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ABSTRACT

Seven papers from the 1988 CAUSE conference's Track V, Impact of Departmental Computing, are presented. They include: "An Approach to Departmental Computing Support" (Cedric S. Bennett); "DEANS--A Fully Integrated Academic Network System" (Eloy Areu, Albert Klavon, and Robert Munn); "Departmental Systems for Administrative Functions" (Stephen Patrick, Stan Sokol, and Wayne Donald); "The Creation of an Executive On-Line Decision Support System" (Charles W. Burmeister); "Integrating a DEC and IBM Environment between Campuses" (Ralph J. Wilson); "Bridging the Gap between the Data Base and User in a Distributed Environment" (Richard D. Howard, Gerald W. McLaughlin, and Josetta S. McLaughlin); and "Remote Operation of a Micro Software Package through a Mainframe Communications Network" (S. Paul Steed). (SM)

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Information Technology: Making It All Fit

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Track V
Impact of Departmental Computing

Coordinator:
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The maturing of information technologies has had a significant impact on academic and administrative computing. So-called departmental machines, either stand-alone or networked, are used by academic departments to instruct in a variety of applications and techniques. Having those machines has encouraged the development of distributive processing on the administrative side. In this track, departmental end users discuss their experiences and strategies.

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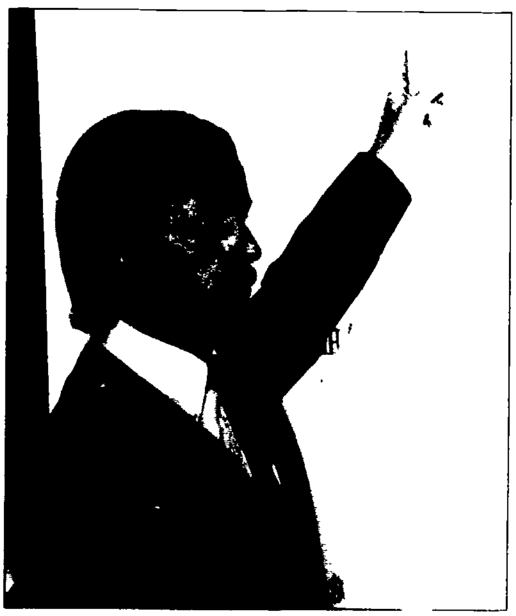

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An Approach to Departmental Computing Support

by

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Abstract:

As departmental administrators become more and more sophisticated in their adaptation of the many rapidly emerging technologies (i.e., desk top processors and other workstations, networks and other communication paths, decision support and other analytical software), there is a rising demand for direct access to the data that is kept in central databases. Many of our universities and colleges are finding ways to provide this access and to reap the benefits of the resulting productivity. This paper is focused on development and implementation issues including strategies for support and delivery of services to departmental administrators, faculty, and students throughout Stanford University. The paper does extract and generalize on some of the lessons learned from the research as well as the project themselves. Examples are drawn from technologies now in place and from work currently in process at Stanford.

An Approach to Departmental Computing Support

Introduction

The following was written by the Administrative Services Manager of the Department of Biological Sciences at Stanford in response to a request for some supporting examples of the needs of decentralized departments for automated assistance (and was included in a planning and budget proposal for departmental support):

> In October, 1987, the Department of Biological Sciences' administrative offices were crawling with many of its 90+ Ph.D. students. Their concerns were not insignificant. It was the infamous period we now refer to as the **I-90 Siege**.
>
> Word had spread quickly among the students that some *were not being paid*. Their "Ayatollah" spokesperson wanted to *hear about it* and distributed a flyer inviting them to outline their 'paperwork' problems.
>
>> *Getting a salary around here is often a privilege bestowed only upon those who wade through 10 miles of red tape, hassle, and confusion to find out where their paycheck bogged down*, begins the flyer. It ends with this: *With your documented problems, however, I can try to get the biology department or the people in graduate awards to get their acts together.*
>
> Meanwhile, the staff was making polite phone calls to various destinations in Paperworkland, trying to locate the whereabouts of a single I-9 Form, an SAF, an RGA, a TAF, not to mention a Fin Form (A or B?), and find out if the correct SU-32 tax form had been submitted at the proper time. Each case seemed to be different: right here; misrouted; lost; stopped; didn't exist. We made these individual phone calls for these individual students, who, for the most part, were hovering about as much as possible. (Often there was no way to avoid trotting around the campus ourselves to make sure something was accomplished.)
>
> Needless to say, had we had access in our offices to student files on line with the answers to these multiple mysteries, we could have pulled off this administrative nightmare in a more professional, efficient, and timely manner. Give me 30 seconds and I could name several other administrative procedures that could easily be streamlined with computer access.[1]

The Environment

The foregoing summarizes in a nutshell the administrative plight of non-central departments, particularly academic departments, throughout the Univer-

[1]*Proposal for Departmental Support -- Departmental Systems Group and A Cooperative for Linked Administrative Systems at Stanford (CLASS)*, December 1987.

sity. Does this statement typify the concerns and the attitudes of academic departmental administrators? Yes, it does! Not only is it the case that most of these departments have not had the benefits of automation support for the past couple of decades, unlike most central departments, but there are also some real differences in the day-to-day problems that each must face and, therefore, some substantial style and approach differences.

For the most part, central departments tend to be very process driven. That is because they are often organized to very efficiently handle some set of university processes (look at most financial or personnel areas for ready examples of this). These departments have a particular set of issues and problems to deal with and solve on a regular basis; they are highly focused and often very operational. And they usually have the benefit of automated support to assist them in these operational missions.

The non-central departments, however, are quite different administratively.[2] They tend to be much more a multi-function operation. They must deal with each and every one of the administrative processes that the central offices have had the opportunity to automate for themselves over the years. And they must often do it in a very interrupt-driven environment. They tend to have more of a support mission (to the faculty and students and the academic mission) than an operational one. And, almost without exception, they manage all this without any automated support, except that which they have managed to create for themselves on local processors.

Departmental administrators tell us that their office work is predominately paper-based, manual and labor intensive. It is also exceedingly stressful and redundant.[3] They have begun to glimpse the possibilities of the future and want their work to be much more workstation oriented and network-based. They believe that they will be able to focus more on the quality and service aspects of their support role and that, as a result, it will be more fulfilling.

The Beginning

The Information Resources organization at Stanford has two strategic goals which articulate its vision of the future: 1) to facilitate data access by providing and ensuring universal access to institutional information and by collecting data only once and as close to the source as possible 2) and to optimize the use of University resources through the integration of academic and administrative computing, library technology, and networking and telecommunications services.

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[2]Of course, academic departments can tend to be very focused on the research and instruction related to their particular disciplines.

[3]It is not just redundant within the particular office, but also when compared to other jobs, particularly those in the central departments. Often data that must be handled in the department is handled again and again by others as it is makes its way through the University paper maze.

Several important decisions were taken early in the 1980's which positioned the University very effectively for the future. In 1980, the University began the planning for replacement of several of its key administrative systems (i.e., financial and accounting, student and academic, development and alumni, physical facilities, and personnel information).[4] At that time there two major administrative database systems in use at the University. It became very apparent that choices in fundamental architecture were going to be the cause of delay and, very possibly, future incompatibilities.

In 1982, after nearly a year long study, a k y decision was reached: to build all future systems in a single, principle institutional database system.[5] That single decision has enabled a variety of other actions that might not have been otherwise possible. By 1983 development and implementation of the Core systems had begun.

At about the same time the University was noticing that the trickle of micro computers being brought into the environment throughout the institution was becoming a flood. A small service unit within the computing organization that had heretofore been responsible for the support of office use of electronic mail, word processors and other office automation technology was refocused into an information center called Departmental Information Services. Its mission was to develop and support local automation expertise within departments throughout the campus. By addressing itself to computer literacy (through instruction, an information resource center and a bi-weekly newsletter), direct micro computer support (though an evaluation and demonstration laboratory and consulting), and office information studies,[6] this group helped to prepare individuals and offices for the future while providing a useful, on-the-spot service.

As the use of technol y grew, the demand for access to centrally-held data also grew. Many felt that if departments had widely available access to data maintained in central databases, some major gains in productivity, as well as quality and service, could be obtained. In 1986 a three year experiment called the Departmental Access Pilot Program was launched to test these ideas. In the experiment a selected set of representative departments were given access to specific databases that had been specially modified to work

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[4]These central systems are often called "Core" systems at Stanford in that they are as necessary a part of doing business as the buildings or staff.

[5]*An Examination of Administrative Data Base Alternatives at Stanford University*, December 1982. The data base system eventually selected in this process was *SPIRES*. [Note: *SPIRES* is a trademark of the Board of Trustees of the Leland Stanford Junior University.]

[6]*Departmental Office Systems, Analysis and Recommendations, 1984*, Information Technology Services, Stanford University and *Office Automation at Stanford University, 1986 Study*, Information Technology Services, Stanford University. Both reports are in the CAUSE Exchange Library.

with a newly developed common interface.[7,8] The program included central support in terms of instruction, consulting, and uncharged access to the databases. It also included access to electronic mail and other communications products. We have learned a great deal from this program (discussed later) which has served us very well as we move toward making departmental support a programmatic reality.

Outcomes From These Beginnings

The strategic outcomes from these beginnings are three: 1) most central systems and databases are in place and ready for use, 2) there is an atmosphere of acceptance and readiness to move ahead, and 3) there is a much more refined understanding of the benefits to be obtained.

Over the course of the past half decade, nearly all of the major central core systems have been designed and implemented for the central offices. And they were all built upon the same institutional database system. As a result, they were constructed with sufficient flexibility to be extended to a wider user community, as needed.

At the same time, not only have more and more departments become ready and willing to move to a more automated form of business, but there is actually a strong and growing demand for such support.[9] Over time this led to the formation of a grass-roots organization composed of administrators from academic departments and research centers who began to (a) develop and support common software for their own departmental needs (including some specialized access to centrally maintained data for downloading to departmental systems) and (b) put more and more pressure on central administrators to provide institutionally supported assistance for these endeavors.[10]

To more clearly understand the benefits and costs of this automation, it is useful to consider three different levels or perspectives -- the individ-

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[7]The term "access" is used to mean information retrieval, local reporting, data entry, and local systems interface with central data bases.

[8]This interface is called *Prism*. It was developed at Stanford in the *SPIRES* database system. The ability to have a single human interface to a wide variety of applications and databases demonstrates one of the major advantages of the "single principle institutional data base decision" described earlier.

[9]Departmental staff have become ready and willing in two senses: 1) they are more educated in the use of technology and much less computer-phobic and 2) they have become active participants in deciding what needs to be done in order to better support their particular needs. In many cases, local systems have been developed on local micro- or mini-computers.

[10]This group named itself the *Team for Improving Productivity at Stanford (TIPS)* as a way of sending a signal to central University administrators. It also obtained a small amount of one-time funding for two and a half years which was used for developing some of these departmentally oriented systems.

ual, the office or department, and the University.[11] As shown in Figure 1, the benefits as well as the costs accumulate as you "move" from the individual to the University level. Moreover, there is a "value-added" effect as the benefits accrue. This framework serves as a reminder of the interdependence of the individual, the office and the University -- especially with regard to automation. Let's look at what automation means at each of these levels.

At the *Individual level* it is that automation which is used to support the individual's tasks such as writing, calculation, and communication.[12] The primary benefits are to the individual and include increased productivity, "burn-out" reduction, improved quality, and improved morale and job satisfaction. Typical costs are for equipment and software, training, support, job-integration time, delays and frustration.

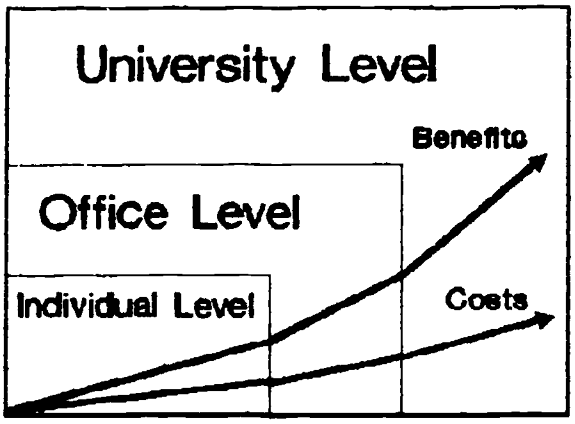

Figure 1: Automation Across Levels

At the *office level* the automated functions **that are added** usually relate to local records management and office communications.[13] Benefits are usually more group-oriented. For example, control over staff growth, better process management, and reduced cost and time are a few benefits that can be obtained. Some costs are for additional equipment, added complexity, personnel management, more training, and additional time to adapt technology to specific tasks.

At the *University level* we typically automate **additional** functions such as transaction processing and information retrieval and reporting. The benefits include reduced redundant effort, time savings, error and rework reduction, and service improvements. Costs include many of those mentioned already plus central system development, operation and support.

Other Lessons Learned

In addition to the major outcomes already described, the research and these projects highlighted several other very critical themes; two of them are ***support*** and ***management***.

"Support" can be a simple word which can hide a great deal of real, and very necessary, effort and resource. As Paul Strassmann argues, the three

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[11]For a more complete treatment of this concept and these findings, see *Office Automation at Stanford University, 1986 Study* (pp. 3-7).

[12]Tools such as word processing, spreadsheet software, and electronic or voice mail are obvious examples.

[13]Tools at this level are typically local databases systems, calendar support software, and local area networks (for equipment, as well as data sharing).

priorities for office automation are "Training, training, and training."[14] He makes the point even more strongly when he argues, "Substandard technology can produce satisfactory results if superior training has been given to users. However, superior equipment will not produce much if user training is deficient."[15] Training and follow up support can easily be underestimated. In this case, hundreds of staff members were trained in the use of (for many of them) unfamiliar technology. And once they were trained they continued to need ongoing support and assistance.

This training and support is all the more difficult because of the types of skills staff members are being asked to acquire. There is a popular misconception that once individuals have formal training, such as a class, they can go back to their offices and immediately be more productive. But, in fact, "Learning to use a computer is much more like taking up a musical instrument than following instructions how to use an electrical appliance such as a toaster."[16] It takes time and practice simply to become familiar with the command structures of any office information system (no matter how "user-friendly" it is). And adapting office procedures for integrating the automated system into one's work takes even more time.[17]

Pointing the finger at management has become as cliche as blaming all problems on communication. But just because these issues have been "sloganized" doesn't mean that they are any less real. We found that it was exceedingly important to have not only senior and middle management involvement but outstanding leadership, as well. The importance of the manager's role is described best by Paul Strassmann:

> In the absence of strong leadership... little success can be expected. By leadership, I mean the strong sense of purpose and a vision that the leader articulates about how the results to be obtained from the technology relate to the real purpose of the business. If such leadership is lacking the whole point of the venture will become muddled... All successful computer technology projects are carried on the shoulders of a handful of enthusiastic and dedicated operating managers (rather than technical experts), who can articulate what the fundamental objectives of the system are.[18]

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[14] Paul Strassmann, *Information Payoff: The Transformation of Work in the Electronic Age* (New York: The Free Press, 1985), p. 60.

[15] Strassmann, pp. 60-61.

[16] Charles Rubin, "Some People Should Be Afraid of Computers," *Personal Computing*, August 1983.

[17] *Office Automation at Stanford University, 1986 Study*, p. 18.

[18] Strassmann, pp. 46-47.

And, of course, in a consensus-driven environmer : like Stanford, it is equally important to develop committee structures which give all parties an opportunity to participate in the process. Even though many tend to snicker at these bodies as more time-sinks than results-oriented, the overall positive effect was to uncover many problems before they became extremely expensive to correct. They als served to bring staff from central and non-central departments together; this had its own very beneficial effect above and beyond systems development.

Today and Tomorrow

Now, having prepared, having studied, having experimented, having assessed the outcomes, what is next? What is Stanford doing with the lessons it has learned? The answer is that it is moving forward in three different, but related major efforts: 1) the Departmental Systems Group, 2) the Cooperative for Linked Administrative Systems at Stanford (CLASS), and 3) Folio.

The Departmental Systems Group provides a dedicated resource to academic departments as well as schools and independent laboratories for the development of local systems. It will provide business systems analysis, applications development and maintenance support. In effect, it institutionally enfranchises the departments in terms of information technology. This group, which is governed by a management coalition of schools and academic departments (an outgrowth of the *TIPS* organization mentioned earlier) is in the process of being created now. A manager has been hired, three-year plans are being finalized, and hiring of additional staff members is actively underway.

The CLASS program is intended to link department and central processes and systems. It delivers and extends the products that were being experimented with during the Departmental Access Pilot Program described earlier. In addition, it is tightly connected to the Departmental Systems Group (reporting to the same director within Information Resources). Specifically, it will provide over 1,200 administrative and support staff with access to institutional information, decentralized transaction capture and management information capabilities over the next three years. It provides the start up training and support to those administrators and their management, some portion of the equipment and communication connections, and builds the necessary linkages between local and central systems. The program is fully staffed and has been delivering these services to the first 350 administrators to enter the program since September 1988.

Folio is designed to provide access to Stanford academic and institutional data resources. It is oriented more toward the delivery of this access to faculty and students.[19] Typical files under Folio include the Harvard Business Review index and abstracts, graduate fellowships and scholarships, bookstore holdings, faculty interests, off-campus housing and about 18 others.

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[19]Whereas CLASS is much more focused on the delivery of access to institutional information for faculty and staff. The Departmental Systems Group is also focused on supporting faculty and staff but supports access to information about the department itself.

Probably most important is the round-the-clock access to the catalog of Stanford's library.

The big payoffs from this effort have been the beginning of the realization of universal access to institutional information, improved management at the departmental level, and improved integration of the administrative function. Given proper information, tools, training, and central support departments are better able to manage themselves. They have improved ability to track and access information (without mediation by central organizations). Information is more timely and accurate because it is transmitted and stored electronically. The integrity of the data is much higher, since it is entered only once as close to the source as possible. And because the number of times information is typed, handled, filed and mailed is reduced, redundant information is reduced. In addition, departments are able to manipulate their own data (using a combination of central and local tools).

How these technologies will impact productivity and quality of work at Stanford depends in large measure upon the role managers throughout the institution play in their development. The opportunities seem nearly boundless. Indeed, as Curley and Pyburn argue:

> "The real advantage of these technologies is that they can encourage fundamental changes in the way that clericals, managers, and professionals work. If managed properly, such changes can dramatically improve the productivity of the entire firm. Managers must envision how technology might be used, and then provide the framework and leadership necessary to use it effectively."[20]

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[20]Curley and Pyburn, p. 32.

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DEANS - A Fully Integrated Academic Network System

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In the summer of 1987, the University of Maryland at College Park embarked on the implementation of a distributed student advising system on an academic TCP/IP network. The impetus for this project was born out of the success of a PC-based advisement system developed fifteen months earlier. Eighteen VAX 2000 workstations resident in all college offices serve as the backbone of the system, which goes by the acronym of DEANS. The users of the system were not for the most part sophisticated computer types, and thus we were faced immediately with the creation of a friendly interface to the underlying UNIX software. The interface evolved rapidly, under user pressure, into a system that provides electronic mail, document transfer, access to a variety of information on the campus, and a powerful advising tool.

DEANS

INTRODUCTION

The University of Maryland College Park campus is comprised of 14 colleges and schools with a total undergraduate population of approximately 28,000 students. The sizes of the colleges range from 500 to 7,000 students. There are 120 programs that lead to the bachelor's degree.

Three years ago a small group of individuals on the campus embarked on an experiment to use PC's using student data downloaded from the administrative mainframe to enhance student advising. During the ensuing months the system grew and began to gain recognition among the colleges as a very useful tool. This recognition drew the support of the Vice-Chancellor for Academic Affairs, who moved to fund a project that would provide each college with a multi-user workstation linked together by the campus Ethernet network.

What started three years ago as an attempt to capitalize on emerging micro-computer technology for the purposes of student advisement has today evolved into a fully integrated academic network system known as DEANS. The system not only provides a powerful advising tool for colleges and academic departments, but also links all the colleges and academic support units via the campus network, providing electronic mail, document transfer, and a variety of other services on different computers.

This paper will describe DEANS. It will also discuss ADVISE, which has been the driving force behind DEANS, and will address those issues that had to be considered when implementing both systems.

COMPUTING ENVIRONMENT AT COLLEGE PARK

Before embarking on a description of DEANS and ADVISE, the authors feel that it is important to describe the computing environment at College Park.

There are two computer centers on the campus: a Computer Science Center, which supports the academic community for instruction and research; and an Administrative Computer Center, which supports functions such as payroll, personnel, and the administrative side of student services.

The Computer Science Center hosts a variety of hardware, including a Unisys 1100/92, IBM models 3081, 4381, and 4341, a CINCOM VAX 11/785, and a number of VAXes that provide access to other computers throughout the campus, as well as the outside (such as the CRAY supercomputer at the San Diego Supercomputer Center). The Computer Science Center also maintains the campus Ethernet network.

The Administrative Computer Center houses two HP 70 machines, a Unisys 1170, and an IBM 3090. The Unisys and HP machines are not connected to the Ethernet network.

Currently, the campus is in the process of migrating all applications on these two machines to the IBM.

Throughout the campus one also finds a variety of micro- and mini-computers from manufacturers such as Apple, DEC, IBM, Sun, Zenith, and others. For it to be successful, any campus-wide software must recognize such a multi-vendor environment.

ADVISE AND DEANS

Prior to the development of ADVISE, much of the advisor's time involved paper record-keeping and time-consuming analysis of a student's transcript. In the fall of 1985, the office of Records and Registrations approved access to student data by the College of Life Sciences to develop a computerized advising system on the college's micro-computer. While the college developed the advising system, the office of Academic Data Systems developed the mechanism for extracting and downloading the student information from the Unisys 1170. The initial success of this pilot program was such that the system was made available to all the other colleges.

When ADVISE was first introduced to the campus in the spring of 1986, it was written in C on an Altos 986 with a XENIX operating system. The pertinent data was extracted from the Unisys at the Administrative Computer Center and transferred via 9-track tapes to the Academic Computer Center, from which it was downloaded to the Altos using KERMIT.

The appeal of a microcomputer-based advisement system was tempered by the unfamiliarity of both the host machine and its operating system. In addition, the download times were enormous for anything but the smallest colleges.

The system was quickly converted to a IBM PC environment. The data tapes were now read on a PC tape drive, and the student data converted to the ADVISE format before being delivered to each participating college on floppy disks, which were then copied to the PC's hard disk. The process, which then served about half of the colleges on the campus, required 3 days of processing time and was repeated every two weeks. This mechanical method of downloading involving magnetic tape is still used today and is necessitated by the lack of a high speed network link to the Unisys. However, the advisement data is now downloaded to all colleges over the campus network in seconds. When the student information system is migrated to the IBM 3090, the data will be downloaded directly from that machine via the campus Ethernet network.

The ADVISE software is written in C, and thus lends itself to running on a UNIX as well as MS-DOS machines. Hence, in the fall of 1986 when the Vice-Chancellor for Academic Affairs committed to fund hardware acquisition for the implementation of ADVISE at every college, the recommended configuration was that of multi-user workstations running UNIX and linked together via the campus Ethernet network rather than stand-alone PC's. The Computer Science Center joined Robert Munn, author of the ADVISE software, and Academic Data Systems, distributor of the data, in implementing the network to support ADVISE.

The emerging system adopted the acronym of DEANS for Deans Electronic Academic Network System. Because of its inter-campus connectivity, the system not only offers a powerful advising tool for colleges and academic departments, but also provides full electronic mail and document transfer capabilities, and access to a variety of computerized information on the campus, including the faculty/staff phone book.

DEANS consists of 18 VAX 2000 stations resident at each of the 14 colleges plus several academic offices. All VAX 2000's run ULTRIX 2.2, have 6 Mbytes of memory, a 70 Mbyte hard disk, an Apple Laserwriter, and an Ethemet controller which links each VAX station to the campus broadband Ethemet. Each college provides its own local area Ethemet, thus giving all participants access to information anywhere on the network.

A Microvax II at the office of Academic Data Systems serves as the hub machine from which data and software is delivered to all the DEANS machines. Thus, software maintenance is done remotely from a central site and all machines have ident'-al software. Colleges are not allowed to load their own software on the VAX'es. Requests for changes and operational considerations are overseen by a small policy group which meets monthly.

Figure 1 shows the DEANS configuration. The Computer Science Center supports the campus network and telecommunication needs for DEANS, maintains the system software on all VAX stations, troubleshoots hardware-related issues, and coordinates maintenance. Robert Munn supports the DEANS and ADVISE software and works closely with the Office of Academic Data Systems, which is responsible for direct user support and training, distribution of DEANS/ADVISE software and student data, and coordination of all activities through a DEANS Project Manager.

A powerful software interface written in C utilizes standard ULTRIX/UNIX software to perform tasks while hiding the details from the unsophisticated user, making all features of the system menu-driven. Recognizing the multi-vendor computing environment on the campus, great care was taken to make this interface available to users with a variety of terminal devices. Currently, users access the system via dumb terminals, IBM-compatible PC's, Apple MacIntoshes, and VAX workst-ion displays. The novice or casual non-technical user can learn to use the system quickly without knowing one UNIX command. Yet the system gives the more technical user access to all features of the operating system. On-line help screens are available to support every DEANS and ADVISE activity.

The DEANS software uses an access file to keep track of all users of the system. This file includes the name of the college VAX station, the user's full name, the electronic mail address name, and the user's access method (terminal or PC). Non-DEANS users may also be entered in this table to record their e-mail addresses. Thus, electronic mail and document transfer requires a minimum of information - the user only needs to know the name of the user at the receiving end, and the software provides all the necessary connectivity.

The system also keeps track of file transfers and automatically informs the recipient by electronic mail. In short, it is very easy to perform PC to PC transfer of files such as spreadsheets and word processing documents in a manner that is transparent to the user.

The ADVISE system is accessible from within DEANS. Each college VAX houses that college's student records, which get updated every two weeks from the mainframe. In addition to having full advising capabilities within their own VAX 2000 (college ADVISE), college personnel are also able to access any current student record on a central Microvax II and have transcripts or audits mailed to their own VAX'es electronically (campus ADVISE).

As the ADVISE system was being developed, and later during the development of DEANS, there were certain issues that had to be examined. These issues included security, frequency of download, and system features.

SECURITY

Entry into DEANS requires a login ID and a password. Users have the option of encrypting transmitted documents, as well as turning read/write access on and off for their saved mail and other files. Not all users of DEANS have access to ADVISE. Some users use DEANS only for electronic mail, document transfer, and other non-advising utilities.

Access to college ADVISE is protected by individualized passwords. Campus ADVISE access requires two passwords: a system wide password, which is changed monthly, and the user's home machine password. An audit trail is created for all accesses to campus ADVISE.

Additionally, the student data is kept encrypted, and is only decrypted when displayed. Thus, attempts to look at the data outside of the ADVISE system will only yield gibberish.

Nevertheless, there were strong concerns about unauthorized access to, and use of, the data. It was felt that passwords and encryption needed to be supplemented by security of a physical nature to protect not only the data, but the equipment that housed it.

The Office of Records and Registrations worked with Academic Data Systems and the Vice-Chancellor for Academic Affairs in defining security guidelines. The result was the implementation of a set of conditions to which a college and any other unit using DEANS/ADVISE had to agree. The highlights of this agreement include:

1. The VAX and any PC accessing ADVISE must be dedicated to administrative functions only.

2. All staff and student employees with authorized access to the data must sign statements indicating that they will treat the data confidentially and professionally.

3. Passwords, login procedures, etc. must be kept confidential, and the equipment must be located in a room that can be locked when staff is not present.

4. The student data must be used only for advisement and the support of internal college/departmental functions. All official requests for verification of university records must be referred to the office of Records and Registrations.

SYSTEM FEATURES

During the design and development of ADVISE, there were certain goals that were identified by its designers. These goals were achieved when ADVISE was implemented, and later carried over to DEANS:

1. **USER-FRIENDLY OPERATION**
   The end-user does not need to know any operating system commands to operate either DEANS or ADVISE, as both systems are completely menu-driven. The screens are aesthetically simple, avoiding unnecessary information or jargon. The user can concentrate on his/her work, rather than the operation of the computer.

2. **SPEED**
   Screen navigation is quick. Access to individual student records is fast. ADVISE uses the student number as an access key, which is hashed to access a disk-based index. The student database thus requires minimal memory and disk space.

3. **SELF-SUFFICIENCY**
   The end-user is able to work entirely within DEANS to access all of its features, including the ability to connect to other computer systems on or off campus.

4. **FLEXIBILITY AND PORTABILITY**
   DEANS does not make use of function keys, or special screen protocols. Thus, it can be run on any simple terminal or PC. ADVISE runs successfully standalone on any MS-DOS system as well as on a UNIX-based system.

5. **SECURITY**
   As discussed earlier, the system is secure from casual browsers trying to access information. Student data is encoded at all times, decoding takes place only at the time when the information is displayed.

6. **DOCUMENTATION AND SELF-HELP**
   Good user documentation, with examples, is available in machine-readable format. Additionally, both DEANS and ADVISE have extensive online help features that the user can invoke anytime.

7. **COMMUNICATIONS AND MAINTENANCE**
   The process of systems maintenance makes extensive use of electronic mail which is automatically generated when problems occur. Exceptions save relevant files for later problem diagnosis.

The next section provides a brief description of all the main features that DEANS and ADVISE make available.

DEANS FEATURES

Below is a highlight of all the features offered by DEANS:

1. **Electronic Mail**
   This feature allows the user to read and send mail, identify any DEANS users and his/her identification, and create mail aliases for a group of users. The program frontends the machine-resident mail system (Extended Berkeley Mail) with an editor (microEMACS) for composing mail, as well as sending files. It also provides access to the campus' faculty and staff phone book entries.

2. **Access to ADVISE and Academic Data**
   This feature provides access to college ADVISE, campus ADVISE, and seat enrollment status in all course sections.

3. **Document Transfer**
   This feature allows the user to transfer documents between VAX'es and PC's, and retrieve transmitted documents. Auto-encryption is provided for sensitive material.

4. **Access Other Computer Systems**
   This feature gives the user the capability to connect to any computer on or off campus that is accessible via the network. In particularly, it allows the download and upload of files between a PC and the IBM 3090 at the Administrative Computer Center.

5. **Information Vehicle**
   The system serves as a vehicle for distributing and making information available throughout the campus. Examples of such information include the faculty/staff phone book, proposed curriculum changes, and all academic audit files (described under **ADVISE FFATURES**).

6. Utilities
   DEANS provides access to many UNIX utilities, among which are:

   a. Change the user login password.
   b. Change file access status to restrict reading or modifying of personal files.
   c. Set an alarm to remind the user when he/she should leave for a meeting.
   d. Remind the user of future events or meetings; the system will mail electronically reminders which increase in frequency as the event date approaches.
   e. Talk to another user that is logged on via the split-screen UNIX 'talk' utility.
   f. List, edit view, print, delete, rename, and copy files.

7. **Access to operating system (ULTRIX).**

ADVISE FEATURES

Below is a discussion of the primary features of ADVISE:

1. **Viewing Student Records**
   ADVISE provides access to all student transcript information on screen and paper. Student data may be retrieved individually by student ID number, or selectively from a file of student ID numbers. A name search capability is also available. The data displayed consists of personal/demographic, academic summary, historic and current course, and transfer credit information. Courses taken at the University of Maryland may be displayed in three formats: chronologically by semester, grouped by subject matter, and grouped by grade received. A summary display of the above three formats is also available.

2. **Electronic Notes**
   The system offers the advisor the ability to enter notes about a student. The notes are date and time-stamped. There are two types of notes: public notes may be accessed by any advisor on the system; private notes may be read only by the advisor that inserted them. Notes are not stored in the same database as the student data, and thus are not destroyed when the database is updated every two weeks.

3. **Extended Search**
   A powerful feature of ADVISE is the ability to search the student database interactively to identify students with common characteristics. In combination with the mail-merge and report-writing capabilities described below, searching provides a powerful tool for reaching and reporting specific student populations. Searches are conducted using the ADVISE query language, whose commands can be issued dynamically, or saved in specially named files for repeated use.

4. **Mail-Merge and Address Labels**
   ADVISE provides the ability to generate mailing labels and letters. These are driven by a file of student ID numbers generated by a search and/or manually-created. The file may be sorted alphabetically by name, zip code, college, major, cumulative grade point average, or cumulative credits earned. The letter text read by ADVISE is nothing more than an ASCII file with merge material indicated by key words in upper case letters. The words are replaced by corresponding items from the student database. The user can also interactively define additional key words, thus allowing the use of generic letters which can be personalized at production time. Labels can be 1-up, 2-up, or 3-up. Labels and letters may be previewed on the screen prior to printing.

5. **Report-Writing**
   The report generator gives the user the ability to create customized reports from a student ID file. As with the Mail-Merge option, the file (and thus the report) may be sorted in a number of ways, and the report may be previewed on the screen prior to printing.

6. **Academic Audit**
The audit system might more appropriately be called a course classifier, as it aids the advisor in examining the advisee's academic record. The system provides a simple and flexible language for describing major requirements. Input to the academic audit process consists of the student database and the major requirements description file against which all courses are matched. Aside from the automated aspect of auditing a student's record, a significant advantage of this system is that, by encoding academic requirements in a common format, an advisor does not have to be familiar with the requirements of every major in order to give effective advise. This allows the student to explore suitable majors that satisfy career goals.

7. **Statistical Analysis**
Programs are available that use the database to produce the following summary statistics about the student population: number of students by college, by major, by class, by sex, by GPA range, by high school, and by transfer institution. It also produces a report of weighted credit hours. These statistics can be valuable in academic planning and recruitment.

8. **Management Tools**
Using the files available through DEANS and ADVISE, a number of management tools have been written that track movement of students between colleges and majors.

CONCLUSION

DEANS has been available at College Park for over a year. ADVISE has been available to the campus for over two years, first on stand-alone PC's, then as part of DEANS. Both systems have not only improved the campus' level of service to its student population and the efficiency of operation among the various academic units, but they have also awakened the campus' consciousness to the use of new technology and have been a driving force in expanding computer connectivity among offices, whether academic or administrative.

A user's group meets monthly and serves as a forum for exchanging ideas, discussing problems, and announcing enhancements. It is expected that the system and the capabilities offered by the software will continue to grow during the next year in response to user demand.

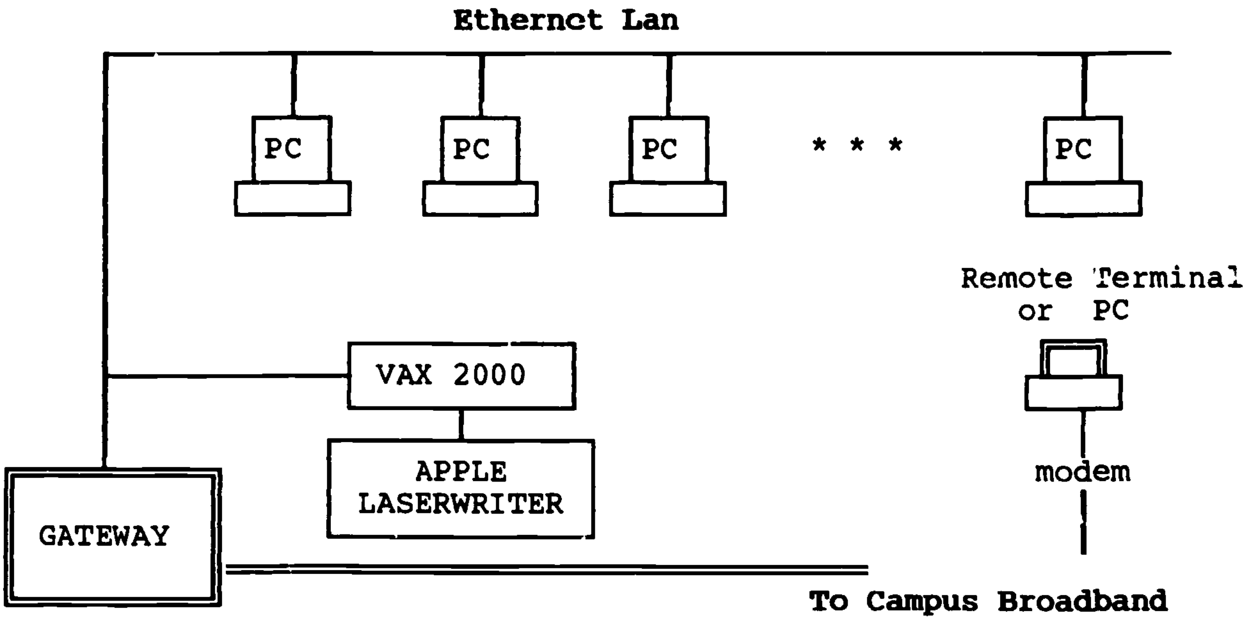

Figure 1. DEANS Configuration

Departmental Systems for Administrative Functions

A Panel Discussion

Stephen Patrick
Director, Administrative Services
University of Wisconsin - Stevens Point

Stan Sokoi
Asst. VP, Office of Information Systems
Hunter College/CUNY

Wayne Donald
Asst. VP for Information Systems
Virginia Tech

University of Wisconsin - Stevens Point

Introduction

The University of Wisconsin - Stevens Point (UWSP) is on the bleeding edge of departmental computing. We do not have a central mainframe. We perform all administrative computing on departmental computers. Listed below are some of the larger departmental systems.

- Student Information Systems - Registration, Admissions, Financial Aid, and Housing on a HP9000/850 in the Student Life division.
- Alumni - AT&T 3B2 in the Alumni and Development office
- Financial System - Sperry 5000/90 in Financial Operations
- Student Accounts Receivable and Bursar - Sperry 5000/90 in the Bursars office.
- Physical Plant and Central Stores - Sperry 5000/40 in the Physical Plant office

These systems all operate in a distributed manner under the control of the operating managers of the units they support. The operating managers are responsible for all facets of computing including operations and programming.

Problems with Centralized Computing

We went to distributed computing because the central computer center did not satisfy the needs of the user. The abject failure of our computing administration pushed us to innovate and be successful at it.

Listed below are the perceived problems with centralized computing at UWSP

- The unit was not responsive to users needs. There was a huge development backlog
- Computing was very expensive.
- A move to on-line computing would require a massive capital investment
- The unit was very bureaucratic.
- The unit treated some users better than others.

Departmental Applications

The key issue to user management is control. With a centralized environment, UWSP managers did not feel they had the control needed to do their job. A manager with a significant computing need would bring that need to a projects committee for a share of programming resources. Once approved, development staff scheduled the project for sometime in the next six months. If the need was not important enough to the committee, the manager had no recourse. The environment was very political with many decisions based on clout of the requester

Computer applications requiring a high degree of integration with other applications, and are very important to the mission of the institution, make poor candidates for distributed computing. The student data base is an example of a poor candidate for departmental computing.

Applications requiring low integration and which are not important to the institution are good candidates for departmental computing. Parking is an example of an excellent candidate for departmental computing.

Between the two extremes is a large gray area. The main determining factor in selecting alternatives is the campus computer network. Campuses with excellent computer networks can use departmental computing. Organizations without a network must centralize that application.

What is Needed to Succeed with Departmental Computing

Departmental computing introduces special problems. Because the data is physically distributed, the consistency of the data is difficult to manage. Programming and human interface standards must be maintained even though computer programmers have different reporting lines.

Each new operating system, or communication protocol added to your environment makes the job of managing a departmental environment must more difficult. As an illustration of this point, with three computers, there are three different one-to-one communication possibilities. If you add one more computer, you are doubling the number of communications links to six. This a a manageable situation if you add a "standard" computer. Because you have already solved the problem of making the connection, you just have to apply the solution three times. In a heterogeneous environment, adding a new type of computer would require solving three new communication problems.

Standards become the critical issue in dealing with departmental computing. We have two operating system standards at UWSP. They are UNIX System V and MS-DOS. We can add a new UNIX computer to our network with minimal effort. This would not be true for any vendor's proprietary operating system.

UWSP is pursuing departmental computing aggressively. We have been able to offer administrative computing in a departmental manner because we have highly developed standards, and a sophisticated campus network.

Hunter College of CUNY

Hunter College

Hunter College is the largest senior college of the City University of New York Some statistics, that give one a feel for Hunter, are given in Table 2-1.

Administrative Computing

Our direction in administrative computing has been towards the establishment of a hierarchy of computing that parallels the organizational hierarchy. However, while technology advances may allow for significant computing power to be available at the lowest organizational level, the need for computing power remains constant at the higher levels In other words, old needs don't seem to go away. Consequently, once a data base is established at some level of the hierarchy, it stays there even though subsequent data bases may be created at higher or lower levels

Primary and Secondary Data Ownership

The effect of this little bit of acquired wisdom is to encourage us to think in terms of primary and secondary data ownership. For example, the university is the primary owner of the Personnel data base but the colleges have the capability, and are encouraged, to establish a secondary data base by duplicating whatever part of the primary data base is needed On the other hand, the primary Student data base resides at each college and the university will select whatever parts of each college's data base it needs. Departments within each college are also creating secondary data bases from their college's primary Student data base.

This sort of structure is where Hunter is at present. This, of course, limits us to a one-way flow of data from primary sites to secondary sites. A true distributed data base, with components that are geographically dispersed, is not in our current plans Within Hunter, we are working on cooperative processing wherein a system is distributed among several computers and communications between the system components is automated. The primary example of this is in the payroll area where each department enters their information on their own computer which is linked to the Payroll office computer.

Evolution of Administrative Computing

Tables 2-2, 2-3, and 2-4 indicate what has been happening at Hunter These tables describe the evolution of administrative computing from 1983 to 1993 in terms of organization (2-2), infrastructure (2-3), and applications (2-4). The conclusion that is implied by the evolution pictured in these charts is that Hunter College and CUNY are committed to distributed computing and that an electric approach is being taken to its implementation This approach has caused the organization, infrastructure and applications to change and will cause more change in the future in response to functional needs and technological opportunities. As always, the most significant determinant of success will be the ability of the people involved t adapt to the new roles in which they find themselves.

Description of Hunter College of CUNY

- o Largest Senior College of City University of New York.
- o Founded 1870, co-ed 1956.
- o 19,300 students of which 4000 are graduate students.
- o 2,900 faculty and staff (1600 full-time).
- o Located on four campuses in Manhattan:
  - Main- 68th st. - Four buildings, 1,500,000 sq.ft.
  - Brookdale - 25th st. Two buildings, 450,000 sq.ft.
  - Social Work - 79th st. One building,100,000 sq.ft.
  - Campus Schools - 94th st. One bldg. 180,000 sq.ft.
- o 7 academic divisions containing 45 departments.
- 0 3 research units, 15 administrative departments.

Table 2-1

ORGANIZATION

	1983	1988	1993
Hunter:	o Lack of Coordination in Administrative Technology area o New Telecommunications (Voice-Only) department reports to Business Manager o Very little high level involvement o Strong desire to move forward in Office automation o Limited Hunter Community involvement	o Administrative Technology united under AVP in one area including: o Telecommunication (Voice & data) o New Office Systems department o High-Level Policy Committee o High-Level Planning Committee o Mid-Level Implementation Committee	o Increased emphasis on partnership o Information Services concentrates on Infrastructure o Departments concentrate on Applications
CUNY:	o Strong, Central Data Processing Organization focused on technology. o Vice-Chancellor of Systems o Telecommunications delegated to Colleges	o Less of a central focus on on technology. o No Vice-Chancellor of Systems o Stronger Central Control of Administrative Systems o Telecommunications delegated to Colleges	o Increased emphasis on technology but more in office automation and networks area o Vice Chancellor ? o Strong Central control of Administrative Systems o Central Control of Telecommunications

Table 2-2

INFRASTRUCTURE

1983	1988	1993
o CUNY Commitment to IBM	o CUNY Commitment to IBM	o IBM
o CUNY Commitment to Cullinet	o CUNY Commitment to Cullinet	o Cullinet
o CUNY Network of Central Mainframes* connected to smaller mainframes at most Colleges	o Same basic structure but with upgrades and mainframes at all Colleges	o Modest growth with emphasis on networking and disk capacity
o Low-Speed Bisync line	o Moving towards T1 lines and SNA network	o Complete SNA network with some fiber optic links
o Hunter has 4341-12 w/3.7 Gbytes	o Hunter has 4381-13 w/15.2 Gbytes	o Hunter has dual CPU w/50 Gbytes
o 30 terminals connected to Hunter 4341	o 100 terminals and 25 PCs connected to Hunter 4381	o 200 terminals and 200 PCs connected to Hunter CPUs
o Hunter starts installation of Main Campus PBX (Voice-Only)	o Hunter installs voice/data PBX at SSW Campus	o Integrated voice/data Network for all five Hunter Campuses.
	o Hunter installs data PBX at Main Campus	

Table 2-3

Administrative Applications

	1983	1988	1993
Academic	o University (Institutional Research)	o University (Inst. Rsch.) o Hunter (Inst. Rsch.) o Hunter-Reports based upon SIS data base	o University (Inst. Rsch.) o Hunter (Inst. Rsch.) o Integrated College-wide Data Base o Decision Support ?
Student	o University Admissions Financial Aid o Hunter SIS	o University Admissions/ Financial Aid o Hunter SIS o Departmental Applications	o University Admissions Financial Aid o Hunter SIS o Departmental Applications
Research	o University System	o University System o Single Department System	o University system o Hunter Research Admin. o Hunter Divisional Systems
Finance	o University System	o University System o Some subsidiary systems on Hunter mainframe o Several subsidiary systems in depts.	o University System o College-Wide Data Base o Subsidiary Systems in depts.
Human Resources	o Hunter System	o University System o Subsidiary Systems in Personnel and Finance	o University System o College-Wide Data Base o Subsidiary systems in Personnel, Finance, Divisions
Facilities	o University System	o University System o Single Department System	o University System o Hunter System

Table 2-4

Virginia Tech

An Organization for Administrative Systems

Automated administrative systems have flourished at Virginia Tech since the early 1970s. The University was one of the first in higher education to have on-line, computerized systems for financial, personnel, and student activities. Realtime updating and inquiry are major features of the systems through thousands of devices for access over the communications system.

The Systems Development Department was established at Virginia Tech to provide support in the design, development, and implementation of computer-based administrative systems. For almost 20 years, most of these systems have been developed in-house using the IMS data base management system and COBOL. Unlike many other universities, once an administrative system is developed, operational responsibilities are decentralized to the major functional office. Thus, there is no centralized administrative data processing group or administrative computer.

Involvement in departmental computing and distributed activities might seem a logical consequence of having no centralized administrative data processing group at Virginia Tech. Indeed, such involvement is almost unavoidable with over 13,000 personal computers and a large number of mini-computers located around campus. However, the departmental and distributed activities are primarily associated with the instructional, research, and extension missions of the institution, and (obviously) some of the "local" administrative functions that are required to maintain an acceptable level of operation. It remains a fact that all major and "official" administrative systems at Virginia Tech are on one mainframe computer and, to a large degree, are in some form centrally controlled. Those groups located in functional offices have responsibility for the operation, maintenance, and minor enhancements of their administrative systems.

Virginia Tech has been in the business of developing and implementing administrative systems for over 20 years, and those in-house systems have generally fulfilled the needs of a diverse group of users. In recent years, new technologies have expanded the opportunities to users and altered directions for administrative systems.

Entering a New Era

Information management is entering a period of eventful change. Distributed data, distributed processing, new information delivery systems, open architectures for information systems, networking, and other technological advances will contribute to new and changing environments. Such advances are altering views on automating administrative functions and making information easily accessible. These efforts are placing increased importance on having better control of information as a university resource. Distributed technologies make it important to maintain a point of central control for ensuring support of overall institutional goals. Distributed activities should not necessarily be discouraged, but solutions created for specific areas need not, at the same time, diminish support of institutional systems.

These apparent changes prompted the Vice President for Information Systems to assign his Assistant Vice President to direct the Data Administration staff and develop a strategy for the future. The staff spent several months evaluating existing environments, discussing new and future technologies, talking with users at all levels, and trying to gain the right perspective for information resources at Virginia Tech. The result of this hard work was a document, "An Information

Infrastructure for the Future," that focused on new directions for administrative systems for Virginia Tech. (This document is available from the CAUSE Exchange Library.)

The document addressed the fact that development of administrative systems at Virginia Tech will change over the next five years through a decrease in actual development of systems and an emphasis on distributed technology, specialized software, and available third party products. As a result, the Information Resource Management Department should assume a leading role and accept new challenges to coordinate, integrate, and disseminate the "new wave" of information technology. In accepting this leading role, the department must become more involved in managing information as a university resource, and deal with issues of information identification, management, accessibility, integration, security, and planning.

A Vision of the Future

The obvious starting point for any successful venture is a clearly stated, clearly communicated vision of where the organization is going. By considering trends, and changes in technology, people, and even higher education, a vision for an information infrastructure will evolve; however, it is only a vision and it must be part of a continuous planning process.

What is the vision for administrative systems at Virginia Tech? The future information infrastructure for this institution is one that will support distributed, decentralized activities. Over the next decade, most administrative systems will be operating on computers located in major functional offices such as Accounting, Purchasing, Admissions, Registrar, and so on. This distribution will be extended to college and departmental machines that will provide more opportunities for decentralized activities.

This vision of an information infrastructure is only the first step in a long and continuous process. A participative planning process will define projects necessary to accomplish the goals and objectives of the organization. Important to the process is the inclusion of individuals who represent all phases of an information spectrum - information owners, developers, integrators, users, and support services. Many of the issues these planners will deal with are not associated with the traditional "components" of an information system, that is, hardware, software, and communications. These areas and issues must be viewed in a global sense, crossing traditional institutional boundaries to recommend directions for the future.

An Organization for Success

The process for developing and implementing administrative systems has been very structured and centralized, responding to specific and clearly defined user needs. As activities are distributed and greater responsibility is placed in operational offices, the process will become increasingly unstructured. It is extremely important to have an organization that can manage this type of environment and support the concepts of an information infrastructure.

A recent article in ComputerWorld also referred to this type of unstructured environment. The author feels that "managing information systems effectively in this increasingly unstructured environment requires an understanding of the attitudes, roles, and responsibilities of those involved."[1] The document prepared by Data Administration recommended an organization to coordinate and control efforts to move administrative systems into the future.

An Information Management Organization

Institutions must recognize the importance of an information management function. Administrative systems and information span the entire university structure and demand a high degree of coordination and integration. If information resources are to be a means for a more productive and

[1] Halsey Frost, "Time for a Change," ComputerWorld, March 2, 1988, p. 19.

effective university, then a central unit must coordinate and control many activities associated with information systems.

The information management organization that supports an information infrastructure should be positioned within the university structure so that it can easily associate with many different individuals, both internal and external to the university. The organization must be able to function well in a liaison role, to provide consultation, to be active in planning efforts, to form a clear view of the university's information requirements, and, at the same time, to enforce standards and procedures to conform to an overall strategy for information systems

James J. Odell, a senior consultant in the field of information engineering, summarized the importance of centralization by indicating that successful data administration requires centralized control. Its functions should not be scattered among the diverse needs of programmers, analysts, users, and so on. Information is a vital university resource. Only by centralizing information management at a level appropriate to a vital resource can information truly support the university.[2]

Information Resource Management

In order to accommodate this type of organization at Virginia Tech, the Systems Development Department was moved to the Computing Center, leaving only Data Administration in the Information Resource Management (IRM) Department. The primary mission of Information Resource Management at Virginia Tech is to provide leadership and direction for an infrastructure that supports all levels of informational needs at the institution. Through management and technical activities, IRM has primary responsibility for the planning, management, and control of information as an institutional resource. The department will capitalize on new opportunities for administrative systems and provide a variety of services to support the information infrastructure.

- Information planning at the university level
- Standard formats and naming conventions for data
- University-wide directories and dictionaries in a medium that is accessible and understandable to non-technical personnel
- Standard access methods that are available to a wide range of users, requiring little or no technical expertise to use
- A quality assurance function for data integrity and for enforcing appropriate standards and procedures
- An awareness of opportunities to enhance and expand information systems
- A methodology and level of expertise to ensure systems conform and, as required, are part of the university-level information structure
- Security at appropriate levels to enforce required restrictions as defined by data owners and/or security officers
- Overall data management assistance from the design phase to an operating environment

These IRM support services will be accomplished through activities in the following areas.

- Systems Planning and Integration
    - Global (institutional) planning
    - Information modeling
    - Information needs analysis
    - Quality Assurance Program
    - Decision Support Systems/Knowledge Based Systems

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[2] James J. Odell, "Organizational Structure for Data Administration," *DataBase Newsletter*, Volume 12, Number 6, November/December, 1984, pp. 1-4.

- Data Management
  - Metadata (directory type)
  - Data dictionary
  - Data standards
  - Documentation
- Operations and Access Control
  - Generic "service" systems
  - Security/ACF-2
  - Electronic authorization
  - Single userid and password
  - Performance
- Advanced Information Systems
  - Consistent Window project
  - Artificial Intelligence/Expert Systems
  - Advanced delivery systems
  - Departmental environments
  - Networking

These activities will require services from various IRM groups and cooperation with outside organizations such as Systems Development, Systems Programming, Internal Auditing, Institutional Research, operational offices, and others. Other services, such as data base design consultation, assistance in evaluating proprietary software, and considerations for standards, will require participation from various university departments and close coordination

This environment can be viewed as a new housing development. A chief architect is responsible for designing the overall development and making sure community needs are met. Other architects and contractors work with the chief architect to build homes and other facilities to meet the development's needs. As with most developments, the demand continues to grow and expansion and improvements are ongoing processes.

Information demand at Virginia Tech will continue to grow and an organization such as IRM is needed to ensure an acceptable information infrastructure is present Such an effort is not short-term in nature and requires a long-term commitment

The Creation of an Executive On-line Decision Support System

Dr. Charles W. Burmeister
Director of Information Systems
Alamo Community College District

A system solution using integrated information technologies is been developed to provide end-users, primarily academic leaders, a full range of on-line functions including selection, ad hoc queries, data analysis, statistical analysis, report generation, and presentation. Institutional key strategic indicators are accessible for viewing or graphical presentation. An information gateway is provided to historical file structures easing access for queries and questions spanning several academic years. All activities are menu driven. The system provides substantial benefits including access to strategic indicators, to key data, to data analysis, and to the presentation to support executive decision making and planning. The system consists of a PC work station or terminal, micro-to-mainframe link, identical application software on PC and mainframe, software for integration and user friendliness, and structured historical file structures.

The Creation of an Executive On-Line Decision Support System

Dr. Charles W. Burmeister
Director of Information Systems
Alamo Community College District

INTRODUCTION. "There is a widely-held perception among administrators on many campuses that the mainframe databases are holding enormous amounts of data that would be extremely useful, if only it could be accessed and manipulated in some relatively easy ways (Desktop MIS for Administrators). For the most part, computer center directors agree, making this the top choice for the hottest administrative computing issue. The mission this year is to turn the day-to-day operational data processing systems into easy-to-use, readily- accessible, information generators. Computer people are looking at applying fourth-generation languages to the data, doing extracts into relational databases, down loading into microcomputers, providing mainframe report writing and statistical analysis packages, and, increasingly, looking at whole new administrative systems that automatically (in sense) provide the responsiveness and control that end-users want."[1]

We may disagree as to whether to reference this issue as Desktop MIS, Executive Information Systems, Decision Support Systems, Executive Support Systems, or Information Support Systems. However, we certainly agree that it is a high priority objective to turn "operational data processing systems into easy-to-use, readily-accessible, information generators." In addition, you and I would certainly place additional criteria on this concept in order to provide greater clarity and definition on this concept within our own university and college environments.

Within the Alamo Community College District (ACCD), we are developing a system to meet needs which may be unique. I will be sharing with you ACCD's approach, objectives, design, experience, and strategies. From these discussions, you may find those elements that are useful on your own campus. As you will see as the presentation unfolds, we currently refer to the system as an Information Support System due to the diverse objectives to be met by the system.

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[1] "Hot Issues 1988-89," The <u>EDUTECH REPORT</u>, September 1988, p. 1.

Further, it should be noted that the creation and maintenance of an information support system for academic administration is a migration toward a not too distant goal rather than a destination itself. Strategies appropriate for the genesis of the process must give way to other strategies as users gain experience and their needs mature. As we move closer and closer, the target, of course, constantly moves upward which maintains the challenge for our profession.

In industry and business, executive information systems have been around for some time. It was in the 1970's that Merrill Lynch, the brokerage firm, installed an EIS. EIS is one of the faster growing areas in industry and there are an abundant number of software offerings ranging in price of upwards to $250,000 depending upon options.

Within industry, there are a sufficiently large number of documented success stories to attest to the viability of the opportunity. These include Marine Midland Bank, Xerox, General Services Administration, Kraft, and Phillips 66 to mention a few. The reader may refer to the book <u>Executive Support Systems</u> by Jack Rockart and Dave Delong of MIT's Center for Information Systems Research (CISR) for more detailed information of what has worked best in industry.

A word of caution should, however, be noted. Various elements of academic administration may be similar to the decision making of business executives, but there are sufficient differences that the temptation to make a direct extrapolation of experiences and strategies should be avoided.

In the academic area, there is at least one offering specifically developed for universities. It is offered by Information Associates and is called IA's Executive Support System. The development of this system was, I believe, directed by Charles R. Thomas, formerly executive of Cause and now Vice President of Information Associates.

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; the implementation that is underway; and finally, a look at future possibilities.

<u>THE COLLEGE ENVIRONMENT</u>. The Alamo Community College District (ACCD) consists of three community colleges, San Antonio College, St. Philip's College, and Palo Alto College, with a total enrollment (head count) of about 32,000 students. Classes are offered at the three college sites and at four other campus centers. Personnel consist of approximately 750 full time faculty, 60 administrators, and 450 professional and classified staff.

Computer resources consist of an IBM 4381 computer for administrative computing, an IBM 4341 and an IBM 4331 computer system to support academic processing, and about 700 terminal devices located at seven distinct sites. A SNA/SDLC data communications software system is used to communicate among all th systems and a T1 communication link connects three major sites. Over 100 of the terminal devices are PC's that emulate the 3270 terminal allowing for stand alone or integrated operation.

In September 1986, a comprehensive financial software system, the College and University Financial System offered by American Management Systems, was installed. In 1988 the Student Information System offered by Information Associates was installed. Hardware was upgraded to the IBM 4381 in 1986 and the DASD system was recently, 1987 and 1988, upgraded and expanded.

Information centers were maintained for use by all personnel at three locations in the period 1984-87. Use of these centers by individual personnel was very low. However, requests for over 2000 production jobs and ad hoc management reports are received monthly and processed by the production analysts. It was in this environment that we set out to create an information support system to provide easy access by administrators to the operational databases. The project is currently underway.

INFORMATION STRATEGY. Due to converging, available technologies the opportunity for an integrated information support system was feasible. Our work and thinking began with the general idea to make information more readily available to end-users. This included end-users at all levels. We wanted there to be easy access and we wanted to expand the circle of users to include administrators and top management. The pattern that has existed within ACCD may be typical of many institutions. An ad hoc request is made. Depending on the nature of the request, how busy the production group is, and the priority placed on the request, the user may receive the ad hoc report in a few days or a few weeks depending on its complexity. A decision maker may not be encouraged by the process to make several iterations in obtaining full and complete information to support the decision process.

We also observed that our "users" by most evaluations were those who we worked most closely with in the creation and maintenance of the database, the admissions and records personnel, finance personnel, and etc.

As noted earlier, the institution had make major commitments in 1986-88 of resources to software, hardware, and communication systems. The next phase of the development should make the data conveniently available to users at all levels. This is the payoff. This is the exciting part.

It was, and is, our primary objective to create a system for end-users at all administrative levels within ACCD whereby data can be easily accessed and structured so that it will be timely, useful, meaningful, and relevant to users work. Coupled within or secondary objectives would include the desire that the data support administrative decisions, that the system would support other departmental initiatives in end-user computing, the system would expand the user base to include upper management, and that there would become one source of consistent, accurate, and reliable information.

SYSTEM DESIGN. Of the three options, PC stand alones, mini-computer systems, or integrated mainframe based systems, we have selected the integrated mainframe approach. The databases reside, of course, on the mainframe and it will allow more control and flexibility. We expect large PC workstations will ultimately exist in key locations.

To allow for ease of access and efficiency, extracts of the databases are created. The term extract is not to imply that key or important fields are not available to the user. The student information system file is created with all the unchanging, not term related, characteristics. These records total 150,000 for five years of historical records The record length is 120 bytes. Another file with record information related to each term is 160 bytes in length. These total 225,000.

FOCUS 5.5, characterized as a 4GL language, is used to access these files, create other extracts, provide menu drivers, and produce the reports or queries. It currently is operating under CMS. FOCUS is available for mainframe as well as PC workstation use. We may also use SAS which provides products for mainframe and PC's to product certain graphics and statistical results.

IMPLEMENTATION. The system consists of three sub-systems; strategic indicators, structured data analysis, and individualized data studies.

In the strategic indicator sub-system, key information areas has been identified as strategic indicators such as student head count, contact hours, and etc. This information is stored in predefined data structures and is formatted for immediate access by the user. The user is "stepped" through menus with options and selections. The data can be plotted using various graphics options. The options available are rigid and highly structured as the information structures are predefined with the choice of the strategic indicator. The reader may argue that this is not access to data in the usual sense. However, the use will provide an important function at ACCD and is, in a sense, a "sampler" for the other two sub-systems.

The structured data analysis allows the user to select many different variables and fields for study. The analysis may be by college, by division, by ethnic group, and etc. The user is "stepped" through menus as elements of the query is structured and as output is selected.

The individualized data analysis sub-system will allow the user "open access" to the extended data structures in the creation of a query. Files can be created for down loading to the PC workstation. The user will be guided by menus in the creation of the product.

The system is targeted for the end-user who would not be characterized as an operational end-user such as admissions and records personnel but the non-operational end-user such as deans, vice presidents, presidents, and academic managers.

FUTURE OPPORTUNITIES. Technology in this area will increase rapidly and will enhance the opportunities that exist. Data from external data bases has not been included. It is expected that as users use the system, it will evolve as the needs of the users evolve and as the users mature as users.

An accurate, valid, conclusion can be repeated from another source. "This new generation of strategic information systems represents an exciting approach to providing support to administrative decision-making and planning activities in colleges and universities... I would suggest that this new era will soon require, if it does not already, a computer based administrative strategic support system as a vital part of every institutions information management facility."[2]

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[2] "Information Systems Support for Future Strategies," The EDUTECH REPORT, July 1988, pp. 1, 6-7.

INTEGRATING A DEC AND IBM ENVIRONMENT BETWEEN CAMPUSES

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Introduction

The University of Colorado like many other universities has more than one campus. While multiple campuses opened up opportunities for the university, it also presented problems. With computers these problems were quite complex. There were problems with distances between campuses, compounded by each campus having computer systems from different companies with different operating systems. This paper is a case study of how the University of Colorado at Colorado Springs integrated a Digital VAX environment with the IBM environment 100 miles away in Boulder, Colorado.

The University of Colorado at Colorado Springs, one of four campuses in the university system, did most of its administrative computing for the campus on the IBM mainframe in Boulder. Until the intercampus network was established, most of the computing was done in batch mode using RJE card readers and printers. This was replaced by IBM terminals and controllers and a spooling protocol called HASP that ran on a Digital 11/750. The IBM in Boulder was upgraded to a NAS XL-60, an IBM compatable mainframe computer. When the University decided to install an on-line student information system, an on-line Accounts Payable system, and an on-line Purchasing system,it became necessary to have a large number of users connected interactively.

Campus Network

The original local campus network was a DCA asynchronous network. When over a dozen computers in a new engineering building had to be connected to the network, options were explored. The ideal was for all users to connect to all computers in the same manner. This would allow easier support and troubleshooting. The first decision was to use ethernet to connect terminals on campus to the network. Bridge Communications CS/100 terminal servers were used to allow multiple users access from various locations on campus. The protocol used was TCP/IP. This was chosen based on its ability to connect to Unix machines and considerations for future connections to outside networks such as the Colorado Supernet and the National Science Foundation network which also uses TCP/IP. (see figure 1.0)

The campus historically has had problems with electrical storms and power fluctuations that at best stop computer equipment and at times damage this equipment. Optical fiber was run between buildings to reduce potential damage from electrical storms. Ethernet cable was run within each building. (see figure 2.0)

Intercampus Network

Initially, there were a limited number of users who had on-line capabilities through the use of IBM controllers on an SNA network connected to Boulder. These were IBM 3278 terminals connected to controllers using coaxial cable. However, this network would only support a fixed number of users and would also be too costly to use as an on-line system for a large number of users. There were several options available. First, we could have continued with the existing equipment. A few individuals had access to IBM terminals. The rest of the campus used central data entry and batch reports for their only access to computers. This was slow, it was not responsive, and was clearly not what the campus wanted. Second, additional IBM terminals and controllers could have been added. This was fairly costly, there would have been problems running enough coax cable to certain parts of campus, and it would not allow individuals to access both campus and Boulder machines with the same terminal or microcomputer. Third, asynchronous switches could be installed. This appeared to be a very costly approach and the campus was moving away from asynchronous switches toward ethernet for connecting academic computers. The fourth and final option was to use the campus ethernet. This minimized the network problems and allowed individuals to use the same terminal to access all of the computers on campus as well as the administrative computer in Boulder. The primary disadvantage of this approach was that non-IBM terminals had to be able to work in an IBM environment. The decision was made to use the campus ethernet to allow administrative departments to connect to the administrative computer in Boulder.

When the main connection from Boulder to Colorado Springs was in the planning stages, anticipation of future growth and additional needs were taken into consideration. As a result, a 56 KB line was chosen using T1 Timeplex multiplexers on each end. This will allow the line to be upgraded to a T-1 line in the future. (see figure 3.0)

How the Intercampus Network Works

The link between the administrative computer in Boulder and terminals connected to the campus ethernet went through several steps. However connections on the Boulder end were fairly straight forward. First the channel from the T1 multiplexer feeds to an IBM front end processor which connects directly to the NAS host computer. The channel from the host computer through the T1 multiplexer in Boulder down to the T1 multiplexer in Colorado Springs was SNA.

A gateway from SNA to TCP/IP was needed to connect the SNA channel to the campus ethernet. The gateway was established using Bridge CS/1 communication servers. Each CS/1 server supported 24 ports. Two servers were installed. The two servers increased the number of ports and provided a backup in case problems occurred with one of the servers. Complications occurred when the servers allowed only 19 ports to connect rather than 24. Limitations in the processors appeared to be the cause. A hardware and software upgrade was needed to increase the number of ports on each server.

After the data traveled through the CS/1 gateway, it then entered the campus ethernet. CS/100 and CS/200 terminal servers were used to connect users to the CS/1 gateways. Since the host computer operated in an IBM environment, it was necessary to emulate an IBM 3270 series terminal. The users on campus had a variety of terminal types, including microcomputers serving as terminals. Since the campus had a Digital VAX environment, Digital VT220 terminals were selected. This allowed access to the administrative computer and worked well with the VAX, allowing access to both resources from the same terminal. The microcomputer situation was similar. The majority of systems on campus were Zenith microcomputers running MS-DOS. The challenge was to make these look like an IBM series 3270 terminal. The VT220 was supported by the CS/1 hardware. It was important to define function keys to cut down the number of keystrokes required to perform functions that were only one keystroke on the IBM. With the microcomputers it was necessary to first emulate a VT100 which was supported by the Bridge equipment. PC-VT was the emulation system most users were using to connect to the VAX so it was decided to use it as the emulation software. Function keys were also defined on the micros in order to shorten key sequences. Because the terminal needed to be set properly in order for the terminal to be recognized by the network, defining the terminal set-up at the time of connection became essential. If the set-up was not correct to match the network then the terminal would lock-up. Using macros available on the terminal servers it was possible to send the correct terminal set-up to the system when the user typed in the initial login command. In this way it was possible to define different logon commands depending which terminal the person was using. The system was set-up for a PC or a VT220 depending on the logon command the user enters. The user was given a menu where they selected the terminal type they were using. After the terminal type was selected the connection was completed and the user was on-line on the system in Boulder.

This system worked well, except for one problem that occurred during the process of setting up the terminals and keyboards. The alpha-lock key function that is available on an IBM terminal that allowed the user to enter a numeric value into a alphanumeric field. This function has not been available on either the VT220 or the Zenith microcomputer. This was a problem with the software and has been reported to Bridge communications.

Conclusions

If we measure the success of the network by the willingness of the users to use new equipment, the use of VT220 terminals and microcomputers has been very successful. Given the choice of IBM terminals connected to the controllers and the use of the new network, most users will select the new network. The networks at the University of Colorado at Colorado Springs are continuing to evolve. As this evolution takes place there will certainly be changes in the existing networks. However this network allowing users to be on-line on a computer on another campus, as well as connect to the local computers using the same terminal, has proven to be beneficial to everyone involved. In addition, the campus Ethernet network running TCP/IP with gateways to other networks outside the university should also be useful for future growth.

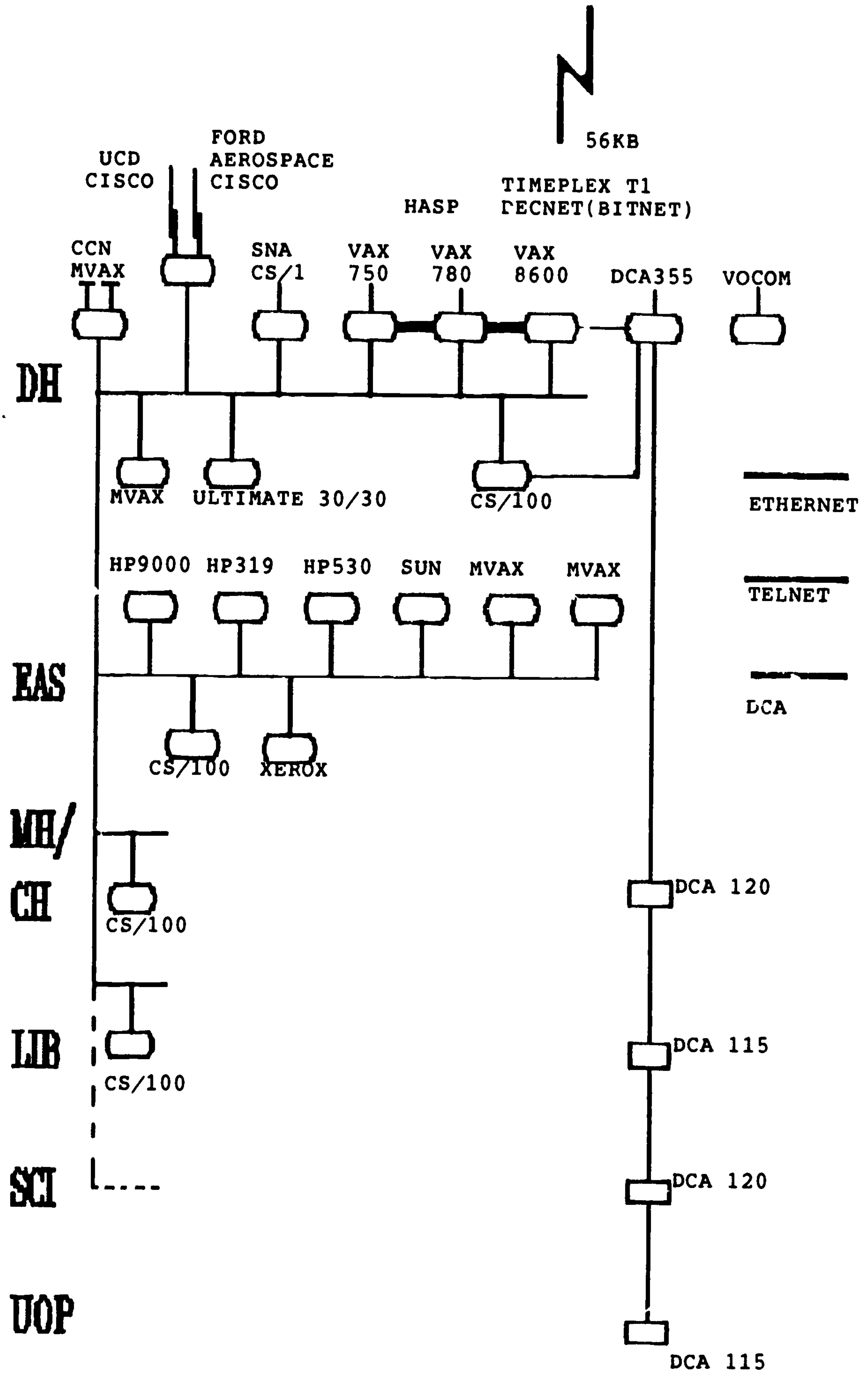
56KB
FORD
AEROSPACE
CISCO
UCD
CISCO
TIMEPLEX T1
DECNET(BITNET)
HASP
CCN
MVAX
SNA
CS/1
VAX
750
VAX
780
VAX
8600
DCA355
VOCOM
DH
MVAX
ULTIMATE 30/30
CS/100
ETHERNET
HP9000
HP319
HP530
SUN
MVAX
MVAX
TELNET
EAS
DCA
CS/100
XEROX
MH/
CH
CS/100
DCA 120
LIB
CS/100
DCA 115
SCI
DCA 120
UOP
DCA 115

FIGURE 1.0

UNIVERSITY OF COLORADO AT COLORADO SPRINGS CAMPUS ETHERNET

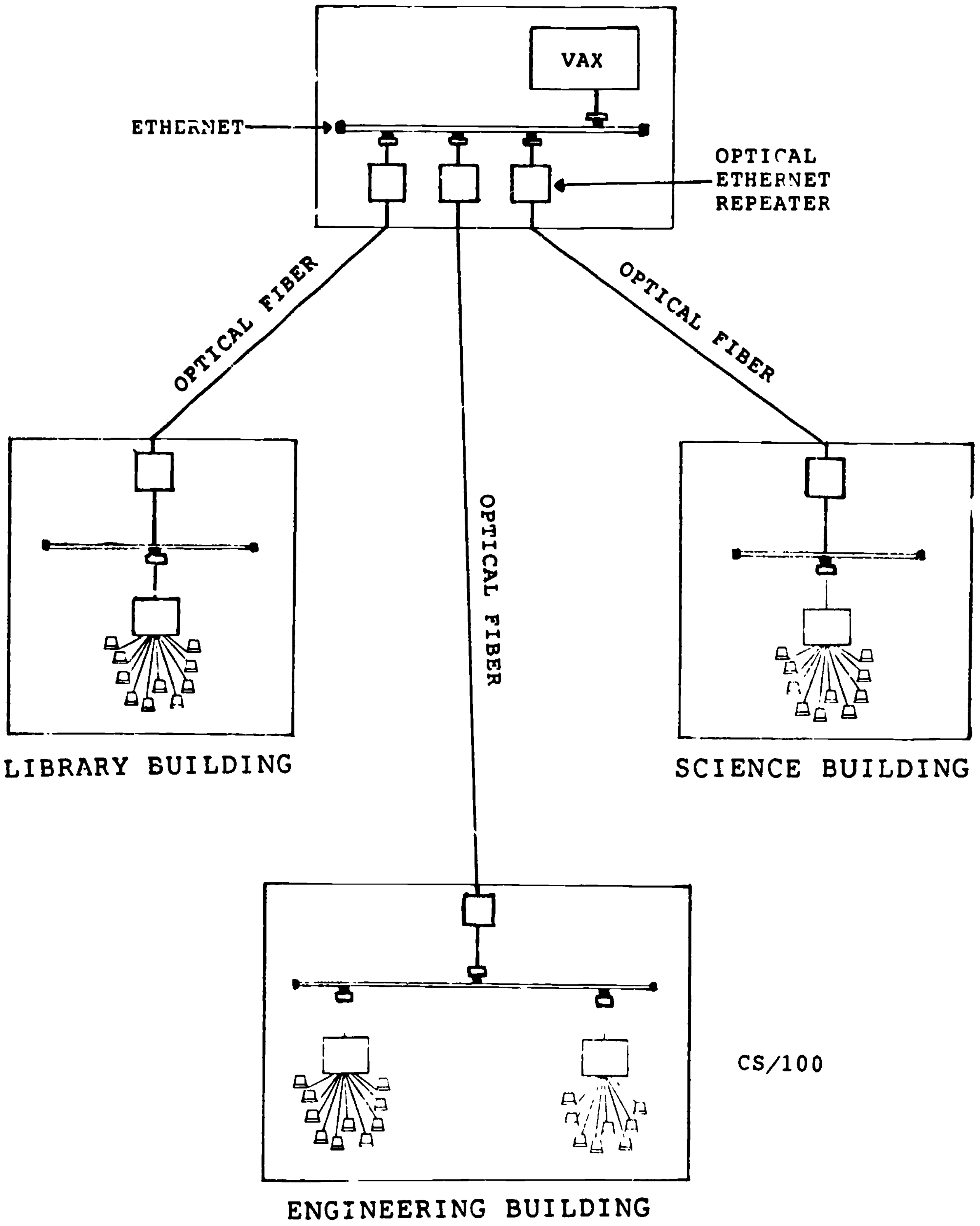

FIGURE 2.0

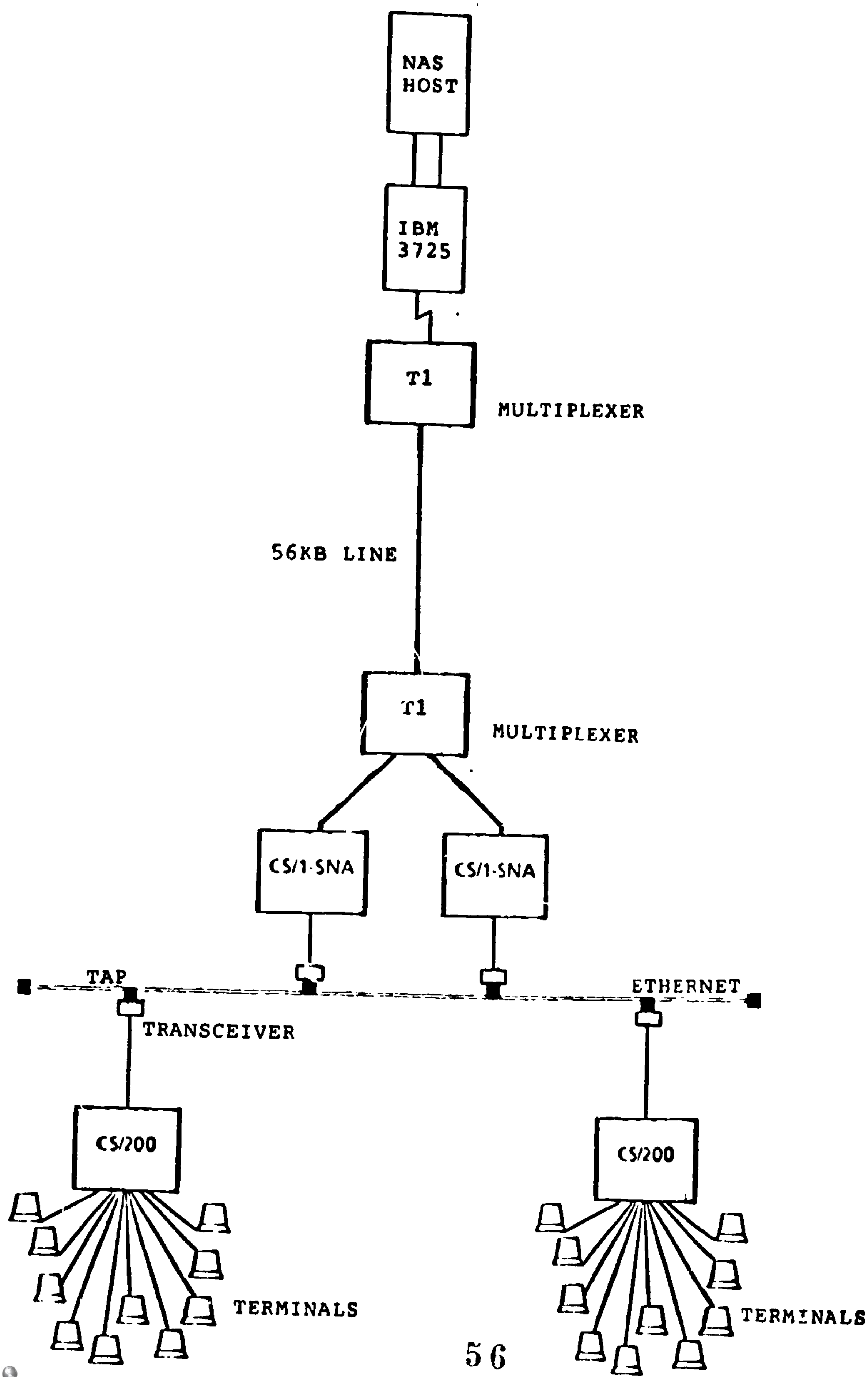
NAS
HOST
IBM
3725
T1
MULTIPLEXER
56KB LINE
T1
MULTIPLEXER
CS/1-SNA
CS/1-SNA
TAP
ETHERNET
TRANSCEIVER
CS/200
CS/200
TERMINALS
TERMINALS

FIGURE 3.0

Bridging the Gap between the Data Base and User in a Distributed Environment

Richard D. Howard, North Carolina State University
Gerald W. McLaughlin, Virginia Tech
Josetta S. McLaughlin, Virginia Tech

Lennie said, "Tell how it's gonna be."

George had been listening to the distant sounds..."Look across the river, Lennie, an' I'll tell you so you can almost see it."

"Go on," said Lennie, "How's it gonna be. We gonna get a little place."

The voices came closer now. George raised the gun and listened to the voices. Lennie begged, "Le's do it now. Le's get that place now."

(John Steinbeck, Of Mice and Men)

The advent of inexpensive desk top computing has resulted in increased demands by decision makers at the college and departmental levels for direct access of administrative data bases. They are setting with us looking across to the ideal distributed information system—just on the other side of the river. This interest of data processing end users in generating their own decision support materials has given rise to a set of data related concerns that fall under the rubric of data administration. As with most new functions, the data administration function has taken many forms. In general, its purpose is to manage the non-technical aspects of data base creation, maintenance and use. In part, the data administrator is responsible for facilitating the use of institutional data bases across the campus. The data administrator needs to build the bridge between the data base and the user. Presentations at CAUSE, AIR, SCUP and other associations have documented that institutions, in one form or another, are building the data administration function. These presentations have also discussed the problems of creating an environment conducive to the effective use of institutional data bases, campus-wide.

While the data administration function is evolving to help users access data, a series of data/information "use" related issues must be addressed to bridge the gap and to assist the user in effectively applying the information. These issues have not historically been the concern of the data processing center. Data quality and its use have been the responsibility of custodians of the data and/or the institutional research office.

Why is data quality now suddenly becoming such a critical issue? Has it not been a concern of those responsible for federal and state reports in the past? Who has assured both external and internal decision makers of the integrity of reports and other decision support activities based on institutional data? Historically, decision support (using institutional data bases) has been been limited by the state of the art of computer and communications technology. In general, administrators were dependent upon the "mystics" that were able to manipulate the data bases to create information. Institutional research (either a separate unit, or through the registrar' office or the computing center) often provided the interface between the decision maker and the "mystics" Often, the institutional research office employed "mystics" of their own that could be dedicated to the development of information for decision making.

It was through these processes of working with data that those in the institutional research office learned about data peculiarities, data collection processes, and reporting time tables. All of these have an effect, often negative, on data reliability and validity. In their role as the interface between the data processing function and the decision maker/planner, institutional researchers developed the processes that insured data integrity in their reporting and decision support activities. However, these processes are not inherent in the collection of the data or its processing by the computer center. As such many operating data bases are created and maintained without concern for their use in decision making or planning activities.

In the past ten years, institutional administrators have increasingly demanded direct access to institutional data bases to support their own decision making and planning activities. Four "conditions" are generally responsible for this change. All four of the following occurred at the same approximate time:

1. Increased competition for fewer dollars.
2. Increased accountability both from a financial and spending concern as well as the latest demand for assessment of what students have learned and how the institution has shaped their academic and personal maturity.
3. Proliferation of cheap but powerful computing across the campus providing the technology that can make institutional data readily available to any one needing or wanting it.
4. A greater number of mid-level and senior managers with experience in using computers to help in solving problems.

Managers in today's institutions know the capabilities of the technology and possess the basic knowledge to use the computer. The result is a desire to manipulate the data themselves and not depend on a central unit that does not know or possibly understand the uniqueness of their unit. The result has been a clamoring by virtually all units on campus to have direct access to institutional data bases stored on the mainframe. Institutional Research is less likely to be in a filtering or buffering role. Computer centers have tried to meet the demand by providing the access and creating Information Centers to help the users "de-mystify" the intricacies of their hardware and software.

Now the additional technical advances along with the promises of local area nets are going to make the distribution of data bases a reality for most institutions. We have dreamed of this day but there are some of us who think we hear voices and are not sure that the future automatically holds the promise that we can, in Steinbeck's words, "live on the fatta the lan'". We are not sure that we want someone to tell us about the rabbits one more time.

The basis for this skepticism comes from the state of the art in data administration. At present data administration seems to focus primarily on issues of sec ity and the development of data dictionaries. Rarely does the data administrator take on the issues surrounding data integrity or use. Though data administration has been viewed as important, it seems to have taken second place to the exciting technical advances of computing and communications. We suggest that if data do not have integrity and usefulness, user frustration will lead to hostility. Attention to enhancing data quality increases the likelihood that "Everybody gonna be nice to you Ain't gonna be no more trouble" (Steinbeck).

The critical question concerns what will happen if data administrators ignore issues of data integrity. Can we assume that natural forces will bring order, value, and worth to a decentralized system? Our premise is that "Left on their own, things do not tend to spontaneously move to more and more ordered states...if things are left unattended they soon become more and more disorderly. Bringing things back into a state of order requires the expenditure of additional energy" (Rifkin and Howard, 1981:43).

As our information systems become more decentralized, they will tend to move from a state of order to disorder. Our challenge is to learn that knowledge which will simultaneously develop an information system's state of order while strengthening the ability to provide of information to our decision makers. When faced with this challenge, we need to find a means for developing a comprehensive set of questions which we can ask ourselves. Through inspection of the answers, we can better prepare efforts to meet the challenges of "un-centralized" data administration.

This paper presents insights drawn from earlier work in the field of behavioral science research to develop a useful set of questions. Specifically, we draw on the work done by the APA on reliability and later work by Donald T. Campbell on internal, construct, and external validity. These concepts are selected since both the behavioral science researcher and the information professional are in the business of providing support for decision makers. Therefore, both must be concerned with similar data information issues. The intent of the following is to apply the concepts of reliability and validity from behavioral research to our use of computerized information. The purpose is to explore whether this process produces a useful set of questions for dealing with data administration.

Reliability

Reliability is defined as the degree to which independent but comparable measures would obtain the same results (Churchill, 1979:64). The cause for unreliability comes from random error. For traditional estimation techniques, reliability is estimated in terms of 1) stability—two looks at a measure over time; 2) consistency—two similar looks at a measurement at one point of time with similar items; and 3) objectivity—two looks at a measurement with different evaluators (Wiersma, 1975).

The following is an adaptation of these three types of chance fluctuation to the use of a data base and to development of the questions we should raise to avoid the problems of unreliable data.

Stability. If the same data is viewed at two points in time will it have the same value? The most obvious procedure to improve the stability of data bases is to create point-in-time (census) data bases. Where this is not possible or not practical, one must make sure that all data values have a time-date stamp of creation. To insure the proper interpretation, the documentation must specify also the procedure used to capture the data. Assumptions need to be developed that this capture was at a point in time or fixed relative point in time (e.g., the fourth day of class). A final help in the stability of the data is to select items which are as stable as possible (average GPA rather than grades in math).

<u>Objectivity</u>. If the data is obtained by two different procedures, will it have the same values? The main challenge to objectivity comes from the capture of the data. Data capture problems arise when clear instructions to coders are lacking. For example, if non-central coders are using different code sheets, objectivity is lost. In a non-central system, it is also important to reduce the number of times a data element will appear. If there are two locations for an item such as high school which a student attended, the data can, and on occasion will, differ.

Two types of problems can also occur with respect to user error. First, the users fail to understand the variables—when is pay equal to total pay, institutional pay, or general pay. The second type of problem arises in the selection of the sample of interest—when is faculty comprised of those who are full time instructional versus those who are not classified and receive pay for their activity. These dangers are increased in a decentralized system where there is a possible lack of continuity or even communication between the custodian and the user.

Preventing such problems will depend on documentation to prevent confusions in interpretation. Introduction of an official flag on important variables such as pay or groups such as faculty is one procedure for dealing with the problem. Such a derivation needs to be documented and its use enforced by the organization.

There is a counter caution, not all variables with the same name will be identical in definition. Therefore, cleaning up a non-central data base needs to be done with care.

<u>Internal Consistency</u>. Are pair-wise combinations of codes occurring which are not possible within variable definition? The lack of internal consistency comes from several main sources. One of the more common problems is the failure to use a consistent, mutually exclusive set of codes for variables. Another problem comes in the improper capture of data. Front-end audit programs can help with both of these problems. Unfortunately, front-end audit programs often require that several non-central data bases communicate. This is often not possible due to failure of organizations to develop information systems with such a capability. Another option is to put edit checks into place with batch jobs which merge and perform internal audit checks. Once an inconsistency is found, there needs to be an enforced procedure of determining the correct category and making the modification to one or more data bases.

Internal consistency also requires a need for a standard set of codes for each element which can occur in more than one place. College code can occur from the FICE code, the ETS code, or a local set of codes. Failure to standardize such codes places heavy dependence on lookup tables and greatly complicates efforts to maintain an internally consistent data base.

Lack in consistency in coding and impossible combinations can be prevented, or at least reduced. Data administration must take an active role while armed with a good data dictionary. It is also essential that common keys be used across data bases of like entities so that relationships can be made for pair-wise comparisons rather than requiring the chaining of data bases.

Validity

Validity is defined as the degree to which something does what it is intended to do (Carmines and Zeller, 1979). The validity of information in data administration is concerned with measuring, or providing information, which can be understood and used. What do the data mean? How can they be used? The lack of validity comes from the presence of systematic bias in the information. Validity can also be limited by the reliability of the information. In other words, unreliable information can not be valid.

Traditional work in the research validity has focused on the internal, external, and construct validity of the information coming from the research. This section of the paper will address separately issues falling under each category.

Internal Validity

Internal validity relates to the ability to draw proper conclusions from a research project, or (for our purposes) a data base. At this level, validity answers questions of "What does this information mean?", "How should we interpret the information?" To address these questions, we will examine the 12 types of threats identified by Babbie in The Practice of Social Research (Babbie, 1986). They are grouped into three categories—internal validity of variables, internal validity of procedures, and internal validity of support.

Internal Validity of Variables

1. History: Has the definition of the variables changed over time? Example — In 1986-1987 room utilization was measured on the first week of class, in 1988 it was measured on the

second week. A complication is that historical occurrences are not likely to be known across decentralized units of an organization.

2. Maturation: Does the definition of this element change at some bench mark? For example, the quarter first enrolled is actually the quarter applied for admission in either undergraduate or graduate and is "updated" when the undergraduate applies to graduate school. Characteristics of other measured elements change over time, for example the number of students will increase up to the last day to add courses and then it will decline.

3. Instrumentation: Is the definition consistent for the entire data base? For example, salary is defined as equivalent pay for those on leave with part pay but is total for those on leave with no pay.

Internal Validity of Procedures

4. Data collection in sequence of events: Do all those who collect this variable collect it at the same point in the sequence of events? For example, one department may post appointment forms before computing number of employees, another department may post after the computation.

5. Selection Bias: Are the same criteria used to include individual observations in the data base? For example, one college includes students who have enrolled for credit courses as students, another college includes those who pay fees.

6. Experimental Mortality: Are identical rules used to determine how long to keep non-active elements on the data bases? Standardized rules for archiving need to be established.

7. Timeliness: Are elements updated before merges? Are "Hours taken this term" part of "Total hours"?

8. Diffusion: When changes are made in and element or an event is captured, does the update go to all occurrences of the appropriate data elements? For example, when a faculty is

removed from the payroll in personnel, does this information get posted to the down-loaded data bases kept by the Dean?

Internal Validity of Support

9. Extremism: Do individuals in various parts of the data/information system work to support each others' needs? Problems easily can occur when one group is asked to collect and keep data elements which are central to another groups success. These extreme or boundary elements typically are not going to receive the same level of support as elements central to the custodian's purpose.

10. Compensation: Are the various elements of the decentralized system receiving their "fair share" of resources to perform their responsibilities to the same standard. Have you been boxed into a conceptual corner where extra resources go to those who do a poor job?

11. Compensating Rivalry: Are all of those who work in the information and data processing system working to support each other? Is there executive competition which is reflected in the operations of decentralized information/data processing units?

12. Demoralization: Have parts of the decentralized data sy tem been bashed until they "Just don't give a damn" any more?

External Validity

External validity of a data base involves the degree to which information from a data base can be used, or generalized, to decisions which need to be made or questions which need to be answered. This is the worth of the data and information. Are application benefits produced in a relevant and sufficient manner? While "threats" to external validity are less definite than internal validity, there are three characteristics w' ch must be designed into a non-centralized data base to insure that the information system has worth—accessibility, comprehensiveness, and relevance.

1. Accessibility: Ar ne data accessible at a level of complexity consistent with user capabilities? If users cannot get to the data they are worthless. As one goes to a non-centralized system,

the likelihood of different softwares, different DBMS, and different machines greatly complicate the accessibility of data. A compounding problem is the data custodian who is over-active in developing security systems.

2. Comprehensiveness: Does the information provide the decision-maker/user with sufficient insight to understand what is occurring, will occur, or has occurred. Can the information address the major components of a problem solving situation? Information systems have worth in monitoring systems and providing input for solving problems. Some of these demands can be predetermined by some front-end information needs analysis. Other needs are much less predictable. The critical element for comprehensiveness is to have a good feel for the relevant decision space of the organization. A particular problem in the non-central system is to balance comprehensiveness while avoiding unmanaged redundancy.

3. Relevance: Does the information focus on the factors which are critical to the success of the users? Within any institution there are going to be specific key problems. At an urban institution the key problem may be anticipating new enrolling students. At a comprehensive research institution the problem may be flexible space. At a two-year school, the problem may be enrollment marketing. The only way to insure that an information system achieves relevance is to get input from key decision makers. Some help can also come from increasing awareness of the types of decisions being made at comparable institutions.

Construct Validity

Construct validity is defined as the degree to which a measure assesses the construct it is purported to measure. The measure must "be useful for making observable predictions derived from theoretical propositions" (Peter, 1981).

A primary threat to construct validity is the use of single items to measure a given concept. Still a data base cannot be expected to contain all possible items or measures and still be cost effective. After identification of the main functional areas in which judgments must be made, the need to be cost efficient while avoiding use of single measures suggests that a minimum of two or three indicators be developed for each construct. This is particularly appropriate where the data base is designed for executives and is comprised of summated or derived elements.

Recommendations

The following recommendations are based on the preceding discussion of internal, external, and construct validity.

1. Develop, use, and enforce a comprehensive data dictionary. This will go a very long way to establishing a data base with adequate reliability. The data dictionary should be done at a central level (Ross, 1981).

2. Develop standard procedures for doing data administration. Have an organization in charge of making these policies into practice, insure it has top level support. Get top level support with vision, resources, and enthusiasm. This support should include a quality control function somewhere in the organization. This will develop the internal validity (Durell, 1985).

3. Insure the interaction of various users and custodians of data with coordination of those involved in the management information and analysis function (sometimes known as Institutional Research). This integration of the key individuals involved in the collection, creation, and use of information should also drive both a formal and informal training program. This will insure training around sound concepts. Also it will meet many of the challenges of external validity.

4. Think logically and strategically about information. Become an an entrepreneur with a product to sell. Get to know your customer (the controller making computations from data, the manager making decisions from information, and the executive making judgments with intelligence). Know your product. It takes effort to move facts into more usable forms of data, information, and intelligence. Know your profession. Your professional level of knowledge, skills and abilities, and a little help from a friendly network of colleagues, will give the maturity of judgment required to provide support in day-to-day operations while putting together the support required when sudden "challenges and opportunities" arise. This approach to information will help ensure the construct validity of decentralized data operations by providing a conceptual framework, plan, or map of activities (McLaughlin, McLaughlin, and Howard, 1987).

Summary

The use of concepts such as reliability and validity to determine the usefulness of research has raised some questions about what is important if we are to perform as professionals in a decentralized information environment—an environment which appears inevitable. These concepts have emphasized the need for a active data element dictionary coupled with a competent and pervasive data administration function. The concepts also emphasize the need for developing a capable user community which shares the value of data as an institutional resource. The final prompt from this exercise is to emphasize that those working with facts in their various forms need to look to their professional competency to take an active role in determining the future use of their professional skills.

What if we fail to take the necessary steps to insure the integrity and usefulness of our data bases? If we fail to turn our attention to the problems at hand, it is unlikely that information for control and strategies decisions will improve in quality or impact. "Printing out of numbers at the computer center will, nevertheless, continue to increase in volume" (Jones, 1982). If, however, one accepts the concepts of Entropy, then the alternative is evident:

> "Strangely enough, it seems that the more information that is made available to us, the less well informed we become. Decisions become harder to make....As more and more information is beamed at us, less and less can be absorbed, retained, and exploited. The rest accumulates as dissipated energy or waste....The sharp rise in mental illness in this country has paralleled the information revolution. (p170)"

> There were crashing footsteps in the brush now. George turned and looked toward them. "Go on, George. When we gonna do it?"
> "Gonna do it soon."
> "Me an' you."

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REMOTE OPERATION OF A MICRO SOFTWARE PACKAGE THROUGH A MAINFRAME COMMUNICATIONS NETWORK

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ABSTRACT

The three segments of higher education in California recently cooperated in the development and field testing of a micro-based package called ASSIST. It takes the graduation requirements of any four-year institution, the articulation agreements between any community college and that institution, and a community college student's transcript and calculates what courses the student has yet to take at both the community college and the four-year institution to graduate. It best runs on an 80386 machine with 300 MByte hard disk capacity. Los Rios has used "ASYNC PASSTHROUGH" on its CDC network to allow counselors at three colleges to use the micros in their offices to access/run ASSIST located on other micros attached to the network.

BACKGROUND:

The Los Rios Community College District, located in Sacramento, California, has 45,000 students currently enrolled at one of our three colleges, an education center, and a number of outreach centers. Administrative and clerical staff are found at these locations and at the District Office.

Computer equipment to support administrative and clerical staff takes three forms:

1. A ten-year old Honeywell mainframe computer located at the District. Office. Approximately 80 terminals located at various district sites are connected to the computer through telephone lines. The Admissions and Records, Instructional Administration, Personnel, and Business Departments use this system heavily.

2. Two small Control Data Corporation (CDC) mainframe computers (Model 932/32) located at the District Office. Approximately 90 terminals at various district sites are connected through telephone lines. These computers were bought to replace the Honeywell computer, and conversion of the Honeywell programs to the CDC is currently underway. The first service provided on this new system was terminal access to transcript data (heretofore available only in printed form) and the remote printing of transcripts. These services were extended beyond Admissions and Records Departments to include the 42 full-time counselors in the District. We accomplished this by placing a terminal in each counselor's office and a laser printer (or two) in each Counseling Department.

3. Approximately 110 microcomputers located in various administrative and clerical offices. All these microcomputers are connected to the two CDC mainframes through the same communications network that is used by the 90 CDC terminals. Most of the microcomputers are used for local word processing (WordPerfect) and Electronic Mail.

Figure 1 shows the number of terminals and microcomputers at each of the major sites.

During the last two to three years while we were acquiring the CDC and initiating the conversion, Los Rios also participated in a statewide Pilot Project of a computer program called ASSIST. In this pilot, the eight University of California campuses, five of the nineteen State Universities, and seven of the California Community Colleges experimented with use of a microcomputer-based computer program developed by the University of California at Irvine in conjunction with Los Angeles Harbor Community College.

The computer program has many features, but one for which it is best known (and most highly valued) is the "progress check" performed for a community college student with plans to transfer to a four-year institution. This portion of the program combines the student's community college transcript, the graduation requirements of the major that the student wishes to complete at the four-year school, and a previously stored data base of articulation agreements (which describe course transferability) to create for that student a list of courses that must yet be taken at both community college and the four-year institution. The computer program requires only one to three minutes to generate this list as opposed to the one to two hours that a student and a counselor usually must struggle with catalogs, transcript, and binders of articulation agreements.

After participating in this statewide Pilot for three years, Los Rios decided to institutionalize ASSIST throughout the District. In the preferred scenario, we would have provided an ASSIST microcomputer and program to each of the 42 counselors. However, the unit cost of $9,000 was prohibitive. An interim solution was implemented, in which we placed three ASSIST micros at each college's counseling center in open and shared environments. The awkwardness of this arrangement are many and obvious. Happily a solution recently presented itself in the form of a new CDC communications network product called "ASYNC PASSTHROUGH."

THE PRESENT:

When we were first told about ASYNC PASSTHROUGH it was described as a computer program that would make it possible to "connect" any two micros on the CDC communications network (called CDCNET) and exchange data between them. This function held out the possibility that, if we replaced each counselor's terminal with a minimally configured microcomputer (approximately $900 each) counselor could access the ASSIST program located in the shared environments from the convenience of their own offices. We bought the product on a trial basis.

With existing microcomputers used by members of the Computer Services Department who are Microcomputer Specialists, we attempted to implement the ASYNC PASSTHROUGH program. We discovered, as one often does in this kind of project, that there was a little bit more involved than we initially expected. Basically, we had to acquire and use two additional micro-based programs, "CONNECT" and "CLOSE-UP." CONNECT facilitates the communication of micros using CDCNET, while CLOSE-UP makes it possible for an individual using one micro on a network to operate any other micro once the two are connected.

When these two programs are installed on an ASSIST microcomputer attached to CDCNET, the following activities occur each time the ASSIST microcomputer is turned on:

1. CONNECT establishes an Async Passthrough connection to CDCNET;
2. CLOSE-UP puts the microcomputer in a mode to be remotely operated;
3. The ASSISTS computer program is initiated and brought to the point where the title screen is displayed, and;
4. The microcomputer waits until a counselor micro seeks a connection.

When these two programs are installed on a counselor's microcomputer, the following activities occur each time the microcomputer is turned on:

1. A "menu" of choices is displayed, one of which is to connect to ASSIST.

2. When this option is chosen, CONNECT works with CDCNET to establish a connection to the nearest inactive ASSIST microcomputer.

3. The version of CLOSE-UP on the counselor's microcomputer works through this connection to establish a link with the version of CLOSE-UP on the ASSIST microcomputer that gives the counselor remote control of that micro.

4. The ASSIST title screen appears on the monitor screen of the counselor's microcomputer, and the counselor begins to use ASSIST as though it were on his/her own microcomputer.

5. When the counselor is finished using ASSIST, the two keys "ALT" and "E" simultaneously and the connection to the ASSIST microcomputer is broken. The ASSIST microcomputer returns to its inactive state and the counselor's microcomputer is available for other options specified on the menu (electric mail, access to student data, word processing, etc.).

Figure 2 illustrates the communication network components employed in establishing the connection between a counselor's microcomputer and an ASSIST microcomputer. When a counselor exercises the menu option to connect with an ASSIST microcomputer, the request passes from the counselor's microcomputer (**A**) through a T.D.I., to an R.T.I., to a modem, across the telephone line to a modem at the District Office, to an N.D.I., and finally to one of the 932/32 mainframe computers. In that computer is stored a list of ASSIST microcomputers and their locations. The CDC mainframe chooses the ASSIST microcomputers (**B**) closest to the counselor's microcomputer and attempts to connect to it. If microcomputer **B** is inactive, the connection is made and the counselor begins to use ASSIST. At that point the CDC mainframe is no longer required to support the communication between the two microcomputers. For in creating the connection between the two microcomputers, it establisned a temporary L.A.N. (Local Area Network) in which the two microcomputers communicate through the T.D.I. that they share. No part of the communication needs pass through the college's R.T.I., the modem, the telephone line, or any equipment located at the District Office.

If microcomputer **B** is active (being used by another counselor), the CDC mainframe will choose the next nearest ASSIST microcomputer (**C**). Once the connection is made, the college's modem, telephone line, and the District Office equipment are no longer required and are redirected to other activities. Again a tempoiary L.A.N. has been established at the lowest level possible.

If all the ASSIST microcomputers at the counselor's college are busy, than the CDC mainframe will attempt a connection to an ASSIST microcomputer located at one of the other colleges (**D**). If microcomputer **D** is inactive, than a connection is established from microcomputer **A** through to the T.D.I., to the R.T.I., to the college modem, across the telephone line, to the District Office modem, to the N.D.I. serving the counselor's college, to the N.D.I. serving the other college, to its modem, across the telephone line, to the R.T.I., and (finally!) to microcomputer **D**. Once this connection is established, the CDC mainframe is no longer involved. A temporary W.A.N. (wide area network) has been established at the lowest possible level.

All of this connection selection activity is invisible to the counselor. The counselor merely selects the ASSIST option (from the menu of choices that appears on the screen when the counselor turns his/her microcomputer on) and waits until the ASSIST title screen appears on his/her microcomputer. The counselor has no idea which ASSIST micro he/she is using, much less where it is located.

FUTURE:

Having established the viability of the Async Passthrough, CONNECT, and CLOSE-UP using the microcomputer specialists, we have now replaced the terminals with microcomputers in fifteen counselors offices (five at each college). Our initial experience with the fifteen has uncovered no new problems. The system is working fine. We are now in the process of incrementally replacing the rest of the counselors' terminals with microcomputers.

Our success in accessing ASSIST through CDCNET and ASYNC-PASSTHROUGH has encouraged us to examine the possibility of accessing other microcomputer- based computer programs/services. Those currently under consideration include:

1. CAPPS - An assessment support system
2. EUREKA - A career advising program.
3. Any one of a number of microcomputer controlled optical disk systems.
4. A financial aids analysis system.

With every innovation or change, there are accompanying problems. No solution is problem free. The great challenge in implementing any change is to ensure that this new set of problems is less painful for the individuals and the organization than the set of problems that the innovation or change was meant to solve. Our brief exposure to ASYNC-PASSTHROUGH leads us to conclude that it is that type of innovation.

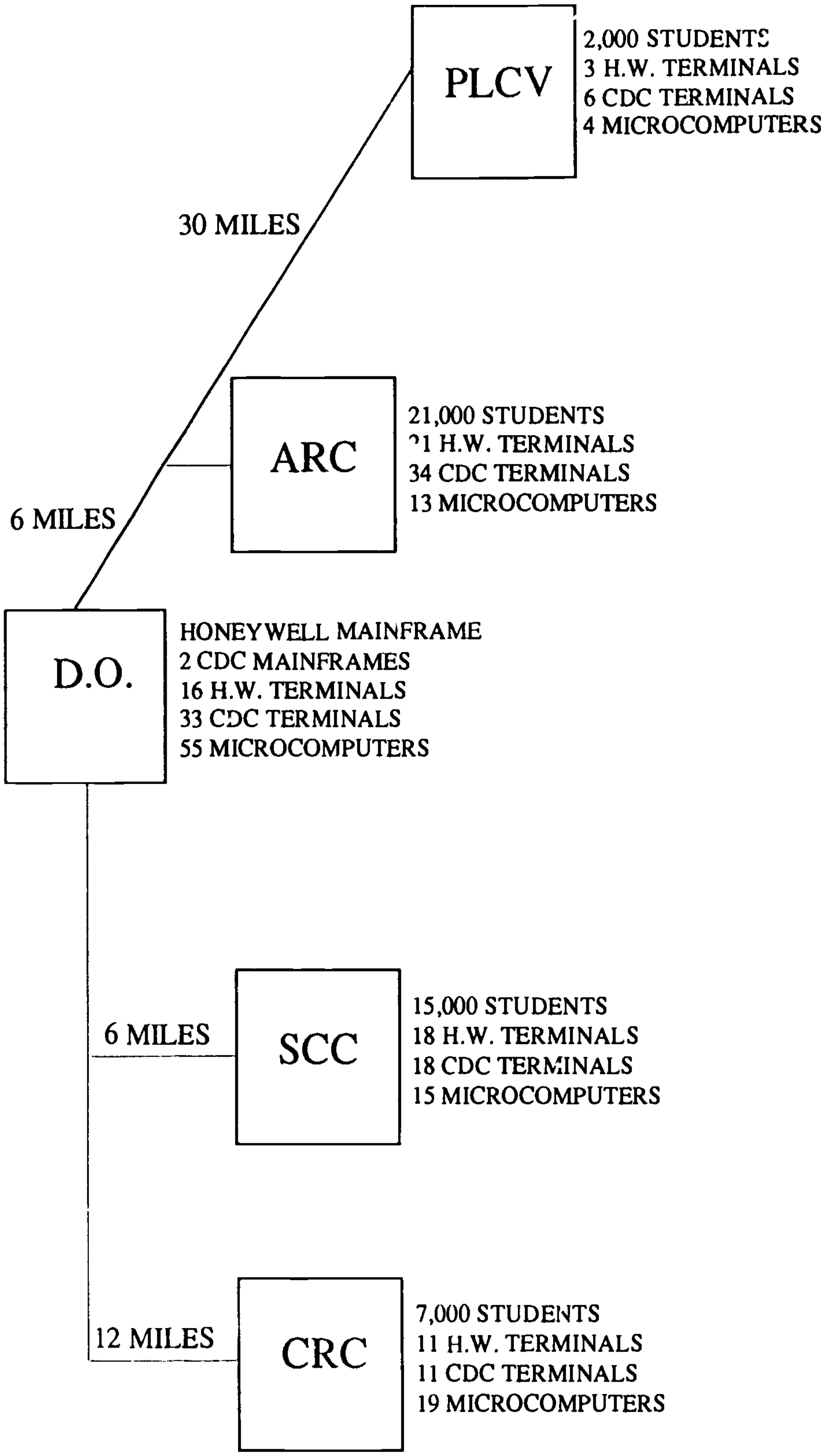
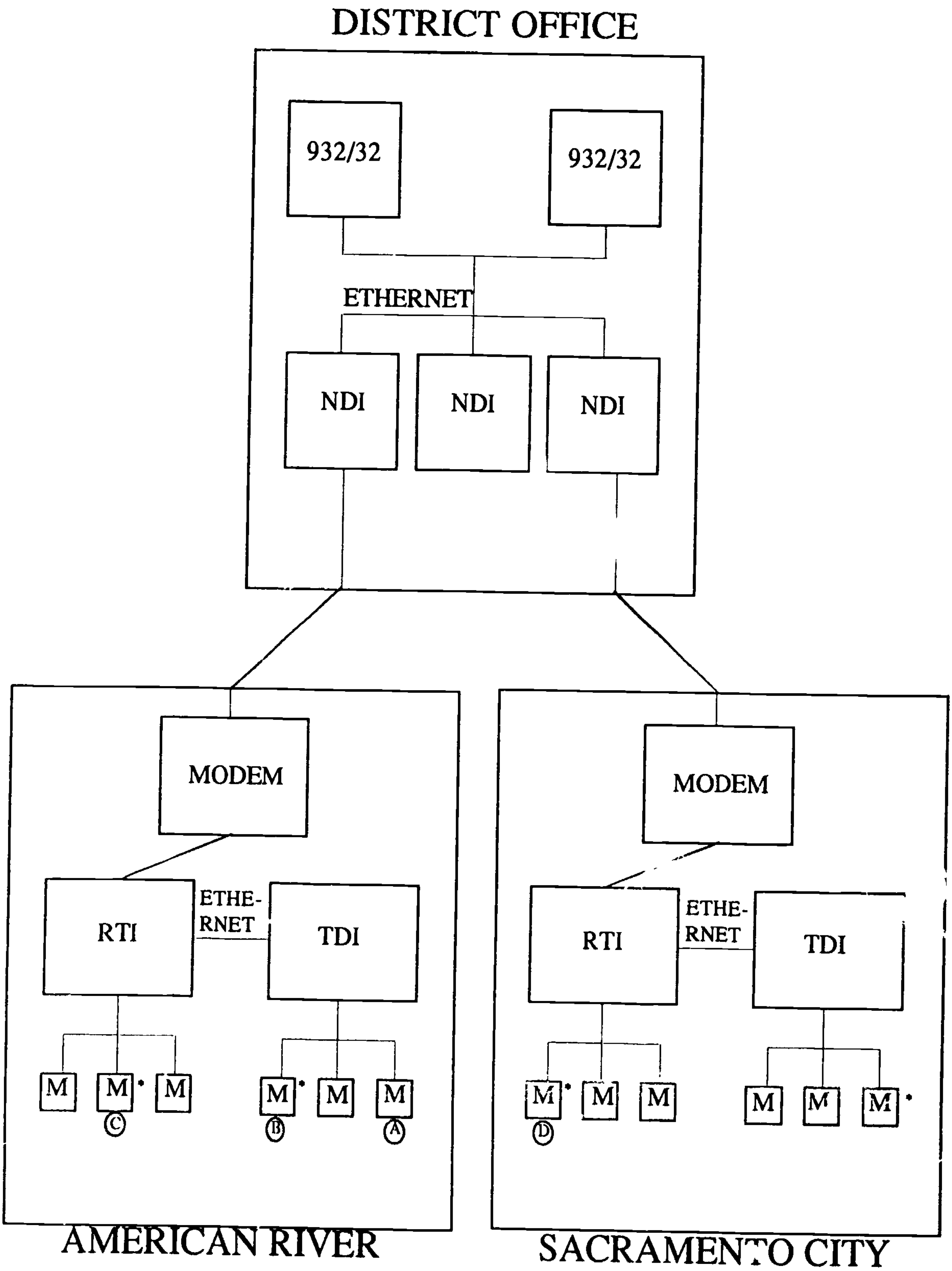

PLCV
2,000 STUDENTS
3 H.W. TERMINALS
6 CDC TERMINALS
4 MICROCOMPUTERS
30 MILES
ARC
21,000 STUDENTS
21 H.W. TERMINALS
34 CDC TERMINALS
13 MICROCOMPUTERS
6 MILES
D.O.
HONEYWELL MAINFRAME
2 CDC MAINFRAMES
16 H.W. TERMINALS
33 CDC TERMINALS
55 MICROCOMPUTERS
6 MILES
SCC
15,000 STUDENTS
18 H.W. TERMINALS
18 CDC TERMINALS
15 MICROCOMPUTERS
12 MILES
CRC
7,000 STUDENTS
11 H.W. TERMINALS
11 CDC TERMINALS
19 MICROCOMPUTERS

FIGURE 1



* ASSIST MICROCOMPUTERS

FIGURE 2