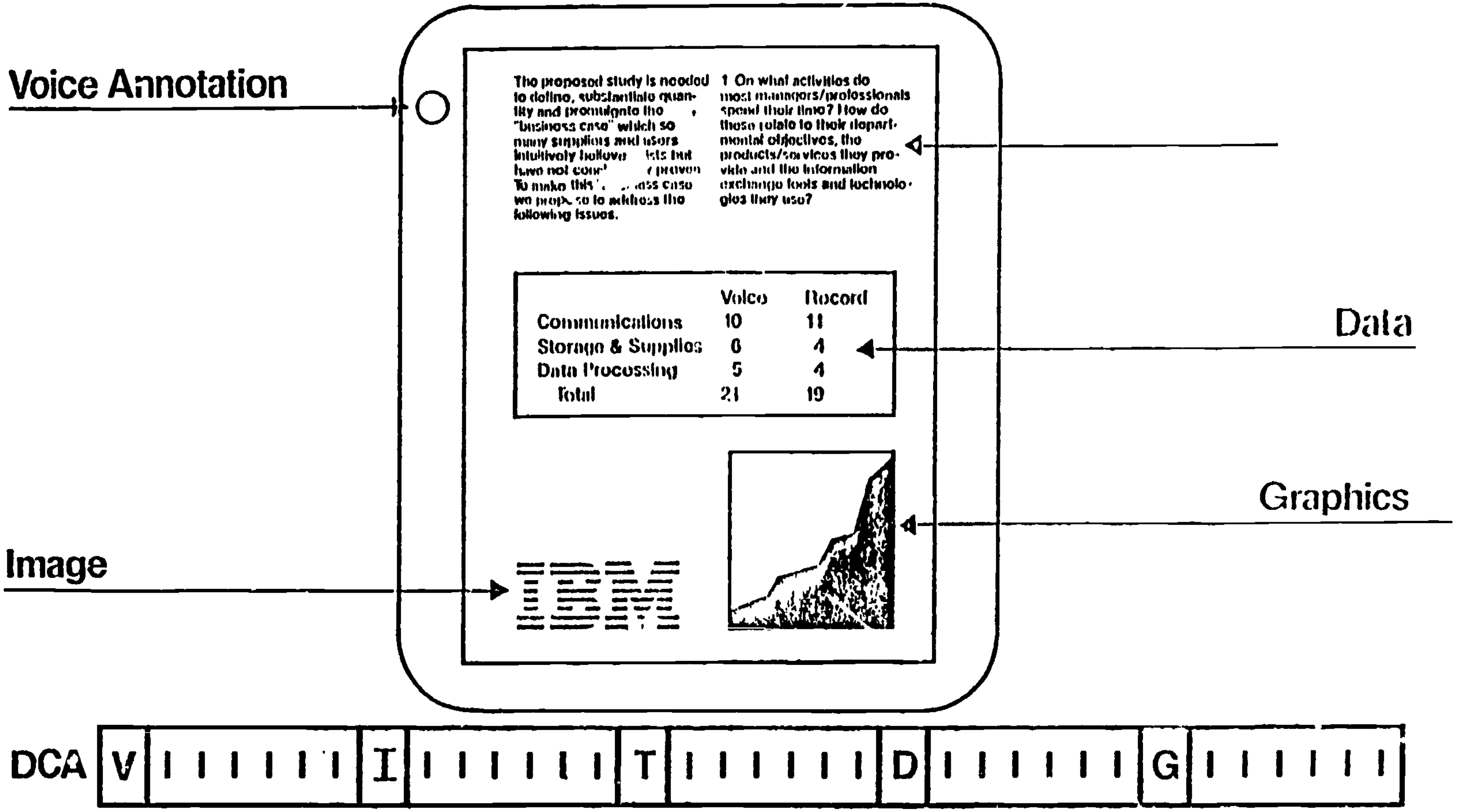
412

OFFICE SYSTEM TOOLS



NATURE OF THE PROBLEM

The Compound Electronic Document



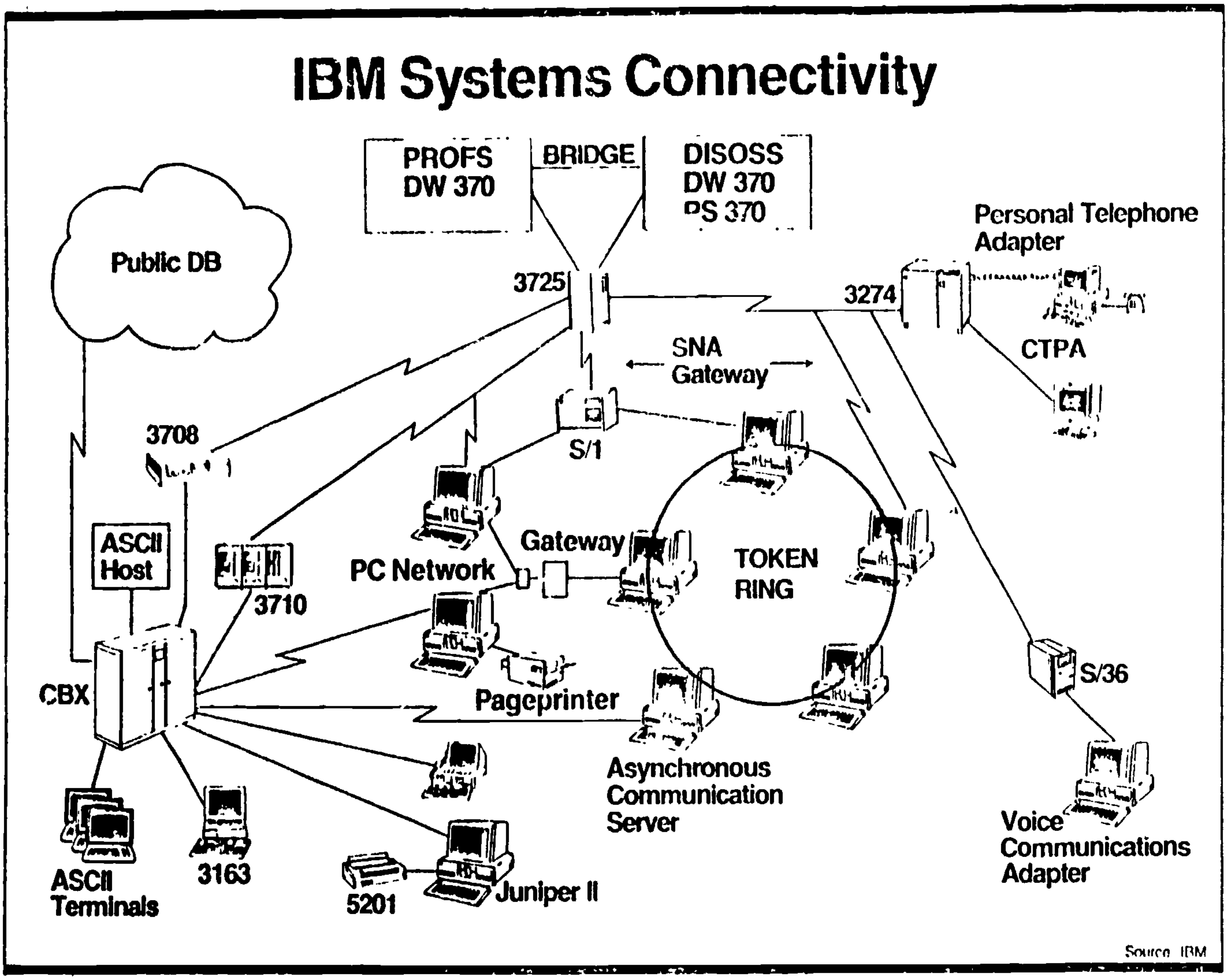
The proposed study is needed to define, substantiate quantify and promulgate the [illegible] "business case" which so many suppliers and users intuitively believe [illegible] but have not con[illegible] proven. To make this [illegible] case we propose to address the following issues.

1 On what activities do most managers/professionals spend their time? How do these relate to their departmental objectives, the products/services they provide and the information exchange tools and technologies they use?

	Voice	Record
Communications	10	11
Storage & Supplies	6	4
Data Processing	5	4
Total	21	19

NATURE OF THE PROBLEM

MAINFRAME BASED



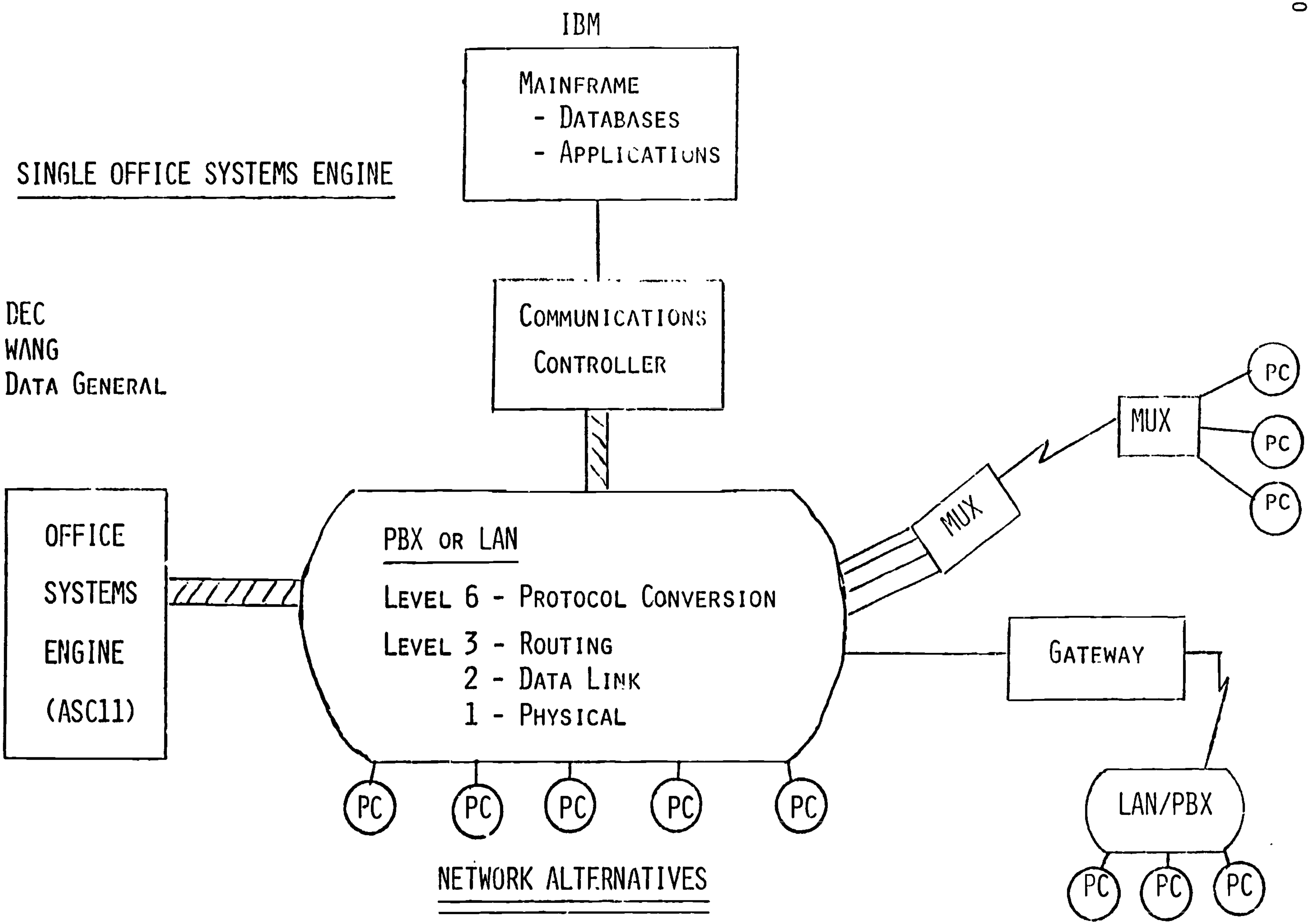
IBM Systems Connectivity

Source IBM

NETWORK ALTERNATIVES

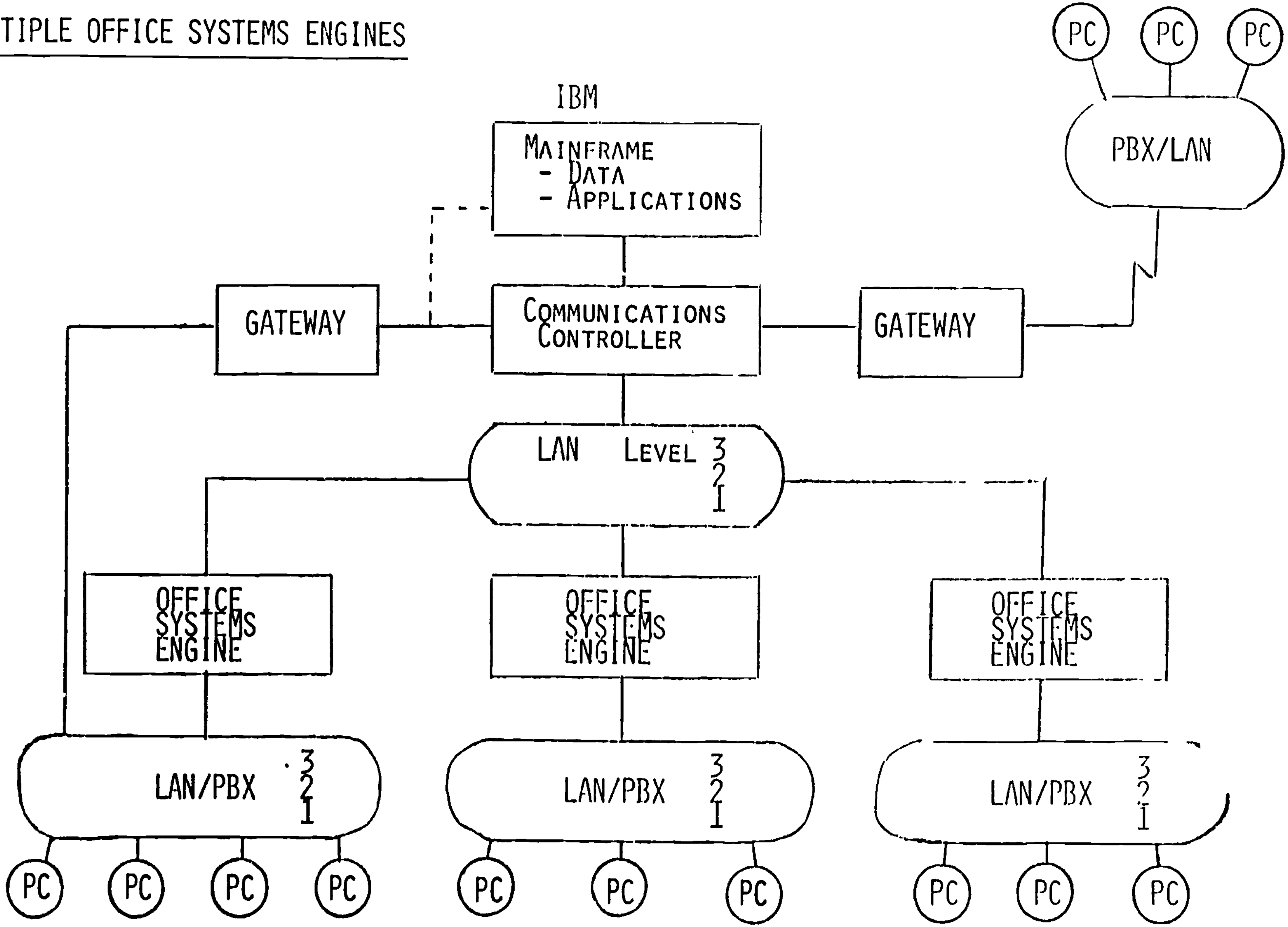
SINGLE OFFICE SYSTEMS ENGINE

DEC
WANG
Data General

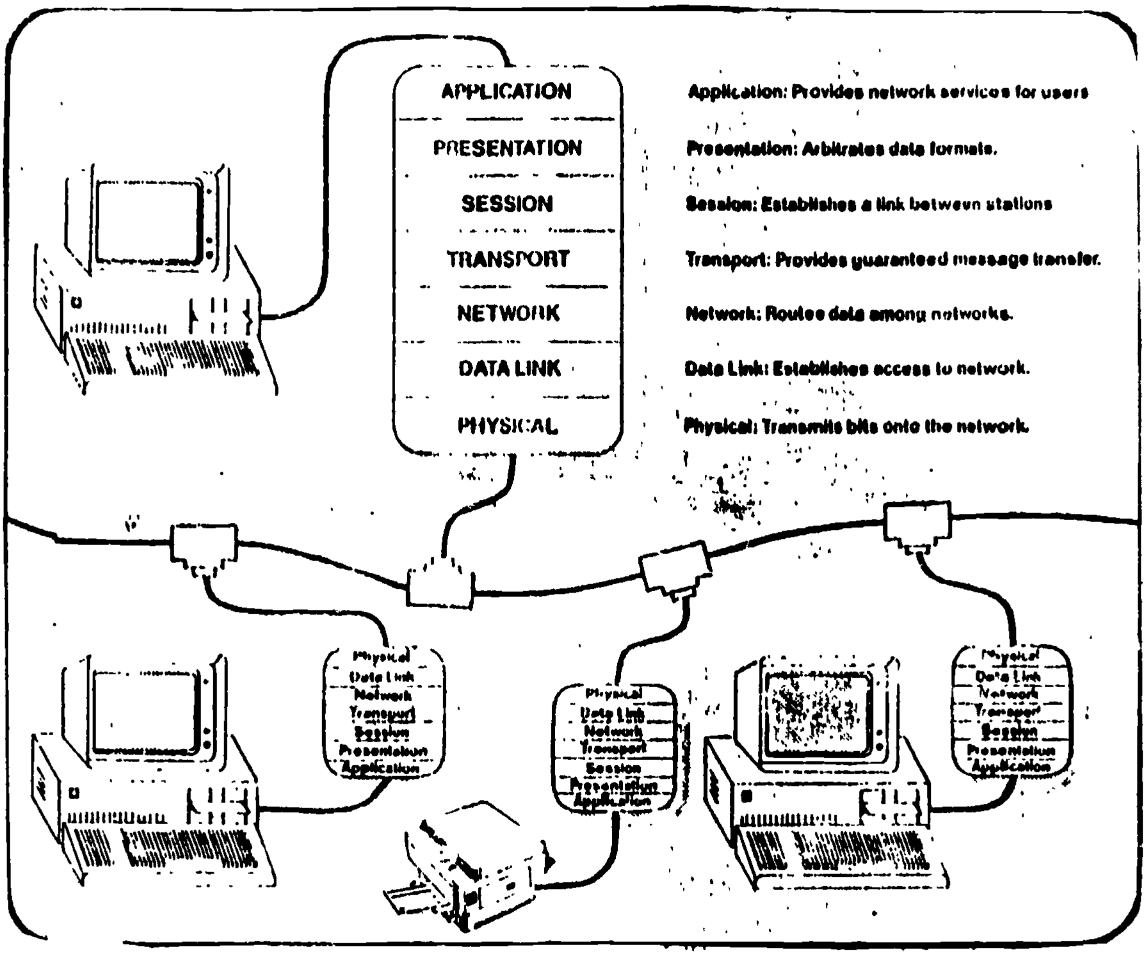


NETWORK ALTERNATIVES

MULTIPLE OFFICE SYSTEMS ENGINES



NETWORK ALTERNATIVES

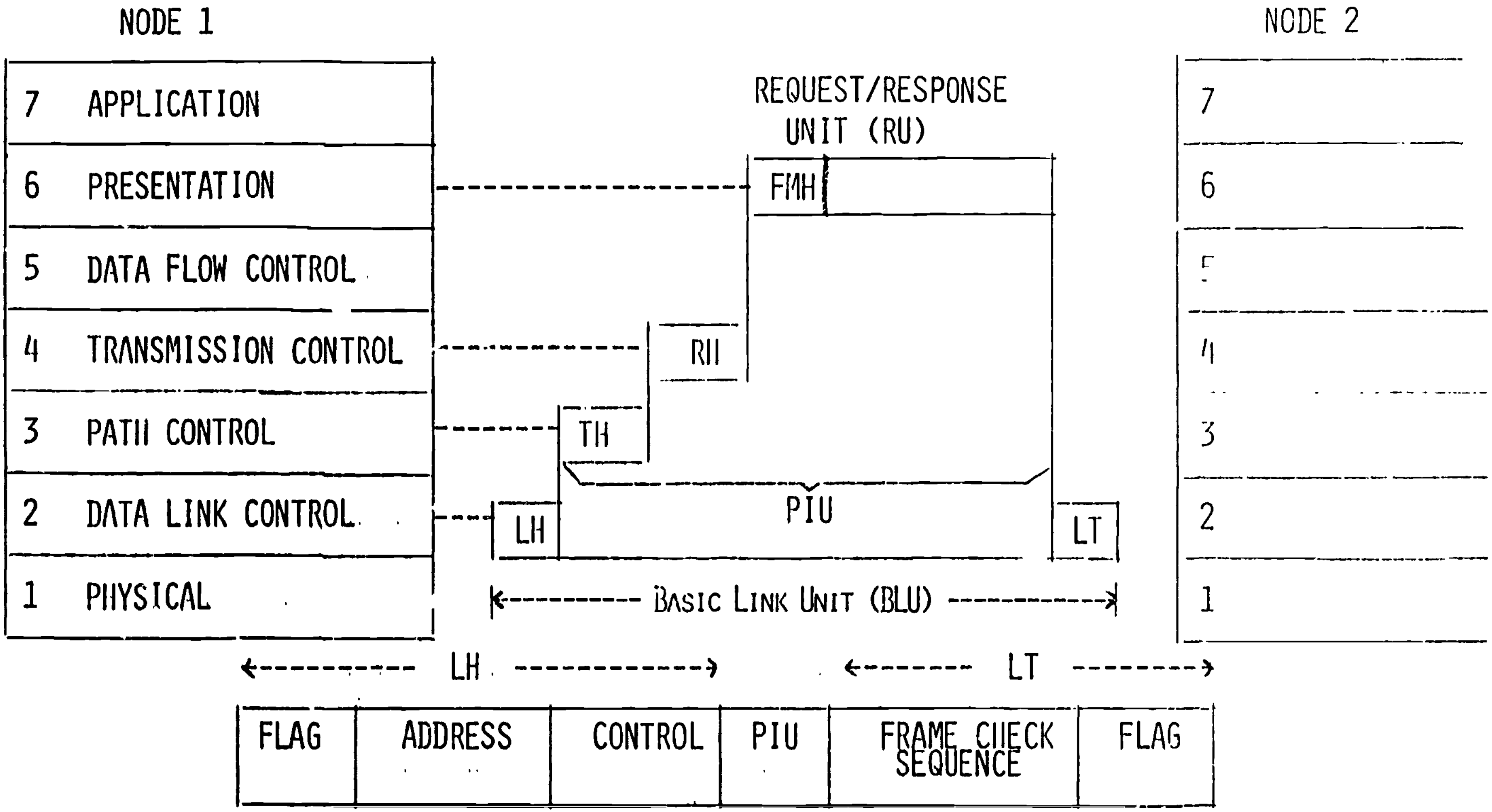


NETWORK MODELS

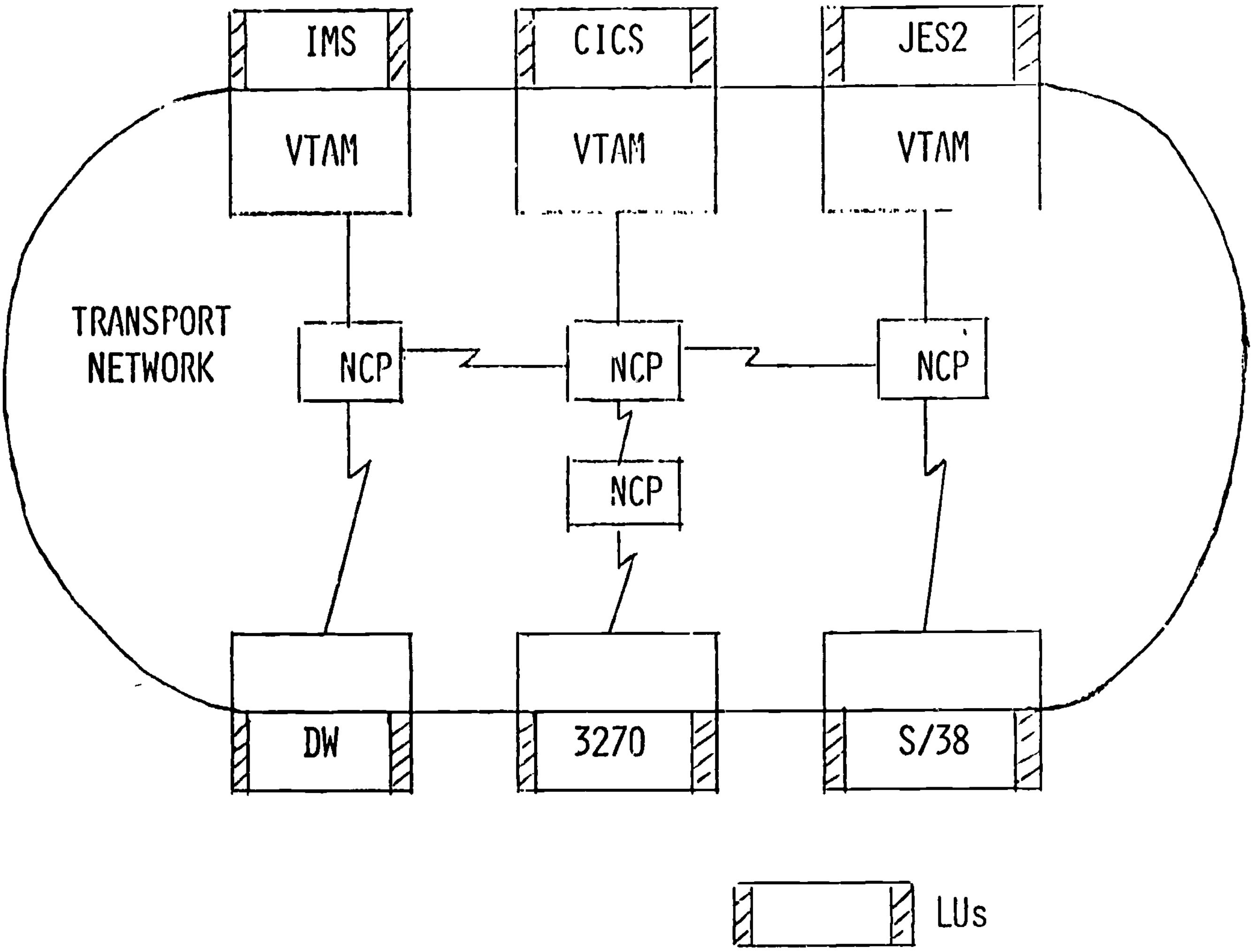
NETWORK LAYERS

LAYER	IBM's SNA	ISO's OSI	DEC's DNA	3 COM's LAN
7	APPLICATION	APPLICATION	USER-LEVEL NETWORK APPLIC.	ETHERMAIL
6	PRESENTATION	PRESENTATION	NETWORK APPLIC.	ETHERPRINT
5	DATA FLOW CONTROL	SESSION	SESSION CONTROL	ETHERSHARE
4	TRANSMISSION CONTROL			
(4)	PATH CONTROL	(TRANSPORT)	(END COMM.)	XNS: XEROX NETWORK SERVICES
3		NETWORK	ROUTING	
2	DATA LINK	DATA LINK	DATA LINK	ETHERLINK
1	PHYSICAL	PHYSICAL	PHYSICAL	

SNA FORMATS

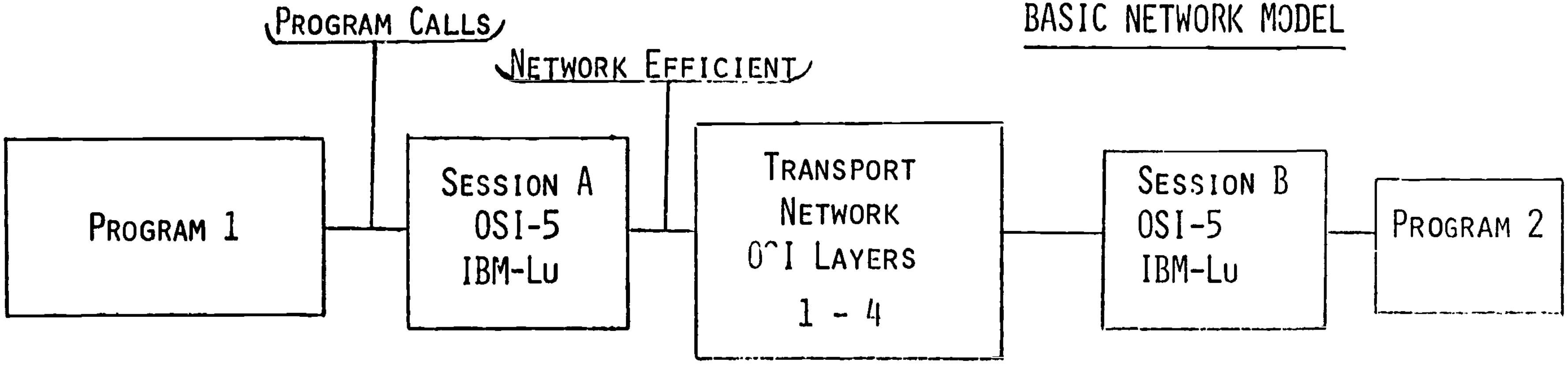

NODE 1
7 APPLICATION
6 PRESENTATION
5 DATA FLOW CONTROL
4 TRANSMISSION CONTROL
3 PATH CONTROL
2 DATA LINK CONTROL
1 PHYSICAL
REQUEST/RESPONSE UNIT (RU)
FMH
RH
TH
PIU
LH
LT
BASIC LINK UNIT (BLU)
NODE 2
7
6
5
4
3
2
1
LH
LT
FLAG
ADDRESS
CONTROL
PIU
FRAME CHECK SEQUENCE
FLAG

SNA STRUCTURES

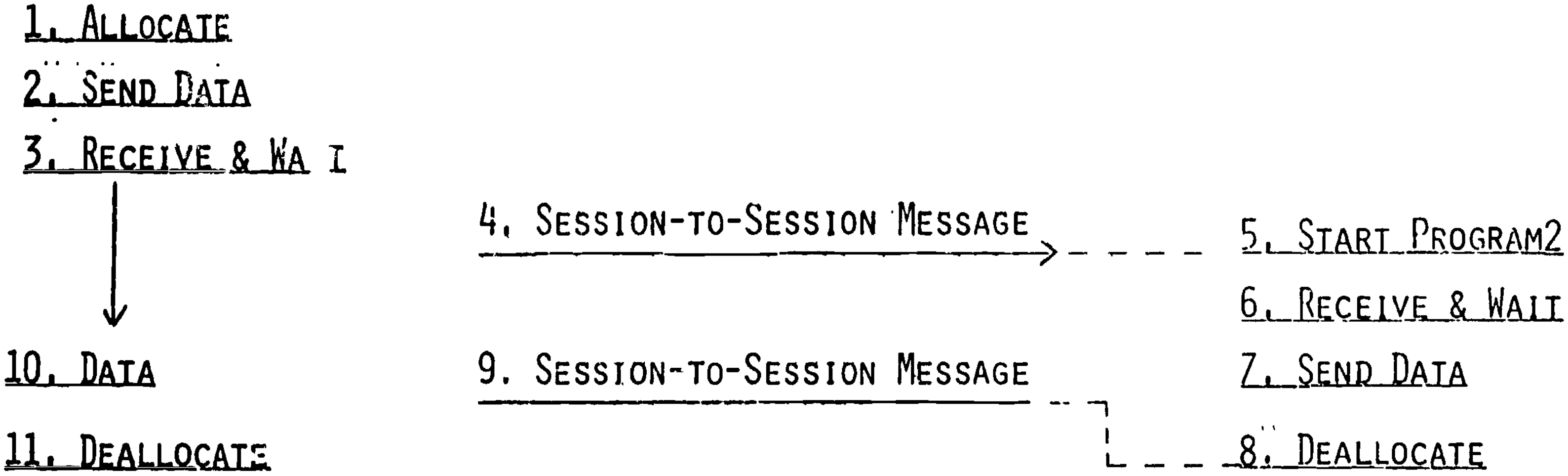


NETWORK MODELS

BASIC NETWORK MODEL



LAN VS. PBX
BASEBAND VS. BROADBAND
COAX VS. TWISTED-PAIR
RING VS. STAR VS. BUS
SPEED VS. FLEXIBILITY



1. ALLOCATE
2. SEND DATA
3. RECEIVE & WAIT
4. SESSION-TO-SESSION MESSAGE
5. START PROGRAM2
6. RECEIVE & WAIT
7. SEND DATA
8. DEALLOCATE
9. SESSION-TO-SESSION MESSAGE
10. DATA
11. DEALLOCATE

CONFIGURATIONS

MAINFRAME ALTERNATIVES

IBM

- Centralized applications driving 3270s
- Coaxial, star
- Static connectivity directory routing
- Limited departmental capability
- PROFS vs. Disoss
- Limited Integration

CULLINET

- Information Database
- High degree of integration
- Basic Network Model available
- Distributed Intelligence but not decentralization
- High Functionality
- Easy short-term path for Cullinet users
- Poor flexibility

INTEGRATED TECHNOLOGIES

- Soft Switch
- Revisable form translation
- High degree of integration for W/P
- Some of the IDB features for W/P
- Poor flexibility

CONFIGURATIONS

SINGLE-ENGINE

- Minicomputer Vendors: DEC, DG, HP, others
- Well established communications options
  - WAN
  - LAN
  - PBX
- Office Systems Engine integrated with PCs
  - not yet integrated with IBM PCs
- Some dynamic configuration services
- Session modes
- High functionality
- Moving towards IBM integration (Mainframes & PCs)
  - Integration problem at PC workstation
- Range of departmental engines

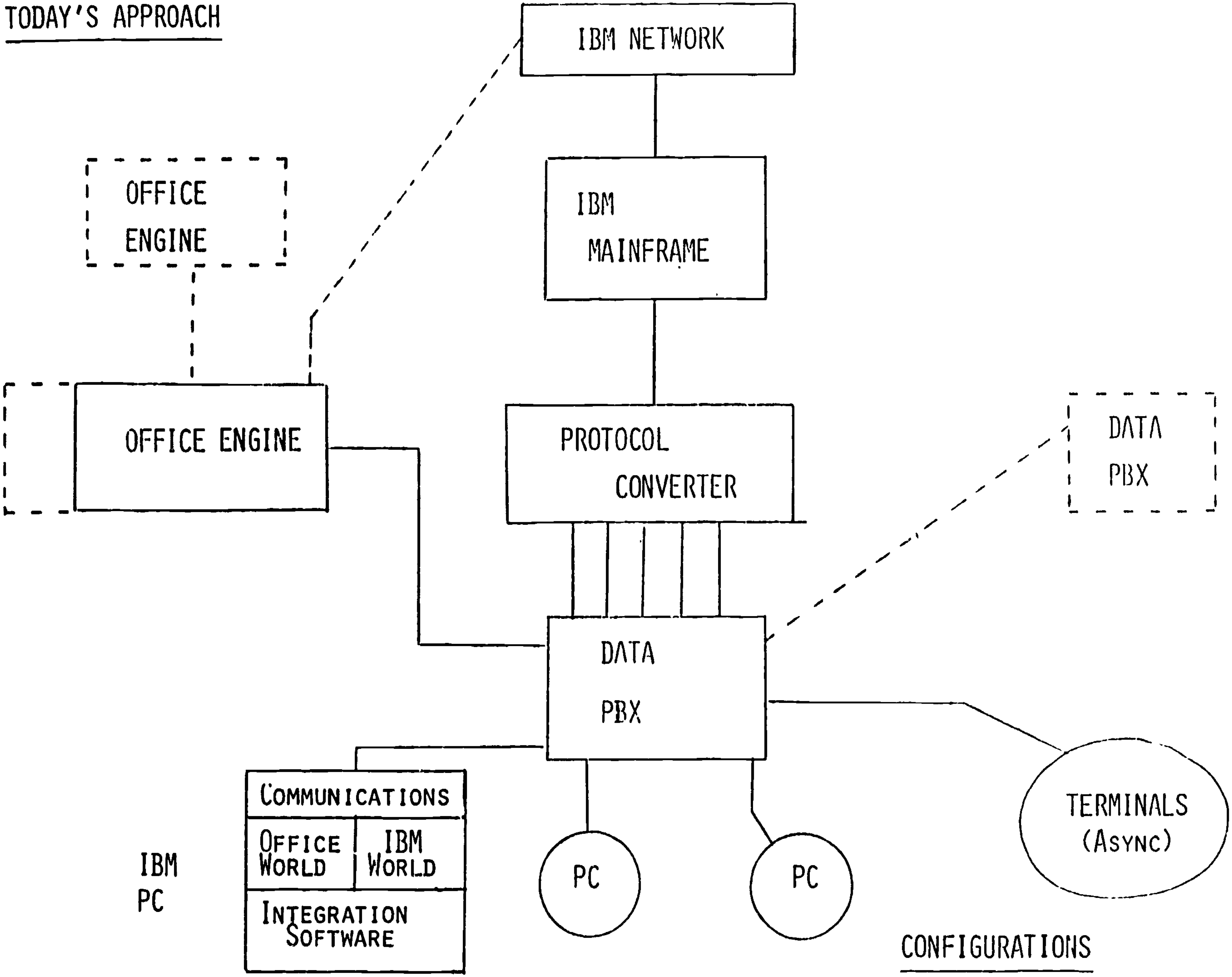
CONFIGURATIONS

MULTIPLE-ENGINE

Minicomputers	LANS	PBXs
High functionality	Network-efficient	Transport Network Only
Good integration	Minimum cost (potential)	Limited functionality
Communications Options	Limited functionality	Simpler network control
Range of engines	Limited expansion	Poor integration
Good network control	More complex network control	Poor network control
Low risk	More risk	Low risk

CONFIGURATIONS

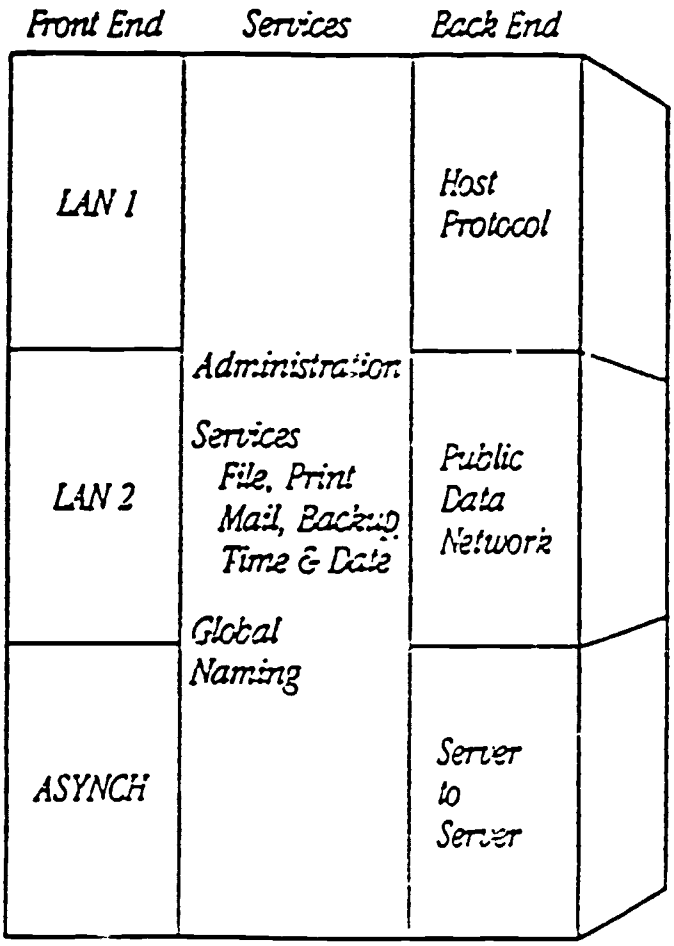
TODAY'S APPROACH



CONFIGURATIONS

NEW APPROACH

BANYAN NETWORK SERVER



Front End	Services	Back End
LAN 1	Administration Services File, Print Mail, Backup Time & Date Global Naming	Host Protocol
LAN 2		Public Data Network
ASYNCH		Server to Server

MULTIPLE ENGINE CONFIGURATION

GUIDELINES FOR ESTABLISHING AN IN-HOUSE MICROCOMPUTER SERVICE CENTER

Casey Tucker
Ball State University
Muncie
Indiana

This paper covers four major areas to be considered in determining whether to establish an in-house service center for microcomputer workstations. In the event that such a center is warranted, suggestions are made as to levels of service to be provided, staffing, training, and equipping the repair facility to provide the best service possible.

GUIDELINES FOR ESTABLISHING AN IN-HOUSE MICROCOMPUTER SERVICE CENTER

I. Determining the Need For A Service Center.

A. Cost Justification

The initial step in considering the type of after-warranty service to procure for your microcomputers is to look at the numbers of units in your organization. This would include those currently on hand and those projected for acquisition in the immediate future.

Using this information you will be able to calculate a dollar value based on the average salaries for the users of the units under consideration. Use this value as a starting point to estimate the costs involved in the service related downtime of your microcomputers.

In addition to the cost estimates based on salaries you will need to include indirect cost estimates based on the work flow disruptions. While this is an intangible factor which is difficult to tie down with a dollar value it is the most important consideration of all when deciding on the type and level of service to provide. Obviously not all machines will be in a critical path in the normal flow of events but you should be able to identify a number whose downtime would have considerable impact in this area.

Another important variable in this development process would be the types and costs of service contracts currently in force for the machines in question. There may be no service contracts in effect, particularly in installations that are relatively new.

B. In-house Versus External Service Program.

With these calculations you will decide whether it is cost effective to set up an in-house service department for your microcomputers. It may be decided that the most cost-effective method of dealing with service is to place it in the hands of an existing outside service vendor. This is a legitimate conclusion which is sometimes discarded in the rush to become completely self contained in the service area.

The success of a microcomputer service program will, to a large degree, be determined by the willingness of the university administration to address the issue of the scope of machines which it is willing to support. Some person or committee in the administrative structure must decide what brands, and options within brands, the service organization will support. Without this key element the program will become fractionated and never achieve its intended goals of providing prompt and competent service.

Make public a list of all supported microcomputers and associated peripherals. This list will not be restrictive in the sense that offices or individuals would be prohibited from purchasing machines that are not included. It should, however, provide a clear message to the users that the institution intends to focus its support on the suggested machines. This list should be updated and altered as dictated by changes in technology and institutional goals.

In the early developmental stages of the service department it may be necessary to make restrictions as to the types of machines to be serviced. The selection will be based on the physical facilities and equipment provided. It will always be easier to expand the list of equipment being serviced than to delete. This limitation will also enhance your chances of success in establishing appropriate chargeback rates for your services. The less complex the rate structure the more interest you are apt to create for the service.

2. Services Provided.

A. Levels of Service.

Having decided that providing local service for your microcomputers is in the best interests of your organization, you will decide which level of service will be appropriate. The level of service will be established first and the appropriate staff hired to carry out this service. Too frequently this phase is carried out in reverse with the service level being based on the person hired to fill the position. The level of service can be as simple as replacing entire component packages as they become defective or it can be as complex as chip level diagnosis and repair.

The most elementary service level is the component replacement. This requires very minimal skill levels and has the advantage of keeping down-time to a very minimum. Normally under these circumstances the actual repair work is done by third-party service organizations. The university merely stocks components for replacement purposes. This requires a high level of hardware standardization and provides little training and technical assistance to the users. It also requires a higher than normal inventory of replacement units, with one complete workstation for each ten stations in operation being a minimum holding.

There will be no technical training required for this level of service and it can be started very quickly. It requires adequate space for storage of the replacement work stations and should be located in an area where there is easy access to facilities for transporting equipment to be repaired.

The next level of service will provide troubleshooting capabilities and will include the replacement or repair of field replaceable components within the workstations. Almost all the major manufacturers of microcomputers have technical classes specifically designed to enable persons with minimal technical skills to become competent in these areas. Armed with diagnostic disks and appropriate background information, the technicians will identify the majority of problems encountered and determine the types of repairs that will be required.

Not all units have field serviceable components. There will still remain a number of items which will have to be kept on hand for direct work station replacement. In addition, a standard inventory of components to replace those items which require bench repair will be maintained. Arrangements will also be made with vendors for the repair and/or replacement of boards and other components which are determined to be faulty. In some instances it is possible to work directly with the parent companies to obtain the parts on an exchange basis. In most metropolitan areas there will also be third-party service organizations to assist you in this area.

The highest level of service normally found in in-house repair organizations is that of chip level maintenance. This requires a technical background which includes a good working knowledge of the instrumentation required for diagnostics as well as the ability to read and understand technical bulletins and wiring diagrams.

This level of service also requires that the technical specifications for all boards and components be on file for reference. In addition a much larger inventory of individual components will be maintained. It will also be more economical to purchase chip replacements directly from the manufacturer when possible. One caution to be mentioned here is that some board manufacturers use proprietary chips. These chips are not available from third-party manufacturers and you will find no service information available for these chips. The only service you can offer on these proprietary boards would be assistance in their return to a manufacturer's service center.

Implied in all three of the previously discussed levels of service is the unpacking and setup of all new microcomputer workstations as they arrive. This service would include checking to see that all items on the purchase orders are received, and properly installed.

One other service that needs to be mentioned here is that of providing maintenance service on a time and materials basis. By providing this service you are, in effect, creating a one-stop service center. You would merely be agreeing to pick up the item that is not working, repair it for a flat rate plus parts or take it to a third party for repairs and/or replacement. This part of the service would also include the return and re-installation of the part or parts in question. By providing this service you will be lowering the frustration level of the users who frequently do not know how or where to have their equipment repaired. This one stop concept can do a great deal for your program in the area of public relations.

B. Organizational Structure.

The placement of this service unit within the organizational structure will vary. In most instances this unit will fall under the general umbrella of the provost or chief academic officer. It will also probably be directly attached to the computing services area of the institution. If there is an intent to integrate an educational program for microcomputer users in concert with the service effort it should be placed under a common administrative head. If there are no training programs currently available for new microcomputer users you may wish to establish a user-education program when the new service unit is established. Training can be as simple as taking a few minutes to explain to the new user how to insert the self instruction disks that accompany most machines, or as complex as conducting regularly scheduled classes for new users.

After the level of service to be offered is determined, charge-back rates will be established based on current third party rates. A telephone survey of local businesses providing such services will establish the prevailing service rates. Unless you have the prerogative of making the service mandatory for all microcomputer users you will have to gear your service contract costs to a rate which is low enough to be attractive to your customers and high enough to pay for the services being performed. Depending on whether the salaries of the personnel involved in this project are to be recovered in the costing calculations, rates of approximately seventy-five percent of the average third party costs for the provided services would be a good target amount.

3. Service Center Operations.

A. Staffing.

Regardless of the level of service desired, the selection of the person to head the service unit is critical to the success of the endeavor. All three service levels require a person with strong communications skills.

In addition to the communications skills mentioned above, all employees would need to be familiar with both the operating system and major software packages being used. A very important component in the service unit is the ability to recognize problems that the user might be creating through the improper use of their software. This interaction capability between the service representative and the user can frequently assist in determining probable causes for system troubles. Even if the service level is unit replacement, the users must feel confident that the service unit personnel are competent and knowledgeable.

Levels two and three will require , in addition to the communications skills already mentioned, a high degree of technical expertise. Technical school and community college graduates with training in electronics and computer applications would be likely candidates for a position of this type. Most institutions currently have someone on the staff of the physical plant who is charged with the responsibility of repairing and/or maintaining various types of university electronic equipment. Such a person might be a candidate for this type of position. Veterans with training in the area of electronics would also be likely candidates.

Another approach to staffing would be to take someone from within the organization who has a strong interest in the area of microcomputers and their applications and send them to the appropriate classes to obtain the necessary technical skills. This would probably not be feasible if you are anticipating a service program which would operate at the chip diagnosis level. It would, however, be a very viable option for either of the first two levels of service.

B. Training

The cost of sending an individual to diagnostic and repair classes for the second or third level of maintenance will vary from no cost to over a thousand dollars per person. Most of these classes will also include a subscription to a service bulletin and update service for a one year period. In some instances institutions can become warranty repair centers and eligible to receive funding from the parent company for service work performed during the warranty period. The institution may also qualify to obtain replacements at wholesale prices through attendance at these classes. Refresher courses will be a requirement as the technology changes.

Since attending vendor sponsored in-service classes can be quite expensive, the university should attempt to calculate an approximate pay-back time for the recovery of these costs. On a very practical basis, how long will it be before the service unit is likely to recover these costs based on the numbers of machines of a particular type currently in use plus the expected purchases of other machines of the same make?

As the service organization expands it will be important to keep in mind that in addition to having a pleasant and reasonably knowledgeable staff, outward appearances will also play an important part in user acceptance of the program. Some type of identifying shirt, sweater, or name tag identifying the person as part of the service organization would be desirable. One of the keys to the success of the program will be the attitude expressed by the people coming into contact with the users. With the wrong attitude toward the users the most sophisticated of service organizations will receive mediocre evaluations at best.

C. Service Facilities and Test Equipment.

The allocation of space for the servicing of microcomputers is critical to the success of the program. At the unit replacement service level, a large amount of space is required for the storage of replacement devices. This space should be easily accessible to loading or shipping areas. As the technical level of repairs increases the space required for the servicing increases drastically. Bench space sufficient to test half a dozen pieces of equipment at one time should be a service unit minimum goal.

The tools required for the beginning level of service which is comprised mostly of installing and substituting equipment would consist of basic hand tools supplemented by a continuity tester for checking electrical outlets. The second level of service would require, in addition to the previously mentioned hand tools, a multipurpose metering device for trouble shooting. The third level would require the addition of an oscilloscope and/or other more precise testing devices necessary for chip level evaluations and repair.

The test bench should contain filtered power supplies and standard multifunction meters of the bench or hand held varieties. The most frequently overlooked item when dealing with the repair area is adequate securable space for the storage of units which are waiting to be repaired. The work station components are bulky and usually require roll around stands to be moved from one area to another.

D. Parts Sources.

The establishment of sources for repair parts can take several directions. The first level of service requires no parts be kept on hand as it deals with a total unit replacement. The second level of service would require the establishment of a network of supply sources that carry the required parts in stock. This might be a business chain that specializes in supplying replacement boards and components on an exchange basis or for outright purchase. If the prices are not exorbitant and you can establish a good working relationship with a source of this type you can cut down on the number of items you will have to keep in stock. The ability to supply required items on short notice will be a key factor in your satisfaction with this type of arrangement.

Another avenue to explore is that of being able to purchase field replaceable units or their components directly from the manufacturer at wholesale prices as mentioned above. This may involve sending one or more persons to company sponsored repair workshops and/or classes and becoming certified as a repair or warranty repair station. You may also be required to maintain a minimum stock of repair and replacement items to maintain this status.

Institutions located in major urban areas will have little problem obtaining vendors for their parts and board replacement items. The Yellow Pages section of the phone book will yield a number of good sources for parts and repairs.

E. Problem Reporting Procedures.

The normal routing of trouble calls will have to be established and appropriate forms for the recording of pertinent information developed. Since trouble calls may come in outside the normal working hours, the location of this service will, if possible, need to be included in the functions of an area that operates on a twenty four hour basis. One such area would be the operations section of the computer center. This department normally works more than one shift and is usually supported on weekends.

The person taking the trouble call would ask for the name of the person reporting the problem, their location and phone number. No attempt should be made at this time to determine the type of problems that may be occurring. This call should only establish that there is a problem and to record the name and phone number of the person placing the call. There should be a guarantee that the trouble call will be returned by a service person within one half working day from the time it is recorded. Paging devices may be necessary to allow the calls to be returned within the allotted time limit. Returning these calls within the established time limit is critical to the user acceptance of the service program.

At the time the trouble call is returned, a place and time should be arranged for someone from the service area to check the equipment in question. In doing so a determination will need to be made as to whether the machine is under a service contract and make arrangements for repairs, replacement, or the use of loaner equipment on an interim basis.

F. Service Contracts.

Since most, if not all, of the major components of the microcomputers in the various offices will have inventory numbers, it is an absolute necessity that complete records be kept of the parts being used in this service. This would also include a complete inventory of replacement units being used and their physical locations.

In conjunction with this type of record keeping a contractual agreement will have to be developed for recording the locations and specific equipment to be covered in the service agreement. These contracts must clearly state the services to be offered and the costs for each. They would also include areas for signatures, listings of the specific pieces of equipment to be covered and the appropriate serial and/or inventory numbers of each item.

It will also be necessary to make a visual and operational inspection of each piece of equipment prior to allowing it to be placed under a service contract to determine that it is in good working order prior to signing the service contract.

In the event that you do not wish to maintain third-party boards which are frequently included in machine configurations all exclusions of this type must be clearly stated in writing and explained to all parties prior to signing any service agreements. It is possible to include certain of the most commonly used third party boards in a service contract with the intent of having these boards repaired locally at a facility which can accommodate these types of repairs. Your in-house contract can then be written to include these pre-determined costs.

It should further be explained at the time of contract issuance that the contract will be subject to revision after a period of one year and that the cost of service may be adjusted at that time. The cost may go either up or down depending on costs incurred by the service department to that point in time.

The contracts should be made available to all interested parties. This may be done through an announcement in the institutions newspapers or newsletters. There should be one central location for information on the subject and the person or office responsible for disseminating this information should be knowledgeable in all facets of the services to be offered.

4. Cautions.

During the course of any service contract year it might become possible to replace a given item or unit cheaper than the current cost of making repairs. Floppy disk drives are a case in point. During the past year it has become cheaper to replace the floppy disk drives with new units than to attempt to repair the damage to the old drives. Anyone who reads any of the current crop of computing magazines would be aware of the prices of the drives and it would certainly not be in your best interests to submit a repair bill with a total that was higher than the cost of a replacement unit.

Another area which needs attention is the appearance of the repaired units when they are placed back into service. Each of the units should be carefully cleaned on the outside to remove any residue picked up in the repair shop. Each unit should also be given a final check to be sure that they will function properly when placed in service. This is particularly important when putting monitors back into service. During the service procedures it is very easy to alter the screen size or focus.

As the price of hard disk drives continues to decrease, more and more offices will be acquiring these devices with original orders or as added devices for existing units. At the present time the technology involved in the repair of these units does not lend itself to the type of service units discussed previously. The clean room requirements and the types of diagnostic equipment required are well beyond the capabilities and budgets of most universities. While the numbers of these units in service will increase drastically in the next few years there does not appear to be any other repair option available than to return the unit to the manufacturer or their appointed service center.

In order to assist in the evaluation and/or improvement of the services being offered the users should have the opportunity to present their ideas, criticisms, and suggestions as the services are rendered.

One way to accomplish this would be to include a short questionnaire as part of the signoff procedure. This questionnaire would be left with the user who would, after completion, return it to the person in charge of the service center. This questionnaire should cover the users level of satisfaction with the services rendered, the courtesy and attentiveness displayed by the service personnel, and the condition of the unit being returned.

Another method of allowing the users to communicate their ideas and suggestions to the service unit manager would be to make use of an interactive questionnaire made available to persons using their microcomputers as terminals. This could be done once a year and set up in such a way as to allow the user to access this questionnaire in their regular log-in procedures, with the questionnaires being tabulated on the mainframe.

One other comparison that needs to be made would be that of listing the types of equipment by manufacturer or type and their respective repair costs and downtime. A careful scrutiny of these data can provide you with a good basis for the year end evaluation of your recommended equipment list. It is important that this list not remain static in nature.

Changing this list may result in additional training for your repair personnel. It can be costly and involve repair personnel being unavailable for periods of time when it is inconvenient but it is essential to the success of both the repair program and the microcomputer user.

EQUIPMENT MAINTENANCE AND SERVICE AGREEMENT NUMBER_______

PAGE 1 OF_____

University Computing Services (UCS) agrees to provide and Customer agrees to accept maintenance service on the equipment listed on the reverse side of this document under the following terms and conditions;

This maintenance agreement is effective beginning ______________19___ and will remain in effect thru June 30, 19___.

COVERAGE:

Only the equipment listed on the reverse of this document is covered by this service agreement (option 1). All costs associated with bringing the equipment up to acceptance status will be charged to the Customer.

SERVICES (OPTION 1)

For the term of this service agreement, UCS agrees to provide on-site maintenance services from 0800 to 1700 Monday thru Friday excluding University-wide holidays.

UCS will provide replacement parts deemed necessary by UCS on an exchange basis.Replaced parts removed from the system become the property of UCS.

UCS will be responsible for all transportation to and from a regional repair center should that become necessary.

The Customer shall not perform or attempt to perform maintenance or repairs to the equipment during the term of this service agreement except with the prior written permission of UCS. Such attempts may void this agreement.

EXCLUSIONS:

UCS shall not be responsible for equipment that is beyond repair or has been subjected to unusual physical and/or electrical stress.

UCS may refuse a service agreement for any equipment not certifiable by UCS as being in good condition until the equipment has been brought up to acceptance status.
This agreement does not cover third party hardware.

CUSTOMER	UNIVERSITY COMPUTING SERVICES
BY:_______________________________	BY:_______________________________
TITLE:____________________________	TITLE:____________________________
DATE:_____________________________	DATE:_____________________________
BLDG:_____________________________	BLDG:_____________________________

[illegible] REV.

SERVICE OPTIONS AVAILABLE ARE: Page 2 of ______

OPTION 1.

BASIC UNIT (IBM, APPLE, KAYPRO, RAINBOW)	
AND TWO FLOPPY DISK DRIVES	$120
PC-XT WITH ONE FLOPPY DISK DRIVE AND HARD DISK	$350
MONITORS (PRINCETON, IBM, ZENITH)	
MONOCHROME	$ 30
COLOR	$ 60
PRINTERS (IBM, EPSON)	
DOT MATRIX GRAPHICS PRINTERS	$ 30
TERMINALS	
Z-29, AND VT-220	$120
Z-19, AND VT-240	$180
LA-36, LA-34, LA-100, AND LA-120	$240

ANY EQUIPMENT NOT SPECIFICALLY LISTED ABOVE WILL BE SERVICED ON A TIME AND MATERIALS BASIS.

OPTION 2.

AN OPTION TO SELECT REPAIRS ON A TIME AND MATERIALS BASIS MAY ALSO BE SELECTED. THIS SERVICE WILL BE PROVIDED AT A COST OF $35 PER HOUR WITH A ONE HOUR MINIMUM ON EACH SERVICE CALL. IN ADDITION TO THIS, THE DEPARTMENT WILL BE RESPONSIBLE FOR THE COST OF ALL PARTS, AND/OR SHIPPING TO A REGIONAL REPAIR CENTER IF THE SITUATION WARRANTS.

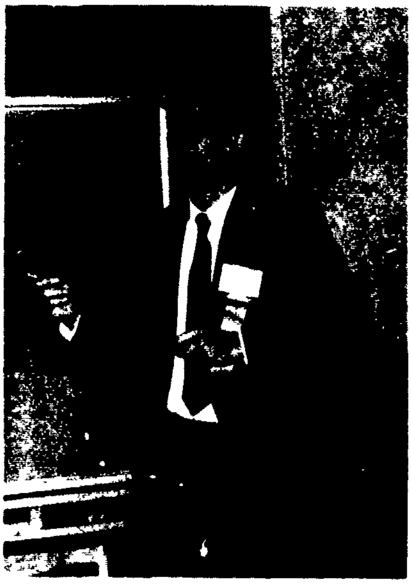
EQUIPMENT TYPE	SERIAL # /BSU #	LOCATION	CHARGES $	DATE	INITIALS

TOTAL CHARGES $____________

Track VI
People Issues in Information Technology

Coordinator:
Samuel J. Plice
University of Michigan

Ronald Woodbury
Evergreen State College



Phyllis Sholtys
Northern Kentucky University

Renee Frost
University of Michigan

IMPLEMENTATION OF PURCHASED ADMINISTRATIVE SOFTWARE AND ITS IMPACT ON THE COMPUTING ORGANIZATION

Elliott J. Haugen

Saint Louis University
St. Louis, Missouri

ABSTRACT

Colleges and universities are faced with a growing need for more responsive, comprehensive information systems to support their planning, management and operational tasks. While the use of internally-developed software systems continues as the norm, many institutions are investigating acquisition of commercially available systems. This trend is especially noteworthy among larger institutions who have traditionally developed their own systems.

While the functional aspects of locally-developed systems and purchased systems may vary slightly, there are significant implementation differences. This paper will explore those differences and the support issues associated with installation of major administrative information systems. The basis will be Saint Louis University's recent implementation of purchased software for financial accounting, alumni/development and payroll/personnel and a pending student information system.

IMPLEMENTATION OF PURCHASED ADMINISTRATIVE SOFTWARE AND ITS IMPACT ON THE COMPUTING ORGANIZATION

BACKGROUND

Saint Louis University is private, liberal arts institution dedicated to the Jesuit tradition of education. The University, founded in 1818, is the oldest university west of the Mississippi, enrolls approximately 10,000 students, employs 4,000 full and part-time faculty and staff and has 110,000 alumni/development constituents. The University consists of Frost campus, the Medical Center / University Hospitals, and Parks College in Cahokia, Illinois. Academic offerings include undergraduate, graduate and professional programs, a medical school, law school, Parks College (aerospace and avionics) and affiliated programs in Spain and France.

In 1984 the University began a major project to replace its administrative data processing systems by purchasing new software and hardware systems. The administrator responsible for this effort, Frank J. Bachich, Vice President for Business and Finance, is also making a presentation at CAUSE 1985. His paper, entitled "Institutional Change: A Fast Track Approach," deals with the institutional perspective, system planning, evaluation and selection, and user involvement.

This paper describes key components in the implementation of major purchased software systems. This is not a step-by-step guide to installing software or converting to new systems, but rather a view of implementation considerations and insight as to data processing implications and impacts. It is important the both the institution and the data processing organization recognize and understand these changes so scheduling, tasks and resource requirements can be properly planned.

INTRODUCTION

There is no question that higher education institutions face some of their greatest challenges ever and dependency on their data processing systems is increasing. However, many institutions must deal with the rapid pace of change without concomitant changes in their computing systems. This is a serious problem since computing the support costs are increasing and information system life expectancy is decreasing. Today's systems must provide 1) a solid foundation of accurate, consistent, timely data; 2) reliable, flexible software tools; and 3) accessibility. An institution can improve its administrative systems by upgrading current systems, developing new systems or purchasing commercially available solutions. St. Louis University decided upon the latter approach and in the past year has successfully installed new financial accounting, alumni/development and payroll/personnel systems and is preparing to implement a student information system. University Hospitals were not included. The software is Information Associates' Series Z (FRS, ADS, HRS, SIS). The hardware is Digital Equipment Corporation's VAXCluster with 11/785 and 11/750 processors. Over 75 terminals and microcomputers are connected to the three systems and another 10 terminals to an interim financial aids package.

Often the first reaction to the need for updated systems is that a truly useful system must be developed in-house. In the past this may have been true, however, today there are a growing number of vendors who offer a variety of highly functional higher education application systems. The software, in varying stages of product maturity, has improved considerably and offers great flexibility without major program customization. Systems include on-line/interactive capabilities, data base management strategies, table-driven logic to isolate variable parameters, screen builders, generalized report writers and cross-application integration. The growing institutional user base has accelerated vendor maintenance and enhancement activity. Additionally, purchasing major systems has become a very cost-effective alternative as computing personnel costs increase.

One of the prime reasons, other than the functional benefits, for purchasing a major administrative system is the potential for a rapid implementation. Changing an institution's information systems foundation is a significant task, but it is even more complicated if it is prolonged. During a change, an institution usually ceases to update old systems thus hampering existing users. A lengthy implementation also requires extended interfaces to old systems if more than one system is changed. A change in information systems is similar to changing key administrators. People do not want to make decisions until they know the new direction. Purchasing software can also provide a fast return on investment (people planning time/effort) and can reduce the need for an extensive data processing effort. The reduced demand for data processing personnel time also makes it possible to overlap the implementation of several systems. Figure 1 indicates the project schedule for the recent St. Louis University effort; it does not show preliminary planning/study.

St. Louis University's
Implementation Schedule

```
Financial Accounting | /////XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX...
                     |
Alumni/Development   |  ////XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX...
                     |
Payroll/Personnel    |  /////////XXXXXXXXXXXXXXXXXXXXXXXXX...
                     |
Student Systems      |             ////////////XXXXXXXXXXX...
                     |
                     |^-----------^-----------^-----------^-
                      85          86          87          88
```

Legend: //// - Design/Conversion
XXXX - Production/Operation

Figure 1

The implementation effort also included the April, 1985, installation of new DEC hardware for administrative information systems. Computer room facilities were completely remodeled and all computing and communications equipment relocated (twice).

TRADITIONAL DEVELOPMENT APPROACH

As a basis for comparing purchased system tasks, the following outline describes steps in a traditional systems development. It is arguable whether the list is all-inclusive or ordered properly since phases overlap, nonetheless, it is fairly typical of a major development effort.

System Planning/Feasibility Study:

a) Investigation: Identify strategy, objectives, tasks, problems, event sequence, basis of control, staff/resource requirements.

Analysis/Design:

b) System Analysis: Study and document needs from user interviews, develop program specifications and get user reviews/feedback.

c) System Design: Define system flowcharts, file layouts, program flowcharts and program specifications/documentation.

d) Equipment Selection: Determine hardware requirements, specifications and acquisition procedures.

Implementation/Conversion:

e) Planning: Define priorities, schedules, data base approach, security/access requirements and data retention procedures.

f) Program Development: Create software modules, review code design, enter code and test for syntax errors.

g) Equipment Acquisition/Installation: Install hardware/terminals.

h) System Testing: Install data base/file system, build test data base and perform program logic checking.

i) Installation/conversion: Install the production version of the software and convert existing data into the appropriate form.

j) Training & documentation: Train users on system/procedures.

Production/Operation:

k) Production: Create "live" data base and install production software. Provide linkages to any associated existing systems.

l) Operation: Activate control, security, and audit features.

The actual effort required for a software development project varies according to the project scope and institutional environment (this is the standard EPA new car mileage warning.) Figure 2 provides a relative comparison of the development process which is usually measured in years.

Software Development Cycle

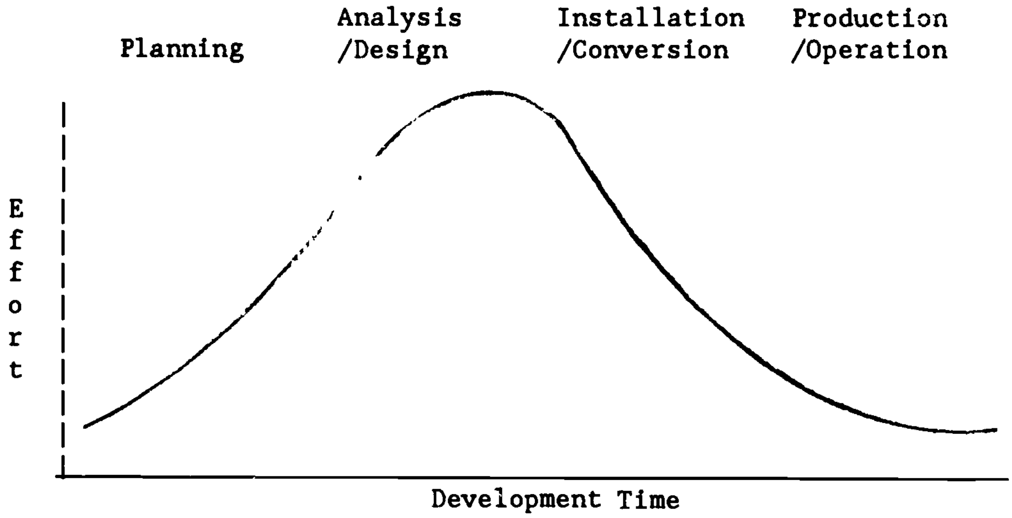


Figure 2

PURCHASED SYSTEM IMPLEMENTATION

The purchased software implementation differs from a traditional development effort in many ways. First, St. Louis University has found the planning and implementation effort curve takes on a bimodal shape. Since the major difference is the decreased effort to design and write the software, the largest part of the bell-shaped curve is removed. However, process differences shift some effort to other implementation phases.

Purchased Software Installation Cycle

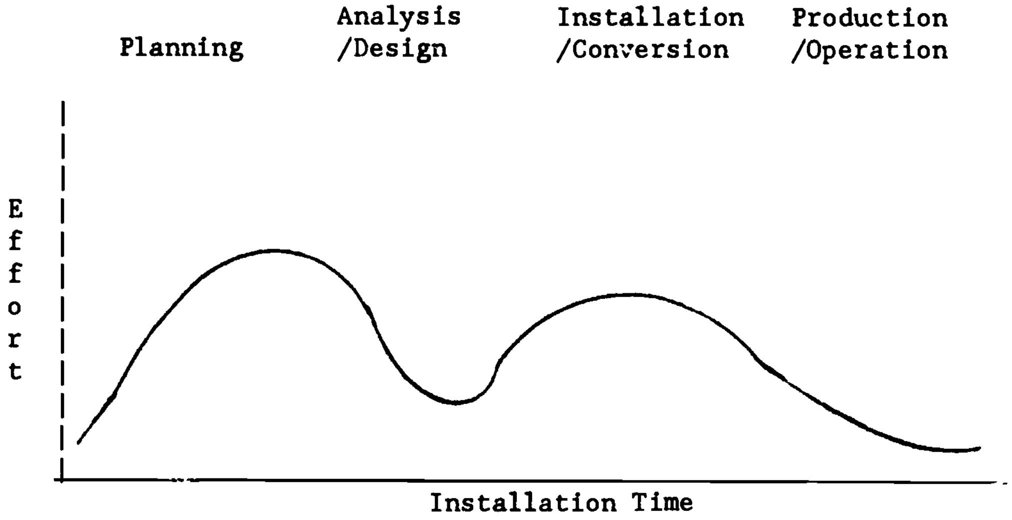


Figure 3

The second major difference is that a purchased system includes many capabilities beyond just error-free application code. This "product bundle" provides an implementation methodology, design experience, advanced software tools and documentation. These may not be noticeable to the user, but are important computing aids to a successful implementation.

Planning tasks are similar, although two points are especially important: organization and scheduling. Since the base software and training is available immediately, some policy and procedure issues arise quickly and decisions are required sooner than under a system development approach. For example, hardware selection, acquisition/installation tasks must be completed early. However, many decision points are dispersed so there must be a structure to focus activities, facilitate decisions and assure progress. While decisions are made as near the problem origin as possible, participants must know how an issue will ultimately be resolved.

If multiple systems are implemented simultaneously, efforts must be coordinated to reduce duplicated efforts and incompatibilities. A project coordinator is needed to get decisions made and integrate interproject activities. St. Louis University has utilized the following structure.

PROJECT MANAGEMENT

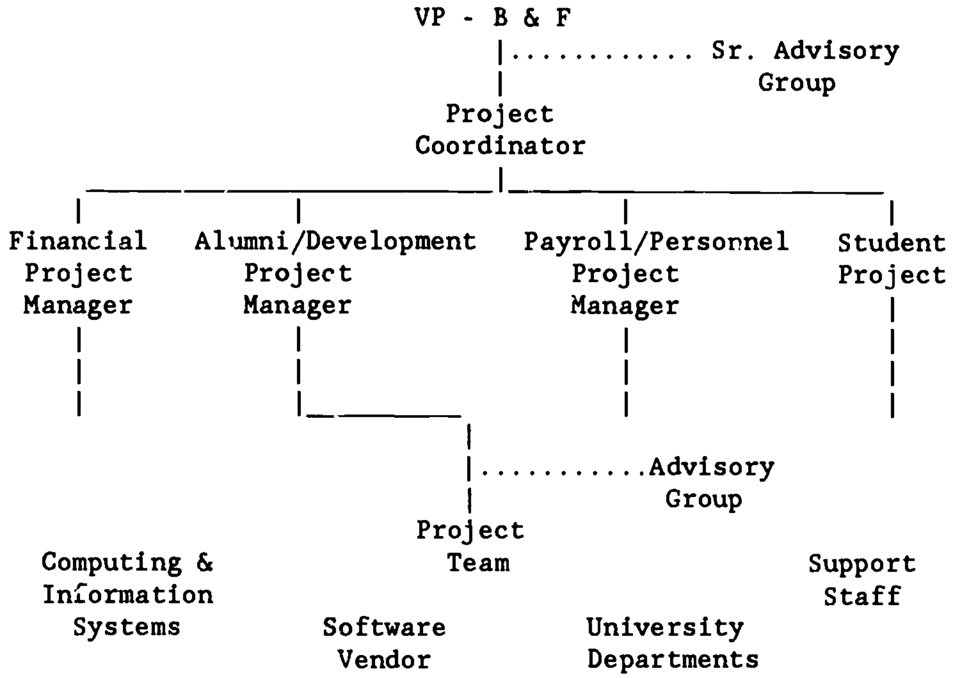


Figure 4

Each project manager heads an independent team comprised of two to four key users and a data processing analyst. Team members are expected to devote full-time to the project. Of significance is that the computing department provides support but is not the primary focus of the project.

As mentioned, scheduling is an important early task and the software vendor can provide guidelines for establishing an implementation schedule. This is usually easier than estimating the timeframe for locally-developed systems. If multiple systems are to be implemented, then the order of installation must also be considered. St. Louis University installed the financial accounting system first to provide the accounting foundation for subsequent systems. The alumni/development system went live concurrently and payroll/personnel followed five months later. Planning for the new student information system will begin in early 1986.

The schedule can be shortened if the training schedule is accelerated and/or the design/adaptation phase is compressed. The bimodal nature of the time and effort curve indicates this is possible since there is an in activity drop in mid-project. However, accelerating training cannot be done at the expense of information overload, or of time spent considering the impact of design decisions. The University experienced a slowdown or reduction in enthusiasm in the middle of each project which required a refocusing of attention and renewed commitment to the schedule. This was due to fewer people being involved and other commitments by team members.

The <u>system analysis</u> phase is a two-part effort: 1) a system study, or RFP process, and 2) the evaluation and selection of software. Traditional analysis process focuses so extensively on current operations that unless explicit planning guidelines exist, there is a tendency to design a system modeled too closely to existing operations and needs. That may not be what is appropriate or desired. Purchased systems provide the opportunity to change an institution's administrative work procedures. The software design has been based on practices or operations of other universities.

The system study/RFP process is not described here, but it is the manifestation of the analysis/needs assessment activities. The software and vendor selection process will determine how closely implementation meets perceived needs. It is often difficult for users to understand what specific capabilities and features will be available since their last exposure was the vendor's marketing presentation. In a traditional system analysis effort, users are provided feedback as to what was found during analysis and how it will be supported in the new system.

St. Louis University addressed this problem by emphasizing a three-stage approach to implementation. This helped develop user expectations as to what would be available. The decision was made early in the project to implement as closely as possible to the base software. Few if any modifications would be made, rather procedures would be changed. The first stage, provided on the "go-live" date, featured the basis software system, the data base foundation and access for central offices, i.e. accounting, personnel, payroll, etc. The second stage adds any special features present in the old systems and distributes access to appropriate user departments. This follows stage 1 by 3-5 months. The last stage, which is a continuous process, is the addition of those management and processing capabilities never available or possible under the old systems. In most cases this involves merely activating existing software features, while in others it may require vendor or local enhancements.

The success of developed systems depends upon the system design phase and how well it matches requirements found during analysis. Success with purchased systems depends upon how well the project team understands the capabilities and features of the software and matches these to identified institutional needs. This is accomplished through a methodology suggested by the vendor and is a key to simplifying the design effort. A second key is the training provided by the vendor through local or remote classes or computer-based lessons. The project team had to be reintroduced to the systems since their last exposure to it was during the evaluation process.

The system design phase is almost entirely user-based (project team) which is the opposite of the data processing-intensive development effort. During this tailoring phase the team examines data element requirements and characteristics, and determines data elements, valid values, editing rules, conversion rules, screen layouts and preliminary reporting needs. The vendor assists by providing functional and technical consulting, system design experience, a user base, generalized tools (screen builders and report writers), hot-line and electronic mail access. These aids will exist long after implementation and will add to further usefulness.

Since data processing staff are not as visible in the early stages, impressions are created that purchased software is just "off-the-shelf". That is not the case; these systems offer the ability to accomplish major tasks in much the same manner Lotus Development Corporation's 1-2-3 offers spreadsheet problem solving. In both cases it is the application of the capability which is the key. Likewise, just as there are LOTUS templates, purchased software provides models to be used as starting points for data base definitions, input screen design and forms/printer layouts.

Hardware selection and the subsequent acquisition and installation occur early in the implementation process since the base software is ready for installation immediately. Determining resource needs is simplified if the vendor can supply sizing algorithms or guidelines. Variables such as transactions per hour, program and file sizes can help determine processor power, memory and disk space. Recommendations from other user sites are also valuable. Sizing locally-developed systems is often difficult since estimates of software requirements and its impact are more abstract. The early need for hardware does, however, require earlier expenditures unless there is a modular growth strategy.

The key to implementation planning is how to deal with the several versions of software and data bases used during implementation. St. Louis University utilized four software versions.

1. Base - original source and executable code used for all training sessions provided by the vendor. It provides a checkpoint if uncertainty arises as to how a feature is supposed to work.

2. Modification - program change/test library.

3. Preproduction - set of all modified/approved software modules which is used to test against the preproduction data base.

4. Production - final version of the software which is never modified unless the changes have been tested elsewhere.

There are also multiple versions of the data base and associated data files. St. Louis University chose to establish five types of data bases.

1. Training - vendor-supplied, sample data base dictionary and data. This file is updated as the project team goes through training.

2. Testing - built by the project team to test base system features.

3. Set-up - subset of the future data base with converted/extracted institutional data and a preliminary data base dictionary.

4. Preproduction - complete data base used by the project team and key users to test new data elements or program versions. It includes security and will become the production system.

5. Production - the "live" data base which is accessed only from production executables and under full security control.

The <u>program development</u> phase exists only if software customization is required. There may be changes to programs to use existing forms or to include special processing formulas not available in the software.

<u>System testing</u> begins as soon as the basic system is available. It is an extension of the design phase since feature testing can affect the final design. This test-and-refine process parallels another system development approach called prototyping. This phase also includes building and testing the preliminary data base with institutional data.

The <u>installation/conversion</u> phase is the final, critical step before production. It is the most underestimated task of a system implementation and is significantly different. Developed systems are usually designed around the existing data so data characteristics, element sizes and values may not change. Purchased systems are installed more smoothly when data is converted to match model data base specifications. Data conversion starts after translation rules are established, usually at the end of the design phase. Also existing data cannot be changed if it is still used by old systems. However, institutional data should be loaded as early as possible even though it may be reloaded prior to production to capture the latest changes. This forces completion of data base definitions, provides earlier conversion validation and creates a user/project team ownership factor regarding the data base.

St. Louis University used a "parking file" approach for the payroll/personnel data conversion since it was an extensive effort. A master file contained all unmodified data which was to be moved directly to the new data base, converted to new values or used to create other required elements. Data came from various files such as personnel, budget and payroll. All conversion programs used this file to create transactions for updating the test and preproduction data bases.

Prior to production, interfaces to existing systems must also be completed and any data-related changes made. St. Louis University's financial system installation included converting to new account numbers and required changes to over 800 programs which used account numbers. This benefited subsequent installations since the accounting base was in place and systems such as payroll were already using new account numbers. Although possibly more difficult, it is better to change the interface programs to match the base rather than vice versa. Security features, access control, journalizing/backup/recovery are all tested in this phase. It is difficult to image how screen, process and data file security could be easier than with purchased systems where features are merely turned on.

The production phase is similar under both approaches, except that if vendor maintenance is purchased, the vendor will supply new features, regulation/tax changes and related companion systems. User production aids include immediate availability of on-line help features while a major data processing benefit is a completed set of program documentation.

COMPUTING SUPPORT ISSUES

Implementation differences obviously affect the data processing function. However, there are other changes and impacts which profoundly affect the role and expectations of the campus computing organization.

The first impact is psychological. The decision to purchase software rather than develop it locally can be viewed as detracting from the computing organization. However, St. Louis University had had no major development for some time and most staff experience was in maintenance activities. It was also emphasized that the wheel would not be reinvented; rather attention would be given to improving its use. In other words, the University wished to avoid a lengthy programming effort or expansion of the data processing staff, but preferred to concentrate on the process of using computing as an operations and management tool. Staff were reminded they would have the opportunity to work with state-of-the-art software and hardware and be part of a major project which would impact the University for years to come. New demands for staff involvement in microcomputing, subsystem development and user (information center) support where more important than writing new systems code. The fact that a new computing director was hired also signaled changes were forthcoming.

Since there is so much user attention during the project planning and software selection process, a computing staff can feel disassociated from the project. Instead of being the focal point of development, the computing department must await assignments from the project team. As the project evolves, all aspects of the organization will be involved, but it is very difficult for some to wait for their turn to participate. The staff must be kept up-to-date on direction, actions and tasks of the project. Communication is important and there were weekly meetings with staff on each project and another meeting with all programming staff. Staff were included in project briefings and were responsible for all conversion efforts as well as keeping existing systems functioning.

The next change is in organization. The administrative information systems staff consists of an assistant director, three systems managers, three senior programmer/analysts and three junior programmer/analysts. One junior position remained vacant throughout the project. The senior manager/analyst in each application area was assigned to the project team, relocated to another building and reported to the project manager. This person was responsible for detailing work for the programming staff. Each analyst was backed-up by a programmer/analyst who attended all training sessions and was the person responsible for completing assigned project tasks. The assistant director performed a function similar to the project coordinator by assuring intersystem coordination. He also assisted in describing and documenting old systems and interfaces, managed conversion programming efforts, applied all security controls, documented approved data base dictionary values and assured proper source code change control.

For the computing organization's management, requirements are simple. Management must offer high-level vision, involvement and enthusiasm. Staff must understand the institution's commitment to a successful implementation. The importance of user-based systems must be established as the foundation of all activities and future efforts. Training, team-efforts, articulated roles and schedules must be emphasized. On the operational side, equally easy tasks exist. There can be no problems; hardware systems must be reliable and available as needed, and conversion and production procedures must be on schedule. Management's role is that of a facilitator -- to assure the availability of resources to support the implementation and production effort. It can be an important, strategic role, and if there are problems it will indeed be a highly visible one.

CONCLUSION

St. Louis University approached implementation of new administrative information system in a fairly direct manner. Functional requirements of user departments and management would determine the software selection, which in turn would result in a hardware decision. Throughout the project the focus has remained on the user and the data base, not on the computing effort. This may be difficult for institutions which take pride in developing their own systems. But is time to examine closely the cost and effectiveness of continuing this practice. Alternatives are available.

Data processing's challenge is to blend the talents of its people into a user support organization, skilled in information technology, rather than COBOL. Staff must be production oriented, not inventors. Training, conversion and maintenance activities provide great opportunities to concentrate on results, not just the tools.

Implementation of purchased systems if reduced to the basics requires a high-level commitment, organization, planning and a team-effort. In basketball it isn't the last few seconds that determine the outcome, it is key events during the game which position a team to be successful at the end. Similarly, the keys presented here can help an institution position itself to successfully implement purchased administrative systems.

INVOLVING THE USER IN STUDENT SYSTEMS DEVELOPMENT

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In 1983, Michigan State University began a campus-wide concerted effort to define, develop, and implement an integrated data-based Student Information System (SIS). It was quickly recognized that a project of this magnitude must, by its very nature, incorporate the needs and concerns of the various constituents who would most directly benefit from and use the system. This paper discusses the integral role user groups have played in the SIS Project to date. In addition to a strong commitment from the vice presidential level, the SIS Project has involved faculty, support staff and students at each phase, including the initial System Requirements Definition, the preparation of a Request for Proposal and an exhaustive vendor bid evaluation and selection process.

I. INTRODUCTION

Michigan State University, a pioneer land-grant institution, was founded in 1855. Since then, MSU has dedicated its resources to the three-fold land-grant mission of teaching, research, and public service. The curriculum, which in the early years concentrated on farm science, now includes 200 undergraduate programs, and graduate work in 75 departments and schools, all taught by more than 3,000 academic staff in 14 colleges.

MSU operates the largest residence hall system in the United States, combining some classrooms, study areas, faculty offices, dining facilities, and living units for the 17,000 plus students residing on campus.

In serving the state, the nation, and the world, MSU offers Lifelong Education Programs, the Cooperative Extension Service, a research program of more than 3,000 projects, and the Office of International Studies and Programs. Over 40,000 students enrolled for classes during the 1985 fall term at MSU's single campus complex in East Lansing, Michigan.

On July 1, 1985, Dr. John DiBiaggio became the seventeenth president of Michigan State University. In the short time he has been in office, he has aggressively begun work on his stated goals: to improve relations with alumni, state and local government, corporations, and community leaders, as well as embarking on a major capital raising campaign.

To support MSU's goals, and to address the complex data handling requirements which have evolved during the past decade, University leadership has identified the development of a Student Information System as an institutional priority. A "student information system" may be defined as an integrated administrative support mechanism composed of student processes and data. During their recruitment and tenure, MSU students are admitted, registered, awarded financial assistance, assessed fees, advised of course offerings and academic choices and certified for graduation. Each of these processes requires the collection and manipulation of student data. Thus the systems and data files currently in use compose a "student information system". However, the student record sub-systems in existence today were developed years ago; they were not technologically designed to accommodate the many changes which have transpired within the University during the last decade. Since the basic sub-systems could not easily change, numerous "interface" systems now augment original systems, and some important needs still remain unmet. The result is a non-integrated set of systems, processes and data bases which only minimally support the institutional mission. Some time ago, it became clear that a modern, unitary, comprehensive, and technologically flexible Student Information System (SIS) was required to meet MSU's needs.

II. PRIOR STUDENT INFORMATION SYSTEM DEVELOPMENT PROJECTS

Over the course of the last six years, several attempts have been made to design and implement a comprehensive, integrated SIS. It is important to note that while none of the attempts produced a new Student Information System, each provided a particular methodology or design element which has been useful and applicable in the current endeavor.

In December 1977, Administrative Information Services (AIS: MSU's data processing department) initiated an investigation of the feasibility of revising existing student record keeping procedures with the goal of a new student information system. From this came a study plan, the identification of project management, and specific system design guidelines. It stressed one important element: the system to be developed must be implemented under a Data Base Management System (DBMS).

In April 1979 the Provost and the Vice President for Business and Finance appointed a Task Force to Study Registration Alternatives. In October, 1980, this Task Force submitted for review a proposal for the development of a Student Information System. The Task Force selected and directed a Project Team to collect the required data. Existing systems and their deficiencies were generally described, a design philosophy and basic design objectives presented, and the costs and benefits associated with the development of a new system analyzed. The concluding section of the proposal summarized the six phases of a system implementation plan as envisioned by the Project Team.

In the Spring of 1982 a new Task Force was appointed to continue prior efforts. The Task Force in turn appointed a Project Team of fourteen members assigned to take a newly purchased system development methodology (AGS Software's SDM/70) and produce a requirements definition for the system.

The SDM/70 approach provides a standard framework for the development of systems, i.e., a predefined system life cycle within which all the required development work can take place; and a structure which provides sufficient flexibility, based upon the needs of the project to choose the tasks and the design considerations within the task appropriate to the project. One of the first major phases in the SDM/70 "Life Cycle" is the System Requirements Definition (SRD), comprised of nine tasks:

1.0 Identify Project Scope
2.0 Establish and Maintain an Index of Collected Data
3.0 Conduct Interviews
4.0 Document and Analyze Collected Data
5.0 Describe and Analyze Work Processes
6.0 Define Information Requirements and Data Attributes
7.0 Define and Rank System Objectives
8.0 Prepare SRD Document
9.0 Process SRD Document through Review Points

The 1982 Project Team initiated work on the SRD with Task 5.0, Describe and Analyze Work Processes. Concurrently the Task Force addressed the larger questions of the scope and definition of the project and the policy issues which accompany a major endeavor of this type.

The documentation and detailed analysis required of SDM/70 is extensive. The time commitment of Project Team members to complete Task 5.0 at the "micro" or detailed level was substantial. It was difficult, if not impossible, to impose schedules for completion of required documents without relieving team members of existing job duties. It was realized that, if the current SIS endeavor was to succeed, a revised approach would be necessary.

III. CURRENT STUDENT INFORMATION SYSTEM DEVELOPMENT PROJECT

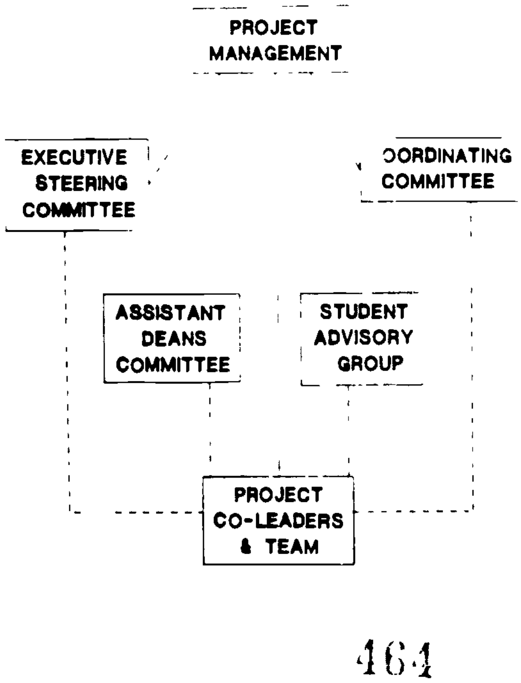
A. Project Organization

The organization of the current SIS project was intended to facilitate the fulfillment of project goals, to reflect the centrality within SIS of the academic endeavor, and to recognize the shared responsibilities of the academic and support units involved. The current SIS effort represents something of a departure from earlier efforts in its emphasis on obtaining extensive input and review from the primary academic units of the University.

Figure 1 depicts the organizational composition of the SIS Project. As in the 1982 attempt, the management of the current project remained the Provost, as chief academic officer of the institution, and the Vice President for Finance and Operations and Treasurer, as the officer chiefly responsible for the development and technical support of management information systems. These two officers have been joined by the Vice Presidents for Research and Graduate Studies, Administration and Public Affairs, and Student Affairs and Services, and the Associate Vice President for Finance and Operations in an SIS Executive Steering Committee, chaired by the Provost. A SIS Coordinating Committee, chaired by the Assistant Provost for General Academic Administration, composed of unit directors designated by the participating vice presidents, the Director of Administrative Information Services, a representative from the Council of Deans, and a representative from the Steering Committee of the Academic Council, has had principal responsibility for ensuring that inter-unit procedural requirements are met to the satisfaction of all units involved.

As for the Project Team, at the request of the Provost, an Academic and Support Units co-leader has provided user needs and policy analyses and support to the Executive Steering Committee. At the request of the Vice President for Finance and Operations and Treasurer, a Data Processing co-leader has provided technical analysis and support to the Executive Steering Committee. Both co-leaders also sit on the SIS Coordinating Committee.

FIG. 1 SIS PROJECT ORGANIZATION CHART



In addition to the SIS co-leaders, the SIS project team consists of data processing personnel, the management systems coordinators from Finance and Student Affairs and Services, and additional staff as identified by the co-leaders and assigned by project management. An Assistant Deans Committee and a Student Advisory Group also provide valuable input and review data for the project through counsel with the SIS Project co-leaders. Table 1 summarizes the SIS Project Organization and the responsibilities of the various groups of participants.

B. Project Strategy

SDM/70 was the design methodology used in the System Requirements Definition. It proceeded, however, on a "macro" level (as opposed to the previously employed "micro" approach). For purposes of this project, a macro level SRD was defined as:

1. inclusive of all components in the agreed scope, i.e., is global.
2. providing a sufficient level of detail to support, without iterative SRD effort, this sequence of events:
    a) a similarly "macro" system design alternatives analysis.
    b) a similarly "macro" system external specifications.
    c) invitation of detailed work on one or more SIS components, such work to include detailed SRDs specific to components but consistent with the controlling global SRD.
3. providing a sufficient level of detail to support the development without iterative system requirements definition effort, of a Request For Proposal (RFP).

Under the current endeavor, SIS will encompass collecting, maintaining, and retrieving student information, beginning with initial contact with a prospective student and continuing for the lifetime of the information. It will also include data maintenance support for the curriculum and course processes at MSU.

The <u>primary functional processes</u> involving student activity at MSU, as identified by Project Management and the Executive Steering Committee, are :

-- Admissions and Placement Process
*Prospecting and Recruiting
*Admissions
*Credit Transfer Evaluation
*Orientation and Placement

-- Student Academic Records Process
*Academic Advising
*Enrollment and Withdrawal
*Grade Process
*Degree Certification
*Academic Progress Monitoring and Discipline
*Transcript Generation

TABLE 1: SIS PROJECT ORGANIZATIONAL RESPONSIBILITIES

Project Management

- Provide institutional project leadership
- Provide final authority on project issues
- Provide project promotion and support in the University community
- Provide 'go/no go' decision for each phase of the project

Executive Steering Committee

- Review & resolve University policy issues
- Review & approve key phase documents
- Act on all unresolved issues forwarded from the SIS Coordinating Committee

Coordinating Committee

- Review key phase documents
- Review project schedules & progress against schedules
- Review staffing requirements & ensure personnel availability to satisfy requirements
- Review & act upon project issues brought forward from the project team
- Provide a forum for discussion & resolution of possible inter-unit coordination problems
- Identify problems & concerns for project team review and analysis

Project Team Leaders

- Establish project strategy
- Develop project plan including: task lists, time estimates & personnel assignments
- Establish realistic schedules based on estimates and personnel availability
- Manage the project team
- Identify policy & procedural issues
- Ensure the proper use of the development methodology
- Report to the Executive Steering & Coordinating Committees
- Coordinate the resolution of technical design considerations
- Coordinate user unit input & review

- -- Curriculum/Course Process
  - *Curriculum Planning
  - *Catalog Development
  - *Course Scheduling
  - *Room Assignment

- -- Student Financial Records Process
  - *Financial Aid
  - *Fee Assessment and Collection
  - *Billing and Receivables

- -- Housing and Food Service
  - *Room Assignment
  - *Interface with Student Billing

Other functional processes that provide or utilize data that are integral to the primary student functional process include:

- -- Student employment
- -- Off Campus Housing
- -- Out-Placement
- -- Vehicle Registration
- -- Athletics (Intercollegiate and Intramural)
- -- Institutional Reporting
- -- Library
- -- Lifelong Education
- -- Health Services
- -- Alumni

C. User Involvement in SRD Activities

As discussed earlier, one of the tasks in SDM/70's System Requirements Definition (SRD) phase is to conduct interviews (Task 3.0). To this end, the Project Team interviewed unit administrators responsible for the functional processes defined earlier, as well as groups of students in the residence halls. The intent of the interviews was to describe and analyze the existing work processes, uncover any problems within current systems and enumerate needs for a future system. Project Team members then proceeded to translate these needs into a set of specific system objectives written with sufficient precision so that they would become a check list when eventually evaluating vendor bids. Users considered each objective and assigned a value ranking for system implementation of "M" for mandatory, "HD" for highly desirable, and "D" for desirable from their individual unit point of view. In addition, objectives were validated against those found in Request For Proposal (RFP) documents available from other major universities which had embarked on similar SIS ventures, e.g., Pennsylvania State and the University of Colorado, to identify missing objectives which required consideration.

Both the interview process and writing of objectives became a highly iterative process. Interview summaries and objectives were written by Project Team members and reviewed by the users. These documents would pass back and forth many times until the users were satisfied that their needs were accurately represented. Also, additional SRD tasks required the Project Team to work with users to document and analyze data collected and maintained in existing files (Task 4.0), to describe and analyze work processes, procedures and operations (Task 5.0) and to define information requirements for the new system (Task 6.0).

The SRD end-of-phase report was written by the Project Team and distributed in draft form to users for unit review. The user rankings of functional requirements, using "M","HD" and "D", were translated by the Project Team into a numerical rating between 1 and 5, with 1 representing functions which are viewed as essential system wide and 5 representing functions desirable at the individual unit level. The directors of the "Big 4" offices, i.e., the four units which represent the "core" functions of SIS, met jointly to discuss functional areas in which there exist interfaces either with data input, output or need to know. Once the Registrar, Controller, Director of the Office of Admissions and Scholarship, and the Director of the Office of Financial Aids were satisfied that both their individual needs and collective interface needs were addressed, the end-of-phase document was sent to Project Management. (The SRD document is summarized here by reproducing its Table of Contents in Table 2).

TABLE 2: SRD TABLE OF CONTENTS

D. Activities Immediately Prior to Release of the Request for Proposals

While the SRD document was in final stages of production, two major activities occurred in preparation for release of a Request For Proposal (RFP) for a Student Information System. The first, in February 1984, was a trip to Penn State to discuss RFP efforts. A review team of users and SIS Project Team personnel met with their counterparts to discuss the process used by the latter in their preparations and release of an RFP for a student system.

The second activity was the selection of a technical environment to support SIS. During the spring and summer of 1984, MSU's Administrative Information Services Department conducted an extensive evaluation of core technology tools. The stated purpose of the Core Technology Project was to recommend products which would

- increase performance activity
- make it easier for users to satisfy more of their own information requests
- improve the collective understanding of the information the institution knew about itself
- retain computer-based information in a flexible, consistent, integrated fashion

The Core Technology Project Team concluded that the "family" of integrated products from Cullinet Software Incorporated offered significantly greater functionality and recommended the acquisition of the set of software products as most suitable to the needs of MSU:

- IDMS/R (Integrated Database Management System/Relational)
- Integrated Data Dictionary
- Application Development System/OnLine (ADS/O)
- Application Development System/Batch (ADS/Batch)
- Culprit
- OnLine Query
- OnLine English
- Universal Communications Facility
- Escape

E. Release of the Request For Proposal

The results of the earlier SRD had a direct bearing in the production of the RFP. The General System Objectives of the SRD document became the core of the RFP, in the form of 318 functional requirements. Once again, users reviewed the requirements for accuracy, realizing that the wording would ultimately become contract language with a successful bidder.

The Project Team wrote most of the remainder of the RFP. (Table 3 replicates the RFP table of contents.) Several sections, including 9.0 and 11.0, represented university policies and were available as boilerplate copy. User input was solicited for sections 6.0 - 8.0, while AIS bore responsibility for section 5.0.

MSU Purchasing Office played a key role with the release of the RFP in October 1984. All communications between any vendor and MSU regarding the

TABLE 3: RFP TABLE OF CONTENTS

SECTION	TITLE
1.0	Introduction
	Proposal Ground Rules
	Proposal Content and Format
	Evaluation
2.0	Implementation
	Project Schedule
	Estimated Staffing Requirements
3.0	Functional Requirements
	General Requirements
	Course Planning and Schedule Building;
	Admissions;
	Student Identification;
	Financial Aid;
	Academic Orientation Programs;
	Grade Reporting; Records Maintenance and Transcripts;
	Housing;
	Graduate Assistant Appointments;
	Enrollment;
	Registration; Billings and Collections;
	Adds and Drops;
	Withdrawals/Reinstatement;
	Holds;
	Student Affairs and Services;
	Programmatic Eligibility Checks;
	Degree Certification;
	Non-Current Student Records
	Other Functions
4.0	Special Forms
5.0	Data Processing Requirements
	Hardware and Operating Environment
	Data Base Management System and Dictionary
	Data Communication Considerations
	Access Control Considerations
	System Development and/or Software Installation
	Specialized Software
	System Development Methodology
6.0	Documentation Requirements
	System Guide
	User Guide
	Program/Subroutine Documentation
	Operations Documentation
	Installation and Maintenance Guidelines
	Documentation Quantity
7.0	Technical Assistance and Training
	On-Site Technical Assistance and Training
	Remote Technical Assistance
	Existing Training Program
	Technical Assistance Response Time
8.0	User Training Implementation
	Training for Designated Trainers
	Training for University Staff and Students
	Existing Training Programs
	Training and Methodology
	User Groups
	Proposed User Training
9.0	Vendor Requirements and Background
	Warranties
	Save Harmless
	References
	Financial Status
	Aggregate Information on Existing Systems
	Aggregate Information on Software Development
	Vendor Organization
10.0	System Ownership
11.0	Minority and Women Business Enterprises
12.0	Glossary
Appendix A	SIS Module Cross Reference
Appendix B	Section/Subsection Cross Reference
Appendix C	Schedule Description Cross Reference
Appendix D	Hardware Configuration
Appendix E	Software Configuration
Appendix F	Schedules

SIS Project or the RFP was channeled through Purchasing. Furthermore, users were instructed that if contacted by a vendor, they were to direct their calls to Purchasing. This procedure provided a means of control over information and insured consistency of all vendor communication.

In November 1984, vendors were invited to campus to review the RFP procedures and answer any questions regarding the RFP process. The proceedings were taped and a summary of questions and answers were sent to all attendees. The agenda consisted of four major items: project history, functional requirements, technical requirements, and RFP bid response information.

Of the fifteen vendors present at the November conference, six submitted bids. These were opened in a formal session at Purchasing on January 28, 1985.

F. Bid Evaluation Process

Concurrent with the release of the RFP in October 1984, the SIS Project Team began work on the development of a bid evaluation strategy. The team produced three evaluation matrices: rating each module within the RFP; a summary rating for an entire system or portions thereof as proposed by a single vendor; and a "mix and match" rating, taking the best modules from two or more vendor bids.

The evaluation process was complicated by the fact that there were general system requirements which pertained to the entire system, while the functional requirements pertained to one or more specific user units. The evaluation model, through an elaborate and statistically valid scheme of mathematical computations, allowed for these concerns. The evaluation matrix was reviewed by user units and the SIS Coordinating Committee prior to the evaluation process.

The evaluation procedure itself consisted of providing each user's unit, including the student group, with two sets of responses from each bid: the functional requirements specific to their unit and the general requirements which were rated by all users. For the most part, users formed internal work teams which met a number of times to discuss ratings and determine a collective rating to be submitted to the Project Team. Project Team members were available during this period to review the process and provide any assistance required, short of suggesting actual ratings. All ratings were collected and recorded on a massive grid so that the Project Team could identify specific ratings with major disparity across user units. In such cases, users were contacted to discuss rationale for their ratings and ultimately agreement was reached over an acceptable rating. The Project Team compiled the final tallies.

The Project Co-leaders were responsible for the recommendation of selected vendors to Project Management. Four factors were used to arrive at the final recommendation: the rating of vendor bids, as described above; telephone surveys of vendor references; site visits to selected locations; and on-campus vendor presentations.

Each vendor, whether bidding existing system or system development, was asked to provide references, including sites in development or in operation.

The Project Team telephoned these institutions and, during lengthy discussions based on a standard survey, sought responses about the vendor, its product and services. If the reference was an educational institution, a number of key personnel were contacted, including registrar, controller, financial aid and admissions directors, data processing staff and project management. Responses tended to be consistent across references for each particular vendor and provided a composite picture of what MSU might expect.

Additionally, a review team including representatives of the user departments and SIS advisory committees visited client sites to further evaluate each vendor's service and operational system product.

During the first week of April 1985, four vendors were invited to campus, each on a separate day, to make final presentations and answer questions. Each day consisted of this agenda:

Vendor Opening Remarks	1 1/2 hours
Registration	1 hour
Controller	1 hour
Admissions	1 hour
Student Records	1 hour
Financial Aid	1 hour
Data Processing	1 hour

Users were invited to attend sessions related to their functional responsibilities and were free to ask as many questions as time would allow. Each day's proceedings were recorded.

A meeting held after the final day-long vendor presentation revealed that the "Big 4" directors were unanimous in the ranking of the vendors.

IV. FUTURE SIS PROJECT ACTIVITIES

Members of the MSU user departments will continue to play a key role in future activities during the design and implementation of the Student Information System. These activities include:

1. Detailed requirements definition for each component of SIS.
2. Detailed functional specifications for each SIS component.
3. Data conversion planning.
4. Acceptance test planning.
5. System component design review and acceptance.
6. System acceptance testing.
7. Training.
8. System certification and implementation.

At Michigan State University, the development of institutional information systems, such as the Student Information System, is viewed as a two-way service contract relationship between the development project team and the ultimate owners of the systems--the users. This service contract relationship is based on active participation by user representatives throughout the "life cycle" of the project.

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MICROS AND MANAGERS - GETTING THEM TOGETHER

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Microcomputer support centers often find their resources are much in demand by office support staff, but little used by managers and executives. Much has been written about why these groups postpone learning to use computers. Lack of time, keyboarding skill, computer phobia, or fear of showing lack of knowledge in front of staff employees are among the reasons given for reticence.

It is this writer's belief that a major reason executives and managers avoid computers is that they see themselves as achieving their goals through directing the work of other people, not by using machines. The executive or manager perceives the direct use of a computer as demeaning to his or her role.

This paper discusses executive/managerial reticence issues and describes the development of a workshop designed to meet the very real problems and hidden agenda of managers. Two major goals were set for the workshop: To enable executives/managers to develop (1) Broader knowledge about computers (policy issues, hidden costs, caveats, expectations); (2) High-level skills that will enhance personal analytical and decision-making processes while delegating computer support functions to staff members.

Background

With the emergence of the microcomputer as a serious tool for the work place, user computing invaded corporate America with incredible speed. A 1984 business survey commissioned by Arthur Anderson & Company indicated that 73 percent of the large companies were using microcomputers and, within that group, a third of their policy level officers used computers at work.[1] Industry trend-watchers concur with the Arthur Anderson finding that many decision makers are already armed with microcomputers. However, except for an initial group of pioneers, it now appears that many managers, from department and division heads to executive officers, resist developing basic computer literacy or utilizing microcomputers as a support tool for themselves.[2]

As functional departments gain increasing responsibility for their own information processing, managers must either develop the necessary sophistication to manage the technology or risk being managed by it. Managers can also benefit from incorporating analytical tools into their administrative style. Indeed there is mounting evidence that as information technologies evolve, a higher premium is being placed on managers who master decision support tools.[3]

Higher education, by nature an "information industry," is now the setting for a bewildering assortment of high technology products, faculty/student computer literacy is a near-universal goal for the eighties and computers promise to become an integral part of the curriculum. However, non-teaching personnel exhibit the same characteristics as similar groups within business and industry: In the office setting, information processing technologies are revolutionizing the way day-to-day operations are conducted while at the same time, managers appear reluctant to personally adopt the new tools.[4]

Analysis of Managerial Reluctance

Recognition of the need for computer awareness and literacy among workers at all levels is increasing. Large corporations typically respond by providing information centers charged with delivery of instruction and consulting support for computer users. Increasing numbers of colleges and universities are also developing support mechanisms for

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[1] Ken Greenberg, "Executives Rate Their PCs," PC World, September 1984, p. 289.

[2] Workstations: Making Executive Decisions," InformationWEEK, September 14, 1985, pp. 44-45.

[3] Jerry Kanter, "A PC Manifesto For Managers," Infosystems, September 1985, p. 48.

[4] Michael Kilpatrick, "Computer Phobia," Infosystems, December 1984, p. 54.

administrative office personnel. Once in operation, user computing support groups often find their resources are much in demand by office support staff, but little used by managers. A persistent challenge is how to reach the higher-level personnel.[5]

Much has been written about why managers postpone learning to use computers. The common threads found throughout the literature include:

* Lack of time: This is a universal problem with all managers and represents one of the major difficulties managers have to overcome in learning to use computers. "With less than an hour a day to reflect on new activity, the task of analyzing and learning the techniques to properly employ personal computing is an overwhelming prospect."[6] The constant interruptions that a manager encounters during the workday, also contribute to the difficulty in acquiring new skills.

* Lack of keyboarding skill: This is often perceived by managers as a stumbling block to using computers. Without typing skills they fear they would be hopelessly slow in learning and using a computer.

* Computer phobia: Many managers are concerned about revealing their lack of knowledge to staff employees and as a consequence, avoid open classes. Others may hide behind a screen of expressed cynicism, claiming computers are distracting toys.

These reasons do not constitute a complete picture. It is this writer's belief that a major reason many managers avoid computers is that they see themselves as achieving their goals through coordinating and directing the work of other people, not by using machines. Many, particularly high-level executives, do not want machines and believe they do not need them since they have staff personnel to provide data or reports whenever requested. Further, good managers possess strong people skills. With emphasis and reliance on personal communication abilities, some managers develop a bias against learning the technology, viewing computer users as introverted technocrats.

In summary, many managers have no confidence that personal computer literacy will enhance their professional skills. However, sensing that an unenthusiastic view of computers is inconsistent with the popular image of a modern manager, real reasons are often hidden and "safer", generally acceptable reasons are offered.

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[5] David Friend, "Distilling Executive Information," Information Center, August 1985, p. 38.

[6] Kanter, p. 48.

Instructional Approach

If the foregoing analysis of managerial reticence is correct, it then follows that the key to an effective instructional program is to demonstrate that learning about computers can enhance managerial skills. Interest in computers will surface when the instructional focus shifts from technology to organizational issues related to the technology. (Even the greatest computer cynic will acknowledge the need to learn about computers at a managerial level.) Hands-on instruction should be structured to down play the "bits and bytes" aspect of computing and instead stress how using computers can enhance the manager's role.

Acting on that premise, the author developed a workshop designed to meet the known problems and inferred hidden agenda of managers. Two broad goals were set: To enable executives/managers to develop (1) knowledge about computers (computer capabilities and related management issues); and (2) practical skills that can enhance personal analytical and decision-making processes while still delegating computer support functions to staff members.

Part of the the workshop focuses on policy issues and, organizational impact of computer technology. The remainder of the scheduled time is spent on practical applications. Hands-on practice is preceded by a demonstration of data base development and data retrieval, simple word processing, and spreadsheet applications. However, the application software is presented from a managerial perspective as:

(1) "what-if" analysis via spreadsheets,
(2) reports from data bases
(3) document "drafting" (word processing)

Format: The chief information officer of the University is currently teaching the course, which takes two half-day sessions to complete. The "issues" component is conducted in a seminar format, followed by a demonstration and lab practicum covering the three applications above. The demonstrations dramatize the power of the particular software so participants became aware of what can be expected of support staff who learn the new methods. Each practicum session starts with manipulation of prebuilt examples designed to illustrate the personal impact, relevance and speed associated with the technology.

Instructional delivery is fast, focused and intensive, attempting to strike a balance between conserving valuable managerial time and not overwhelming participants. A workbook was developed for class use. It combines short articles focused on background information about computers with a series of lab exercises and reference notes.

Follow-Up: All participants are made aware of the resources available to managers for follow-up instruction. These consist of four support categories:

1. Individualized one-on-one sessions, available by appointment with the chief information officer or any of the regular program instructors.

2. Assistance with specific questions or problems is available from either the micro consultant or through the telephone hot-line system. (These resources are available to all micro users.)

3. An "Executive Workstation" is now available on a one-month loan basis. This consists of a microcomputer configured with hard disk, installed software, a series of demonstration files and additional exercises.

4. Regularly scheduled classes in data base, spreadsheets and word processing are offered through the University micro support group.

Assessment

The class has been offered once as originally developed, to a group of managerial personnel. It was well received, and even more significant, half of the attendees later took the initiative to learn more about computers, signing up for regular classes and calling the "hot line" for assistance in using software in their offices.

The University President and his executive staff were also interested in attending a managers' session, but wanted their initial orientation limited to a single half-day program. Therefore, the lab component was reworked to limit the hands-on session to spreadsheets, the application most used by executives and thought to be of greatest interest to them. At the conclusion of the session, the President and several of his executive staff asked to return for the word processing and data base segments.

It is difficult to assess the impact of the issues component since the focus was on developing broader understandings and influencing values. Therefore, any impact will be long term, and difficult to identify. The hands-on component appears to be successful in overcoming personal hesitancy about getting started.

Conclusions:

A course designed and offered from a managerial perspective will attract its target audience. Based upon the follow-up activity that occurred after each presentation, the workshop succeeded in overcoming manager's hesitancy in approaching microcomputers. Unit managers responded to the class with a higher level of follow-up activity than that demonstrated by the executive participants, but even here the reception was positive and modest follow-up activity ensued. The initial success was sufficient to encourage us to repeat the workshop for other managers.

Development of the course and its related workbook took considerable time and thought. Overall, the project represents a significant investment of time to reach relatively few people. However, the small numbers represent a major audience - the University's managers. For any institution to reap maximum benefit from microcomputers, they should be understood by and used to support its managers. This project represents a first step toward achieving that ambitious goal.

PREPARATION OF A UNIVERSITY COMMUNITY FOR A NEW TELECOMMUNICATIONS SYSTEM

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A University owned and operated telecommunication system is being installed at the University of Michigan. The system includes the installation of a completely new distribution system (from the erecting of microwave towers to new voice/data outlets in every University facility) and new equipment and features for each University employee and occupant of University residence halls. All members of the University community will be directly impacted. The involvement of the members of this community in the development of such a system is critical to the ultimate acceptance and use of the system.

Major projects like this are becoming manageable from the viewpoint of technology, but all too often the human element is ignored or veiwed as a minor factor in the planning and implementation phases. This can create serious obstacles in the progress, or at the very least, failure to realize the full potential of the new system.

The University has taken major steps to address this area. Emphasis has been placed on adequately preparing and involving the University community throughout the project. Department coordinators were designated to aid in identifying communications requirements and in determining solutions. A variety of communication channels have been developed to facilitate information exchange concerning the impact and progress of the new system. University-oriented newsletters, tutorials, seminars and hands-on training video programs have been developed to educate the University community in the capabilities and use of the new system.

Increased user involvement is one of the most significant results of the rapidly changing technology for information resources and hence, one of the greatest challenges facing the higher education computing professionals in the next decade. The advances in microelectronics used in the information technology industry have made it economically feasible for virtually all end-users to become involved in attaining the goal of utilizing information resources more efficiently and effectively. Strategic planning is an integral part of any management function, but becomes more critical in this environment where so many are looking to the information technology professionals for leadership in coordinating and integrating this growth and involvement.

The Telecommunication System project at the University of Michigan is one initial phase of the overall strategy for providing integrated voice and data networks throughout and between the main campus in Ann Arbor and the two branch campuses at Flint and Dearborn. The purpose of the project is two-fold: to provide a university owned and operated telecommunication system with the latest technology in voice and data switching capabilities and to provide the foundation for an integrated data network through the installation of a completely new distribution system. The distribution system is a combination of four different transmission media: copper pair wire, coaxial cable, microwave links, and fiber optic links to provide present day efficiency and future growth and flexibility. New dual modular outlets for voice and data connections are replacing every telephone outlet in virtually every University facility on all three campuses. Each

University employee and each occupant of University residence halls is receiving new telephone equipment and features and the capability for high speed data transmission. All members of the University community are being directly impacted. The involvement of the members of this community in the development of such a system is critical to the ultimate acceptance and use of the system.

With approximately 27,000 telephone lines, it is one of the largest individually operated telecommunication systems in the country. The telecommunication host and remote switches being used are among the most sophisticated available and the allowances for potential growth and flexibility in both voice and data transmission and connectivity provide an awesome set of solutions and options for use plus the potential to include everyone. The project presents an opportunity for establishing and testing a management strategy for user involvement that could be a model for subsequent projects involving information technology.

Management of such a project requires not only the traditional technical expertise but also communication skills and marketing/public relations strengths. Major projects like this are becoming manageable from the viewpoint of technology, but all too often the human element is ignored or viewed as a minor factor in the designing and implementation phases. This is particularly important in the bottom-up "corporate culture" which exists in higher education and with a user base diverse in its level of knowledge and needs. This can create serious obstacles in the progress of the project, or at the very least, failure to realize the full potential of the new system.

The University of Michigan has taken major steps to address this. Emphasis has been placed in preparing and involving the University community with extensive information exchange and education throughout the project.

Early planning included the establishment of a telecommunication task force to assist an outside consultant conduct individual needs analyses for the three campuses and the Medical Center complex. These documents were central to the preparation of the request for proposal to vendors. The task force aided in the review of proposals received and participated in several site visits to vendors and designated organizations with systems in operation. Subcommittees for the voice, data, video, and security and environmental control areas were also formed with specialists from the various campuses participating. Each subject was reviewed and needs addressed in more detail at this level.

Once the preferred proposal was selected and recommended, a contract was awarded by the Board of Regents and the planning progressed to detail designing of the system. Deans, Directors, and Department Chairmen were asked to designate a telecommunication coordinator(s) for the department or group of departments they deemed appropriate to aid in designing and implementing the new system. These coordinators were selected based on knowledge of the department functions and communication needs and were expected to serve in this liaison position for approximately a two-year period. The attention and support of these coordinators from that level was essential to achieve the commitment and involvement necessary.

Ensuring valuable user involvement requires preparing these individuals and their constituency for their role in the process. A slide tape presentation describing the project - its purpose, selection process, capabilities and benefits - was prepared to introduce the coordinators and the University community to the new system. The presentation was given at campus-wide forums and in special sessions for the coordinators, and then made available to the coordinators for presentations to the staff of the units they represented. The slide tape format was chosen to maximize the coverage while minimizing the use of telecommunication staff resources. Copies of the presentation could be loaned independently of staff to interested groups or individuals on campus. For example, the Human Resource Development staff continues to use the presentation in their telephone communications skills class to aid in preparing employees for the transition to the new system.

This introductory slide tape presentation also continues to be shown at a variety of locations on all three campuses. These seminars are open to the entire University community in a continuing effort to make all individuals aware of the new system and its capabilities.

Individually designed presentations are developed for and given to special interest groups on campus as needed. Presentations are one of the most effective forms of disseminating general information to and responding to questions from a variety of groups and individuals.

Just as the University is a community of multi-interest individuals, and information technology at the University of Michigan exists in a multi-vendor environment, the marketing of the telecommunication system must involve a multi-media approach. The coordinators needed to develop a sense of trust and ongoing rapport with the individuals on the telecommunication staff. Therefore, individual instructors presented the next phase of information exchange: a seminar on telephone equipment and features available with the new system. Hardcopy handouts paralleling transparencies used in the presentation and supplementary handouts on rate projections and comparisons with the current system were made available at these early sessions. A tutorial on completing a telephone equipment inventory, necessary to design the new department-specific system, completed the session. By identifying all current equipment and its location, billing and special uses, the telecommunication office had current, complete information and the coordinator could begin to see the organizational needs and interaction that would be critical to designing and implementing the most efficient set of equipment and features for his or her department.

The data communication capabilities, while an integral part of the life of many of the telecommunication staff, was a new concept to many of the department coordinators and would provide an expanded set of options to those already involved. A tutorial on data communications and the corresponding survey of data equipment was the next milestone in preparing the coordinators and exchanging information. Many departments elected to designate a separate coordinator for data communications.

A hotline telephone number was established at the outset to provide a readily available and consistent source of timely answers to individual questions. This proved to be particularly valuable immediately following each of the previously described educational sessions. The more information is disseminated, the more questions arise.

The log of hotline questions proved extremely valuable to the telecommunication staff in identifying areas of lack of knowledge and areas of concern to the University community. Common questions became the basis for newsletter articles, memoranda, future presentations, and even for additional need analysis and subsequent searches for additional services to address these needs.

The written word is still one of the most pervasive and enduring media for information dissemination. Arrangements were made and interviews given for timely articles to appear in both external and internal publications. It is important for such outside groups as local residents, alumni, and potential hospital patients to be aware of the change and its benefits as well as the University employees.

Internally, a newsletter called Communication Lines was established at the time the contract was awarded and is published approximately every six weeks with major articles describing various aspects of the design and implementation stages, System Briefs for brief announcements, Coordinator Briefs for direct communication with the coordinators and frequently a question and answer section. These are routinely mailed to all Deans, Directors, Department Chairmen, and Telecommunication Coordinators and are available upon request to any University employee.

Major articles in the newsletter have included telephone feature descriptions, data connectivity capabilities, specifics of the new University Hospital switch to the new system and the data network at the School of Business Administration, and detailed descriptions of configuration meetings (where departmental equipment and features are determined) and the training program. Clip out sections have been included for such information as dialing instructions and new department telephone numbers for the new University Hospital.

To address particular needs of the University faculty, a series of eye-catching one-page memoranda called Communication Flash is being developed. These memoranda to be sent to all faculty will describe the benefits and capabilities of the new equipment and features for the telephone and data connections. Other informational handouts prepared include a telecommunication glossary, dialing instructions, information on patient phones, and sample applications for telephone features. These informational pieces are intended, in part, to assist the coordinators in soliciting specific needs of the various personnel within the department. Special request presentations and consulting sessions supplemented the written material for departments with particularly complex communication needs.

The main objective in training the coordinators is to provide them with enough knowledge to collect the necessary information about the department to make educated decisions regarding their telecommunication needs. The coordinator is sent a packet of information, a questionnaire, and a checklist to aid in final preparation for a configuration meeting with the telecommunication staff. It is during this meeting that the department determines what telephone equipment and features will be implemented and how data connectivity will be handled. A joint understanding of office functions and needs and the capabilities of the new system provide the best opportunity for each office or unit to realize the full potential of the new system.

Once the unit configuration has been determined, attention is turned to training the other personnel within the unit to ensure the intentions of the unit are carried out. An extensive hands-on training program was developed and is being made available to every University employee. The vendor contract stipulated that two training facilities be constructed on the campus with 30 stations each, to be equipped with the main types of telephone sets to be installed. A great deal of attention went in to the design of the training rooms to ensure a pleasant atmosphere conducive to learning and flexible enough to serve for current and future equipment training needs.

A multi-media approach was also adopted for the training program. University-oriented training materials were developed to stress the uniqueness of the system and to explain the rationale and benefits of the system to all members of the University community. Two standard hands-on training classes were designed - one for each of the two main types of telephone sets - and corresponding user guides were developed. With the volume of individuals to be trained in a limited timeframe, video tape with paused practice time for each feature was chosen as the main training tool. This ensured the the material was presented in a timely, consistent, and controlled manner. Three video tapes were produced with the help of one of the University communications offices. All filming was done on campus to instill pride in the system and to foster identification with it.

The training program consists of a main instructor to explain course objectives and content; two additional instructors to assist with hands-on feature practice and to answer questions; an introductory video to describe the system and its benefits and capabilities; a hands-on training video specific to the type of equipment being taught; transparencies with corresponding handout at each station which give directions for team practice of each feature during pauses in the video; a question and answer session; and time to complete a questionnaire. Certificates of completion are provided at the end of each class. Add-on training modules for special equipment or features were developed and are used with the standard classes as needed. A display table of all types of equipment used by the University is provided in each room.

Knowing that not all employees would attend a training class, other less formal educational opportunities are provided. Open sessions are designated weekly at the training rooms and employees are encouraged to come and experiment with the new equipment and to ask questions of the trainers. Twenty minute telephone briefings, where the introductory video is shown and equipment is explained, are scheduled in various auditoriums on campus. An information table is set up periodically at strategic locations, such as the hospital cafeteria during lunch, to display equipment and provide informational handouts.

On-the-job training aids were developed for use at one's own desk. In addition to the two types of user's guides, Quick Reference Cards are being developed. A University-specific faceplate with instructions for accessing frequently-used features was designed for personal line telephones and University-specific feature button designations are used on the electronic telephones.

The marketing strategic plan called for every University employee to have the opportunity to learn about the new telecommunication system and its potential and how to use the system in his or her role in the University. A University-specific, ongoing, multi-media approach to information exchange and education is necessary to accomplish this goal. Information technology staff must take on the role of facilitating, coordinating, educating and advising the entire University community in the use of new information technology to provide the most efficient and effective integrated solution to the needs of the University as a whole.

Managing a Major Urban University's Expanding Network

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Abstract

The Wayne State University Computing Services Center is rapidly implementing an integrated administrative and academic computing network which serves both the University and external computing communities. The network provides access to all central mainframe facilities and departmental minicomputers using both hard-wired and dial-up terminals. Remote dial-up access is available to the entire Detroit metropolitan area through a network of strategically placed multiplexor facilities and statewide through the Merit Computer Network. Access is also provided through public packet-switching networks and inter-campus electronic mail links.

This presentation describes the evolution of the network, details its present configuration, and offers plans for its future growth. Many issues related to the management of the network are discussed, including University commitment, management and staff participation, establishment of new services, user training and consulting, documentation, equipment acquisition, and coordination between the Computing Services Center and departments providing their own computing facilities. Two important components of the network management plan -- a Network Task Force and a Network Control Center, will be described. A subjective evaluation of the results achieved using these tools will be presented.

I. Computing at Wayne State

This paper deals with managing the expansion of Wayne State University's computing network. It begins by describing the computing environment at the University, the recent rapid growth of the network, and the management issues associated with this growth. It then describes two management tools which have been used successfully to address these issues: a Network Task Force and a Network Control Center. It continues with a description of the results observed through use of these tools.

A. Organization

Computing activities at Wayne State University are undergoing a process of centralization. A new position, that of Vice President of Computer and Information Technology, was created in mid-1985 to support this process. Wayne State is one of the nation's largest urban universities, with a student population of 29,000 and annual expenditures of $269 million. The eleven schools and colleges include a college of engineering, a law school, and one of the country's largest medical schools. In an institution of this size and complexity, computing is a very significant activity.

At this time, the Vice President has four functional units reporting to him:

- *Marketing and Development* is responsible for developing external computing business. External revenue totals 2.2 million dollars annually.
- *Academic Programs* is a newly formed unit responsible for developing institutional incentive programs to help integrate computing into the University curriculum. It is presently staffed by a former professor of education at the University.
- *Telecommunications Services* is responsible for implementation of the campus data and voice system.
- The *Computing Services Center* (CSC) provides the computing utility. It is responsible for mainframe services, the data network, microcomputer services and user support.

At this time, responsibility for development of new administrative systems rests under the Senior Vice President of Business and Finance. The CSC is responsible for operation of administrative batch and online systems, as well as for operation of the computing network which provides online access to the applications.

B. Computing Services Center

The CSC presently employs 86 staff members and has an operating budget of $7.4 million. There are four major departments which report to the Director:

- *Operating Systems and Communications* is staffed by systems programmers and is responsible for hardware configuration, operating system software, and communication software.
- *System Services* is responsible for the installation and maintenance of application programs and for system security.
- *User Services* is responsible for consulting, documentation, microcomputer support, and user training.
- *Computer and Network Operations* is responsible for mainframe operations, the MVS production environment, and the communication network.

Operating Systems and Communications and System Services are collectively referenced as "Technical Support" throughout this paper.

C. Computing Environment

The present computing configuration at Wayne State is shown in *Figure 1*. The CSC presently operates three mainframe systems:

- an Amdahl 470 V/8 with 16 megabytes of main memory running the Michigan Terminal System or "MTS." This machine principally serves academic and external users.
- A new IBM 3081 GX with 32 megabytes of main memory running MVS/CICS and CMS. This machine runs the University's administrative production systems.
- An IBM 4381 with 16 megabytes of main memory running CMS and PROFS, IBM's *Professional Office System*. This machine serves a mixture of academic and administrative users.

All three mainframes run under IBM's Virtual Machine (VM) operating system and are linked using IBM's RSCS and PASSTHRU products.

Both bisynchronous and asynchronous communication networks are supported. Bisynchronous access is provided through an

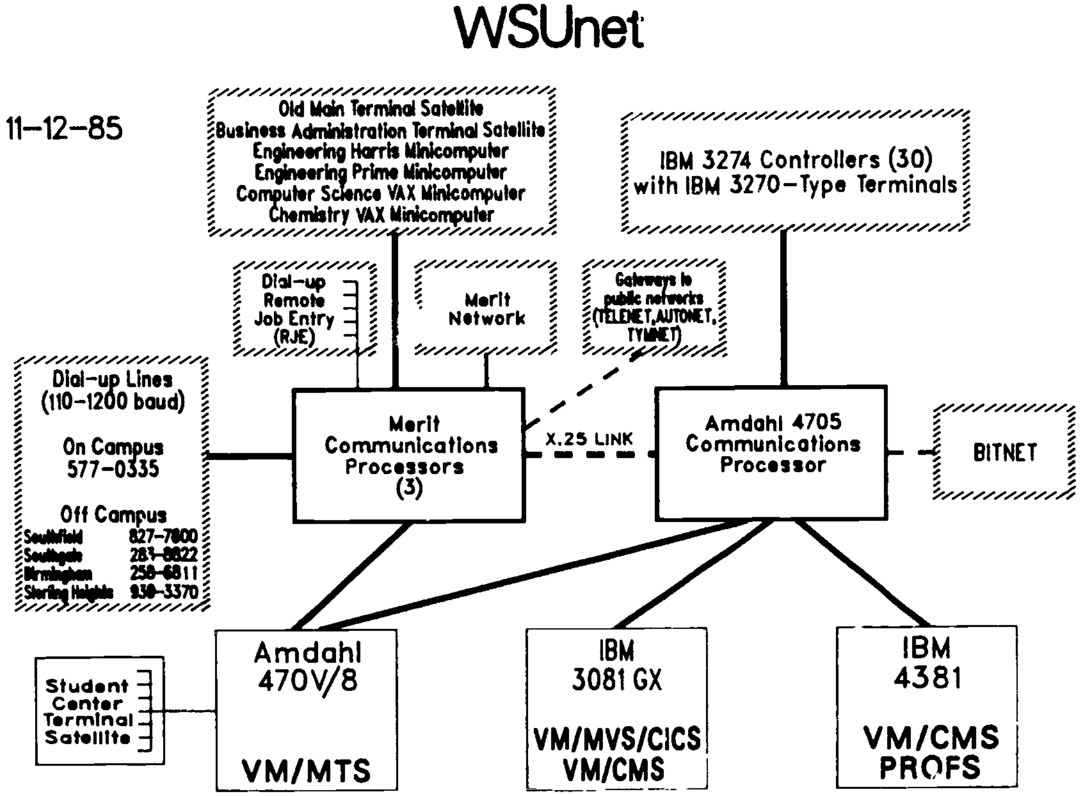


Figure 1. Wayne State University Computing Environment

Amdahl 4705 front-end processor. We have recently installed an IBM 3725 front-end processor which is presently being used to build the CSC's SNA network. The bisynchronous network presently supports approximately 30 local and remote IBM 3274 terminal controllers located on campus. These controllers provide network attachments for over 700 IBM 3178 terminals and personal computers.

Asynchronous access is provided through hardware and software developed by he Merit Computer Network, which is a consortium of Michigan public universities based at the University of Michigan. Our asynchronous network provides local dial-up numbers, additional dial-up ports throughout the Metropolitan Detroit area, private RJE stations, campus links to DEC, Prime and Harris minicomputers, and connections with Telenet, Autonet and Tymnet.

Local electronic mail is provided by the MTS message system and PROFS. Remote mail service is provided by MTS-net, Mailnet, ARPAnet, CSnet, and BITNET.

The Merit Computer Network provides access to mainframe facilities at the five major Michigan universities. Wayne State is presently the only member of the Merit consortium to provide access to all mainframe operating systems on campus. An X.25 link between the Merit processors and the Amdahl 4705 allows users dialing the asynchronous network to access all three Wayne State mainframes. We have installed protocol conversion software on this link to allow users with asynchronous devices to use our full-screen systems.

II. Growth of Computing

Wayne State's computing facilities have grown dramatically over the past two years. This growth has resulted in increased mainframe capacity, network coverage, greater geographic expansion, and the integration of services.

A. CPU Capacity

The CSC has installed three new mainframe systems within the last three years. We began with two Amdahl 470 V/6 mainframes in 1982, and are now looking to the installation of a fourth processor (or its performance equivalent) during 1986. *Figure 2* shows the installation schedule of our mainframe processors with their accompanying main memory capacities.

Linking our mainframes was a major step toward providing an integrated computing environment. An integrated environment was accomplished in two stages: first, IBM's VM operating system was installed on all machines. As part of this process, Wayne State was the first site to implement the MTS operating system under VM. Second, IBM's PASSTHRU software product was installed under VM on each machine. PASSTHRU allows users connected to one virtual machine to establish a link to another machine via a channel interface. This makes it possible for one terminal to be used for multiple applications. For example, administrative users connected to the IBM 3081 processor can quickly establish a link to our academic machine, and vice versa.

Technical Support staff are now working to migrate our network to SNA. SNA, or Systems Network Architecture, is IBM's single architecture for Data Communications Systems.

B. Communications Network

The growth of WSUnet over the past two years has been as significant as the growth of our mainframe capacity. We have migrated from a dial-up asynchronous environment to an integrated asynchronous and bisynchronous network, with the total number of ports rising from 270 to 890 during this time. **Figure 2** shows the growth of WSUnet in terms of available ports.

As part of our effort to provide dial-up access to all

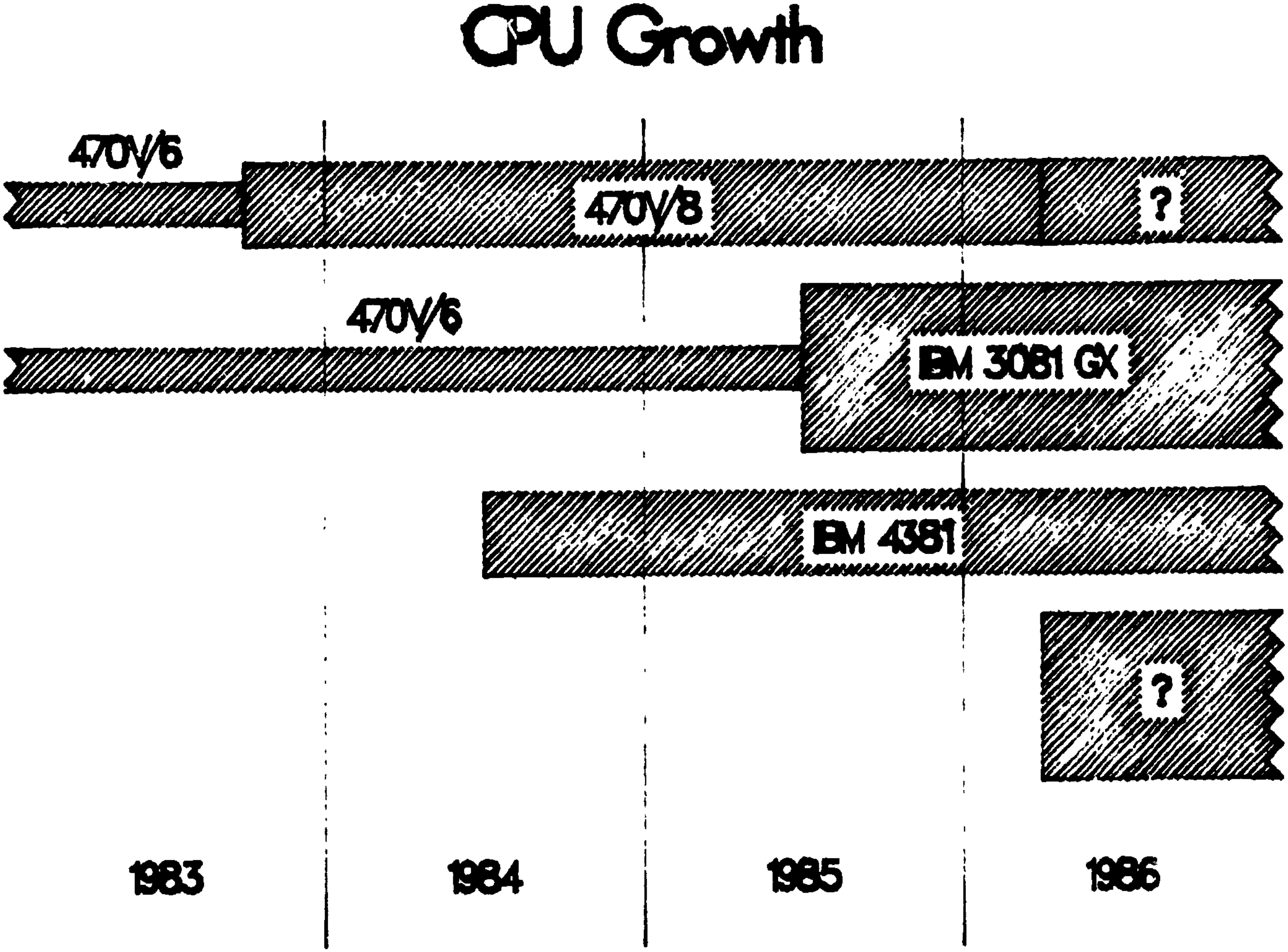


Figure 2. Growth of Mainframe Facilities

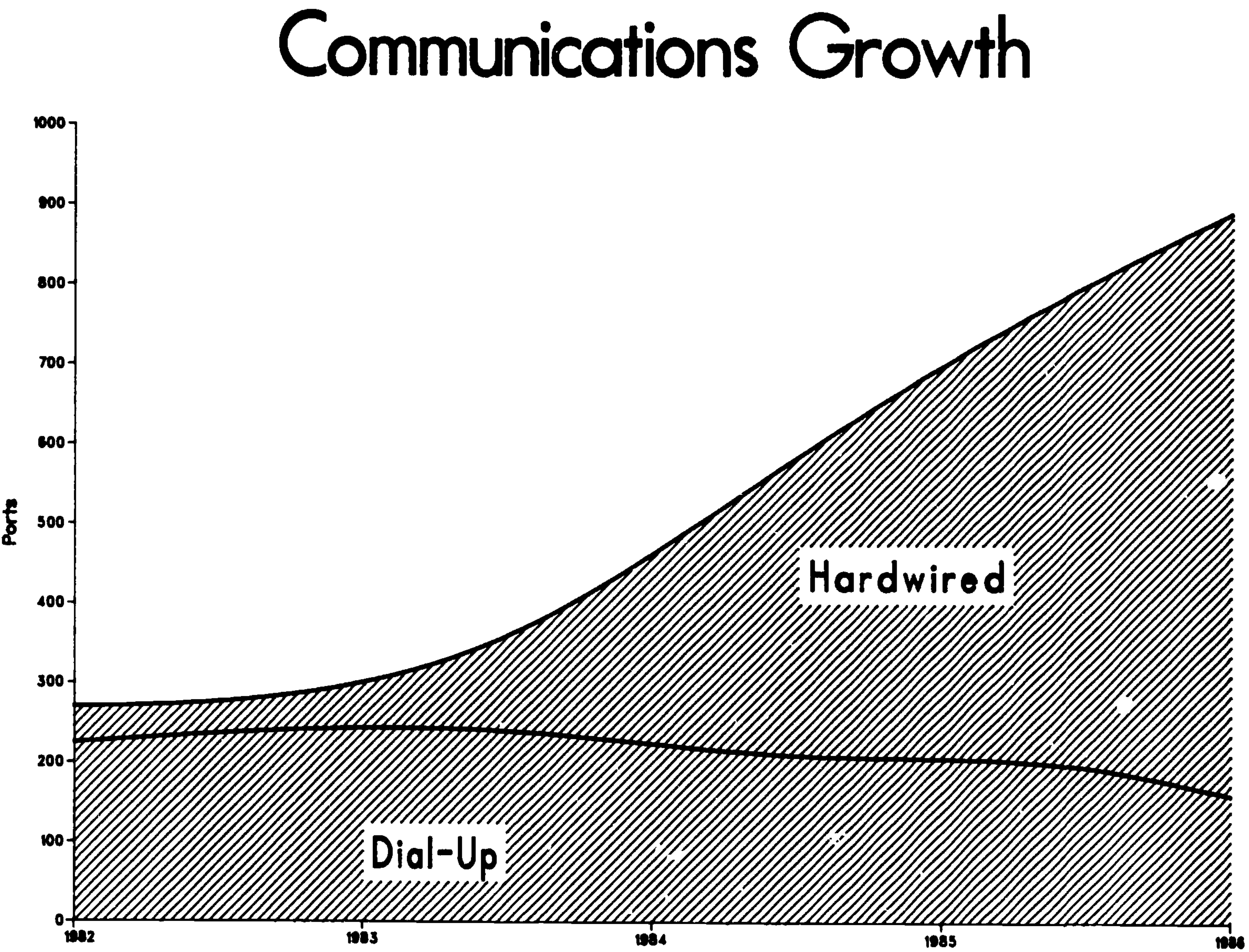


Figure 3. Growth of Communications Network

mainframes, we consolidated our asynchronous access methods using the Merit Computer Network. In 1983, for example, seven different campus dial-up numbers were used to access the various mainframe systems and applications. As of November 1985, only one on-campus dial-up number is used. This single number provides access to all three mainframe systems at 110, 300, and 1200 baud. 2400 baud access is presently being planned.

Much of the growth of WSUnet has been associated with the expanding bisynchronous network, which principally serves the University's administrative users. Our network services have been provided to coincide with new online systems acquired from Information Associates. The demands of the administrative user community differ significantly from those faced only two years ago, when most online access arose from academic users.

While WSUnet has grown rapidly and the size and composition of our user community have changed markedly, CSC staff size has been reduced from 131 in 1983 to its present level of 86. The reduced staffing levels and increased workload have been accomplished in spite of having to work with two locals of the United Auto Workers, the union which represents the University's technical, professional, and clerical staff.

C. Access to WSUnet

Wayne State is not a residential university. Students live throughout the Detroit Metropolitan area and commute to campus. Our graduate student population numbers over 10,000. The average age of a Wayne State student is 27, with the majority of students holding full time jobs and raising families. It was therefore very important for us to provide off-campus access to our mainframes.

The AT&T divestiture coincided with our decision to provide wide-ranging geographic access throughout the metropolitan Detroit Local Access Transport Area, or LATA. Working with the University's College of Lifelong Learning, the CSC has placed four terminal multiplexors at extension center locations throughout the metropolitan area. A fifth multiplexor is being installed now. Like our on-campus facilities, these multiplexors provide 110, 300 and 1200 baud access to all mainframe systems and applications. They have placed the University's mainframes within local calling range of approximately 4,000,000 people throughout the metropolitan area. The locations of these dial-up facilities are shown in *Figure 4*.

In addition to home access, a number of our graduate students use Wayne State mainframes from their businesses during the day. Students from other universities, such as the University

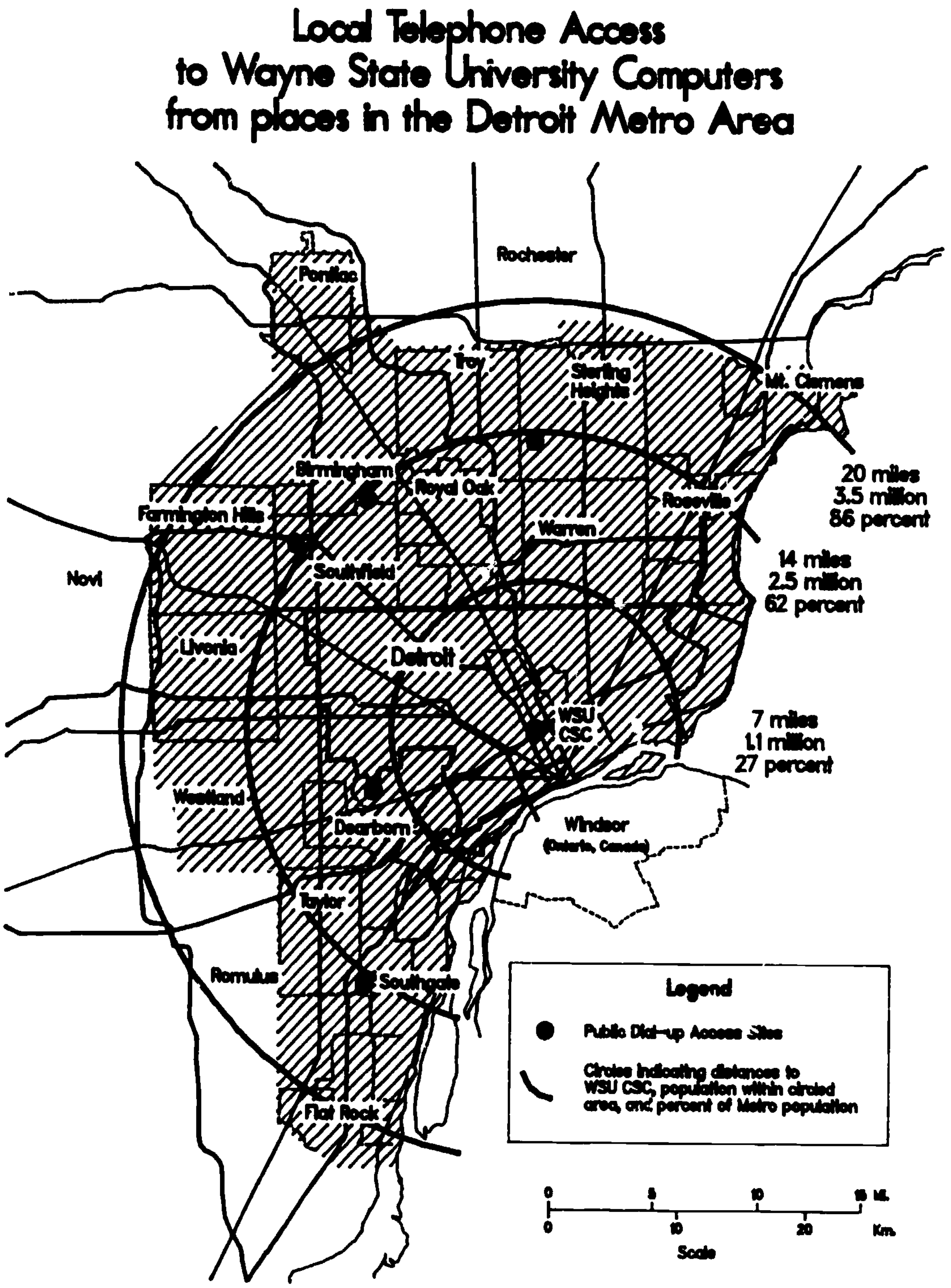


Figure 4. Dial-Up Access to WSUnet

of Michigan, access their campus mainframes through Wayne State dial-up ports. Furthermore, facilities provided by the Merit Network allow caller-paid connections to Telenet and other public networks. Over 40 networks are now available without value-added billing.

D. Merit Computer Network

As a member of the Merit Computer Network, Wayne State can also take advantage of dial-up facilities installed throughout Michigan by the Merit consortium. The areas serviced by Merit are generally associated with the campuses of the five universities presently linked by the network. Other dial-up facilities have been placed to serve remote extension programs and, in some cases, external customers of the various computing centers.

E. Integrated Services

As mentioned earlier, the CSC operates a communication network which provides access to both academic and administrative computing systems. We also provide service to a large number of external customers who access our systems through the public networks. The CSC chose to integrate its academic and administrative computing networks for a number of reasons:

- Hardware and software costs are lowered because the CSC supports a smaller range of front-end processors and communication software.
- Operating costs are lowered because system and network operators manage fewer operating systems and front-end processors.
- User training costs are cut because single training programs can in many cases address both administrative and academic users.
- University departments need only purchase single workstations to access both the administrative and academic systems. The stable environment also prepares them for development of local area networks and distributed computing.
- Standardizing operating systems and access methods helps the CSC remain current with operating systems and communication software. For example, despite our rapid growth, we are presently involved in several major conversion projects which include installing SNA, migrating our mainframe systems to XA architecture, and installing IBM 3480 cartridge tape drives.

- Our integrated network makes it possible to initiate new development projects. One example is the Detroit Area Library Network, or DALNET. DALNET represents a major commitment by the University to provide computing services to other public sector institutions in the area. This will be done by linking the Wayne State Library with the 28 branches of the Detroit Public Library (including two remote libraries which will use radio links to the network), 14 hospitals, at least two other universities -- a total of 55 library systems.

  The CSC will operate Northwestern University's NOTIS circulation system on an IBM 4381. Implementation has begun with full implementation scheduled for the fall of 1987. Because terminal access will be through WSUnet, all terminals which can access NOTIS will be able to link to the other mainframe computing facilities of the University. DALNET represents the first library network in the country shared by multiple segments of the public sector.

III. Management Issues and Tools

The rapid growth of WSUnet over the past two years created a variety of new management issues which needed to be addressed. The issues seemed to fall into two areas: planning and service.

A. Network Planning

Planning management and service management require different approaches. Planning is a very dynamic process which requires input from all CSC departments. The level of planning activity varies widely over time, and planning decisions need to be made quickly and accurately. For these reasons, we decided to approach the planning process by utilizing a task force model.

Task forces are suited for managerial situations in which a wide range of expertise is needed to solve specific problems. The lack of bureaucracy which is characteristic of a task force provides an environment in which decisions can be made quickly. As a task force carries with it no departmental "turf", there is little contention among the participants. A task force differs from a committee in its formal authority, short-term existence, and (in many cases) the results it achieves.

Prior to the initiation of the task force, the planning processes did not involve all operating departments of the CSC and did not take into account the wide range of concerns which the task force addresses. There were several factors which indicated the need for a Network Task Force:

- WSUnet was growing at a very rapid rate. We recognized that we needed to control the growth of the network or the increased demands of users for network connections would control the CSC. Furthermore, the growth placed the CSC in a position of high exposure on campus.

- The University had made a commitment to office automation on campus by making a pool of matching fund monies available for acquiring workstations. While this was a positive move, the program could not be administered effectively without a corresponding commitment to network planning by the CSC.

  Several departments submitted requests for matching fund monies but were not originally slated to receive terminal controllers. And, of course, several departments originally scheduled to receive controllers did not apply for matching funds to acquire new workstations. In addition, several departments changed leadership during the planning phase, and as we all know, some leaders are more equal than others and can affect the planning process on short notice. These discrepancies required that controller installation schedules be checked frequently and rigorously.

- Several CSC departments were making commitments to University units for network resources and personnel time. Since there was no central person or group acting as a clearinghouse for commitments, both hardware and personnel resources were being overcommitted. There was constant political pressure to reallocate resources in an effort to solve these problems, but it was not possible to cover all commitments in a timely fashion.

- Furthermore, there were cases in which more than one CSC department worked with the same unit to develop office computing plans. Because of the different orientation of the various CSC departments, these plans often conflicted in both approach and configuration. Aside from the obvious confusion, the political price associated with these incidents was very high.

- A final impetus for creating the Task Force was the lack of departmental coordination. Each of the CSC departments plays a role in the future of WSUnet. These roles, however, often overlapped or were not clearly defined. As a result, departments occasionally had conflicting priorities. Effort was duplicated in areas such as workstation evaluation, microcomputer software selection, user documentation, consulting, and training.

B. Network Service

While the conditions surrounding the network planning process indicated that a task force would be an appropriate solution, those surrounding the provision of network services indicated another approach. Because network services needed to be characterized by responsiveness and coordination, a more formal management approach was indicated. However, no existing CSC function was able to offer the service needed to support the network. A new service unit called the Network Control Center was created.

The need for a Network Control Center was first discussed in the summer of 1984. The Network Control Center emerged as a service requirement due to a number of factors:

- The CSC was supporting complex networks. The coupling of a non-standard asynchronous network with a rapidly growing bisynchronous network presented a challenge in effective management. The CSC experiences heavy network traffic from the Merit Computer Network and from the commercial data networks. In one recent month, users from 47 states used CSC systems. We realized that we could not achieve our goal of inexpensive, reliable access for our users without providing specialized network services.

- The CSC was supporting multiple systems. We operate an integrated network which allows a user to access all systems using the same terminal. The use of PASSTHRU created a truly "virtual" communications environment which made problem tracking more difficult. The use of Simware's SIM3278 product for protocol conversion increased the number and variety of terminal devices which could access the systems. The problems encountered in using these packages were beyond the scope of past experience and required special attention.

- We set specific goals for availability and reliability. These goals were consistent with our charge of providing the computing "utility" to the campus. We view ourselves in much the same way as an electric or telephone utility: users expect computing services 24 hours per day, 7 days per week, and expect good response time and system stability. In our environment, network stability is as important as operating system stability. We recognized that our staff was not prepared to respond quickly and effectively to network problems. We also recognized that network services needed to be provided whenever the mainframe systems were available, not just during business hours.

- A direct result of improved system availability and reliability is increased user satisfaction. But it was also important to provide a higher level of user support to our customers. We wanted network problems to be handled in an efficient, business-like manner. Prior to the creation of the Network Control Center, problems were addressed haphazardly. Network knowledge was scattered among a number of staff members, and there was little coordination between departments. If one key staff member was out of the office or on vacation, problems often "disappeared."

- Our final goal was to provide users with a central point of contact for network-related problems. This addressed the need for centralized record-keeping and efficient problem routing inside the CSC. Prior to the creation of the Network Control Center, users were frequently passed from one person to another, often without problem resolution. Our technical staff were inundated with inappropriate calls. In one instance, a terminal controller was powered off so an employee could plug in a fan. Due to inadequate procedures, a systems programmer spent time resolving that particular problem.

IV. Network Task Force

The Network Task Force is Wayne State's tool for managing the network planning process. The task force represents an integrated approach to problem-solving which does not lie within the domain of any single CSC department.

A. Task Force Composition

Implementing the Network Task Force was simple and straightforward. Every CSC department was already involved with WSUnet so it was logical for each to have one or two representatives. The Task Force has a total of seven members, including the CSC Director who functions as group leader. His participation has been one of the most important factors in the success of the Task Force. His presence gives the group the authority to make decisions and to establish policy. A second important factor has been representation by technical staff and management. This ensures that both technical and managerial considerations are discussed before a decision is made.

B. Task Force Responsibilities

Members of the Task Force are responsible for developing policies and procedures related to networking and workstations. These range from a policy for the acquisition of computing equipment to a procedure for attaching devices to WSUnet.

Several units, such as the CSC, Purchasing, and Physical Plant, provide services which affect the network. Policies and procedures define these services. They also define responsibilities for departments acquiring and attaching equipment to WSUnet. For instance, these departments are responsible for maintaining the terminal devices attached to the network. The CSC is responsible for installing and maintaining everything up to and including the cables attached to the device.

As part of developing policies and procedures, the Task Force members evaluate and select the hardware and software which can be purchased without special justification. Our goal is to have multi-function workstations which can be used with all systems. We have made the assumption that a microcomputer or word processor purchased now will eventually be connected to the network. We want to be sure that it is compatible and that it will allow users to be productive. We believe that if we don't place restrictions on what can be purchased, we will pay a price for years.

The Task Force is responsible for identifying the network training needed by staff and users. The appropriate CSC departments actually design and implement the training programs. Several of the Task Force members also meet with unit representatives to help them define their computing needs and plan accordingly.

The Task Force coordinates network installation. This begins with setting priorities for controller locations and determining a schedule. One member monitors the status of the controllers, leased lines, modems, cabling and electrical work. This person coordinates the efforts of the vendors, the telephone companies and the electricians in order to meet completion dates.

Finally, the Task Force plans and controls the network's expansion. They estimate how many controllers will be installed in the next few years and determine where they should be located. They help prepare budgets; and, with network expansion in mind, they plan the modifications and additions to the CSC's communications hardware and software.

C. Problems Encountered

The Network Task Force has encountered a few problems in implementing its plans. It is not surprising that the major problem is political in nature. There are political implications associated with determining the order in which departments receive controllers. As on other campuses, Wayne

State has some departments which are more influential than others. This influence has to be taken into account.

University priorities have to be considered and when they change, the installation schedule has to be modified accordingly. This has a ripple affect which can impact the entire installation process. Another problem resulted from confusion related to University procedures. In many cases, it was not known what the procedure was or whether one existed. As described earlier, the Task Force wrote procedures which clarified numerous situations.

Frustration is frequently experienced in working with non-CSC departments and companies which are involved in network installation. For instance, we cannot control the length of time taken by the telephone companies to install a leased line. Since the divestiture, more than two months can elapse before one is installed.

The University's Physical Plant is another source of frustration. This unit strings the coax cable. When the Budget Office needed to have a local area network wired, Physical Plant provided an estimate of $8,000 to do the work. Electronics technicians from the library did the actual work for $400.

We also contend with vendors who convince people that they need hardware which is not on the CSC's approved equipment list. One smart vendor decided to start at the top. Wayne State now has a word processing system in the President's Office which is not on the approved list. This system became a headache for the CSC once it was connected to the network.

D. Results Achieved

In spite of these problems, the Network Task Force has been a very successful tool for network planning at Wayne State. Network goals and tasks are more clearly defined and are known to more people. Hardware and personnel resources are being utilized more effectively and staff feel less frustration because they are pulled in fewer directions.

Cooperation between the CSC and other University departments has improved as a result of working out inter-departmental policies and procedures; and, having procedures in place has helped the CSC to operate more professionally. Staff know their network responsibilities and can respond to user inquiries with more information as well as greater confidence.

Users are gaining more knowledge about networking and workstations and are becoming more comfortable with computer technology in their environment. As a result, they are using more of our computing resources.

There are also political advantages which have resulted from better planning. Having a comprehensive network plan has allowed us to modify central administration's perceptions of the network. This has resulted in additional monies for network expansion.

V. Network Control Center

Wayne State's second network management tool, the Network Control Center, addresses network services. The Network Control Center has two components: a Network Control Desk and Network Operations. These components have different responsibilities and are staffed by people with different qualifications.

A. Network Control Desk Responsibilities

The Network Control Desk provides the "front-line" contact for users experiencing network problems. Control Desk staff receive calls and identify problems. Whenever possible, they reproduce them using the tools at their disposal. If a problem is diagnosed as network-related, they invoke first-level problem determination procedures. Staff are also responsible for logging incoming calls, maintaining system status messages, monitoring the status of all network lines, and interfacing with the CSC's problem management coordinator.

Another important function is working with WSUnet "site administrators." Each terminal controller located in a campus department has a staff member from that department who acts as the site administrator. The CSC assists in selecting this person. The site administrator is trained to work with Network Control to help diagnose terminal or controller problems and reload the controller if necessary. They also serve as focal points for information disseminated by Network Control, and help train other staff who use the controllers.

B. Network Operations Responsibilities

Network Operations staff are responsible for operating the hardware and software components of WSUnet. This includes operating the front-end processors, terminal controllers, and the asynchronous and bisynchronous communication software. They perform second-level problem determination for problems which the Network Control Desk cannot solve.

Other responsibilities include configuring the network and working with system operators and Technical Support staff to resolve problems with hardware or system software. Problems which Network Operations cannot solve are forwarded to the Technical Support staff for third-level problem determination.

C. Organizing for Network Control

The first planning issue addressed was the Network Control Center's placement within the CSC's organization. Two departments were considered: User Services and Operations. We decided to place the Network Control Center in Operations. This department's name was changed from Operations and Control to Computer and Network Operations to reflect the addition of the Network Control Center.

It took CSC management approximately 4 months to decide that, for Wayne State, the Network Control Center would be most effective in Operations. This decision was contrary to the model many organizations are following.

1. IBM Model

The model proposed by IBM is, perhaps, the most common one. In this model, users do not contact network operators, system operators or Technical Support. They have one point of contact which is the "help desk." We did not believe that this would be the most effective model for our organization. If we had chosen it, we would have incorporated the Network Control Center into the existing User Services consulting function. We felt strongly, however, that the Network Control Center should have close ties with operations. By placing the Network Control Center in the computer room, we could staff it 24 hours per day, seven days per week by cross-training system operators. We concluded that having close ties to operations was more important to us than having one point of contact.

2. WSU Model

The CSC, therefore, has two points of user contact, the Network Control Center in the Computer and Network Operations Department and the Consulting Desk in the User Services Department. The Network Control Center is charged with resolving problems in accessing WSUnet. The Consulting Desk is charged with solving problems in using the operating systems and applications. In other words, Network Control helps users get to the systems; Consulting helps them once they get there. In our model, users do not contact the system operators or technical support staff. There is, of course, no right or wrong

IBM Network Control Model

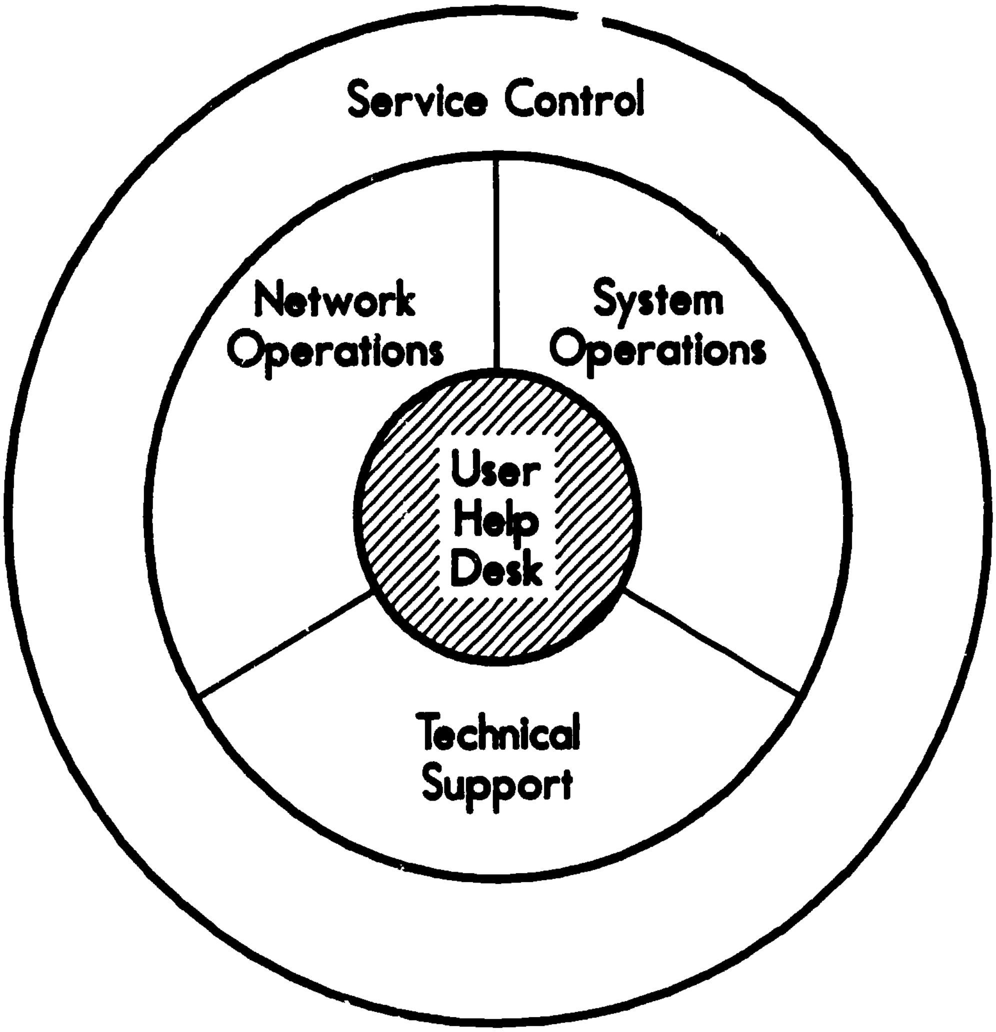
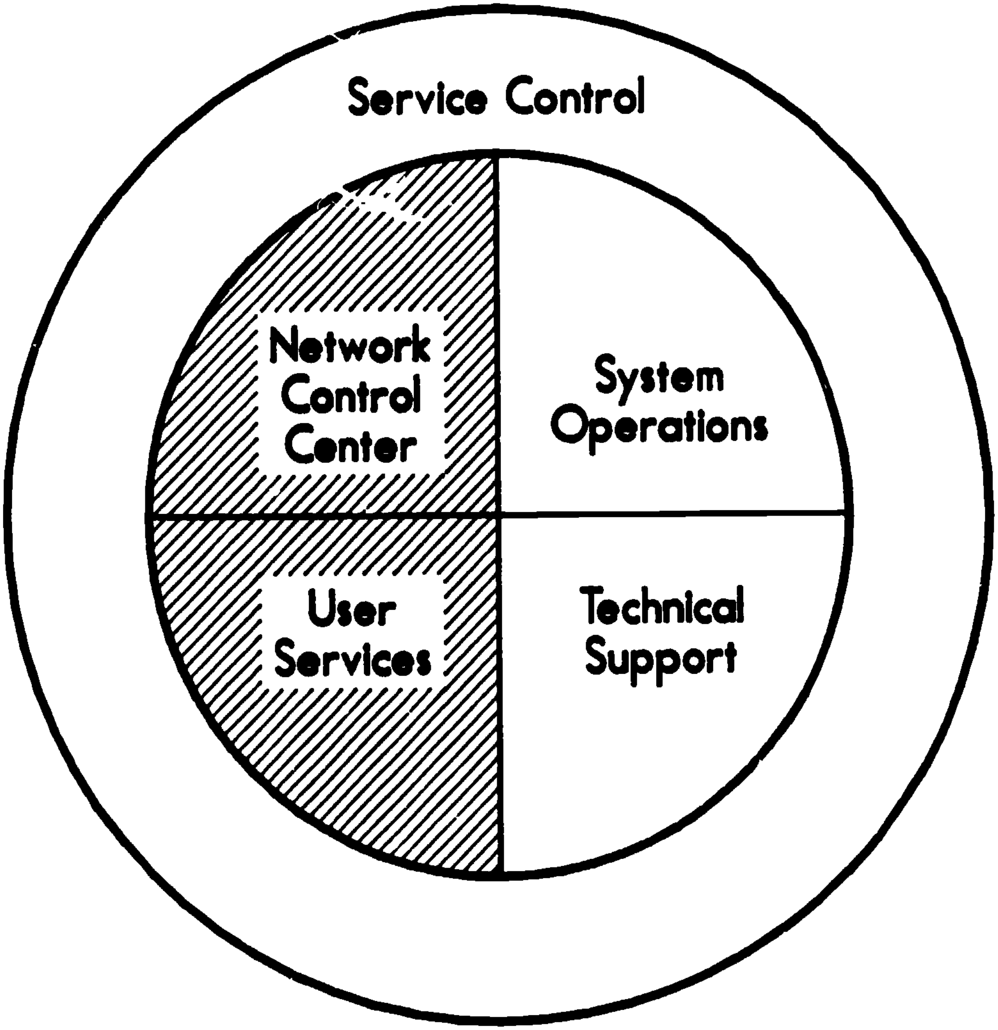


Figure 5. IBM Network Control Model

WSU Network Control Model

Figure 6. WSU Network Control Model



location for a Network Control Center. Each organization should place the Network Control Center where it can be most effective in managing the network and most responsive to the users.

D. Planning for Network Control

Computer and Network Operations management formed a task force charged with establishing the Network Control Center. The task force included representatives from all CSC departments and vendor consultants. These people determined the duties which the Network Control Center staff would perform and selected and ordered the appropriate tools. They also participated in training the staff and planned the integration of the Center into the CSC.

Computer and Network Operations management selected the Network Control Center staff from within the department. No additional staff were hired. A data entry operator and a secretary were chosen to be Network Control Desk operators. Both people have good communication skills. A senior computer operator was selected to head the Network Control Center as network operator.

E. Training for Network Control

The Network Control Center has been successful as a network service tool because we invested time in management, staff and user training.

1. *Management Training*

Management training was very important and was accomplished by attending network courses. Representatives from all CSC departments attended problem and change management courses and made several site visits.

2. *Network Control Staff Training*

Training was critical for the Network Control Center staff. Technical Support staff and vendor consultants gave in-house presentations. On-the-job training was the best technique with the Technical Support Department providing considerable assistance in the early stages.

We had weekly meetings between Network Control and Technical Support staff in which the problem sheets from the previous week were discussed. Solutions were examined as well as alternate actions. We also ordered self-study courses which included PHOENIX computer based training.

3. *Consulting Staff Training*

Training for the User Services consulting staff focused on understanding the role of the Network Control Center and on developing working relationships with Network Control Center staff. In joint staff meetings, we stressed having a consultant or Network Control Desk operator "own" a problem. With two numbers which users can call for help, we don't want a user passed back and forth because everyone believes the problem belongs to someone else. We used role-playing to reinforce good practice in working with users. The self-study courses have also been available for the consulting staff.

4. *User Training*

User training is on-going. We use newsletter articles to help them understand the roles of the Network Control Center and Consulting. We also provide orientation sessions for site administrators on a regular basis. These sessions will give them a chance to meet the Network Control Center staff, tour the facility and become familiar with the tools and procedures used by Network Control. In addition, we offer a seminar on attaching microcomputers to WSUnet and are planning a seminar on networking fundamentals.

F. Problems Encountered

The problems which the Network Control Center has encountered have stemmed from two primary sources: a non-standard environment and rapid growth. The non-standard, or non-SNA, environment has made it more difficult to acquire hardware and software for network control. It has also made it difficult to find formal training for the Network Control Center staff. SNA courses are available for management and network operators; but, we have not found courses designed specifically for network control desk operators.

Rapid growth can cause problems in any environment and ours is no exception. Again, one of the areas affected is training. As the network grows and more people are exposed to computing, user training becomes a larger task; and, as the computer room environment changes and conversion projects are completed, staff training becomes more time-consuming.

G. Results Achieved

These problems have only kept us from realizing the Network Control Center's full potential as quickly as we would like. They have not kept us from achieving very positive results.

1. *Improved Services*

Better network management provides immediate access to current network information. This allows us to respond to problems more quickly. Fewer problems are lost on someone's desk since we have improved our problem management. It is much easier, now, to track a problem. By examining problem sheets written before and after the Network Control Center was established, we can see that problems are being resolved much faster, often in minutes instead of hours. Faster problem resolution results in greater network availability.

Planning and implementing the Network Control Center have increased communication between CSC departments and between the CSC and network users. And new policies and procedures have helped us to operate in a more business-like manner.

2. *Increased User Satisfaction*

We were made aware of increased user satisfaction immediately since they were more vocal, for a change, in their praise rather than their criticism. They appreciate having one point of contact for network problems as well as knowing the telephone will be answered at all times. Their frustration is reduced because someone assumes ownership of their problems and because downtime is decreased. This increases their productivity.

3. *Increased Staff Satisfaction*

We began to see increased staff satisfaction within two months. Technical Support and User Services staff receive fewer network calls since these are now focused on the Network Control Center.

Computer and Network Operations staff have been cross-trained to establish the Network Control Center without additional personnel. Although this has increased the work load, they are pleased with the additional knowledge and skills. The Network Control Center has also introduced new positions. As a result, we have begun to develop career paths for operations personnel.

Conclusion

This paper has described Wayne State's computing environment, WSUnet's rapid growth and the network management issues addressed. It has also presented the Network Task Force as a network planning tool and the Network Control Center as a network service tool.

It is important to recognize that these tools can be implemented and can be effective without large capital expenditure and without additional human resources. We believe these management tools have positioned us to respond effectively to the rapid growth of Wayne State's large urban network. We anticipate orderly growth in the future as a result.

Improving User Support by Establishing a Customer Service Center
OR
Have a Problem? Call the Help Desk!

Judith Hagen DiMarco
Marist College
Poughkeepsie, New York

A simple strategy for improving user satisfaction is the establishment of a Customer Service Center, or Help Desk, within the data processing department. A Help Desk provides users with a single service facility for two way communications about problems, complaints, questions, service status, downtime, user education, documentation, and other information. The Help Desk can service all center users, whether administrative, academic or other, and provides data processing with a central repository of information regarding all aspects of DP Services.

This paper describes the concept of the Help Desk, including purpose and functions. It discusses the experience of one institution in establishing the facility, including staffing, organization, and benefits. It also gives readers "Helps for Establishing a Help Desk".

Improving User Support by Establishing a Customer Service Center

> Probably the most important management fundamental that is being ignored today is staying close to the customer to satisfy his needs and anticipate his wants. In too many companies, the customer has become a bloody nuisance whose unpredictable behavior damages carefully made strategic plans, whose activities mess up computer operations, and who stubbornly insists that purchased products should work.
>
> --Lew Young, Editor in Chief, *Business Week*

It sounds painfully familiar. Managing user relations (or user satisfaction) is one of the most difficult challenges faced not only by information managers in our business, but the world over. High demand and expectations of users, a shortage of resources, the rapid pace of technology growth, long lead times needed for equipment planning and systems development, constantly changing requirements of users and state and federal agencies, technological obsolescence, communication problems, not to mention interpersonal problems, contribute to the challenge. Users are more knowledgeable of and more involved in computer operations than they were 10 years ago. Alternative sources of information services including micros, outside time sharing vendors, systems development and programming consultants, and easy to use off-the-shelf software offer new solutions to user needs--and competition to the traditional DP function. Effective user relations is essential if our business is to continue.

But how can we improve (or even begin to concentrate on) user relations? One simple strategy which addresses this issue is the establishment of a Customer Service Center, or Help Desk, within the data processing department. This paper will describe the concept of the Help Desk, including purpose, functions, and benefits to both users and the DP department.

Purpose of a Help Desk

A Help Desk provides users with a single service facility for two way communications about problems, complaints, questions, service status, downtime, user education, documentation, and other information. The Help Desk can service all DP users, whether administrative, academic or external, and provides data processing management with a central source of information regarding use of and user reaction to all aspects of DP services.

Functions of a Help Desk

A Help Desk can serve a variety of functions depending on the needs and organization of the data processing department and the users. A description of the basic functions of a Help Desk follows.

First Line Problem Determination. A Help Desk provides a central contact point for users of DP services. The Help Desk staff can receive problems and questions, and can provide solutions/answers without interrupting programmers or other technical staff. If a question/problem is beyond the scope of Help Desk expertise, the Help Desk staff member can work with the user to fully understand the problem, can identify the area or individual on the DP staff who would be most appropriate to deal with the issue, and can pass on the problem in a timely fashion.

Information Resource. The Help Desk provides a centralized information repository for all documentation, periodicals, manuals, schedules, etc. This resource can be accessed by users and data processing staff. A centralized information facility, if managed well, can eliminate duplicate information and reduce costs (i.e.; multiple DP staff receiving the same periodical; rewriting documentation that exists but can't be found). The information function can, in fact, go beyond paper information. The Help Desk may have access to various on-line networks and/or bulletin boards, and may be able to network people at the same institution with the same interests together.

Handling Complaints. Effective handling of complaints can increase user satisfaction substantially. The most important step in handling complaints is listening -- all the way to the end without interrupting. Help Desk staff must be good listeners, and must be able to separate the *content* of a complaint from the *feelings* a user is expressing. As a "user advocate", a Help Desk staff member can be the user's partner. By dealing with specific content, and helping the user to clarify his or her request, constructive action can be taken. If there is no request; the user is simply expressing anger and/or frustration, the Help Desk staff can provide a place to "ventilate" and can log the incident(s) which provoked this reaction.

Logging calls and Producing Reports. All calls received at the Help Desk must be logged. The minimum amount of information recorded should include date, time, initials of the Help Desk staff member who took the call, identification of the caller (area or office, name of caller and/or account code), caller's phone number (for follow up), brief description of the problem. Other useful information may include status of the problem (open or closed), type of problem (request for documentation, programming problem, communications problem, etc), initials of the resolver, brief description of the resolution, date of resolution, time used solving the problem. Management reports can be generated periodically from this data. It is useful to identify the specific reports that will be useful to managers prior to designing the form or data base that will be used to log calls.

Follow up. This is a simple yet extremely effective method of improving user relations. DP staff often gets caught up in solving problems, and never gets back to the user to inform him/her of changes, solutions, or simply to see if the problem has been solved from the users point of view. The Help Desk can provide this often missing link.

A Case in Point - Establishing a Help Desk at Marist College

Marist College is an independent co-educational liberal arts college located on the Hudson River in Poughkeepsie, New York midway between New York City and Albany. The institution was founded by the Marist Brothers and chartered as a four year College in 1946. In 1969, ownership of the College was transferred to the Marist College Educational Corporation with an independent Board of Trustees.

Marist is tuition intensive with a large proportion of revenue provided by sponsored programs. The 100 acre campus accommodates 3450 full-time equivalent (FTE) undergraduate students and 425 FTE graduate students.

The Marist Computer Center organizationally falls within the aegis of the Vice President for Administration and Finance. The Center provides all computer support for both administrative and academic users at the College. Current computer center staff consists of 15 FTE professionals and 50 students. Administrative users utilize in-house developed systems written in APL and operating in the MUSIC environment under VM on a 4341-L1. Academic users utilize various facilities in the MUSIC as well as CMS environments under VM on a 4341-P12. A software package called SSI (Single System Image) produced by Adesse Corporation provides communication between the two CPUs and makes the hardware environment transparent to the user. Approximately 100 IBM Personal Computers are distributed in administrative and academic areas around the campus.

Why a Help Desk was Established

In 1984, the College received a $4.5 million equipment gift from the IBM Corporation to support academic computing. The 1984 gift tripled the hardware and software resources managed by the computer center. Prior to receipt of the gift, the service environment was one where the user who screamed the loudest (or knew the most staff to call) got service. There was no centralized clearing house for calls or problems; in fact, the staff on occasion would literally run into each other while trying to solve the same problem for the same user. It was recognized that with the addition of new equipment and facilities, hence new users, the center could no longer operate in this fashion if it was to be effective in serving users.

General Description of the Facility and Function

A User Support Specialist (USS) was hired to establish a Help Desk. The USS reports directly to the Director of User Services. The Help Desk is located at the front of the User Services office area and is a desk with a phone and an IBM 3290 (4 available screens) terminal. The desk is open between 8:30AM and 5:00PM and accepts calls from all users; administrators, staff, faculty and students (although students are primarily supported by student aides in the labs). Calls are logged on either paper forms or through full screen entry into an SQL (Structured Query Language) database using DBEdit. The paper form (or printed panel) is passed on to the resolver who returns it to the Help Desk when the problem has been resolved. Information from the paper logs is entered into the database, and reports are generated on a monthly basis using QMF (Query Management Facility).

During the course of it's development, the Marist Computer Center Help Desk has been responsible for answering user calls, solving problems (whether at the Help Desk or through another DP staff person), handling complaints, providing information and/or documentation to users, organizing and maintaining a library of manuals, documentation and periodicals, writing documentation, conducting one-on-one training sessions with users, distributing the Newsletter, calling users regarding unscheduled downtime, scheduling special facilities, managing academic accounts, and coordinating problem tracking and change management throughout the center. The job of the User Support Specialist is a difficult one; in eighteen months we have had three different people in the position. We have discovered that, although the ideal situation is to have one person answering the phone, responsibility for phone work can be distributed as long as ONE person is responsible for making sure problems are resolved, complaints handled and follow up calls are made. We also discovered that the responsibilities and the tasks of the User Support Specialist must be well defined if the person in the job is to be effective. (See Appendix A - Performance Standards)

Helps for Establishing a Help Desk

Identify the specific responsibilities of the person responsible for the Help Desk. The job can become a "catch-all" -- or more often a dumping ground for tasks no one else wants to do. Be sure the individual, the users, and members of the DP staff are informed as to the function(s) this person serves.

Select the right person for the job. The person responsible for the Help Desk must have good communication skills, ability to organize, ability to supervise, and patience. Some technical background is useful; however, this should not be a primary requirement for the position.

Clearly identify the reports that will be produced from the phone log data. The phone log provides a wealth of information regarding chronic and occasional problems, requests for information, complaints that users have. Managers can use this information to identify trends in user needs, critical and/or chronic problems, users who are experiencing difficulty. It can be used as a planning tool, and as a evaluation of "how well we're doing" in meeting service standards and satisfying users. The manager(s), however, must be responsible for identifying what they need, in what form, and how it will be used.

Train the person responsible for the Help Desk. A structured (or at least organized) training program is important. The person responsible must have a clear idea of what is expected of him/her, be familiar with the users system(s), and have some opportunity to work with each DP staff person during the training period. Help Desk staff members must also have a clear idea of computer center and college policies and procedures.

Maintain clear and useful Help Desk documentation. In other words, make sure the person at the phone has knowledge of (and easy access to) information and resources which will help them solve problems. If the person at the phone has to leave the phone to find information for users after every call, the Help Desk will not an effective customer service center.

Support the person responsible for the Help Desk. Each member of the DP staff should spend one day a month at the Help Desk. Not only does this give the individual responsible a "break" from the phone, it brings DP staff closer to the user. It's also a useful training tool in that DP staff learn to relate to users, and person responsible for the Help Desk almost always discovers some "private knowledge" of the system or facilities that is possessed by each DP staff member. This arrangement also allows DP staff members to see first hand the enormous service the Help Desk provides to them.

The Benefits

The primary benefit of a Help Desk is improved user service and user relations. Channeling service calls through a Help Desk provides a central log of user problems and complaints. Items don't get "lost". Problems can be followed up and resolved more efficiently. Having a central place to call is less frustrating to users than being shuffled around from place to place, or trying to get answers themselves. It is less disturbing to the data processing staff who can concentrate on solving problems rather than handling phone calls about them. This arrangement provides a quick response to requests and more timely resolution of problems. In many cases, it assists users in making more effective use of DP services.

Another benefit is increased productivity of DP staff. When programmers are concentrating on solving problems and making enhancements to systems rather "holding users hands" and/or answering users questions about problems, they are more productive. The addition of a User Support Specialist to the Marist staff released an FTE programmer; where two FTE programmers were required to maintain administrative systems prior to establishment of the Help Desk, today one FTE programmer is required. Two factors account for this shift; programmers have less interruptions, and, by logging problems and identifying those that were chronic, pieces of code have re-written to solve the problems "once and for all".

A third benefit is the problem tracking function that is provided through the phone log system. The data can be used by programmers to identify chronic problems and plan tasks to resolve them. It can be used by managers as a planning tool. By identifying major problem areas we can better project user needs and make plans to meet them. Managers can also use the data to evaluate service effectiveness and adherence to service standards.

Summary and Conclusions

A simple strategy for improving user satisfaction is the establishment of a Customer Service Center, or Help Desk, within the data processing department. A Help Desk provides users with a single service facility for two way communications about problems, complaints, questions, service status, downtime, user education, documentation, and other information. The Help Desk can service all center users, whether administrative, academic or external, and provides data processing staff with a central repository of information regarding all aspects of DP Services.

Establishment of the Help Desk gives users a single telephone number to call about service problems A specific individual should be in charge of the Help Desk, though s/he may not always be the person who answers the phone. All phone calls should be logged and complaints and problems followed up and resolved. The Help Desk cannot be an ineffective user interface. It needs a good, in-place information system that provides intelligent answers to users' inquiries so that responses to users will be rapid, accurate and creditable. If the Help Desk works in this manner, it will very likely be welcomed by users as an aid to the resolution of service problems.

APPENDIX A

User Support Specialist
Performance Standards

RESULTS EXPECTED

The User Support Specialist is responsible for insuring that user problems, complaints and requests for information are adequately handled or solved and followed up in a way that is satisfactory to the user and is consistent with the service standards agreed to by the computer center and that user.

METHODS

ORGANIZING

- Know the skills and services offered by the computer center which will support the users in meeting their goals and objectives.

- Know computer center policies and procedures (i.e.; service standards).

- Provide written job responsibility documents to student aides (may be done through the Student Staff Coordinator).

- Develop a Help Desk Coverage schedule on a monthly basis.

- Develop Help Desk documentation (information base) for use by part-time Help Desk staff members.

- Develop Help Desk procedures for interacting and following up with users.

MAINTAINING and UPDATING

- Maintain Help Desk documentation.

- Maintain the User Services library.
  - Periodicals and manuals checked in and logged
  - Documentation is current
  - Copies of documentation are available

- Log all phone calls.

- Maintain the phone log data base.

SUPERVISING

- Supervise student managers (Student Staff Administrator, Student Staff Coordinator and Student Scheduler).
  - Monitor activities

  - Provide professional staff liaison with student staff
  - Coordinate problem solving with the Student Staff Administrator
  - Supervise the development of a training program for student aides
  - Supervise the development of a "project list" for student aides

- Supervise and coordinate the Help Desk function.
  - Train all Help Desk Staff (students AND professional staff)
  - Make sure all problems/complaints/requests are resolved
  - Make sure all problems/complaints/requests are followed up with the user
  - Follow up unresolved problems with CC staff responsible
  - Review all open problems each morning
  - Inform the Director of User Services of all problems which have been open for more than three days
  - Escalate all problems that have been open for more than a week to the Director of User Services

PROBLEM SOLVING

- Assist the user in identifying their problem or request.

- Clearly define the problem and/or request.

- Identify possible causes of the problem.

- Identify alternative solutions to the problem.

- Identify resources needed to solve the problem.

- Call the proper person to
  - discuss the problem, causes, solutions.
  - get the resources required to solve the problem.

- Work with the appropriate resources to solve the problem.

- Follow up status with the user.

- Follow up status with the resolver.

CONTROLLING and REPORTING

- Conduct performance reviews with Student Staff Administrator.

- Conduct review of open problems with the Director of User Services on a weekly basis.

- Control usage of the resources in the User Services Library.

- Provide month-end reports of activities to the Director of User Services.

- Provide monthly reports from the phone log data base to the Director of the User Services.

SEXISM AND ELITISM IN ACADEMIC COMPUTING: TURNING IT AROUND

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ABSTRACT

Opening its doors in the fall of 1971 on the Dartmouth College model of free, unlimited, interactive computing for all students, The Evergreen State College, without departmental structures, majors, or an official computer curriculum, inadvertently created a Darwinian environment for the acting out of sexist and elitist patterns in the larger culture: a paradox of freedom for the few and near-ostracism for the many. Turning around this culture of computing was traumatic but instructive of the difficulties of affirmative action, the crucial role of administrators, and the benefits which may accrue to those who undertake the challenge.

Introduction

Computers and the role which they play in U.S. and Western society not only are a product of Euro-American culture but in fact manifest that culture, attract particular elements of it, and, in that, create a sub-cultural microcosm within Euro-American society. In 1971, when it opened its doors, The Evergreen State College became the first publicly supported liberal arts college in the country to provide free, unlimited, interactive computing to all students, even those not registered in computer offerings. Without departmental structures, graduation requirements, or an official computer curriculum, however, it inadvertently created a fertile environment for the playing out of sexist and elitist strains in the larger culture. There emerged a stunning paradox whereby enormous freedom existed for the few able to take advantage of it, while near-ostracism existed for the vast majority intimidated by the Darwinian environment. Turning around this culture of computing was traumatic but instructive of the difficulties of affirmative action, the crucial role of administrators, and the benefits which may accrue to those who undertake the challenge.

Evergreen was unique not only for its computer facility, modeled on the Dartmouth College example. The philosophy which governed the decision to provide free, unlimited, interactive computing at a tax-supported, liberal arts college also governed the college as a whole. While the core of the curriculum was in highly structured "coordinated studies programs" encompassing the entire academic work of each student in a program, there were no specific requirements for graduation, other than 180 quarter hours of credit, no departments, and no prescribed majors. With Evergreen also pioneering another mode of study called "individual contracts" whereby a student would design his or her own unique course of study for a quarter or more, students were encouraged to design their own "majors." Evergreen opened its wide-open, resource-rich, computing facility with no official computer curriculum, not even a course.

Laissez-Faire Individualism

Without a computer curriculum, students turned on to computers by themselves and sought academic credit through individual contracts with the administrative programming and technical staff there to support the administrative computing needs of the college and maintain the software and hardware of the Hewlett-Packard 2000 computer. Students with an interest in computing tended first to show up just to look around. If they were well-motivated and aggressive enough, they might find someone to help them get started. Once started, they would need to attach themselves to a group of students and especially a staff person to learn how to use the system effectively. If they met the grade as a member of the inside circle, they could in turn expect to be hired on as a student employee. Almost all of Academic Computing's regular staff, as time went by, came to be composed of former student employees.

It was a wonderful world for those who made it. As an employee, a student had virtually unlimited disk space available; an opportunity to do systems programming as well as applications programming, game-playing, and hacking; and a virtual monopoly of the staff to whom they had attached themselves. Once on the "inside," a student could count on a staff person sponsoring directly, or through a cooperative faculty member, an unlimited sequence of individual contracts exclusively devoted to computing. In the absence of an official computing curriculum, and with none of the breadth requirements of other colleges and universities, students were able, through individual contracts, to avoid the interdisciplinary coordinated studies programs which substituted for breadth requirements. Evergreen established, for a few students, a de facto computer curriculum more concentrated than the most concentrated of an engineering school's majors. No wonder that the National Science Foundation declared Evergreen one of the ten best institutions in the country for undergraduate computing!

In fact, in the academic area, Evergreen's Computer Services emerged not as a servant of the college but as an instrument of a small number of students and staff. At another institution, with a tradition of academic requirements and departmental structures, the combination of free, unlimited, interactive computing and no official computer science curriculum might have evolved into a unique model of computing across-the-curriculum in the arts, the humanities, the social sciences, and the natural sciences. Leadership in this direction was, however, incompatible with the prevailing laissez-faire philosophy of the college in that era. What curriculum was offered was decided in Computer Services; the Deans and Provost exercised no oversight. Instead, students and staff alike came to view Academic Computing as their personal playground. It was at some students' instigation that the operating system of the HP computer was rewritten and one of these students was in turn hired on as a regular employee to maintain the system he had helped create. So it seemed were all decisions made to meet the desires of a very small number of students and employees for learning more about computing.

Darwinian Elitism

Unfortunately, the social dimensions of creating free and unlimited interactive computing contradicted all the implications of "freedom." Not only did there emerge an elite of privileged students attached to a small number of staff, the particular circumstances of their emergence in a Darwinian environment of survival of the most aggressive meant that primarily persons of certain characteristics survived and they tended to make the survival of other persons extremely difficult. Joseph Weizenbaum, in Computer Power and Human Reason, aptly describes the "compulsive programmer" inhabiting most college and university computer centers.[1] What he does not go on to point out is that the characteristics he describes as obsession with power and control are more specifically core characteristics of the white male in American society. Computers are especially attractive to insecure people. Computers provide an artificial sense of power. There is no person in our society more susceptible to the attractions of the computer than the young white male in his teens and twenties.

The difference between Evergreen and other, more structured, institutions is that at Evergreen, the compulsive programmer was put in charge of the facility, not just allowed to hang around. Insecurity took the form of arrogance. Access became privilege. Opportunity became oligopolization. Evergreen's Computer Center became a place not only where women and minorities hardly dared tread, but most students and even most faculty found themselves unwelcome and discouraged. Symbolic of the attitude and the lack of receptivity to outsiders was the student employees' designation as "consultants," a reference which, in the Evergreen context at least, took on a meaning quite different from "aide." To use the words of one woman student, it was a strictly "rock music, dirty sneaker, macho environment."

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[1] Joseph Weizenbaum, Computer Power and Human Reason: From Judgement to Calculation (San Francisco: W.H. Freeman, 1976) pp. 111-31

The situation reached the critical point when the head of Academic Computing, who was not an experienced manager but was trying to move the area in the right direction, could not get the manager of his own technical services area, the former student who helped write the operating system, to do what the head of Academic Computing wanted done to serve the area's users. The response of the Director of Computer Services was to separate technical services from Academic Computing and make the recalcitrant manager of technical services the head of his own, autonomous, department, employing his own student staff. (See Chronology, page 10.)

Curricular Change and Organizational Crisis

As the 1984-1985 academic year drew near, change was in the offing. The head of Academic Computing resigned, a new Director -- the author -- was appointed, and most significantly, a formal computer curriculum was established. From one interdisciplinary program for first and second year students in which computing was one part, a PLATO-based computer literacy course in BASIC, and various courses taught by staff and adjunct faculty, computing was transformed in barely a year to a full curriculum of upper and lower division offerings taught by regular faculty and meeting Association for Computing Machinery standards. There was an explosion in the number of students, and especially the number of regular faculty, formally involved in computer offerings. The Deans and Provost began to take charge of the curriculum, planning it and committing to it in the college's catalogue. The scene was set for another kind of explosion: the kind resulting from the clash of two cultures.

There was probably no way the new circumstances of computing at the college could have been accommodated without significant turmoil. The new Director invested hours, days, and weeks, on top of learning the routine of the job, in studying, talking, negotiating, and compromising as much as he thought possible over a nine month period from July of 1984 through March of 1985. Excluding the vacancy in the head of Academic Computing position, he started with the status quo, knowing, as a faculty member, the historic problem of hostility to outsiders but completely ignorant of the social, organizational, and personnel implications of past events. At the same time, as a former Academic Dean, he was aware of the role the Deans should be playing in curriculum planning, and, as a practicing social scientist, he had the analytical tools for understanding the social dimensions of what he encountered. In addition, he had a strong record of commitment to affirmative action and multi-cultural education.

Recognizing the need for a change in the orientation of Academic Computing, the new Director first of all abolished the old classified staff position for the head of the area and created a new, exempt, position of "Coordinator of Academic Computing," emphasizing the responsibility as instructional as well as managerial and technical. After the only acceptable candidate for the new position refused the offer, however, the second action of the new Director was an unknowing exacerbation of the problem: with no other options apparent, he appointed the manager of the autonomous Technical Services area also as acting Coordinator of Academic Computing. The Director's third decision, this time reflecting commitment as much as necessity, in turn set the stage for the real crisis: he promoted out of Administrative Computing, a woman former student and part-time faculty to run the Computer Center under the direction of the head of Technical Services/Academic Computing!

Making Choices/Making Changes

In a series of decisions which followed, the Director supported the woman's leadership, ostensibly accepted by the Technical Services manager, for a transformation in the face Academic Computing presented to its users. First to go was the blasting stereo, then the word "consultant," transformed to "aide." The new title in turn reflected a new policy: student employment would ignore "inside" status and hiring criteria would emphasize teaching skills as much as technical knowledge. New trainee positions were created especially to encourage women and minorities. With Technical Services a separate unit, the hardest core of the clique of student employees persisted, but the new Director more and more began to emphasize responsiveness to student and faculty users, user documentation, "plain vanilla" software, and applications programming over systems programming. There was a curriculum to support, it was the responsibility of Academic Computing to support students and faculty, and it was the responsibility of Technical Services to support Academic Computing.

Throughout the first quarter, the conflict in philosophy between the manager of Technical Services and the woman running the Computer Center became worse. It grew more bitter and more personal every day. It was compounded by the equally apparent reality that the Technical Services manager, promoted to his position without a search and without consideration of his aptitude for the job, was not well-suited to management, while the woman was extremely well-organized with a clear understanding of the relationship between goals and implementation. To begin the second quarter of the academic year, the Director promoted the woman to acting Coordinator of Academic Computing, supplanting the Technical Services manager back to his earlier position and making the two equals in reporting to the Director.

As personal and professional conflicts went from bad to worse, the nadir was reached when the Technical Services manager refused to provide to the acting Coordinator of Academic Computing the same access to privileged commands on the Academic Computer that he provided to his own staff and two of his student employees. Protestations about "trust" and "competence" could not hide the fundamental sexism. Technical Services, all of whose members were white and male, was refusing to let a woman into its club. The idea that the person who was in charge of Academic Computing, and a regular employee, could not be given the same access to the academic computer that two student employees had was unacceptable. The conflict had come to a head. The fundamental nature of the problem and its significance for the college appeared to the Director as challenge he had to face.

Aside from his personal hostility to the acting Coordinator of Academic Computing, it was increasingly obvious that the Technical Services manager was not prepared to subsume his personal and professional interests to the needs of the new users now flooding the Computer Center. With his background on the faculty, in women's studies, and as an Academic Dean, the Director's inclination towards the acting Coordinator of Academic Computing was increasingly obvious. In a series of events, starting at the beginning of the spring quarter of 1985, first the manager of Technical Services resigned, then the Director announced his intention to abolish Technical Services as a separate unit, and finally the Director completed the steps necessary to make the woman acting as Coordinator of Academic Computing the regular appointment to the position. The structural and personnel changes at the foundation of a new vision of Academic Computing were complete.

Hostility and Hope

It is too early yet to know the final results of the changes carried out over the past 18 months. Certainly, much bitterness remains. With the abolition of Technical Services, the non-cooperation -- a virtual labor boycott -- which characterized both staff and students in Technical Services, has ceased. The personal attacks, insidious grapevine, and near, if not actual, sabotage, continue. The Coordinator of Academic Computing has received anonymous threats to her job and her person. Both she and the Director have received several anonymous requests to resign. Events not adequately explained even by the vagaries of computers keep on occurring in the computer system. The former Technical Services student employees continue an unceasing opposition to almost every decision the Coordinator and Director make and carry their complaints to any and every administrator who will listen.

For all the hostility and anxiety, there are signs of hope. New student and faculty constituencies are appearing to recognize, to a certain extent, the accomplishments of the new regime. The Deans and Provost have a growing awareness of the problem of adding new demands without new resources. They are helping to create new structures to accommodate a need which had never existed for planning, establishing priorities, and managing resources according to priorities. People are making a sincere effort to accommodate as much as possible the desires of the old constituency while asserting the fundamental importance of supporting the new curriculum. In many ways, moreover, even among some of the old guard, there is a better feeling and a more cooperative attitude.

The Hard Way/The Only Way

There are several lessons to be learned from these events, all of the lessons applicable far beyond the narrow confines of Evergreen's particular philosophy and organization. First of all, there is the paradox of freedom. Evergreen's unstructured environment with free, unlimited access to computing appeared to provide the best of all possible worlds to everyone, but one person's freedom can be another's tyranny. While providing superb resources for a few highly assertive and sophisticated students, mostly white and mostly male, Evergreen's facility worked to exclude the uninitiated, women, and third world people. Bringing service to the disinclined requires an "affirmative action" policy reaching out to people. Neutrality is not enough; arrogance is a disaster.

Secondly, in considering the events which took place most recently in Evergreen's Academic Computing area, the real meaning of change becomes more clear. Making real change means changing the culture of computing. To draw in new constituencies, it is not enough to change a few policies or personnel, or even the curriculum; one must change a whole way of doing and thinking. It is especially important to realize that bringing in new people, especially women and third world people, does not just mean white male mentalities in the bodies of females and people of color. Different people bring different ideas, perceptions, and ways of doing and living. Making changes means difficult decisions, no easy answers, and results likely to make at least a significant minority unhappy.

The most important reason for making the changes Evergreen's Academic Computing made is that it is the right thing to do. These changes also brought new life and energy to the area. They brought to computers a human aspect, a commitment to making better the lives of the people learning and working there. There has been a notable change in emphasis from machines managing people to people managing machines.

Finally, the most important lesson to be learned, although it is not clear that it is yet understood at Evergreen, is that higher level administrators play a crucial role and have a crucial responsibility in the success or failure of changes as important as those described here. The woman Coordinator of Academic Computing never would have survived even to become Coordinator without the support of her supervisor, <u>including</u> his understanding of the peculiar cultural dynamics of sexism and machismo in a computing environment. There were many occasions when it seemed the complaints of males about the incompetence of a female could not all be untrue and the female's accounts of harassments could not be true at all. Successful affirmative action sometimes requires administrators to say "no" to complaints and give their subordinates time to make changes, even when all the administrators' "instincts" tell them the complaints are valid. If the new Director of Evergreen's computer facility erred, it was probably not in acting too quickly, but in acting too slowly. Human "instincts" are not instincts at all but acculturated assumptions.

Making changes requires not just changing cultures but changing people -- even oneself.

Chronology

January, 1983: Technical Services separated from Academic
Computing

January, 1984: New Director of Computer Services appointed

April, 1984: Head of Academic Computing resigns
New position of Coordinator of Academic
Computing created

September, 1984: Manager of Technical Services also named
Acting Coordinator of Academic Computing
Woman appointed to run Academic Computing
Center

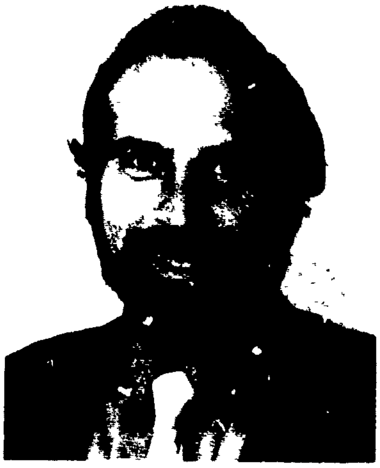
January, 1985: Academic Computing separated (again) from
Technical Services
Woman appointed Acting Coordinator of Academic
Computing
Both positions report equally to Director of
Computer Services

April, 1985: Manager of Technical Services resigns
Technical Services abolished
Academic Computing technical staff reports to
woman Coordinator

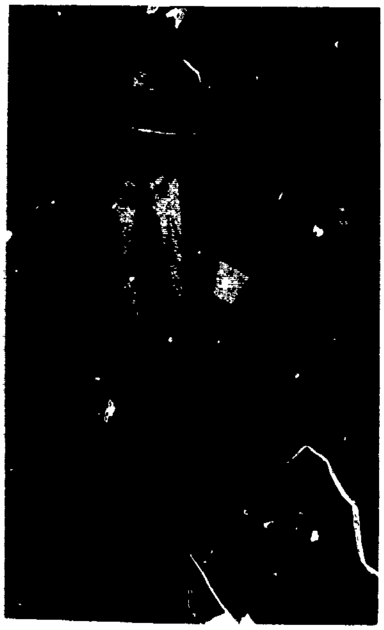
May, 1985: Woman made Coordinator of Academic Computing as
a regular appointment

Track VII
Managing Academic Computing

Coordinator:
Kenneth Klingenstein
University of Colorado



Robert Chew
University of New Hampshire



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VALUE-ADDED NETWORK SERVICES FOR UNIVERSITIES

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The combined annual revenues of the dozen largest U.S.-based value-added network (VAN) service vendors is now in the multi-billion dollar range. Most businesses today are to some extent dependent on these VANs (e.g., TELENET, TYMNET) for their data communications enhanced transactions across the U.S. and internationally. As VAN services expand to include: advanced forms of electronic mail, access to more and more data bases, internetworking, etc., not only businesses but universities will increase their dependency on general-purpose and specialized VANs (e.g., BITNET, MAILNET). Competition among VANs for this huge market will make VAN services more financially attractive to universities, such that traditional methods of academic and administrative information processing operations must be re-examined. The paper describes the evolution of VANs, current technology, and some of the major VAN vendors and types of services for universities.

EVOLUT' OF VANS

A value-added network may be concisely defined as "a privately-owned, packet-switched network whose services are sold to the public."[1] (Packet-switching is a technique to break up messages into groups of 1000 or so bits for more efficient transmission of messages over a network.) VANs enable diverse user terminals and computers to interconnect over wide-area data transmission facilities augmented by such value-added services as speed conversion, error recovery, code conversion, protocol conversion, database access, application package use, and network management.

Research on VANs began in the late 1960's, following the initial time-sharing developments. The first VAN was created by a joint effort of various universities and research institutes sponsored by the Advanced Research Projects Agency (ARPA) of the U.S. Department of Defense. Thus, even though VANs are heavily used commercially, they have their roots in university cooperative research efforts.

Currently the ARPANET connects over 100 host computers of many vendors in research locations throughout the continental U.S. as well as in London, Norway, and in Hawaii. It is a geographically distributed, packet-switched, highly-connected network that leases high-speed 56 Kbps digital lines, attached to switching minicomputer nodes. System monitoring is the responsibility of Bolt, Beranek, and Newman, Inc. of Cambridge, MA, while system modeling takes place at the University of California at Los Angeles.

The Tymshare company initiated a parallel and independent VAN effort by 1970 called TYMNET, designed to facilitate direct terminal access for time-sharing computer services. Another VAN, TELENET, was a direct spin-off of ARPANET, where a group of participants used the technology to form a commercial venture. TELENET modified the ARPANET data transport technology to allow for more efficient use of resources by terminals (ARPANET was designed for host-to-host transfers). Both TELENET (acquired by General Telephone & Electronics in 1979 -- now known as GTE/TELENET) and TYMNET (acquired by McDonnell Douglas Automation Co. in 1984) have evolved to become two of the largest international VANs today. The Canadian DATAPAC and France's TRANSPAC were the first two government-sponsored public VANs to provide computer-communications services similar in scope to each national government's voice telephone network. Today many countries have one or more VANs offering nation-wide services with connections to international networks; there are almost 20 multi-million dollar VANs based in the U.S.

VANs have evolved technologically and have added significant access, computational, and service values. Although VANs are normally viewed as public access networks, the largest VANs have not only marketed their network designs and components to companies for use as private networks, but they also work with companies to integrate private and public network facilities, depending on data traffic growth, geographical topology, and special services required.

In addition to classifying VANs according to their public or private (access) attributes, they may be seen as national or international in scope, and may be either government-owned or government-regulated. This taxonomy could continue according to spectrum and specialization of services offered (e.g., electronic mail, file transfer, database access, financial, research, industrial), or technological basis (e.g., architectural standard, packet- versus circuit-switching, transmission media). Thus we see today an expanding multi-billion dollar VAN information-enhancing industry within 15 years of initial research, with most businesses and many universities depending upon these computer-communications services for their competitive survival. Let's review some current VAN technology, vendors, and markets before looking into VAN services for universities.

CURRENT TECHNOLOGY

Van technology can be described by examining network architecture, hardware and transmission media, switching techniques, protocols, protocol conversion, and network management.

Network Architecture

A network architecture is an overall structural plan consisting of network configuration layering rules and protocols for controlling communications among, and access to, network components. All VANs have some kind of architectural plan that designers referred to while constructing the network components and services. The early VANs, however, were experimental; their individual architectures evolved from the ARPANET model as they expanded, solved problems, and provided new services.

Now, national and international guidelines exist for architectural protocols and interfaces, the most widely referenced being the International Standards Organization's Open Systems Interconnection (OSI) model. All the major computer vendors have defined their own five-to-seven communications layers (e.g., DEC's Digital Network Architecture and IBM's Systems Network Architecture) that are conceptually comparable to the OSI seven layers (Physical, Link, Network, Transport, Session, Presentation, and Application).

Since the OSI model is an unimplemented, compromise set of guidelines only, data communications users still must face the challenge of integrating computers, terminals, and peripherals made by a variety of vendors. Inevitably, multi-vendor networks require extra work to bring about useful communications. Indeed, even relying on a single vendor does not guarantee compatibility; IBM's SNA, as yet incomplete, began as an effort to allow formerly incompatible IBM systems to communicate.

Hardware and Transmission Media

Mainframe computers, minis, and micros are all configured in a variety of VAN topologies (nodes connected by communication links). IBM has an Information Network VAN that employs standard IBM hardware and software products and of course uses their SNA architectural rules to link these components together. General Electric Information Services Co.'s MARK*NET uses over 500 custom-built switching nodes to link its 50 Honeywell DPS-8/70 and 3 IBM 3081 mainframe computers for international VAN services. AT&T's IS NET 1000 uses a set of 3 DEC VAX 11/780s front-ended by an IBM Series/1 for each of its "intelligent" network processing nodes.

VAN communications transmission media are varied and mixed. Computer Science Corp.'s INFONET has over 175 specially-built Comten nodal processors connected by 130,000 miles of leased 56 Kbps telephone lines internationally, permitting user access of speeds from 50 to 14.4 Kbps. RCA Cylix provides C band (4/6 GHz) satellite-based communications facilities within the U.S. and Canada. TYMNET represents one of the largest international networks, consisting of about 2000 packet-switching nodes, interconnected by leased lines, microwave links, and satellite channels, running at speeds from 4.8 to 56 Kbps.

Switching Techniques

Techniques include circuit-switching, message-switching, datagram packet-switching, and virtual-circuit packet-switching. Each has particular characteristics suited to different operating environments. All forms and some hybrid combinations are found in VAN offerings, but most VANs use virtual-circuit packet-switching for good performance and efficiency with "bursty" data traffic. Performance, in all techniques, is a function of signal propagation delay, data transmission time, and node processing delay.

Protocols

A protocol is a logical abstraction of the physical process of communication, and as such, governs the syntax, semantics, and timing elements of this process. Protocols are required across all communications layers and are mostly symmetric (between peer entities) rather than between asymmetric entities (e.g., exchange between a "user" and a "server" process).

The International Telegraph and Telephone Consultative Committee (CCITT) has developed a number of standards for attachment of data terminal equipment (DTE) -- meaning both terminals and computers -- to public packet-switched data networks (PSDN). Recommendation X.25 serves specifically as the standard for providing multi-access attachment of packet-mode terminals and computers to PSDNs. The X.25 interface provides the capability for the DTE to multiplex many logical connections over one communications link between the DTE and the network.

Asyschronous DTEs that use start/stop protocols can be attached to packet networks using packet assemblers/disassemblers (PAD). Recommendation X.3 together with the X.28 and X.29 protocols define the various components needed to communicate between an X.25 DTE and asynchronous devices over PSDNs. Another inportant standard is Recommendation X.75, which is used by PSDNs for interconnections between networks. X.75 is the key to worldwide communications between X.25 DTEs attached to different PSDNs.

Most packet-switching X.25 PSDNs or VANs use a proprietary internal protocol between switching nodes. By supporting various de facto standard link interfaces -- such as IBM's Binary Synchronous (BSC), and IBM's SDLC -- as well as the OSI international standard High Level Data Link Control (HDLC), the network can provide virtual connections (dashed lines) between diverse machines. X.75 provides the link between PSDNs. See illustration in Figure 1 below.

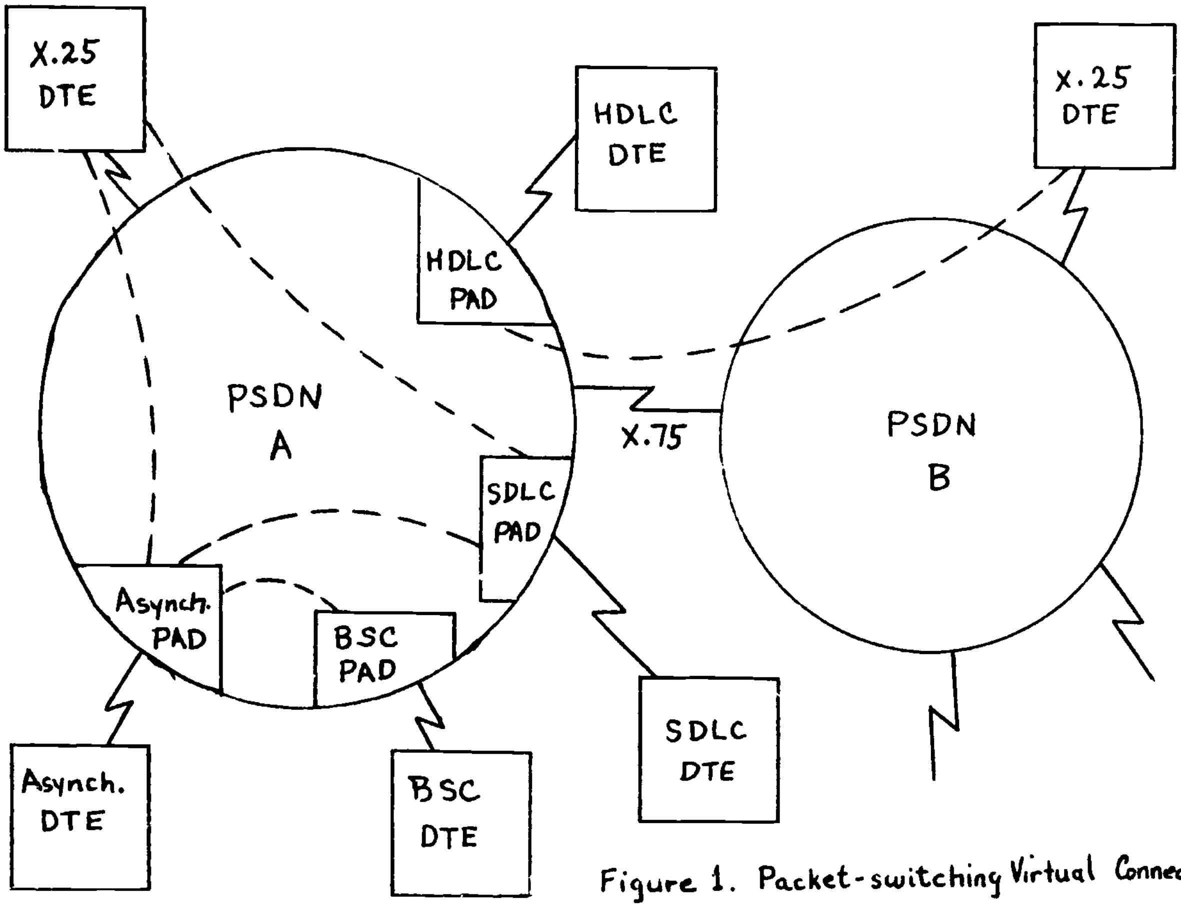

Figure 1. Packet-switching Virtual Connections

Protocol Conversion

Protocol conversion involves the translation of various protocol features (e.g., flow control -- controlling speed differentials and buffering requirements) across an interface between two different processes. We can observe that protocol conversion implementations will continue to expand in the current environment of slow acceptance of international standards in the multi-vendor VAN service market.

By definition, protocol conversion adds system overhead, since additional translation software and/or hardware is required to allow incompatible devices to communicate. Translation functions occur throughout VAN implementations, but most VANs provide at least some conversion services within the network backbone switching nodes for international access (X.25) and gateways (X.75). Similarly, access and interconnection is normally provided for SNA de facto standards. Many protocol conversion services are alternatively offered in a more distributed manner, at the customer site for large volumes of terminal and host traffic. Furthermore, many VANs also provide access to their own proprietary network computer resources, including a variety of computer applications. database host resources, and communication services such as electronic messaging. Thus higher-level VAN communications and computer services create many of the requirements for protocol conversion services.

Network Management

The management of such technical complexity is where VANs are particularly attractive to businesses, which find it not only too costly to privately duplicate VAN services, but also find they are unable to hire the technical expertise necessary to implement and control network resources.

Network management includes sophisticated monitoring devices and programs for design and optimization of lines and costs, depending on dynamic data flow and changing tariffs and technology. The VAN companies must have in-house technical competence to either integrate or build these management tools for control and for billing. This in-house capability must also be able to integrate new switching techniques and media as technology evolves.

IMPACT OF PERSONAL COMPUTERS AND LOCAL NETWORKS ON VANS

Personal Computers

Increasingly, personal computer and intelligent workstation users will determine the shape of VAN services. As PCs proliferate, users turn to VANs to augment their local capabilities as well as to communicate with other non-local PC users.

The current emphasis of personal computer users to utilize networked resources is simply an evolutionary stage of increasingly distributed computing access by simple ASCII terminals, then to PCs, and to more and more intelligence, capability, and variety in workstations. Of course, without universal standards, users have a multitude of different vendors' access devices, network switching computers, and host computing resources. In most cases each has its own unique method (or protocol) for communicating with other devices. To be sure, any ASCII device can exchange messages with other devices connected to VANs. However, PCs using different word processing or spreadsheet techniques cannot interchange documents or data files or graphics without the need for modification, if the files can be interchanged at all. VANs are rapidly addressing these needs with new service offerings (e.g., GEISCO has a word processing translation service.

Local Networks

Internetworking of local area networks with VANs is becoming a major developmental activity for protocol conversion. Even with LANs absorbing a great deal of intra-organizational communications, users are realizing that a LAN is only part of a total solution to communications needs. LAN decisions will more and more be based on LAN interfaces to VANs. Public VANs will increasingly view connections with private LANs as a market opportunity. Various VAN implementations and independent software company packages are available to meet this LAN-to-VAN need, while we wait for standards to be agreed upon.

The Institute for Electrical and Electronics Engineers (IEEE) has been in the forefront of this standards effort. There are some distinct differences between local and long-haul networks that must be taken into account when devising protocol standards: 1. In terms of speed differentials, LANs are typically in the range of 1 to 50 Mbps, while VANs are often 56 Kbps or less, and 2. The local network link is generally direct with no intermediate switches; while on a long-haul network, there may be a number of packets outstanding between stations.

VAN SERVICES FOR UNIVERSITIES

Just as LANs are providing communications within campuses, VANs provide communications among campuses and provide access to specific external database services. The major worldwide VANs used by universities today are identified in the Appendix.[2] In addition, the Research Libraries Information Network (RLIN) is an example of a specialized network combining databases of library collections and computer systems to support the Research Library Group (a consortium of generally large universities and other research institutions) as well as many non-member institutions.[3]

Increasingly, universities are finding it economically feasible and even necessary to conduct research with the assistance of the following types of commercial VANs: 1. On-line bibliographic search services (e.g., Dialog, Knowledge Index, BRS, BRS After Dark, Orbit), and 2. On-line business search services (e.g., Dow Jones News Service, Vu/Text, Nexis, NewsNet, The Source).[4,5]

If you have a personal computer or computer terminal with a 300 or 1200 baud modem and asyschronous communications software, you can access a range of electronic services that provide unlimited information resources. All of these services can be accessed via a packet switched network's local telephone number. These services fall into three categories -- general business, full-text, and bibliographic. A general business service provides a generous number of daily news sources; financial resources, such as current stock quotes and S.E.C. filings; and additional conveniences, such as airline schedules, electronic mail, and sport scores. A full-text service functions as a repository of the word-for-word articles and news stories that have appeared in paper publications. A bibliographic service provides indexes to a vast number of paper publications -- books, magazines, literature, and conference papers.[5]

The escalating cost of maintaining university libraries as the principal research base has forced innovative library sharing arrangements, greater reliance on external commercial databases, and the merging of library and computer services.[6]

U.C.L.A. recently surveyed 125 university business schools regarding their computer use for instruction and research.[7] Forty-two of these schools reported having at least one wide-area network (VAN) available for use, with 67 different networks mentioned. Two-thirds of the schools reported using BITNET, while CompuServe and ARPANET were each reported by one-fifth of the schools. The most frequently mentioned databases for research and instruction were, in order of usage, Compustat (used at 67% of the schools), CRSP (48%), Citibase (18%), Value Line (15%), Dow Jones (14%), DRI (9%).

Helpful guidelines and experiences in the use of VAN services are being published with increasing frequency. The LOTUS Journal recently surveyed some of the popular on-line information services.[8] An interesting experiment using Videotex on CompuServe's VAN was reported by the University of Wisconsin, where, as a member of the Electronic Text Consortium they agreed to develop electronic text materials which would support the PBS television series, Congress: We the People."[9]

SUMMARY

Value-added network services have evolved in only fifteen years to become heavily used by businesses and universities worldwide. VANs are classified along many lines and offer varied and competitively priced services. The technology of VANs is becoming increasingly sophisticated while: migrating to international architectural standards, designing and integrating network node components, selecting and optimizing hybrid switching techniques and transmission media, providing an array of protocols and protocol conversion implementations to meet the "anything-to-anything" communication requirements of users, and simply managing the VAN resources with sufficient error-free transmission and security for user confidence.

Personal computers and local network to VAN connections are having major impacts on VAN services. All these factors plus specific current uses of VANs by businesses and universities indicate a major growth in dependency on VANs in as yet unforseen and creative ways. [10]

ENDNOTES

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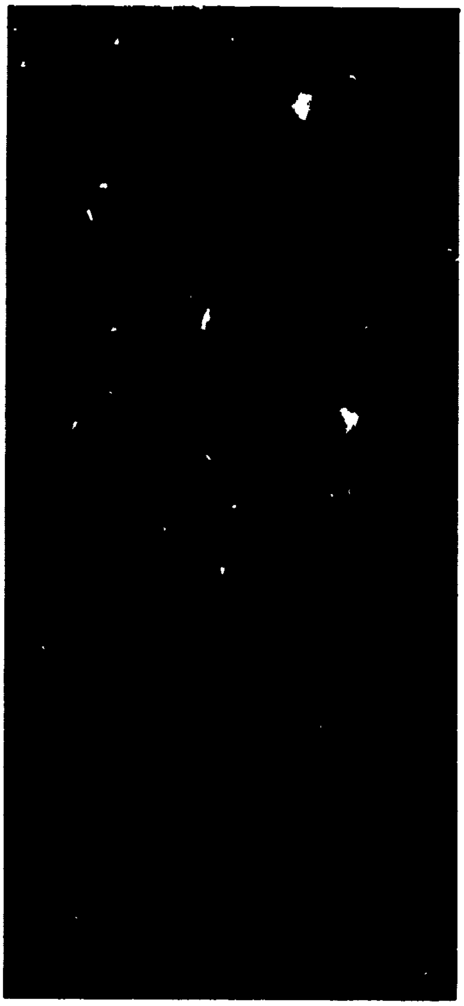

NETWORKS

ARPANET - The first long-haul packet-switched computer network, funded by the Advanced Research Projects Agency (ARPA), now called the Defense Advanced Research Projects Agency (DARPA). In 1983, the ARPANET was divided into MILNET, a military network, and ARPANET, a research network. ARPANET and MILNET hosts are connected to Interface Message Processors (IMPs), which are interconnected via 56KB dedicated lines.

BITNET - An RSCS-based store-and-forward network of over 350 computers supporting mail, file, and interactive message transmission among over 100 academic institutions in the U.S., with direct links to counterpart networks in Canada and Europe. BITNET operates over 9600 baud leased telephone lines. Most BITNET sites run IBM's VM/CMS operating system; MVS TSO, VAX VMS and UNIX, CDC NOS with NJEF and other operating systems are also supported. In addition, BITNET supports gateways to other academic and research networks including ARPANET, CCNET, CSNET, MAILNET, UUCP, and a limited access gateway to IBM's VNET network.

CCITT - The International Telegraph and Telephone Consultative Committee, an organization charged with developing standards for international telecommunications. CCITT protocols include X.25 and X.400

CCNET - A DECNET-based network that includes Carnegie-Mellon, Case Western Reserve, Columbia University, New York University Business School, Stevens Institute of Technology, and Vassar College. CCNET sites communicate with BITNET and MAILNET through gateways.

CSNET - Computer Science NETwork, a logical network of institutions involved in computer science research, composed of three physical networks: PhoneNet, X25Net, and the ARPANET.

DARPA Internet - The Defense Advanced Research Projects Agency Internet is a collection of networks, all based on TCP/IP, that communicate with one another and share a common host table. The DARPA Internet is composed of more than 800 hosts including those on the ARPANET, MILNET, and numerous local networks at universities and private companies. Network facilities include remote login, file transfer, and mail.

EARN - The European Academic Research Network, linking over 150 computers and 100 institutions in 18 countries. EARN uses the same networking technology as BITNET and is directly linked to both BITNET and its Canadian counterpart, NetNorth. Gateways to several national academic networks in Europe are also planned.

EDUNET - A project of EDUCOM Networking Activities which allows member institutions to access computing resources at 16 universities over dialup telephone lines or public data networks. EDUNET staff provides administrative and user support services (directories, documentation, account initiation, consolidated billing) associated with locating and using desired software and services.

JANET - Joint Academic NETwork, a network of approximately 200 academic and research computers in Great Britain.

MAILNET - A star network, with hub at MIT, that allows a variety of university mail systems on different hardware to exchange mail over direct-dial telephone lines and public data networks. Most sites exchange mail with the hub twice daily, using the MMDF protocol at the link level and SMTP for message transfer. Twenty-four sites participate in MAILNET and communicate with the other major academic networks through mail gateways.

MILNET - The Defense Data Network, which split from the ARPANET in 1983. MILNET is connected to the ARPANET by mail gateways. File transfer and remote login is limited to the military and defense contractors.

NETNORTH - An RSCS-based network of 40 computers at 20 Canadian academic and research sites with direct links to BITNET and its European counterpart EARN. Plans are underway to provide connections between NetNorth and other Canadian networks

NJEF - Control Data Corporation's Network Job Entry facility; enables Cybers to send files over BITNET.

PhoneNet - A star network, with its hub at CSNET-RELAY, that allows computer science researchers on primarily UNIX-based systems to exchange mail over direct-dial telephone lines. Most sites exchange mail with the hub twice daily, using the MMDF protocols Approximately 100 sites participate in PhoneNet and exchange mail with the other CSNET networks.

RFC - Request for Comments, the name of documents containing proposed and accepted communications standards used by the ARPANET community For example, the ARPANET standard for message format is described in RFC 822.

USENET - USENET is a news network, with articles sent by a flooding routing algorithm to all nodes. While the transport mechanism is UUCP for most links, numerous others are used, including ethernets, and the ARPA Internet. USENET combines the idea of mailing lists long used on the ARPANET with bulletin board service as has existed for many years on TOPS-20 and other systems There are over 1000 USENET hosts worldwide, but there is no general central authority for USENET. The name USENET is supposedly derived from USENIX, which is the name of the UNIX users group.

VNET - An IBM internal network that uses the same technology (RSCS) as BITNET.

X25Net - CSNET's X25Net implements the ARPANET TCP/IP protocols over the X.25 facilities of the Telenet public data network. X25Net sites may perform file transfer, remote login, and instantaneous electronic mail transmission to other sites on the DARPA Internet. Seventeen sites currently participate in X25Net.

DEVELOPING A CAMPUS-WIDE LOCAL AREA NETWORK: WE'RE HALF WAY THERE

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This paper will review the plan and strategy to implement a campus-wide LAN on a broadband cable for an institution heavily committed to computing with 8,000 students utilizing computing on a regular basis on 1,200 microcomputers throughout the semester.

The presentation will focus on the plan to:

1. gradually phase out a 500 port MICOM front-end which supported over 400 terminals and a few hundred microcomputers, and 5 PR1ME systems,

2. develop a broadband system which sits above a variety of PR1ME, Microvax, HP3000 and other systems and which will provide node-to-node communication between any two users on campus in a network of several thousand microcomputers and terminals, and

3. install a digital PBX system.

The plan that will be reviewed is a 5-phase implementation plan that in the first three phases focused first on the academic podium and provides data and video communication to th six buildings in this area. These developments which are completed co-exist with th MICOM system which supports primarily administrative users at this time while the majority of academic users are on the broadband network. As a parallel development we will review the acquisition of a digital PBX system to support voice communication which we felt, for the time being, should exist on a separate transmission medium.

As a part of this presentation, we will review the reasons that we wanted to move away from a front-end processor such as MICOM a why we selected broadband over baseband and digital PBX for the major campus backbone system. We will also discuss the developments of several smaller networks which are currently planned, or implemented to support faculty chairs, the CIS department and the Information Services Division.

HISTORICAL PERSPECTIVE

Since the mid-1970's, the academic and administrative computing needs of the College have been serviced by on-line access to one or more computers via RS232 communication lines on a point-to-point connection between terminals in various buildings and a front-end processor in Lindsay Hall. During the time when we had a DEC10KI processor, we had approximately 128 terminals wired to a DCA front-end communications processor. Although this provided adequate service in it's early years, the front-end deteriorated and was difficult to maintain. This combined with the excessive number of users trying to access the processing capability of the DEC10 were the main reasons why we decided to replace that computer with a network of Prime computers. During this early period, we did not use multiplexers and we had initially 8 then 32 dial-up lines for remote access.

With the installation of the PR1ME systems, the data communications needs of the Bentley College data center were met by using a MICOM 600 data switching unit. All of the 400 terminals on campus were wired directly to the MICOM unit where connection to one of the five Prime computers is made. This unit provided us with the flexibility to direct users to a particular computer for a special function(port selection).

The telephone system, which was installed when the College was built, is an AT&T 701 mechanical switch and has been in operation since the opening of the campus. There was a study done in the mid-70's and a recommendation was made to replace the switch but that was not acted upon at that time. In 1983, the College ordered a Dimension system primarily because of the needs of the new Graduate Center but also because of the deterioration of service and the inability of the telephone company to service this equipment. This switch was never installed.

COMMUNICATIONS PLANNING AND STRATEGY

It was at this time that the Campus Communications Committee was formed and one of it's first priorities was to review the decision to order the Dimension system. The group made a recommendation to cancel the order for the Dimension system and this was acted upon.

Having set aside the telephone decision as premature, the committee set forth to specify the College's communications objectives and these are as follows:

1. transparent, user-oriented environment,
2. convenient access to off-campus computer and information resources,
3. convenient capabilities to promote resource sharing (maximize accessibility to available hardware and software resources),
4. reliable, fault-tolerant hardware and operating software environment,
5. campus-wide access to appropriate information resources from classrooms, offices, dormitories, auditorium and other facilities,
   e.g., graphics, video resources, electronic mail, word processing, library catalogs, directories, administrative data,
6. convenient capability to interface computer and communication devices and peripherals, regardless of make or type,
7. improved support of physical facilities management (phones, energy, security, scheduling, etc.),
8. provision of controls for data security and user privacy,
9. maintainable user environment.

In addition to these global objectives we had an immediate need to satisfy the data communications needs of the new Graduate Center building. We also had to concern ourselves with the larger issues of data, voice and video transmission from virtually any point to any other point on campus. With the limited time available(two months), we tried to make the most informed decision on the Graduate Center while building the first leg of a system that would have campus-wide applicability.

One of our main concerns at this point in time was whether we wished to perpetuate the MICOM front-end. The MICOM unit has very little intelligence and can not perform any conversions or high speed CPU to CPU transfers. Further, centralized control and connections results in major disruption in user service in the event of a malfunction in the front-end processor. This is the case even with the availability of a primary and secondary processor since a "soft" restart is impossible. Other reasons for considering alternatives to the MICOM were: lack of conduit space, a need for more flexible topology, isolation from lightning, better security provisions, and easier system maintenance.

In search of a solution, the Campus Communications Committee visited a number of sites including Brown University, Dartmouth College, and the U.S Military Academy at West Point all of which had installed extensive local area networks of different varieties including baseband and broadband. After several months of investigation and deliberation, the committee developed a communications strategy that focused on the following:

1. build a network independent of the computers that are being used at any given point in time,
2. migrate academic users to this system first,
3. provide a video capability on this network for the upper campus(academic podium),
4. install a new digital telephone switch,
5. migrate administrative users to the network, and
6. provide student housing access to all computing resources whether mainframe, mini or micro.

As a first step in implementing this strategy we decided in June of 1983 to install a broadband network in the new Graduate Center building that would open in September of 1983. While the short time frame did not permit an exhaustive analysis, this decision, even in retrospect, seems to have had merit since it serviced the data communications needs of that building while leaving open the questions of how we would handle voice and video service for the campus. While baseband would have provided the data communications service and allowed us to reduce our dependence on the MICOM, we felt that broadband satisfied this requirement and:

"1. provided the capability to accommodate data, voice and video on the same cable,
2. made use of proven CATV technology,
3. provided an integrated approach to our future needs for interfacing information resources,
4. providing video transmission for instructional use, and
5. would allow multiple data transmission for energy, facilities management and security systems."[1]

In the absence of a formal long-range communications plan, we felt that this approach provided us with the most flexibility to satisfy our future needs.

Having made the decision to install a broadband network, we quickly reduced the available systems to Sytek and Ungermann-Bass. Ungermann-Bass was selected to be implemented in the Graduate Center and implementation proceeded as scheduled in September of 1983. A valid question at this point is why we selected these two companies since they are both relatively small and one would of course prefer to install a network supplied by

AT&T or IBM or Digital or another substantial company. The answer is that networks from larger vendors were simply unavailable. This presents a dilemma that colleges and universities as well as industry face, even today although the choices in terms of vendors are multiplying almost daily. The issues which we face in making a cable decision were summarized by this author in an article in CAUSE/EFFECT in September, 1984 and dealt with cable selection, spectrum allocation and the question of multi-vendor networks.[2]

ACTIVITIES DURING 1984

Our original intention was to develop a long-range plan early in 1984 to expand the LAN to the remainder of the campus. This was based on the assumption that all freshmen would have computers. Instead, activity during 1984 focused on a pilot project of 110 freshmen who were issued portable computers and the campus-wide planning activities regarding new building construction. Both of these would have a major impact on the campus communication requirements since the successful completion of the freshman project could result in 4,000 additional microcomputers on campus and new building construction would add six buildings by 1987.

The decision to conduct a freshman pilot project delayed the requirement for connectivity in the dorms. Freshmen do not require connection to the Prime computers since the curriculum for that year is organized to use micros in the Accounting, CIS, English and Math courses. Thus, this will not become an issue until freshmen move out of the freshmen dorms(clustered together) into other dormitories scattered in the lower campus in 1986. As a consequence, we have an additional year before we needed to have the lower campus connected to a network. In the meantime, access from dorms by students who chose to acquire computers could be accomplished through the use of a modem.

Since we delayed the expansion of the broadband network, we satisfied the increasing demand for lines to the system by using multiplexers tied in to the MICOM. This was required in locations where limitations of conduit space did not permit the insertion of additional RS232 lines.

The telephone system continued to deteriorate in 1984 but, until we could get a sense of the eventual scope of the new building project, it was decided to delay a decision on replacing the telephone switch. This also afforded us the opportunity to evaluate the offerings of a variety of companies in the wake of the post AT&T divestiture.

Once we had determined that we would equip all freshmen with computers in the fall of 1985 and the campus building plan was finalized, we proceeded to develop the next four phases of the five phase plan to develop a campus-wide LAN. These phases are depicted graphically and narratively in Attachment A.

ACTIVITIES DURING 1985

During this past year, there have been five primary activities regarding communication as follows:

1. expansion of the cable plant on the upper campus to complete phases II and III,

2. acquisition of additional network interface units(NIU's),

3. building a network communications center,

4. hiring a telephone communications consultant, issuing an RFP and selecting a telephone switch, and

5. hiring a network consultant to assist us in assessing the current state-of-the-art in LAN hardware and software and finalizing cable plant design for the remaining phases of the system.

In view of the delay in equipping freshmen with microcomputers from 1984(the original date recommended by the faculty) to 1985, we decided to proceed on a more deliberate schedule to expand the broadband network. It was decided to proceed to the second and third phases of the cable plant expansion. This expansion consisted of extending the cable plant throughout the upper campus to provide data and video communications to the academic podium. This has been completed and we also have acquired additional ports(NIU's) to connect some of the academic users on the lower campus to network interface units in Waverley Hall where we are building a network node for the lower campus which is the location of all of our residence halls.

The strategy thus far has been to leave administrative computer users on the MICOM and transition the academic users to the broadband network. Our current distribution of ports on the MICOM and the broadband is depicted in Attachment B. The use of the MICOM provides additional security(through separation) and the broadband system causes a minimum of interruption to the academic users when we have a malfunction to some portion of that equipment. The reason for this is that system failure is usually limited to one board which affects six ports rather than a system failure which was often the case with the MICOM. P. 1986, with the completion of Phases IV and V, we will migrate the administrative users to the broadband network. However, additional software developments are required to provide additional security within the network control processor before we will feel comfortable in having our administrative users intermixed on an intelligent network with academic users. This has been one of our major disappointments in that vendor supplied software has been slow in coming.

The third activity that we have been engaged in 1985 was the construction of the network control center. This provides a central location for the Network Control Processor, amplifiers and other network equipment isolated from the computers. This has been completed and will provide space for the expansion needed during the next few years. We initially had placed the head-end in the computer room but this did not provide adequate space for expansion and did not secure the network from the computers. This resulted from lack of experience on our part and bad advice from our cable plant designers. They also designed the first leg of the system in such a way that we had to recalibrate the whole system when we added Phases II & III. The message here is to be wary of the one opinion solution.

When we proceed to a full implementation of the network, we anticipate that we could release the MICOM by mid-1986. There is a possibility that the MICOM could be diverted to some other use such as a port selection device for the lower campus rather than proceeding with extending the broadband to the lower campus. Another possibility that is currently being evaluated is whether we could use the new telephone switch, a Northern Telecom SL1 system, for data switching for the dorm rooms. We will have to examine the reliability of the MICOM and the cost effectiveness of that approach vis-a-vis the broadband network approach, versus the telephone system before proceeding to Phase V.

FUTURE ACTIVITIES

The phases of development for completing the network are as follows:

1. extend network service to Morison F&A, This is Phase III and was delayed until this Fall in order to coordinate this wiring with the cable plant installation for the telephone system,
2. installation of the replacement telephone switch(early 1986),
3. extending the cable plant and network service to the new Student Center and the new Administration building, Phase IV of the LAN plan (Spring, 1986),
4. expansion of the network to the lower campus, Phase V of LAN plan(Summer 1986 through 1987),
5. develop specialized PC networks for department chairs and other groups(currently in progress),
6. provide network software for name and file servers as well as security(includes replacement of the network control processor),

7. extend the pilot video broadcasting capability to all of the classrooms and conferencing facilities on the upper campus.

ISSUES AND PROBLEMS

The issues that one needs to address in planning the development of a campus-wide LAN are for the most part those which were identified by this author in the September, 1984 issue of CAUSE/EFFECT as follows:

"1. In addition to the lack of standards and the unpredictability of when standards will be defined and finalized, the fact is that the large computer and communication companies have not yet announced major local area network products....
2. Another factor which impinges upon any evaluation is the impact of AT&T's divestiture and the difficulty of trying to acquire specifications of future PBX systems and what relationship this will have on LANs.
3. A concern faced by current implementators is that they have to deal with small specialized LAN companies....
4. Another major problem is that there are few knowledgeable consultants in this area, those who do exist are overworked, and we do not always understand that of which they speak....
5. We are also faced with the fact that the vendors' literature and rhetoric is outstripping the software capabilities of the networks. The problem is that the software resident in either network control processors or network interface units for file transfers, name-servers or network management is really at the first stage of development...."[3]

The last point is at the heart of much of our hesitancy to move ahead with a given company's product. We have purposely "dragged our feet" on expanding the network and we have been actively engaged in evaluating other vendors' products. We must decide whether this is the propitious time to switch to a vendor that might have a more sophisticated plan for network management software. While we have a sunk cost invested in our current vendor, the lack of network bridges makes it imperative that we make the right vendor decision. While bridges do exist within a given vendor's products such as bridging NETONE baseband and broadband approaches, bridges between two vendors require specialized software development that is beyond the reach and budget of most colleges and universities.

Another factor that is impacting our future developments, especially the implementation of the dormitories(Phase V) is the cost per connection in existence today. This connect cost is one of the major dilemma's that we face at this time since the price per connection has not been reduced to the comparable cost of a dataset connection. In the event that the connect cost doesn't decrease between now and the decision for the installation of the lowe campus link, we will have to determine whether we wish to sacrifice the potential for video projection into dormitory rooms and proceed with a more traditional four-wire approach(RS232) to dormitory connections versus a broadband connection.

Our experience further suggests that one should be wary of cable plant designers. We have had three different firms involved in designing subsequent legs(phases) of the LAN and each has critiqued the approach used by the previous firm in designing the preceding phase. This has resulted in our having to redo a portion of the cable plant or head-end. Fortunately, our approach was to add in small increments and we were able to absorb these changes with a minimum of impact to our users. However, it serves to highlight the need for a formal campus-wide design prior to proceeding with the installation of the cable plant. I would venture even further and argue that once this plan has been prepared a second opinion should be secured to insure that the design does not reflect the particular subjective view of one firm or individual. These people are rather like psychologists or computer people or other non-nature disciplines where there are few accepted theories or rules for the "right way" to address a problem or complete a project. The net result of all of these factors is that there is not much room for errors in planning or vendor selection.

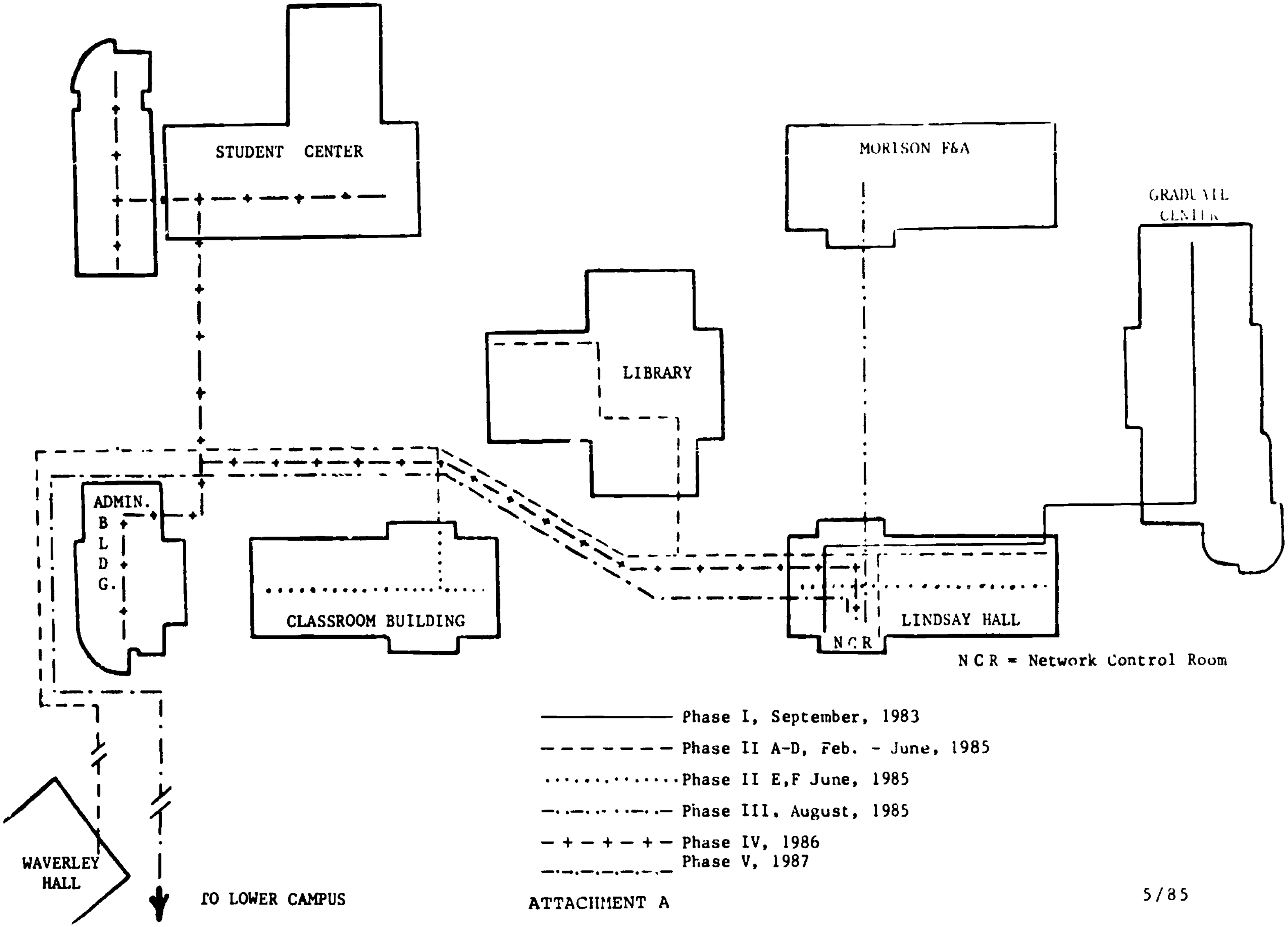
Footnotes

[1] G. T. Hopkins and N.B. Meisner, A summary of the advantages and disadvantages of "Choosing Between Broadband and Baseband Local Area Networks", Mini-Micro Systems, June, 1982, pp. 265-274.

[2] P. J. Plourde, "Perspectives on Data Communications", CAUSE/EFFECT, September 4, 1984, pp. 4-5.

3IBID., pp. 4-5.

CABLE PLANT EXPANSION MAP



ATTACHMENT A

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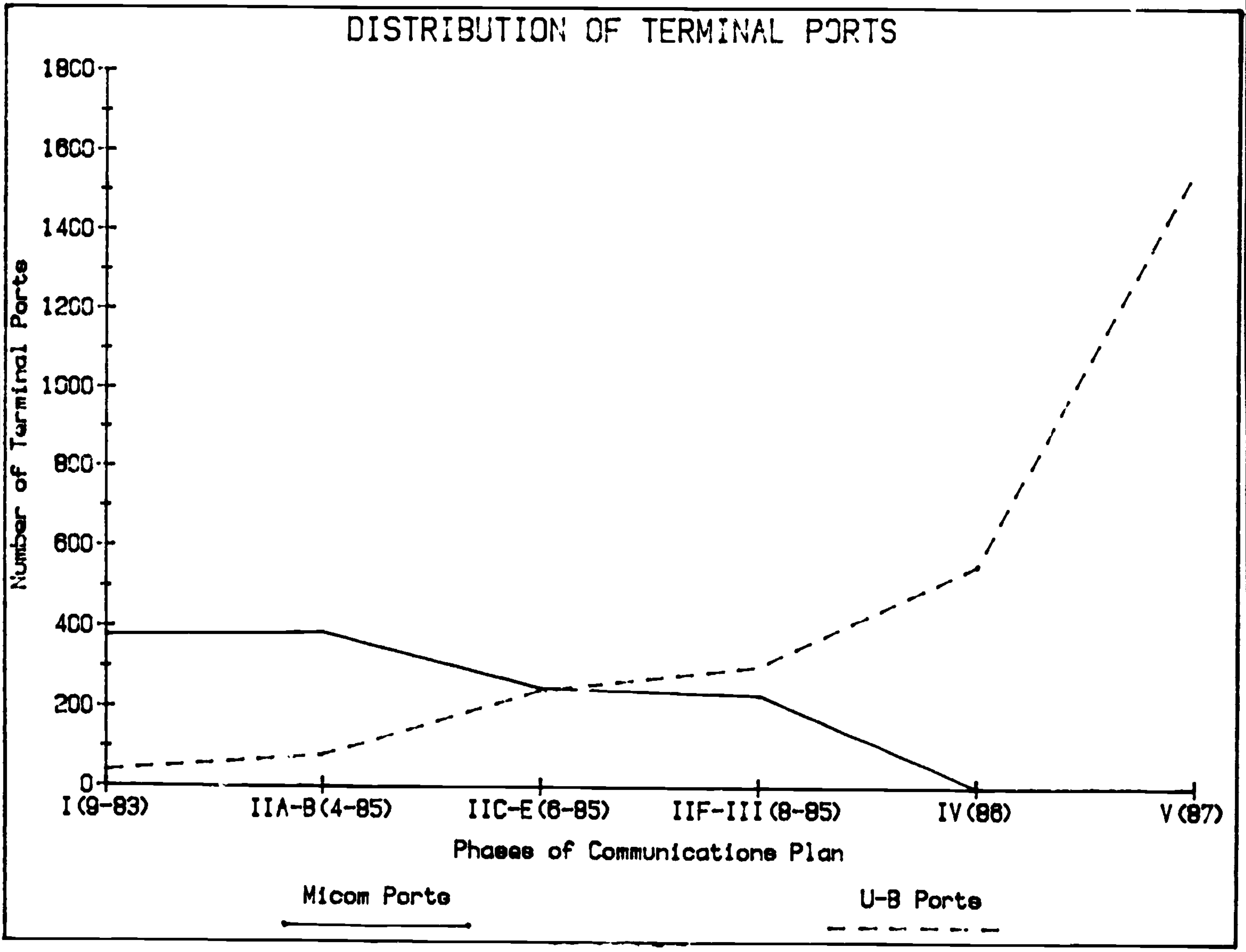

ATTACHMENT B

Academic Software—Vision and Perspective

by Steven W. Gilbert

Portions of this paper were adapted and presented by Steven W. Gilbert at the CAUSE85 National Conference. The full text is reprinted here with permission from the EDUCOM Bulletin (Summer 1985, vol. 20, no. 2). The attached chart was also presented at the CAUSE Conference.

Recent discussion of academic software has been stimulated primarily by a rapidly growing interest in microcomputer software in the higher education community.* The current overall picture, however, of efforts to develop and apply academic computer software for higher education can be described as disorganized at best: vendors view the market as fragmented and chaotic; no widely accepted vision of the future role for academic software in higher education currently exists; most colleges and universities have yet to establish their own clear set of objectives for committing to the development and/or use of academic software; and no single organization is capable of addressing the entire confusing scenario.

Moreover, the incentives — financial or otherwise — to encourage individuals and educational institutions to develop software that, primarily, serves the needs of the academic community have yet to be adopted and applied. Solutions that would encourage more effective development and dissemination of academic software often are hindered by the erroneous assumption that all software can be acquired and used the same way.

Further, a convenient, low-cost, widely accessible mechanism for sharing noncommercial software (software for which the recovery of development costs is not sought) has not been established; nor is there a convenient, widely accessible mechanism for *delivering* software throughout higher education. In fact, there is no single, centralized source of information about academic software for higher education, nor is there a system for identifying promising faculty-produced software that can be developed beyond noncommercial status.

Little progress also has been made in developing software licensing or pricing agreements that provide students, faculty, and staff with reasonably priced access to commercially successful software while simultaneously offering adequate revenue to the commercial developer.

Compounding this confusion is the fact that faculty developers and faculty users many times fail to recognize the complementary nature of their roles Most faculty developers don't realize that faculty from other institutions may be interested in using their software — even if it isn't fully polished and supported. Faculty, especially those who have neither the resources for nor the interest in developing software themselves, often fail to recognize that colleagues at other institutions may have already developed software that may be useful to them.

If the goal of revolutionary change in the higher education learning process through increased use of computers is a realistic vision, conceptual breakthroughs — the development of new academic software applications and entirely new ways of thinking about using information technology to enhance the learning process — must emerge Eventually, a breakthrough in instructional applications of information technology similar in impact to that of word processing and spreadsheet software may occur.

Considering the variety and magnitude of problems associated with academic software, no single organization alone can address all of these issues and problems. Allocating tasks to appropriate organizations and developing communications among them would provide a chance to reach specific goals more quickly and efficiently Easy availability of information about software, a cost-effective delivery system, and a cost-effective marketing system could further enhance development and use of academic software The description below attempts to categorize "kinds" of software and to describe a set of coordinated development and distribution mechanisms for higher education.

Software Categories: Noncommercial to Commercial

To encourage the continuing development of better quality, more widely available software for individual learning and productivity, two somewhat conflicting

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Academic Software is a purposely undefined term referring to all computer software — micro, mini, and mainframe — used by faculty and students goals must be met: low price for end users, and *reasonable* revenue to the developing institution. The enormous capital expenditures required of large-scale commercial software businesses to develop and market their products more than justify the energy devoted to finding ways to prevent unauthorized copying, provide fair revenues, and convince users that conventional ethics should apply. However, the same conditions do not apply to all categories of software in all markets Forms of software differ in regard to:

— how marketing information is distributed

— levels of technical support

— availability for multiple operating environments

— cost, pricing, and billing mechanisms

— delivery methods

— opportunities for copying, usage, and modifications

Scholarly tradition not only encourages, but requires the free exchange of intellectual products. Differentiation among software categories should enable the academic and commercial communities to understand that at least one important type of software is intended for copying and intellectual piggybacking.

Noncommercial (Grassroots) Software may be defined as software usually developed on campus by faculty for which financial reward is not an immediate or dominant incentive. One example might be software developed by a faculty member working alone or with help from a student programmer, perhaps on a single "module" to supplement a course, possibly simulating a principle that has proven difficult to teach through conventional means. Minimal, if any, documentation is prepared, and initially, little thought is given to peers who may use the software for instructional purposes. Faculty developing such software are often unwilling to provide even the most essential support services, thus stalling the "modules" far from ready for commercial distribution.

Precommercial Software, also usually developed on campus by faculty, differs from Noncommercial Software in that cost recovery for a portion of development and distribution expenses is expected. The software is "pre" commercial because the institution supporting this level of development significantly subsidizes the process, hoping for return of revenue to partially finance the effort.

Academic Commercial (Educational) Software may be described as software found economically viable based on sales in higher education alone, yet having sales potential in other markets. Recently, representatives of textbook publishers, software houses, software distributors, hardware manufacturers, and the academic community have been discussing the possibility of "commercializing" educational software The underlying assumption, however, is that an economically viable format can be found. (Combinations of disks and textbooks are being tried.)

The traditional support, distribution, and maintenance mechanisms associated with commercial software, however, may not be realistic for the higher education market. Perhaps potential revenue from academic software in higher education will not sustain the same level of investment in development, marketing, production, and distribution appropriate for commercial markets.

Commercial Software may be defined as software found economically viable based on sales in markets outside higher education. Two challenging and promising tasks for higher education lie in this category· developing educational applications for commercially available software and negotiating favorable pricing policies with software vendors. Colleges and universities are not well-suited to developing commercial-quality packaging, quality control, and support services necessary for success in the commercial market; however, concepts from which successful "academic" commercial software is developed must, at least in part, grow out of educational environments.

Obvious advantages for higher education exist in developing instructional and research applications for commercially available software — the underlying framework is reliable, reasonably well-documented, supported by a responsible off-campus organization, and likely to be widely available (for a price) to faculty and students. In general, applications "built on top of" commercially available software have the greatest chance of functioning on more than one kind of computer with relatively modest re-development costs, since the developer of the underlying commercial software has high incentive for making the product run well and as uniformly as possible on many different machines.

Some projects and institutions have been encouraging faculty teams to develop "templates" that tailor commercial software for a narrower academic purpose Creating simulations or models for a particular discipline by using commercial spreadsheets is the most common example Template developers may be required to pay special licensing fees to the developer of the underlying software

Many colleges and universities are attempting to negotiate "site licenses" with software vendors. The most frequent targets are publishers of the more popular spreadsheet, word processing, and database management products in general demand both within and outside higher education These are priced much higher than other personal educational materials such as textbooks

Unfortunately, many of the larger software companies see higher education as a tiny, disorganized market in which illicit copying is treated more often as a game than a crime Consequently, many college or university representatives have been rebuffed when attempting to negotiate pricing arrangements better suited to institutional structures Attempts to develop single-fee licenses for copying privileges within an entire institution have succeeded in some cases, but have often been slow to negotiate and difficult to conclude. However, efforts are underway to develop effective models for software site license contracts and for other pricing strategies Recently more software vendors and publishers have been willing to explore such options

Who Develops Academic Software?

Independent individuals Many campus producers work individually to develop academic software with little or no institutional support Independent faculty developers are often willing, sometimes eager, for colleagues to use, criticize, and improve the software — with the expectation that the creator will be acknowledged However, they are usually not interested in taking on the additional work required to make the software easier and more attractive for others to use

In many cases, the financial incentives are uncertain, career incentives rare, and oppor-

> *"The current overall picture...of efforts to develop and apply academic computer software for higher education can be described as disorganized at best..."*

tunities for sharing results with peers limited. In fact, success in developing software may not be a career enhancement in the academic community. While faculty-developed discipline-specific software is the result of demanding, creative, intellectual activity it is more often associated with enhancing instruction or research methodology than contributing to a growing body of academic research results This fact coupled with promotion and tenure committees' lack of experience in evaluating software may explain why so few colleges and universities reward faculty software development in promotion or tenure procedures. Consequently, individual academic software developers are usually motivated by potential peer approval, the satisfaction of contributing to the evolution of an academic discipline within the tradition of scholarly research, the pleasure of sharing ideas, or the inherent intellectual excitement of creating things with computers while improving the instructional process.

Individual Faculty with Modest Institutional Support. Institutions (maybe dozens, not hundreds) that provide some formally organized assistance to faculty software developers usually offer limited help from professional centralized support staff, and offer more extensive assistance — student personnel, computer access, and release time — to a select group. The latter have usually survived some form of selection process such as obtaining an internal grant. Even with typical budgetary constraints, faculty developers are more often limited by the scarcity of well-qualified support staff than by lack of hardware, software tools, or other resources.

Institutions Committed to Systematic Development of Academic Software. Very few institutions fall into this category. As colleges and universities begin to discover the real requirements and costs of producing commercially successful software, they become less willing to commit to broad software development programs; most institutions are still questioning the appropriateness of such ventures within an academic environment.

Unfortunately, institutional policy discussions on faculty development of software often center around one of the least likely outcomes of such efforts — vast wealth Faculty are not going to get rich from software development; neither will many colleges or universities. Although modest returns may be quite feasible, great financial rewards are rare. Popular media stories about a few software creators who become millionaires eclipse stories about thousands who entered the software market and departed wiser but no wealthier. Moreover, faculty don't realize the level of resources required to produce commercially successful software — 10 to 100 times the money, people, and time — compared to requirements for the initial version

Commercial Software Companies. Developing a product designed primarily for the higher education market is an enormous risk for commercial software companies. Commercial enterprises would be risking market image, reputation, and general credibility by delivering any product that lacked the characteristics essential for success in the highly competitive software industry. Such companies can't afford the luxury available to colleges and universities of delivering a product that isn't as "finished" as typical commercial software By contrast, colleges and universities can decide not to invest in the preparation and production of cross-indexed, clearly written, attractively printed documentation. They can decide not to invest in menu-driven online help functions or national mass-market advertising, and can even release software without elaborate debugging and quality assurance processes.

Consequently, most commercial software companies interested in the higher education market are still looking for new ways to reach it, or for products that will serve other markets as well.

Academic Software Distribution Systems

An effective software distribution system for higher education would create both the perception and reality of a more national, coherent, effective market for academic software in higher education. The power of colleges and universities to influence the marketplace would greatly increase if institutions' purchasing power grows in size and in ability to direct that power toward common purposes.

Academic Software Development Information Exchange. A variety of periodical publications, online databases, and newsletters cover parts of the higher education academic software scene But a comprehensive listing of all discipline-specific commercially available software just doesn't exist, thus making learning about the availability of noncommercial software in any field a matter of luck. Useful evaluations of academic software are even more difficult to find, and when found are often outdated

What is needed to encourage "grassroots" software developers is a combination of guidelines, periodically published listings, and an online database or structured system of bulletin boards. This combination should provide easy, inexpensive access for those offering information and for those trying to find it. Information about how to acquire software should also be included. Administrative overhead and expenses should be minimal, and if an inexpensive, simple device for adding user reviews is possible, so much the better Information about commercially viable or commercially oriented software could also be included

The result will facilitate intellectual exchange that may reduce duplicate effort and enable one developer to build on the work of another. Faculty (and others) will be able to find out easily if someone else has already begun developing software for a certain academic function. The Exchange would, primarily, serve those not concerned with commercial success — low cost and ease of use would be paramount. The Information Exchange should also facilitate sharing of noncommercial software as inexpensively as possible — perhaps electronically. Software that "grows" as a result of this intellectual exchange process might be able to move on to one of the other structures described below.

Academic Software Delivery Service. Any physical delivery mechanism for academic software must meet two seemingly conflicting criteria: fair revenue for software developers, and low prices for purchasers Such a service might be electronic in nature — possibly through a network — although this is not the only alternative Whatever the mechanism, the service is intended to

— help recover a portion of development costs for colleges and universities

— keep unit prices as low as possible — making software more accessible to more faculty and students

— facilitate acquisition of a rich set of low-cost, "ready-to-run" software (especially for institutions planning to integrate computing throughout the curriculum)

— remove complexity from the dissemination process

Academic Software Agency The software

> *"...there is no single, centralized source of information about academic software for higher education..."*

industry has become so complex and fragmented that finding the right partners requires much more time than most faculty and administrators can allocate. An individual or organization that functions as a knowledgeable broker and go-between to represent the interests of campus software developers is needed. This agent or agency could be responsible for facilitating communications between developers and the software companies or commercial academic publishers best suited to particular projects.

Agents are needed to recognize and promote new talent and negotiate solid deals, and would be expected to make judgments about software projects worthy of promotion beyond the Information Exchange or Delivery Service. Agent compensation could be based on revenue earned by projects adopted for promotion, or by other fee structures negotiated with individual developers or sponsoring institutions. Agents could also provide advice and guidance to software developers about documentation and other development-related tasks.

Commercial Academic Software Publishers. Will companies be established that can survive by developing and publishing academic software only? Divisions assigned such tasks within major print publishing companies are not yet self-supporting. The possibility of such commercial organizations emerging and succeeding may depend on support services like those described above. Development of a structured market and a more responsible approach on the part of higher education may encourage large commercial companies to be more receptive to pricing and licensing patterns that fit the unique characteristics of colleges and universities.

Faculty Software Developers and Faculty Software Users

Many faculty developers have the time, interest, and resources available to enable them to develop software modules, but most don't have the time and resources necessary to develop full courses It also seems reasonable to assume that most faculty developers are found on research university campuses or at institutions that have made significant commitments to supporting faculty software development. Yet not all faculty share the attitudes of faculty developers and their interest in the "process" by which software is created

Other faculty in search of software for a specific application often end up modifying existing software, a much less demanding process Faculty who adapt software add subject matter to a software framework developed and supplied by others, a practice becoming more common among consortia of colleges and universities that share easy access to one type of microcomputer, minicomputer, etc. The most common examples are the development of specialized databases built on commercially available database management systems, and simulation models described via commercially available spreadsheets. On several campuses the development of a unique instructional software module is soon followed by development of software tools that facilitate using the same approach in other academic disciplines For example, several campuses have developed software that gives students access to verbal information by "pointing" to a portion of a visual image.

Still other faculty (and students) find and use software developed by others "as is" (unfortunately, neither the "finding" nor "using" are always simple). Faculty users — especially potential faculty users — are often individuals whose teaching loads and institutional priorities don't allow time and resources for software development or embellishment. These individuals need to know what software is available, where to get it, and exactly how it is going to make them more productive as teachers or researchers

There still remains a group of faculty and students who don't seem interested in computer technology and often refuse to participate in on-campus computing. For this group it remains to be seen if compelling arguments can be found to convince them to join the "computer revolution" We are still so near the beginning of our efforts to integrate computing into academic life that it would be premature to conclude that this remarkable technology cannot be effectively applied in any discipline. Their lack of interest may be due to many factors — lack of incentives (promotion and tenure policies) and resources (funds, personnel, information, software, etc.). Or, we may find simply that not everyone *needs* to use computers.

A Critical Factor

Effective dialogue between faculty developers and users is difficult to achieve as each group focuses on different software aspects Currently, faculty users far outnumber developers and tend to think primarily of using commercial software But commercial software is too expensive to develop and distribute and too slow to emerge Faculty developers must learn to provide software and information about it that will engage users, and users must look to faculty developers and accept software that doesn't always have the polished characteristics of commercial software

Improvement in quantity and quality of the software developed on college and university campuses will only occur if faculty developers believe that the interests of potential faculty users are real and relevant, that the results of faculty developers' efforts will be useful to others, and that offering information encouraging others to use the software is worthwhile. Until the communications gap between faculty users and developers is bridged, the software distribution mechanisms described above will be difficult to achieve

While the ultimate goal involves discovering or inventing new roles for information technology in higher education, the more immediate goal is to make high quality software available in quantities and at prices that meet the unique needs of higher education This must be done while also providing fair compensation to those who develop, produce, market, and deliver academic software. Consequently, we need

— new incentives for faculty software development, mechanisms for sharing results, and mechanisms for delivering feedback from users to developers

— development of parallel, interrelated information and delivery systems for "publishing" software, based on sharply defined software categories

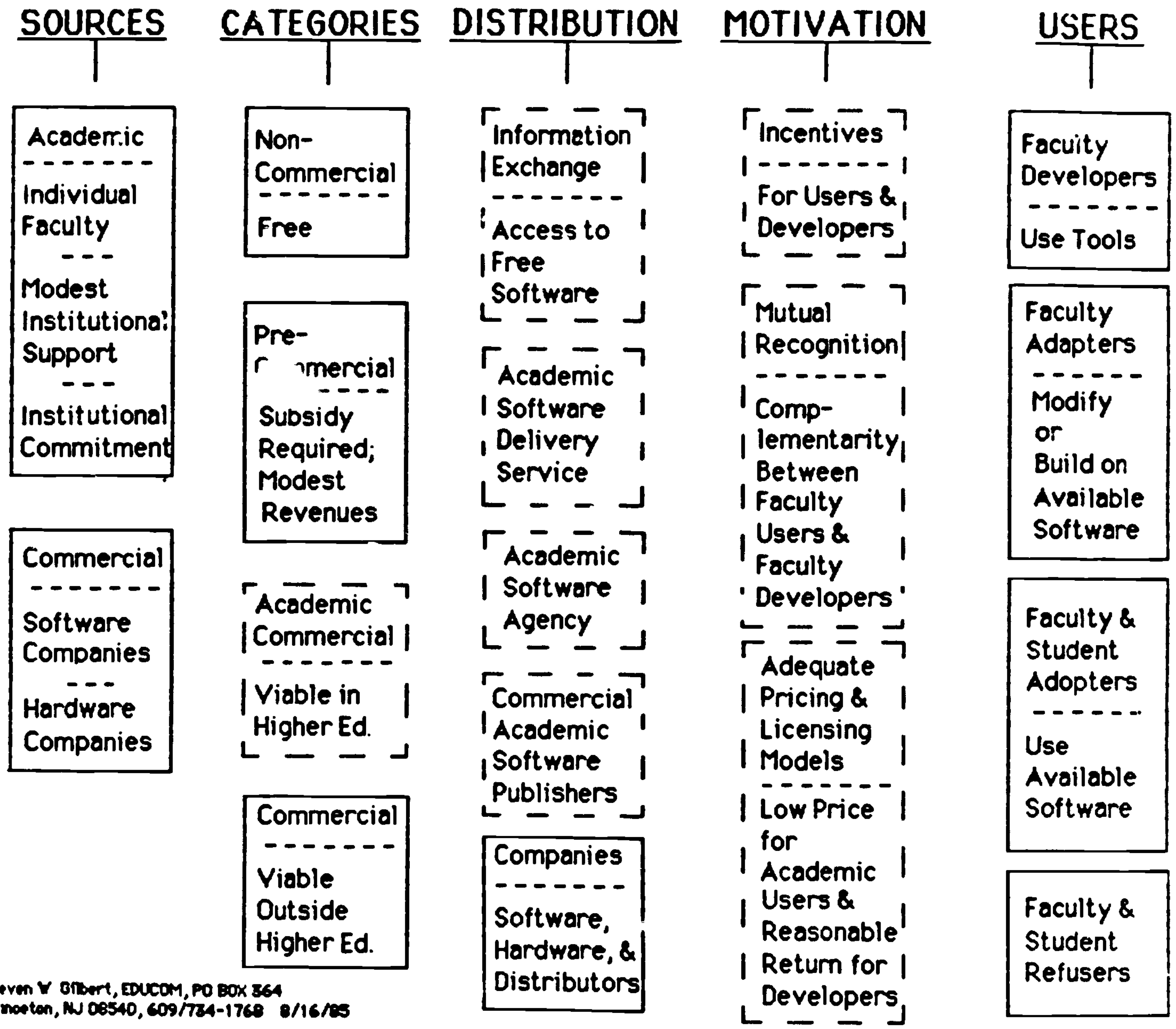
— continued opportunities for new working relationships between the academic community and software-producing companies

The next step must involve the formation of coalitions and partnerships within higher education to develop a coherent agenda for action The time has come to establish a forum for bringing together representatives of all interested parties

> *"...conflicting goals must be met: low price for end users, and reasonable revenue to the developing institution."*

(Dozens of individuals, from both member institutions and EDUCOM's staff, contributed ideas and/or criticized earlier drafts of this paper Special thanks to these individuals and especially to Brian Hawkins, Stephen Ehrman, Kenneth Green, and William Arms)

HIGHER EDUCATION ACADEMIC SOFTWARE



SOURCES

- Academic
  - Individual Faculty
  - Modest Institutional Support
  - Institutional Commitment
- Commercial
  - Software Companies
  - Hardware Companies

CATEGORIES

- Non-Commercial
  - Free
- Pre-Commercial
  - Subsidy Required; Modest Revenues
- Academic Commercial
  - Viable in Higher Ed.
- Commercial
  - Viable Outside Higher Ed.

DISTRIBUTION

- Information Exchange
  - Access to Free Software
- Academic Software Delivery Service
- Academic Software Agency
- Commercial Academic Software Publishers
- Companies
  - Software, Hardware, & Distributors

MOTIVATION

- Incentives
  - For Users & Developers
- Mutual Recognition
  - Complementarity Between Faculty Users & Faculty Developers
- Adequate Pricing & Licensing Models
  - Low Price for Academic Users & Reasonable Return for Developers

USERS

- Faculty Developers
  - Use Tools
- Faculty Adapters
  - Modify or Build on Available Software
- Faculty & Student Adopters
  - Use Available Software
- Faculty & Student Refusers

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The above chart is explained in some detail in the article "Academic Software--Vision and Perspectives" as found on pages 18 to 21 in the Summer 1985 issue of the EDUCOM Bulletin. This article provided the conceptual basis from which the EDUCOM Software Initiative is now being developed. If you would like further information about the current status of the EDUCOM Software Initiative, please contact Steven W. Gilbert, Managing Director, EDUCOM, P.O. Box 364, Carter and Rosedale Roads, Princeton, NJ 08540, (609) 734-1549.

Searching for Answers
Trying to Manage the Chaos of Academic Computing

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Massachusetts

A single year's experience as Coordinator of Academic Computing at a small college with a preference for liberal studies does not qualify one as an expert in academic computing questions, except perhaps with respect to the puzzles, problems and difficulties. This paper considers two of the more perplexing topics for one in the position of manager of the academic computing enterprise in the setting described. The clarion call of some for computing power and computer literacy, while hearty and widespread in Academe, seems in some instances unexamined and lacking in cogency. A econd thrust examines the ambiguous role of the manager, termed coordinator, the instrument or catalyst in the process of ushering in the new technology to the faculty

THE SETTING

"I feel very anxious and nervous. I really feel threatened and resentful," a senior faculty member from the chemistry department blurted out angrily. Until this moment he had been silent, content to listen to others in a small group discussion with faculty and administrators from several colleges. Inevitably, the general topic of evaluation of faculty focused for a time upon the concepts of "deadwood" and " faculty burnout." During the two day workshop devoted to "Chairing the Academic Department" no one to this moment had mentioned computing. "If I choose," he continued, "not to use computers does that infer that I'm not as good a teacher as my colleagues who are wild about the machine? Does everybody have to get on the same bandwagon?"

A summer omnibus committee of faculty and administrators discussed at length on a daily basis a wide range of subjects- mission statement, quality of college publications, facilities, campus cultural life, student activities, search procedures for administrative vacancies, academic structure, student advisement, curriculum reform, values education, computer literacy. In the fall, the study group would convey the relevant recommendations to the Faculty Senate for its action. On the question of computer literacy, after mild and brief debate, the commitee voted 8-1 to recommend a computer literacy competency requirement for all students.

During an early fall meeting of the college Academic Computer Users Committee a professor from the business faculty voiced a prime concern "I'm afraid that our students do not learn the software or use the microcomputers that employers expect. They're losing a competitive edge when they go for jobs. We need to know what micros and software packages companies want students to run so that we can prepare them better for the realities of the workplace." The ensuing discussion of the problem ended after one committee member volunteered students from his class on Market Reseach to investigate. At the subsequent meeting, the student project team presented its proposed hypothesis, objectives, and methods of research for committee review; then went about the job of investigation of employer vocational expectations for graduates with the charge to report their findings by semester end.

The same committee, charged by the president of the college to develop for his review an integrated five-year plan for computing, a condition for the expenditure of further funds for computing, wrestled at length with the question of mini-micro mix, the requisite specifications of a minicomputer to serve the needs for the next five years, the number of terminals, the number and location of micro labs, hardware and software for a writing center and electronic classroom, the choice or choices of microcomputers networking, student ownership of micros, and whatever else is fodder for a five year computing plan After several meetings devoted to these topics without apparent progress in building consensus and motivated by a combination of frustration, advocacy, and mischievousness (loyalists to IBM from Business have numerical advantage in the group as well as in student enrollments), a physics professor proposed that all freshmen commencing with the class of 1990 be required to purchase a Macintosh microcomputer.

To meet the faculty and listen to their concerns, the newly appointed academic dean, a strong believer in the necessity and value of academic computing, hosts small group, informal luncheons with all departments during the first few months of his tenure. Academic computing ranks high as a mental agenda item of the luncheons, particularly with those departments "not yet up to speed." Judging enthusiasm important, and a workshop the catalyst, the departments present at one meeting espouse the dean's idea, a concept which two days before, in another context, several present argued strongly against "We don't need workshops yet. We need equipment, hardware. It makes no sense to attend workshops if at the conclusion the machines aren't on our desks" The workshop is scheduled for next semester break

Most faculty consider student advisement a primary and crucial obligation. One faculty member counsels an advisee to substitute a course in computing for an intended elective philosophy offering. The former, as the argument goes, offers "relevance, promises rewards of conceptually clear thinking, promotes problem soving ability and skills, prepares one for life in the 21st century" The compliant student erases PH 321, pencils in CS 101

Expanded, these vignettes of local origin, drawn from my extremely limited, one year experience as Coordinator of Academic Computing at a small comprehensive college, might provide a chapter of case studies for the tyro I would call the chapter "Compatibility of the Academic Mission and the Goals of Academic Computing." The selected episodes register for me that the first, in time and in import, and the continuing task for a coordinator of academic computing is conceptual, to locate a defensible position, based on careful reflection of many factors, but particularly curriculum related ones, for the place of computers in the undergraduate academic environment. The second task is to work with other faculty, whose views, as a group, span the length of spectrum, from euphoria to skepticism about computers in teaching, to develop an individual and reasoned viewpoint for academic computing.

Erasmus, teacher of royalty, in the late fifteenth and early sixteenth century thought that classical Latin would provide the foundation for confecting a common culture. Isocrates in the 5th century BC judged his native Greek culture sufficiently powerful to accomplish this objective in his "uncivilized" world. "Will computers" asks Professor Connolly, "then provide the future foundation of our common culture, the means by which we experience one another? Not a shared history and shared language , nor an appreciation of arts and sciences that have evolved over millennia, but a multicabled web of monitors, megabytes, microprocessors, and daisy wheel printers" (48). Derek Bok asks an unfashionable and rare question. " Apart from the excitement of the new machines, what is it, exactly, that they can do to improve the process of learning? What effects will they have on the campus environment" (7)? Bok emphasizes that these powerful tools can't contribute a great deal to learning open ended subjects like moral philosophy, religion, historical interpretation, and literary criticism Inspiration, service as role models, genuine dialogue, evaluation, each critical to effective teaching, extend beyond the capacity of the machine (7). Using the metaphor of a labyrinth, and urging caution mixed with skepticism, Dean Robert Golden characterizes the computer literacy floodtide in academe as "part genuine response to need and part craze While the chorus calling for student computer literacy is loud and widespread, cogent reasons why this goal is so important are often lacking" (80).

Another thoughtful analyst of the collegiate computing scene labels the phenomenon "computer mania," charging that adoption of computer power is "more cosmetic than thoughtful. The endless enumeration of who is doing what can be dazzling, but there has been little critical analysis," asserts Bonham, "of the educational significance of what is being done It is as though with the invention of food processors, we were determined to consume only that food capable of being sliced, diced, and pulverized. Such behavior would be of substantial benefit to manufacturers of food processors, but would hardly improve the national diet" (72). Brian

Champness describes the introduction of computers to the classroom as "an irrational push of technological determinism," and asks, not only what will students be like after this, but the complementary question of what subjects and activities will computing replace Weizenbaum and others suggest that soon students will not need much hands-on computing experience. The computer will be largely invisible, as it is now in many commonly used machines in everyday life (225). Thus the emphasis replaces more significant realms of learning.

Several attend to the unprecedented entanglement of profit motivated vendors with education "What the computer literacy movement seems to be most enriching" states Menosky, challenging the popular view, "is its backers, sellers of computers and computer programs, promoters of retraining courses for workers and teachers, writers and publishers of the industry's books and magazines Last year for example US schools spent nearly $500 million on personal computers and programs" (78) Computing too has spawned an enormous training culture as colleges join American industry in affection for short workshops and one day seminars Economic in time and money, though value is another matter, the itinerant training cohorts travel from motel to motel conference room, making a quarterly circuit through San Francisco, Houston, Atlanta, New York, Chicago, and Boston Like the wandering Sophists of ancient Athens, the seminar sponsors promise results for a stiff fee. Joseph Weizenbaum defines computer illiteracy a disease invented to market the cure (McCracken) Weizenbaum also offers a provocative anecdote on the promise that computing course work will aid in perfecting problem solving skills, though perhaps humor rather than insight is the main intent of the quip "Take a great many people who've dealt with computers now for a long time-for example, MIT seniors or MIT professors of computer science- and ask whether they're in any better position to solve life's problems And I think the answer is clearly no They're just as confused and mixed up about the world and their personal relations and so on as any one else" (Menosky 81) Walter Reich's spoof article suggests that the "great computer diversion has been an extremely clever Soviet scheme," an effort "to neutralize the American intelligentia." His evidence in part, the example of an apparent vocational change of a thoughtful ex-presidential speech writer and acclaimed author who uses his considerable writing talents to expose the tricks and pitfalls of WordStar.

Patrick Suppes, a durable and respected leader in CAI, bears witness to the independently arrived at wisdom of Casey Stengel and Neils Bohr, each of whom articulated in similar grammar, the aphorism that it's very difficult to predict, especially when talking about the future In 1966, Suppes divined in an article in Scientific American. "One can predict that in a few more years millions of students will have access to what Philip of Macedon's son Alexander the Great enjoyed as a royal prerogative. the personal services of a tutor as well informed and responsive as Aristotle" (8). The skeptics recall that technology introduced to teaching is littered with failures or partial successes. A press release from Carnegie Mellon compares the use of personal computers with respect to increasing learning to assembly line methods increasing significantly productivity in the auto industry (Chorover 224). Derek C. Bok reminds intemperate enthusiasts that experience should make one wary of dramatic claims for the impact of new technology. For some faculty, the innovation and revolution accomplished by the copying machine and the paper-back book have more immediate classroom significance. Thomas Edison's opinion that the phonograph would revolutionize education supplies one piece of evidence that technology's path to the classroom is not always smooth Bok quotes Richard Clark, a leader in evaluation of technology: "Five decades of research suggest that there are no learning benefits to be gained from employing different media in instruction, regardless of their obviously attractive features or advertised superiority . The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more that the truck that delivers our groceries causes changes in our nutrition" (8-9).

The literature sometimes seems to identify teacher resistance and conservatism, and lack of quality software as primary obstacles to the widespread introduction of computers in the classroom. A more plausible explanation may be the hesitancy of some to, in the language of Francis Bacon, accept as truth things that are weakly authorized or warranted The innocence of educators coupled with intense competition for a diminished supply of students and the profit motives of relentless and well trained vendor representatives, may obscure the prior questions of mission, goals, and curricular aptness.

To manage the chaos of academic computing, a necessary condition is, it seems to me, an effort to form a clear conception, stripped of childish enthusiasm and vendor hyperbole, of the role of computers in the various disciplines of the undergraduate college curriculum. Computers should be used in the classroom not because they are here, available, and publicized in competing schools, but because teaching is enhanced

WAYS OF LOOKING AT THE MANAGER, THE COORDINATOR OF ACADEMIC COMPUTING

The second most important task of the coordinator of academic computing is, it seems to me, like the first, conceptual The role, at least in a small college where one person is the show, lacks definition It is extremely diffuse, amorphous, and unchartered. The coordinator of academic computing is truly an odd creature in an odd situation Assumed by administration to be a manager, and by faculty, a colleague, the position is essentially, in a delegated sense, powerless, lacking in formal authority To succeed in meeting chosen objectives, without control or genuine authority, in the often individualistic and anarchical setting of a college, and in a sphere where voluntary cooperation is necessary to success, requires at least perseverence and luck as well as other less definable qualities In addition, skills learned experientially in classroom teaching are not identical with those needed to perform successfully as a coordinator-manager.

Writing about another setting, Orr identifies "four monumental problems" creating a management crisis: "too much to do, too little time to do it in, too few good people and too many options" The same factors apply equally to the position of managing academic computing, at least in the setting of a small college and a one person operation. The challenge of the position is to fashion, or help fashion, with others the direction of academic computing. Time is the scarcest resource and while there are many good people, each has other responsibilities "Too many options," as Orr indicates, is a main culprit in creating problems -a choice of 752 models of cars and trucks to select from, a store with 2,500 types of light bulbs- has computing counterparts. The great number of computing options can easily paralyze decision-making, especially in a collegial setting, and when past experiences suggest that any selection is two weeks too early. The range of personal choices has exploded (megatrend number 10) in all spheres of life with multiple options in religion, foods, entertainment, workplace, neighborhood, and word processing (over one hundred) programs (Couger). There exists a dazzling array of choices in computerland, in machines and software, and if not managed, the college will find itself host to a Babel of incompatibility.

To define the position of coordinator, an examination of the specific tasks performed suggests the appropriate competencies The editor of The Computing Teacher provides such an analysis and evolves a list of four primary competencies. The context of the derivation is precollege, but this seems inconsequential to Moursund's conclusions. The suggested competencies are,

> "C1. Technical knowledge in the fields of computer science and computer education.
>
> C2. Interpersonal relations skills; written and oral communication skills; administrative skills
>
> C3. Overall intelligence and perseverence; good ability to learn; a broad general education and dedication to lifelong learning.
>
> C4. Knowledge and support of our education system; good skills in teaching school children and educators." (3-4)

According to Moursund, successful coordinators are all "exceptionally strong in one of more of these competencies" and possess additional characteristics such as good learners, dedication to education, good listeners, open to learning, and a strong work ethic. Finkel, in a reaction to the article, disagrees on the necessity and desirability of in-depth technical skills, conceding that in the mainframe dominated past, but not the present stage of development of computing, the necessity of an in-depth level of technical knowledge existed. The then esoteric knowledge created the so-called "computer priests," resulted in the exclusion of other academics from the computer sect, and helped to impede the implementation of widespread academic computing. "It's my feeling," states Finkel, "that a good computer coordinator does not need to be a computer science expert, but does need to have a basic computer science understanding plus a host of other skills; the first being to know where the resources are and how to tap into them. Today's computer coordinator needs a strong curriculum background in a variety of subject areas as well as administrative knowledge and skills. This person should have had classroom teaching experience, including the use of computers in a curriculum area(s)" (22). The coordinator is an advocate for the totality of the curriculum, not just for the computer science domain. A corollary, perhaps less appropriate to colleges, is the rule articulated by some that computers should not be physically placed or associated with the mathematics department, lest the impression of proprietory rights, to the detriment of college wide implementation in all disciplines.

Computing literature, such as Computerworld and Datamation, suggest tactics for managing computing environments in business-ways for winning over colleagues, influencing people, communicating skillfully, establishing horizonal links, leading, building cohesion, and providing feedback (Jackson, Linder, Nienburg, Orr, Sinetar) The variety and number of articles suggest the multifaceted nature of the role and do provide direction and hints for the academic counterpart, especially one drawn from the ranks of teaching where getting the job done, meant doing it personally

Listing the interpersonal, informational, and decision type activities provides snapshots of the position The computer coordinator-manager assumes protean roles and deals almost daily with several intra-mural and extra-mural constituencies-students, faculty, staff members, administrators, software and hardware vendors The variety of roles provides a clue to the "too much to do" and "too little time" complaint as well as suggests, to do the job well, the complement of skills needed A list of dominant roles and assumed masks includes

- problem solver
- coordinator
- representer
- reseacher
- trainer
- negotiator
- entrepreneur
- teacher
- innovator
- advocator
- advisor
- motivator
- learner
- resource allocator
- decision maker
- mentor
- planner
- leader
- disseminator
- student
- supporter

In an article, "How Senior Managers Think," Daniel Isenberg's research indicates that senior managers "tend to think about two kinds of problems how to create effective organizational processes and how to deal with one or two overriding concerns or very general goals" (26) This assessment agrees with other's findings relating to critical activities of managers "developing and maintaining an extensive interpersonal network and formulating an agenda" (26) For managers, organizational and interpersonal processes, getting colleagues together to remedy a problem, receive major attention Put simply this might mean to answer the question whose help do I need to accomplish this purpose? According to Isenberg, "successful senior mangers think a lot about interpersonal processes and the people with whom they come in contact They try to understand the strengths and weaknesses of others, the relationships that are important to them and their agendas and priorities" (27) Ask an experienced coordinator of academic computing how to begin to get faculty into using a computer in the classroom, and, in my experience the reply is, "give a friend or a senior faculty member a terrific and useful software package" If workshops seem a good idea, let those targeted carry most of the burden Managers devote most of their attention to the tactics of implementation rather than the formulation of goals and strategies. Most senior managers studied "were occupied with a very limited number of quite general issues, each of which subsumed a large number of specific issues" (27)

The tactic of implemetation of academic computing is helping faculty master the computer culture in their own way and at their own speed Networks - people talking to people, sharing ideas, horizontal links- have always been the rule in academic institutions.

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PARTICIPATING VENDORS

The twenty-two vendors with computer-related products and services listed below participated in the CAUSE National Conference. The vendor presentations, sponsorships of conference activities, vendor hospitality, and suite exhibits offered by these companies contributed a great deal to the success of the conference and its value to conferees.

American Management Systems, Inc. (SE/H)

Business Information Technology, Inc. (S,P)

Business Systems Resources (SE/H)

Cincom Systems, Inc. (P)

COMPUTER ALLIANCE (SE/H)

Control Data Corporation (P, SE/H)

Coopers & Lybrand (P, SE/H)

Datatel Minicomputer Company (P, SE/H)

Digital Equipment Corporation (S, SE/H)

Hewlett-Packard Company (S)

IBM Corporation (S, SE/H)

Information Associates, Inc. (S, SE/H)

Information Solutions, Inc. (SE/H)

Integral Systems, Inc. (P, S, SE/H)

International Telephone and Telegraph (SE/H)

Pansophic Systems, Inc. (SE/H)

Peat, Marwich, Mitchell & Co. (P, S)

Price Waterhouse (P)

Racal-Vadic (P, SE/H)

Sperry Corporation (P, SE/H)

Systems & Computer Technology Corporation (P, S, SE/H)

Texas Instruments Incorporated (P, SE/H)

KEY:
P = Presentation
S = Sponsorship
SE/H = Suite Exhibit/Hospitality

Business
Information Technology, Inc.
A Professional Corporation
P O BOX 4569 • WILMINGTON, DELAWARE 19807 • 302-656-3606

ABSTRACT

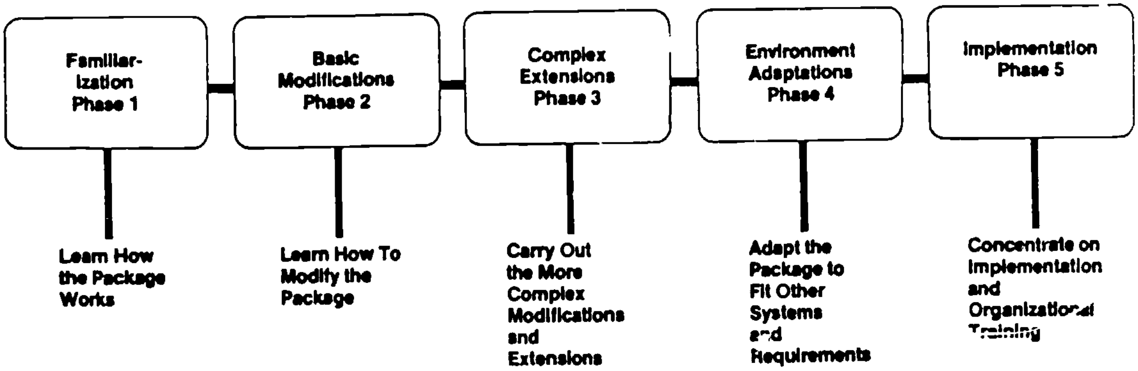
Business Information Technology, Inc. is a national consulting firm with four offices across the country specializing in the implementation of the ISI Payroll/Personnel System. The firm approaches the implementation of purchased software packages using a "Prototyping Approach" that avoids the pitfalls associated with traditional systems development methodologies. They are extremely successful in applying their approach not only in the College and University market but also for Fortune 500 firms like: Carrier Corporation, Hartford Insurance, Hughes Aircraft, Meridian Oil, and dozens of others.

The following graphics provide an overview of the "Prototyping Approach" employed by the firm.

PROTOTYPING GUIDELINES

- **Definition:**
  A Step-Wise Approach for Effective Implementation of Purchased Software Packages.
- **Training Commences Immediately and Continues**
- **Forces Thinking In Terms of Package**
- **Requirements are Stated In Context of the Package**
- **Base Level Modifications Begin Early**
- **Project Is Statused In Terms of Completed Tests**
- **Results are Demonstrable**
- **Users' Participation Is Defined**
- **Management Can Participate**
- **Demonstrates True Training Requirements**
- **Clarifies Conversion Requirements**
- **Clarifies Interface Requirements**
- **Project Team Gains Early Knowledge of Software**
- **Project Estimates Based on Experience**
- **Brings All Project Members Up Learning Curve**
- **Makes Project Planning More Realistic**

PROTOTYPE PHASES



Familiarization Phase 1 — Learn How the Package Works

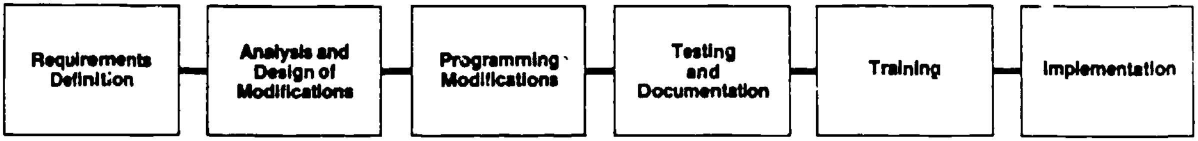
Basic Modifications Phase 2 — Learn How To Modify the Package

Complex Extensions Phase 3 — Carry Out the More Complex Modifications and Extensions

Environment Adaptations Phase 4 — Adapt the Package to Fit Other Systems and Requirements

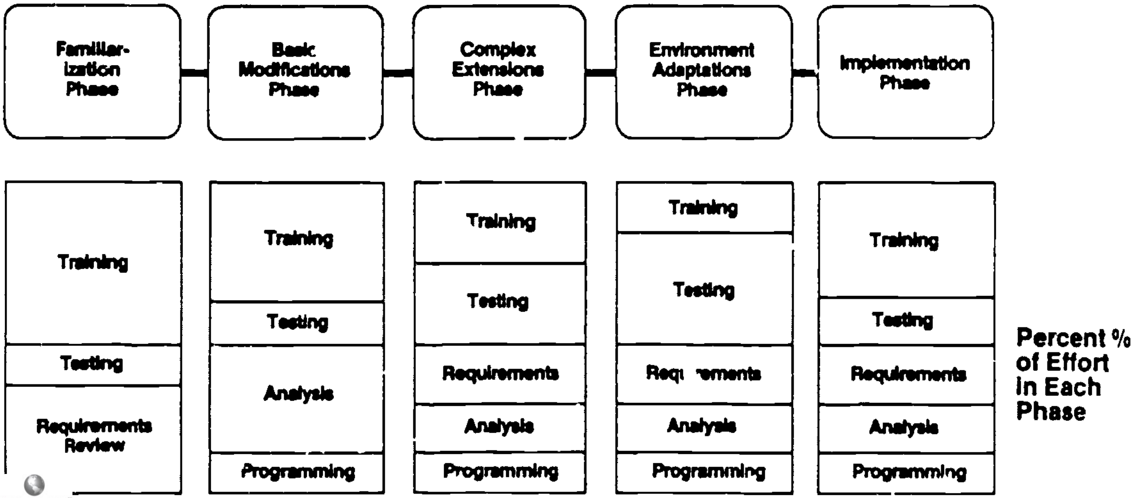
Implementation Phase 5 — Concentrate on Implementation and Organizational Training

TRADITIONAL IMPLEMENTATION METHODOLOGY



Requirements Definition — Analysis and Design of Modifications — Programming Modifications — Testing and Documentation — Training — Implementation

PROTOTYPING METHODOLOGY



Familiarization Phase
- Training
- Testing
- Requirements Review

Basic Modifications Phase
- Training
- Testing
- Analysis
- Programming

Complex Extensions Phase
- Training
- Testing
- Requirements
- Analysis
- Programming

Environment Adaptations Phase
- Training
- Testing
- Requirements
- Analysis
- Programming

Implementation Phase
- Training
- Testing
- Requirements
- Analysis
- Programming

Percent % of Effort In Each Phase

PRODUCTIVITY FOR DATA ADMINISTRATION

Abstract of Presentation made at CAUSE85

Cincom Systems, Inc.

How well an organization performs depends largely on the availability and accessibility of up-to-date, accurate, meaningful information for anyone who needs it, when they need it. The frustrations of administrative end users in getting such information access is well documented. No one knows better than data processing that the real culprit is the complexity and limitations of first-generation and even relationship-type data base management systems.

Till now the productivity advances in data processing have occurred primarily in the programming function. Data processing has been restricted in the area of data structuring within the data base while trying to deal with the diverse needs of production and query processing. Limited data structure independence has also impacted the information access process by forcing data processing to spend its time on maintenance rather than new development--restructure of data leads to rework of application.

Data administration has also faced complexity of data base design, normalization of data, and constraints on insuring the integrity and security of data. It has been these constraints on data processing that have formed the real burden and bottleneck to information access.

With the arrival of advanced relational technology in 1985, data administration finally gains the architecture and tools to break that bottleneck. The implementation of a three-schema architecture in data management insulates applications from both physical and logical changes. The result is simpler and quicker application development with fewer errors. Multiple data structuring techniques for high transaction production systems and query facilities become possible. Tools to automate data administration tasks are now available in data base implementation and the critical areas of referential and entity integrity.

The availability of these recent technological developments brings to data management and administration a true foundation for effective information access. Such access brings to an institution the critical resource needed to not only suvive but prosper.

THE EDEN STUDENT RECORDS SYSTEM

Control Data Corporation

Eden, the comprehensive student records system designed by college administrators for administrators like you

It's five state-of-the-art subsystems that you and your staff need to optimize use of your human and financial resources Here are a few of the many benefits Eden delivers

Gateway	Streamlines and personalizes your admissions processing, forecasts resource requirements, tightens cost control
Student Records	Registers students, maintains and reports grades, prepares and archives transcripts, creates your course catalog and much more
Student Aid Management	Uses approved Department of Education methodology to assess student needs, provides peace-of-mind by helping to assure your school's compliance with government regulations
Bursar	Automates student accounts receivable to save labor, reduce errors maximize accountability
Alumni	Enriches present campus development activities by maintaining lists and accounting controls, simplifies and personalizes communications

How Will the Eden Student Records System Benefit Your School?

The Eden Student Records System is the management tool that enables you, the campus administrator, to

- improve/expand student services
- optimize your human and financial resources via improved controls and interdepartmental communications
- obtain the management information you need for planning resource requirements, responding to local, state, federal regulations, reporting to your school's top officials
- achieve accountability, you can access an instant information source that gives you the edge in making decisions from funding requirements to classroom reservations
- serve your students better by streamlining and improving the entire student records effort

LASER DISK INTERACTIVE SYSTEMS FOR HIGHER EDUCATION ADMINISTRATION

Abstract of Presentation for CAUSE85

Coopers & Lybrand

Technology has advanced to permit end users to design special applications which are extremely user friendly and which employ some of the techniques and equipment emerging from the artificial intelligence community.

C & L has established relations with high tech firms to develop applications using laser video disk technology whereby video programs can be interactive with users. The video can be preprogrammed to respond immediately to different user inquiries and programs superimposed on the disk so computations can be done with information provided by the user at that moment. The application potential of these technological advances is significant. Any area where an institution has significant need to communicate repetitive information to large numbers of people (e.g., applicants, employees) on a "face-to-face" basis is a candidate. Opportunities exist in registration, admissions, and personnel for such applications.

Coopers & Lybrand with Mandell Institute demonstrated an application of laser disk technology in the financial planning area. They also discussed how institutions should plan to develop similar applications in relevant administrative areas.

Coopers & Lybrand also demonstrated a budgeting system developed using PC FOCUS, a fourth-generation language. They discussed how this can be related to the proliferation of end user applications in the university community.

GUIDELINES FOR SELECTING YOUR ADMINISTRATIVE COMPUTER SYSTEM

Abstract of a presentation prepared by
Donna Evancoe and Sandy Opstad
and given by Bill Petersen

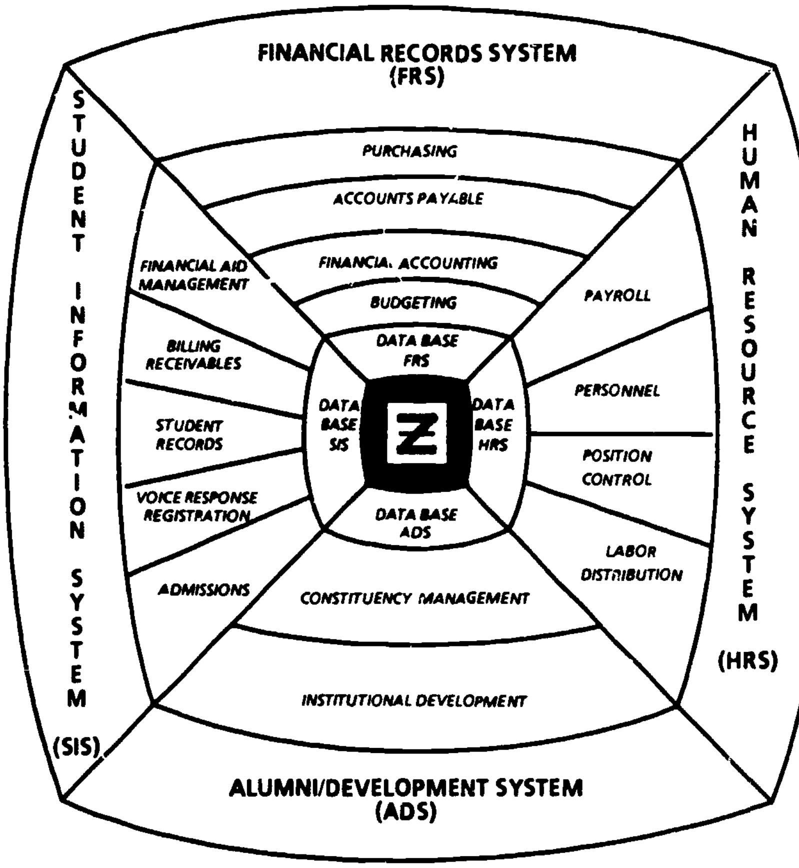
Datatel Minicomputer Company

Institutions that are planning to introduce, improve, or replace an administrative computer system are faced with a great variety of choices. Because there are so many affordable and technically feasible options, it is extremely important that colleges and universities take a deliberate and systematic approach to selection and implementation of a computer system.

Technological advances have brought us to the point where administrative computing decisions should no longer be made on the basis of hardware alone. In fact, hardware is really of secondary importance. In administrative computing today, decisions should be made primarily on the basis of software. Forward-looking institutions are analyzing their administrative functions and seeking total systems--software and hardware--to run administrative operations efficiently and effectively.

This presentation suggested procedures to follow and identified important factors to consider when your campus seeks a new computer system.

SERIES Z: GENERAL CHARACTERISTICS AND FEATURES



A proven system for today's information management needs.

Series Z is an integrated, on-line software system designed specifically to meet the information management needs of colleges and universities. Incorporating proven concepts from our years of experience with colleges and universities, we've created an affordable system for today's mini and mainframe computers.

Series Z is actually four application systems in one: Financial Records, Human Resources, Student Information, and Alumni Development. All four systems interact with each other. Most of all, however, Series Z provides you with all the information you need to make timely, accurate, intelligent management decisions.

Series Z incorporates an integrated system structure to efficiently handle separate categories of processing, yet address the entire administrative needs of the institution. The Series Z design eliminates data redundancy and promotes efficient processing.

A modular approach to design and integration has been applied. Such design permits 1) phased implementation allowing systems to be added as necessary and within the priorities of the institution, 2) modular sequence flexibility, 3) ination of data redundancy, 4) a consistent data definition to be maintained as well as system integrity and security, 5) insulation from computing environment changes, and 6) continued development of modules to meet the higher education administration computing needs.

Series Z Data Handler

The Series Z Data Handler controls the storage of data and defines how that data will be integrated. The Data Handler functions as a Data Base Manager for the Series Z administrative programs, integrates with other Data Base Manager Systems or with other non-Series Z application programs. The Data Handler also controls screen formats, and procedures and enables the user to quickly make changes within the system, often without reprogramming.

Security

Series Z has been designed to "police" your information and let you control who sees what. The various levels of security control include: system, application, function or data element or the institution can define special access for limited use. Series Z also defines on-line changes according to security levels in the same fashion.

On-Line Data Entry, Inquiry and Update

Input to Series Z goes through a single channel, regardless of date, quantity or sequence. This includes both initial data entry and update. All entries can be submitted in on-line, or in batches. Series Z also provides for on-line inquiry to the data base, at any time.

Screen Generation/ Modification

Series Z permits you to build your own screens, to meet possible user-defined needs not already addressed by the system.

On-Line Help

On-line help features include diagnostic, data definition and screen help. Series Z is designed with such on-line features to assist the user or operator in learning how to use the system faster without the need to consult a manual or leave the terminal.

Software Maintenance

An important aspect of any software purchase is the availability of maintenance. Series Z has a complete maintenance program for regulatory changes and/or enhancements.

Series Z Report Writer

Z Writer efficiently meets the report generation needs of Series Z users. From the simple to the complex, Z Writer is ready to provide the solutions to your ad-hoc reporting and on-demand data needs.

SERIES Z VOICE RESPONSE REGISTRATION

IA has added a telephone registration system to its Series Z - SIS. The new component enables students to register or inquire about their classes from any touch tone telephone, from anywhere The application of hardware developed by Perception Technology Corp. and IA's student registration system has resulted in a creative, cost-effective tool. The frustrations of long lines, short tempers and confusion have given way to the calm convenience of the telephone. While it simplifies life for your students, it also helps to cut your registration costs.

IA Microcomputer Offerings

Information Associates has introduced another labor-saving, state-of-the art software option to assist in meeting administrative responsibilities. FBS provides a top down budgeting vehicle which allows your personal computer and mainframe to work together to build your budget. IA's Financial Budgeting System supports the entire budget process, producing a sound, workable document.

A Leader in Information Services

Our capabilities are backed by a staff of more than 220 professionals who concentrate on every element of each customer's individual requirements.

We are dedicated to seeking better solutions to turn data into useful information. We offer a full range of support services including customer training, user group participation, the necessary documentation, source code, test data, software maintenance and technical support.

Our experience and success in providing flexible, state-of-the-art systems makes us confident that Information Associates has a complete system solution to meet your needs.

Whether you're improving your present system, or just beginning to look for administrative software, investigate Series Z first. Call the Information Associates office nearest you.

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EXTENDED USES OF HUMAN RESOURCES INFORMATION

Abstract of Presentation
made at CAUSE85

Integral Systems, Inc.

Integral Systems, Inc. (ISI), provides a full-featured system to meet the payroll, personnel, position control, and applicant tracking requirements of colleges and universities. Exciting new uses of the information recorded to suppport those functions have been developed for both mainframe and microcomputer applications. Of particular interest to institutions of higher education are tenure tracking, budget modeling, graphic capabilities, and inventory of instruction skills. Other new functions include information download to spreadsheet packages, affirmative action planning, graphic organizational charts, succession planning, and flexible benefits programs. As the information requirements of payroll and personnel offices continue to change rapidly, application systems must change to support their needs.

NOVEMBER/DECEMBER 1985 Volume 13, Number 6

The Big Byte

Published bimonthly by Pansophic Systems, Incorporated

Pansophic premiers PC version of EASYTRIEVE PLUS

"It really is EASYTRIEVE PLUS on the PC!"

Surprise at seeing an old friend in a PC environment is the most common reaction that beta testers of Pansophic's latest offering have expressed over EASYTRIEVE PLUS • PC. EASYTRIEVE PLUS is Pansophic's information retrieval and data management system for end user reporting applications.

EASYTRIEVE PLUS • PC -- the EASYTRIEVE PLUS information retrieval system with a host of additional PC features -- was actually written from scratch to maximize the benefits of running on a PC. Designed to operate on IBM PCs and compatibles with 256K of memory and a hard disk, the product will also support dual floppy systems if it is stored on the mainframe and run through PANLINK (Tempus-Link from Pansophic), a universal mainframe-to-micro link.

Common uses

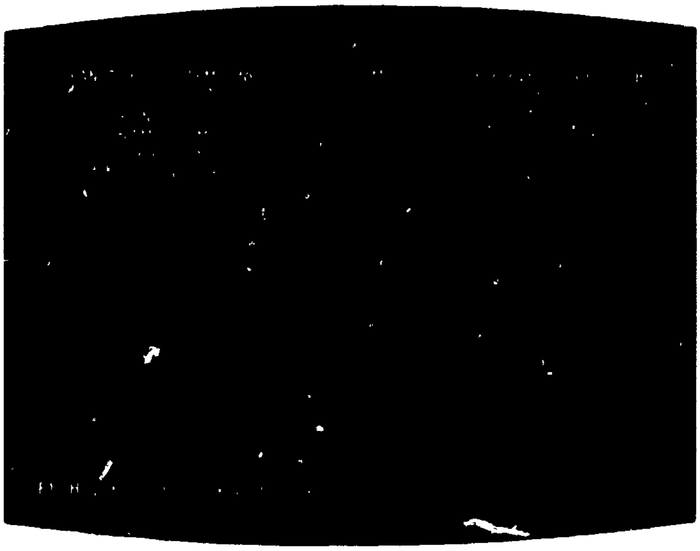
The PC version of EASYTRIEVE PLUS offers companies a number of new options. No longer tied to the mainframe, MIS can offload reporting to PCs, encouraging departments toward report writing independence in the friendly PC environment. Since the PC product features the same syntax as mainframe EASYTRIEVE PLUS, there is little new training necessary.

Because of operating system differences, the mainframe and PC products vary slightly in file specifications. However, the PC product contains a syntax checker not only for PC EASYTRIEVE PLUS jobs, but also for mainframe jobs. This means that the PC serves as an effective programmer workstation -- allowing the programmer to enter a job and syntax check it on the PC before executing it on the mainframe.

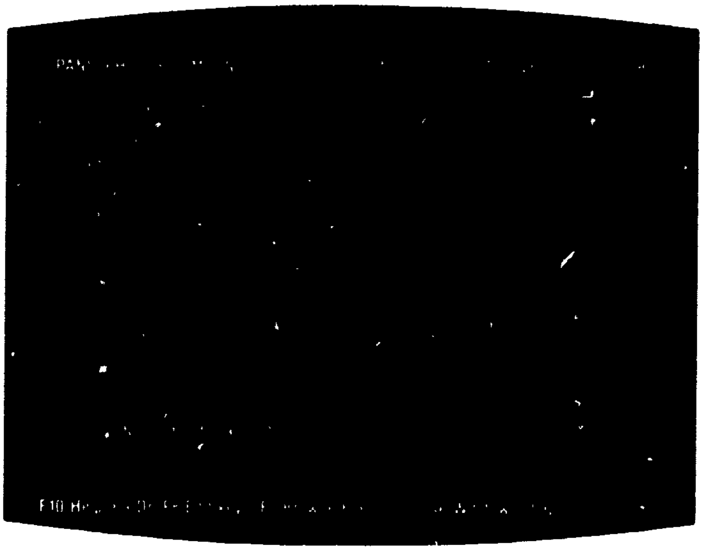
PC features

Besides offloading reporting to PCs and serving as a workstation tool, EASYTRIEVE PLUS • PC is an information center product allowing the end user to engage in self-service computing. New PC oriented features of the product include forms creation suitable for data entry; a database in which the data can be stored; an editor for entering and correcting jobs; and help windows offering cues to syntax. Thus, end users have all the tools needed to enter, maintain and report on their own data sets.

EASYTRIEVE PLUS • PC
(continued)



Mainframe EASYTRIEVE PLUS users will find the same syntax in the PC product.



EASYTRIEVE PLUS • PC scans a job for errors. The editor stops at each error, allowing for corrections. Here the user splits his editing screen to browse his data file in the top portion and edit his program in the bottom portion. The check marks show him which half he is working in at the moment.

Designed for the less experienced user as well as for the computer professional, the forms creation facility of EASYTRIEVE PLUS • PC automatically constructs forms from file descriptions. Users can then alter the screen to fit their own tastes.

Forms can also be used to browse records in a file or to add, delete or update records. They lend themselves well to key searches too, like displaying all accounts in a particular state or displaying all salesmen with sales over a half-million dollars.

When it comes to keying in an EASYTRIEVE PLUS job, users who feel a bit rusty on syntax can bring up a HELP window right on top of their editing screens, entering a line of type while viewing the syntax cue.

EASYTRIEVE PLUS • PC automatically brings up a HELP screen related to the key word the user is entering. Another alternative for the user is to scroll through an alphabetical list to select HELP topics. A HELP window for the editing commands themselves, is also available.

When users want to look at a second file--of data definitions, for example--while writing a job, they can split the editor screen and browse the second file for information while entering or correcting the first. Thus, if the field name has been forgotten, they can refresh their memories while entering the job commands.

With forms creation, HELP windows, editing and data management, EASYTRIEVE PLUS • PC marries the user-friendliness of the PC to the power of a program that originated on mainframes.

EASYTRIEVE PLUS • PC will be available in December on a site license basis. For complete details on how you can obtain it, please contact your local Pansophic Marketing Representative or call Pansophic at 800/323-7335. Illinois and Canadian residents will reach Pansophic by calling 312/986-6055.

International release dates for EASYTRIEVE PLUS • PC will be determined by individual region. ☐

STER PLANNING FOR COMPUTING TECHNOLOGY

Peat, Marwick, Mitchell & Co.

This presentation explained a sequential process through which individual campuses or institutions can establish or revise a master plan for computing. The master plan should provide the long-range direction, set the stage for tactical (annual) planning, incorporate the needs of both the administrative and academic segments of the institution, and become a "living" document through annual revisions.

<u>Step 1 - Evaluate Computing Technology Systems in Terms of the Institution's Mission</u>. Identify the appropriate level (i.e. leading edge, state-of-the-art, stay-with-the-art) of technology for instruction, research and administrative areas. This step should include broad participation across all institutional areas to develop concensus, clarify expectations, and establish ground rules for the planning process.

<u>Step 2 - Establish Institutional Programmatic Objectives</u>. Academic users should determine how computing and information technologies can most effectively enchance or support their programs. Likewise, administrative users should focus on the degree of intra- and interdepartmental information systems integration and sophistication needed to reap the greatest business-oriented effectiveness.

<u>Step 3 - Establish Functional Requirements</u>. Technological areas that should be considered for inclusion are telecommunications, office automation, computer assisted instruction, and video disk, in addition to administrative functional requirements. These requirements should be documented and reviewed to ensure they are comprehensive and clearly articulated. Next, vendors of products satisfying these requirements should be identified, and demonstrations should be arranged.

<u>Step 4 - Prioritize User Requirements</u>. This step should be carried out with agreed-upon evaluation criteria based upon institutional mission, program objectives and technological preference.

<u>Step 5 - Develop Alternative Approaches</u>. No more than three approaches should be developed to address the prioritized functional requirements. Examples may include upgrading hardware, networking existing equipment and systems, developing interfaces, procuring software pakcages, and beta test site agreements.

<u>Step 6 - Select Preferred Institutional Approach</u>. Analyzing each alternative will result in the selection of a preferred approach. This analysis should consider organizational adjustments required; the impact on current technologies of the institution; staffing levels, individual experience and capabilities; and the financial resources available.

The final result should be a master plan for computing that satisfies the need for all users, is in concert with the institution's mission and goals, and takes best advantage of the institution's unique strengths - its individual faculty and staff members.

For additional	Sally Campbell	Schuyler Lescher
information call:	(213) 927-4000	(212) 872-5618

"ENSURING THE ODYSSEY ENDS, A.K.A., GETTING THE RIGHT PLAN APPROVED"

Many computing organizations are in the midst of an odyssey when it comes to achieving their computing goals. The goal of educational computing is to provide the systems, technology and management to support an institution's academic and administrative needs and thus its overall educational mission.

Let's look at each component of the computing goal to understand why it is a moving target and so difficult to achieve.

Technology - provides the tools for producing and communicating information. As in any industry, improved technology demands new procedures and techniques for properly utilizing that technology. There are many pressures to utilize new technology. These include:

- Older technology is discontinued and expensive to maintain.
- Improved price performance is attractive for meeting user growth and performance demands without increasing your budget.
- Automation of certain business functions is now feasible.
- Functions that used to require specialized equipment can be consolidated into a single device.
- The latest technology provides a competitive advantage for attracting students, faculty and administrators.

Systems - The competitive environment for students, administrators and faculty and new business functions and external reporting requirements create pressure to automate additional functions. There are also more choices of how to acouire additional systems.

Human Resources - Technology change creates an initial limited source of technical resources. Many educational institutions are under financial pressures, and as a result, have a salary structure that is not always fully competitive with private industry, and thus, have difficulty keeping needed technical resources.

With this moving target, it is not difficult to understand why computing goals are not easy to come by. As the pace of technological change accelerates, the opportunity to make wrong turns and extend the odyssey increase.

One of the truest adages of our time is the MIDAS commercial, "Pay me now or pay me later," with the correct implication that pay me later is considerably more expensive and aggravating. Odyssey's tend to be in the "pay me later" category.

The way to end the Odyssey is to develop a computing/IRM plan - that is, define where you want to go (i.e., the target computing environment and how you will get there (i.e., an implementation plan). However, having a plan isn't enough. The name of the game is developing the right plan and getting that plan approved.

Let's look at some of the major success factors in producing the "right" plan:

- Understand the administrative/academic areas being addressed.
- Define the project scope "up-front."
- Produce the plan in a reasonable amount of time.
- Use a relatively small and senior level project team.
- Ensure the independence of the system planners.
- Utilizing a planning methodology.
- Participation of key user personnel.

Now, let's look at some of the major factors that need to be dealt with in order to ensure that the right plan gets "approved:"

- Commitment at the top
- General consensus within an institution
- Need to control misinformation
- Project scope up-front
- Identification of benefits at business level
- Need automated support tools
- Having the right plan to begin with

I would now like to focus on three of these and relate them to what we did on the CSU job:

Methodology - First, information processing is composed of three pieces: systems, technology and management. Second, the planning process has three stages: understand the current environment, define the target environment and develop the plan. This conceptual framework was used to organize deliverables, the project team and in the development of the work plan. It set the framework for all discussion within the CSU.

Consensus - We had the benefit of a CSU individual who had a good historical perspective of the systems and understood the environment and sensitivities. A letter from the Vice Chancellor of Administration was transmitted to all Presidents announcing the project and soliciting support. A Steering Committee was formed. Work products were marked and characterized as draft so as not to preempt a feeling of participation. CSU specialists in each of the major administrative areas were identified and made part of the project team. We conducted a workshop at which other universities attended to solicit input as to where they stood. We explained the process/methodology. Comfort was developed by many just understanding the planning process. Meetings were held in Northern and Southern California with the campus coordinators to explain the tailoring process.

We attempted to make sensitive professional judgments that were in the best interest of the CSU overall.

Justification - Justification was paramount because the CSU is a State controlled agency. When studying the current environment, we gathered data that allowed us to quantify the problem. We then identified the objective of a new system in terms of solving or improving existing problems. Finally, we identified the business (not technical) benefits.

By: Edwin N. Homer, Price Waterhouse, Newport Beach, Calif.

Abstracts of Presentations made at CAUSE85

Racal-Vadic

STANDARDS IN DATA COMMUNICATIONS

The first data communications products that attached to the public-switched telephone network following the Carter Phone Decision in 1969 were to begin an interesting evolution of technology and innovation that has provided the conduit for today's information revolution.

This discussion followed the paths of that development, focusing on the changes and standards which guide present development and future trends. Topics covered included modem standards, dialing protocols, error control standards, and security methods.

LOWER YOUR COSTS AND GAIN CONTROL OF YOUR DIAL-UP NETWORK SERVICES

Computer managers face a common dilemma in serving an increasingly sophisticated user group. Users with personal computers and modems in their homes or dorms usually want dial-up access to local and remote mainframes. The dedicated terminal, operating over a dedicated line, is no longer adequate to serve these needs. In many cases, access has been restricted to a select few in the ranks of the faculty and graduate students. With personal computers becoming more prevalent and extending to undergraduates and to people living within the university's sphere of influence and service, the demand for dial-up access is rapidly increasing. All too often, this rapid growth is hard to manage, and users get frustrated with the service or lack thereof.

The growth in dial-up services also creates a growth in operations expense as more floor space, installation and maintenance services, telephone line expenses, etc., are incurred.

With the recent advent of small, intelligent VLSI modems and network management and control systems to go with them, many of the problems of growth can be circumvented. The large public datacom networks have worked with suppliers to conceive and develop the next generation of data communication equipment. Many of its attributes were described in this presentation.

SPERRY
KNOWLEDGE SYSTEMS CENTER

A COMMITMENT TO ARTIFICIAL INTELLIGENCE

RAYMOND E. SANDBORGH

Sperry Corporation made a decision about eighteen months ago that the technology popularly known as Artificial Intelligence was mature enough to use in practical business applications as well as in military applications. This decision means Sperry must treat AI as a field of engineering rather than a topic of research. Consequently Sperry had several critical tasks to accomplish:

1. Selection of the AI Hardware and Software tools that encapsulate much of the technology.
2. Development of working applications and additional specialized tools.
3. Formation of a Corporate focus for AI in the Knowledge Systems Center.
4. Establish a worldwide capability to create knowledge engineers.
5. Establish a multi-phased program of college and university support.

Each of these points is critical to Sperry's thrust into the field of AI.

First, the AI tools chosen should be effective for the application oriented problems. We are working to use and refine an established set of techniques and methods based upon research and mathematics, not to expand those AI techniques. This means that the large Lisp machine designed for research is an extravagance. Sperry has selected a well engineered, commercially packaged system, with a visible preplanned future, and a speed and power versus cost tradeoff that is appropriate to the application domain. The software chosen emphasizes knowledge representation flexibility, and power in the human interface, with bit-mapped graphics, pop-up menues and other aids to ergonomic niceties, such as a mouse and user modifiable system characteristics. The reason for this choice in software is the major problem in AI is developing an expert system, not using it, and the two major problems to be solved in developing an AI system are (1) knowledge representation and (2) the rapid exploration of options via a powerful user interface.

Second, Sperry is working on over 30 applications in such diverse areas as:

- o EDP Auditing
- o Airline Ticket Pricing
- o Ceramic Chip Testing and Fault Diagnosis
- o Ambiguity Resolution
- o Threat Assessment
- o PC Computer Diagnosis

In addition, Sperry is working on specialized capabilities such as interconnect to mainframe computers and Unix machine based delivery systems.

Third, Sperry needed a group to coordinate the necessary diverse application developments. Sperry has over 200 people in numerous locations including several foreign countries, requiring a coordinating center. The Sperry Knowledge Systems Center (KSC) provides such a policy, strategy and coordinating function. Consisting of experts in data processing, psychology, engineering, software, linguistics and consultants in knowledge engineering, the KSC acts as a catalyst in Sperry's AI thrust.

Fourth, Sperry has developed an effective way to develop competency in creating expert systems. The key is a standard and guided apprenticeship that results in a working "proof-of-concept" expert system. The basic steps are:

1. Develop a basic understanding of AI and a list of several possible projects.
2. Develop the capability to use the tools of AI in the Sperry Knowledge Workstation.
3. Select a project and then address the basic knowledge representation issues such that development appears virtually certain.
4. Develop a "proof-of-concept" expert system.
5. Complete the expert system.

This process is duplicatable, repeatable and results in professionals with the experience base to use the sophisticated theoretical knowledge base in Artificial Intelligence.

Fifth, Sperry has developed a program that supports Artificial Intelligence research in academic institutions rather than taking them out of teaching and research. These programs are:

- The Sperry Knowledge Engineering Environment Grants
- The Sperry AI Fellowship, where ongoing professional level research is supported upon recommendation of senior technical Sperry people.
- The Sperry Knowledge Systems Center Internships where outstanding graduate and undergraduate students can gain practical experience in knowledge engineering at Sperry locations worldwide.

This is a thoughtful program, one designed to make major impact in a specific way.

Our commitment to AI is a natural extension of Sperry's ability to engineer precise solutions to customer needs.

MASTERING THE TOOLS TO BUILD YOUR FUTURE: APPLICATIONS DEVELOPMENT THROUGH 4GL

Abstract of Presentation made at CAUSE85

Systems & Computer Technology Corporation

Under the direction of Michael Emmi, SCT has embarked upon a number of exciting new programs, one of which is focused on maximizing productivity through research and development efforts. With higher education under increasing pressure to deliver both completely new systems and new features for existing systems at an almost geometrically accelerating pace, the techniques SCT is employing will be of value to all data processing professionals. The case study presented was the new version of SCT's Student System under Cullinet's IDMS/R data base.

KNOWLEDGE ENGINEERING APPLIED TO UNIVERSITY MANAGEMENT

Abstract of Presentation
made at CAUSE85

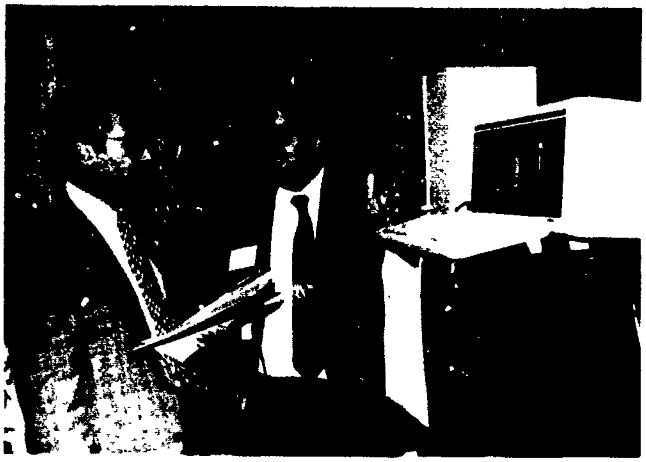
Texas Instruments Incorporated

The combination of artificial intelligence techniques, such as knowledge engineering, with sophisticated expert system development tools furnishes the catalyst for the next generation of software. Providing the ability to solve real-world problems, this new software can emulate the way human experts use knowledge and experience. This capability opens up a whole new world of computing utility in technical, administrative, and managerial areas. Expert systems provide computer support for problems requiring human judgment, experience, reasoning, and expertise.

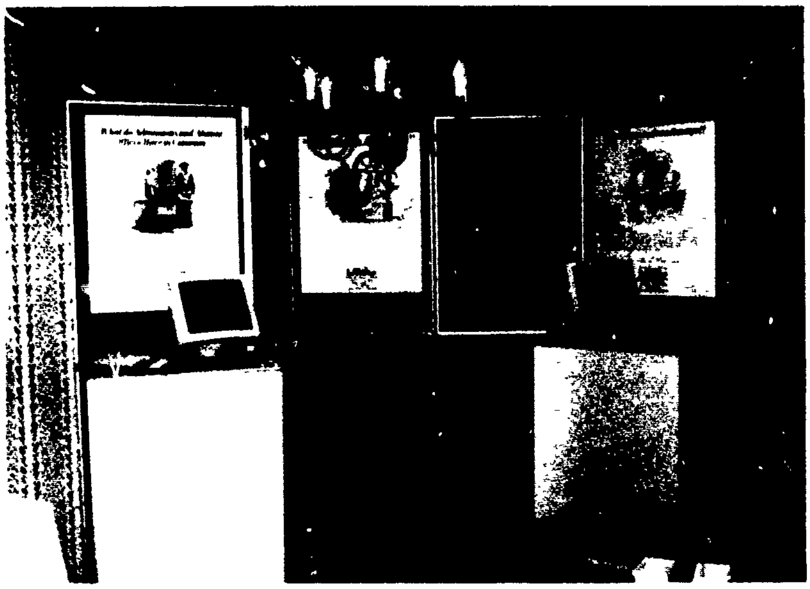
This panel discussion introduced ways that "knowledge engineering" tools can help deal with the complex decision making in university management.

SUITE EXHIBITS

The following vendors offered Suite Exhibits at CAUSE85 to display and/or demonstrate their products or services: American Management Systems, Inc.; Business Systems Resources; Control Data Corporation; Coopers & Lybrand; Datatel Minicomputer Company; Digital Equipment Corporation; IBM Corporation; Information Associates; Information Solutions, Inc.; Integral Systems, Inc.; ITT and The Computer Alliance; Pansophic Systems, Inc.; Racal-Vadic; Sperry Corporation, Systems & Computer Technology Corporation; and Texas Instruments.



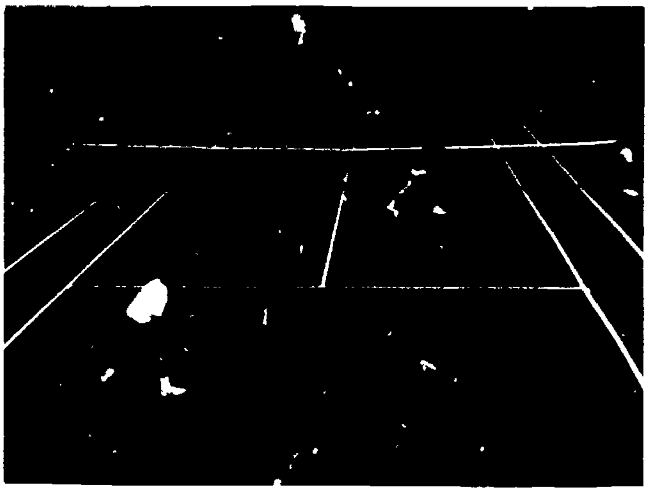
SUITE EXHIBITS

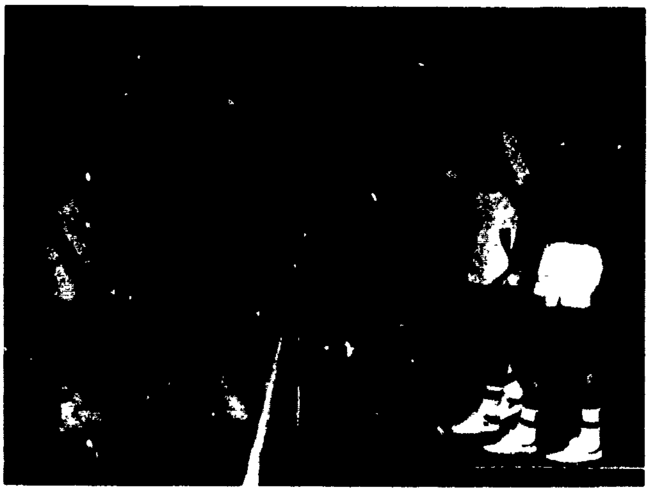


BUSINESS AND PLEASURE

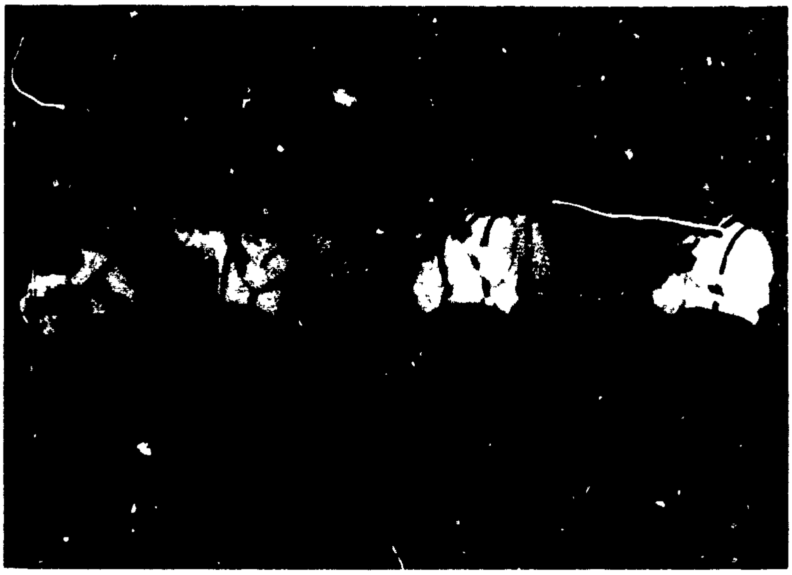
Ideas are exchanged as readily during breaks between sessions as they are at formal track presentations. An important part of the conference experience are the social gatherings--the scheduled ones, such as the Registration Reception and the luncheons, as well as those that occur spontaneously on elevators or at casual dinners, when new friendships are formed and old acquaintances renewed.

CAUSE85 featured two "special" activities in addition to the extra-long Registration Reception sponsored by our sustaining member companies Hewlett-Packard Company and Systems and Computer Technology Corporation. A round robin tennis tournament was held on the afternoon prior to the opening of CAUSE85 at the beautiful indoor Rivercenter Tennis Club affiliated with the New Orleans Hilton. Peat, Marwick, Mitchell & Co., sponsor of this tournament, also reserved court time for any conferees who wanted to get together for informal play after the completion of the tournament. The "Mardi Gras Madness" gala was one of the liveliest and most colorful of any of our conference dinner entertainments, providing conferees a taste of the New Orleans Mardi Gras. This evening of excitement, surprises, music, and good fun included a reception, dinner, flaming dessert served in a second-line parade, and an authentic Mardi Gras Krewe "fashion show" followed by a 50-piece marching band led by a motorcycle police escort complete with sirens! The evening closed with dancing to a Dixieland jazz band, and many conferees took advantage of the opportunity to have their photos taken with Krewe members.



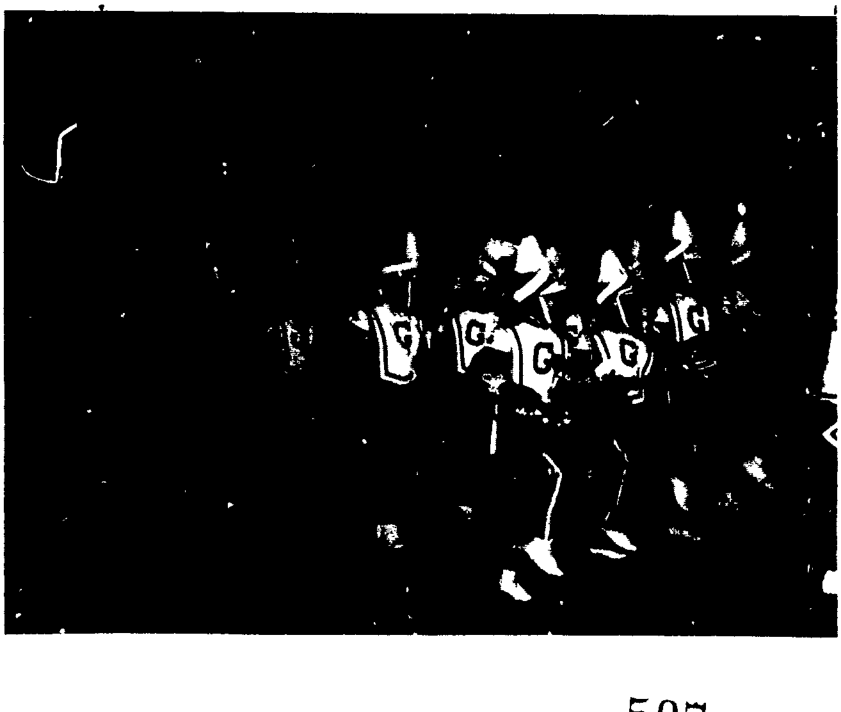


REGISTRATION RECEPTION



Special thanks to Hewlett-Packard Company and Systems & Computer Technology Corporation for co-sponsoring the CAUSE85 Registration Reception.

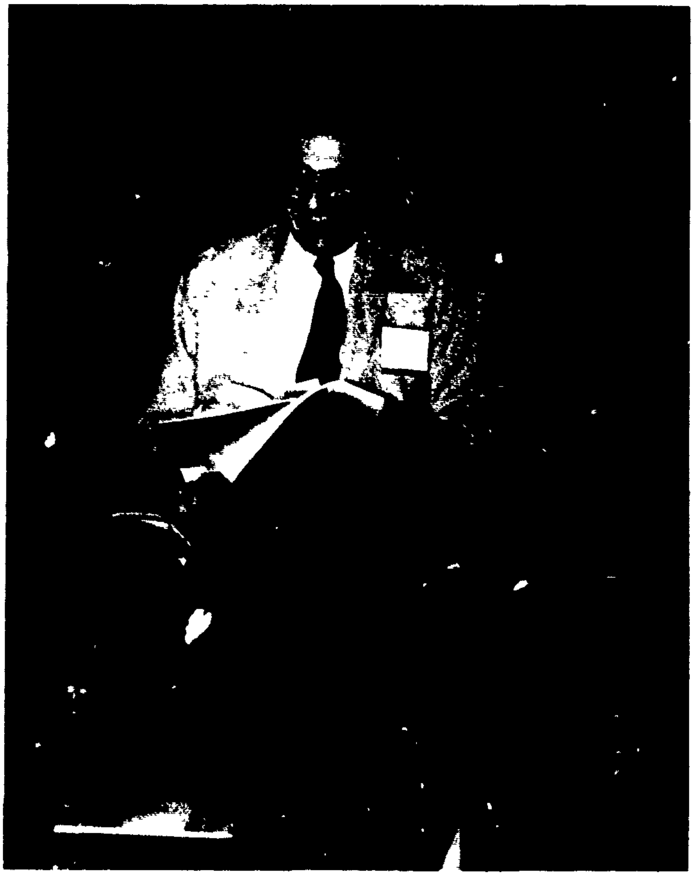
"MARDI GRAS MADNESS"



REFRESHMENTS

Special thanks to the following vendors for sponsoring refreshment breaks: Apple Computer, Inc.; Business Information Technology, Inc.; Digital Equipment Corporation; IBM Corporation; Integral Systems, Inc. Apple and DEC provided coffee mugs and BIT provided note cubes to all conferees at these breaks.

BREAKS



CAUSE85