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ABSTRACT

Six papers from the 1988 CAUSE conference's Track VI, Hardware/Software/Networking Strategies, are presented. They include: "Technological Synergies Are No Accident!" (James I. Penrod and Michael G. Dolence); "Augmentation Quotient" (William H. Branch); "Step 2: Of Bridges and Gateways--The Linking of Winthrop College's Novell NetWare LANs" (William J. Moressi and C. Brown McFadden); "Which Comes First--The Plan or the System?" (Donald L. Hardcastle); "A Handy Guide to Campus Telecommunications" (Gene T. Sherron); and "Public Infrastructure Networks: The INdiana TELEcommunications NETwork Case Study" (Thomas I. M. Ho and Edward J. Tully). (SM)

Information Technology: Making It All Fit

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TRACK VII: Hardware/Software/Networking Strategies

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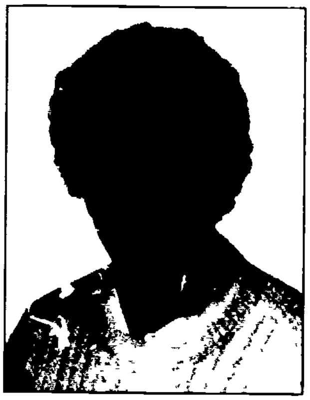
Track VII
Hardware/Software/Networking Strategies



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Policy planning, implementation, and organization affect strategies for hardware, software, and networking. How are specific strategies developed and implemented within an overall strategic plan for information systems?

Papers in this track present case studies and discuss institutional experiences in developing such strategies, whether starting from ground zero, describing a transition, or retrofitting an earlier system.

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CAUSE 88

Technological Synergies are No Accident!!

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ABSTRACT

Managing the integration of technologies requires maximizing the natural synergies between technologies and the organization. These synergies are no accident. They must be carefully developed in concert with institutional priorities, with buy-in from key constituents, with support deep within the organization. These can only happen through effective planning and management of information resources. Realizing these synergies is one benefit of an IRM approach.

Cal State L.A. is in the process of implementing an integrated information infrastructure including a new digital telecommunications system ($4 million purchase/cut-over August 1988), a new administrative computing system (IBM/IA installed Fall 1988), and an academic technology system (access labs, faculty workstations, a broad array of software and networked output devices). This paper explores the interrelationships between organizational structures, the introduction of technology, and the development of synergies.

Technological Synergies are No Accident!!

Introduction

A *synergism* is defined as "a cooperative action of discrete agencies such that the total effect is greater than the sum of the effects taken independently." [1]

What are technological synergies? They are events that happen in an organization very naturally. They capture the energy of the people in the organization. They are instances where the investment (human, financial, and technological) is the genesis for an exciting outcome--where, for example, a faculty member can fulfill a dream to create a center of excellence, to grow beyond his or her current bounds and bring the institution, its students, and other faculty along with the vision.

How do they happen? Not just by accident! They happen where information is seen as a vital institutional resource. They don't happen where layers of bureaucracy, middle managers, and overseers filter, sift, and sterilize ideas to fit a pre-ordained chalice. They happen where the energy of the individual with a vision can be recognized, nurtured, and assisted to develop the vision. They happen in an organization that welcomes that vision into the information culture and draws creatively on its collective resources to realize it. They happen where there is organizational sensitivity and expertise for treating information content and technology as a strategic resource.

Creating this environment is what a true information resources management approach is all about. Such an approach changes the strategic orientation of the organization. It empowers the people in that organization with the flexibility to act on intuition, to exercise judgment, to nurture original thought, and to translate that thought into reality within the basic bounds of the organizational mission. It creates an organization that tests its mission against realities, seeks challenges and opportunities, explores new methodologies, and views new horizons. The organization becomes less concerned with the lockstep of authority and more on the quality of each individual's action, stressing accountability. It is an organization that recognizes that the individual is the center of creativity but the organization is the primordial soup that brings the creative spark to life. The organization provides tools, expertise, and resources.

What is an information resources management approach? First, it goes far beyond the management of technology. It requires managing information as a **strategic** resource. In order to do this, there must be a focus on both the information technology and the information content of the organization, and a formal linkage between the institutional strategic vision and the information resources management program.

Second, it has certain characteristics where (1) the information resource management concept is defined in the context of the institution, (2) there is a governance structure for the management of information resources, (3) there is a desire to understand and articulate an appropriate vision for information resources, (4) there is a commitment to translate that vision into a unique design for the information architecture of the institution, and (5) there are appropriate technology policies and standards to allow the desired environment to be realized. [2]

California State University, Los Angeles undertook the creation of an IRM organization with such characteristics. The vision for IRM originated with the President, and was sharply focused on three strategic goals: to manage information technology more effectively, to maximize University investments in information technology, and to recognize that the use of information technologies for instruction, research, and in the management of the University is a necessary condition for institutional advancement. In 1983, he appointed a Presidential Blue Ribbon Task Force to make recommendations on how the University should go about accomplishing these goals. In February of 1984, the Task Force recommended taking an IRM approach. The new organization was fashioned out of existing units combining computing, telecommunications, media, mail, and reprographics and was brought to life in July 1985. [3]

Prior to establishing the IRM program, Cal State L.A. faced a host of problems many other MIS organizations face. Such problems included the lack of systems integration, failure to adequately satisfy user needs, users being estranged from the Data Center, systems not being synchronized with institutional objectives, inadequately documented systems, the frustration felt from systems development always being in maintenance mode (where "firefighting" is the norm), and lack of senior management control over the systems development process. Like many other organizations these problems led to strong end-user demands for change.[4]

The desire for change has resulted in strong support for the IRM approach. To date, the support is broadbased, encompassing the executive officers, academic leadership, and mid-level administrators. The commitment involved the reallocation of staff and budget; participation in IRM governance, task groups, and project teams; and acceptance of shared responsibility for the development of information resources.

As with any new development, the building of an IRM program at Cal State L.A. was bound by certain constraints. Some reflected the nature of a large state university within a multi-campus system, while others were very specific to the campus. Examples are having a nontraditional student body with unique needs, and having strong faculty involvement in planning and administration. Constraining realities include the Governor's cap on the number of State employees, the mandate to serve a specific geographic area, a primary mission as a teaching institution, and a static State budget for administrative computing. Although opportunities existed such as State funding for replacing the telecommunications switch, overall resources normally available through historical channels were inadequate.

Resources are provided through a wide variety of mechanisms with varying degrees of flexibility for usage. For example, some State funds are calculated and distributed by formula but allow flexibility at the campus level when expended. Other funds are allocated by line item with no choice or flexibility. Certain monies are allocated on a one-time basis with no commitment for continuing support. There are funds allocated directly to IRM or other segments of the University and other funds that require a proposal or individual justifications in order to acquire them.

In establishing the IRM program, the University was faced with the problem of determining how to strategically utilize these diverse funds. The concept of leveraging was a natural conclusion. Leveraging meant recognizing that no one source of money was necessarily big enough to realize the strategic vision. A process of matching funding components with project components was implemented along three general guidelines: (1) projects must be built on realistic estimates, (2) projects must have deep involvement and buy-in from other segments of the institution, and (3) there should be open reporting of expenditures back to those segments.

On large projects where resources were still insufficient, the campus undertook more creative solutions such as building relationships with vendors for joint development. Major efforts were launched including partnerships with IBM and Information Associates for administrative computing, with AT&T for academic systems development, and with Centel for campuswide telecommunications networking.

In like manner, human resource needs required creative solutions and a sort of leveraging. As a new organization grows and develops, some vacant positions are critical to recruiting external expertise. Beyond that, ways must be found to maximize existing human resources. One way is careful selection of key individuals for involvement in projects. Once selected, the key is giving those people the power to impact the implementation, while providing them with training and advice so that recommendations are sound. Another approach is to combine training and professional development funds and to order them according to institutional priorities. Requiring those who attend professional development or training to return to campus to become the trainers stretches both the value and impact of scarce dollars. In any dynamic information organization, there will always be a need for external expertise. The trick is to make sure that when the expert leaves, the expertise does not. Leveraging investments in human capital in these ways expands opportunities by increasing individual potential; this in turn increases organizational flexibility, improves morale, and provides powerful motivation for change.

Communication is a critical component of maximizing the organization's human capital and effectively utilizing fiscal and physical resources. Developing adequate formal channels, keeping them open and freely flowing, and encouraging the necessary informal networking is a major undertaking. One key to pulling all this together is planning.

Planning Dynamics and Evolution

> Instability characterizes information systems strategic planning. During the past 20 years, alterations have been so frequent that planning has sometimes seemed faddish, yet research shows that the emergence of key planning ideas generally has coincided with advances in information technology. Planning may be viewed as a rational response to the evolving information systems environment.[5]

For best results, the strategic direction of an information management program must not only be aligned with but supportive of the strategic direction of the institution. Herein lies a problem: if the organization does not have a well-articulated strategic vision mapped out; can information resources planning still take place? The answer is yes, but care must be taken to ensure the match. At Cal State L.A., strategic planning for information resources predated the development of the university process. Great care was taken to ensure that the development of the IRM program was made within the context of the verbally articulated institutional strategic vision. Recognizing that, when implemented, strategic planning for the University would necessarily be evolutionary rather than revolutionary was also important. Further, the strategic planning process needs to be fused with the management process. The plan should be built with wide user consultation, and the goals and objectives should reach deep into the heart of the organization.

Three different forces drive strategic planning for IRM for Cal State L.A. The first force, the *Campus Information Resources Plan* (CIRP), mandated by the CSU system, formed the basis for the system budget request. The second force, the need to build and shape a newly-formed campus IRM organization, was required to map the transition of diverse units into a functional IRM program. The third force, the institution-wide strategic planning process, came along later but designates IRM as one of ten areas of tactical importance to the entire campus.

The first force, the CIRP process, requires each of the CSU's 19 campuses to develop an individual institutional plan which is then compiled into a system plan which drives information technology budget requests to the State. Started by The CSU in 1985, its existence provided a rather detailed, organized methodology as a foundation on which to build the initial IRM plan.

Second, as a new organization to Cal State L.A., the need to shape amorphous units into an information organization was a demanding one. There was a lack of understanding as to what an IRM organization was about. There were a number of turf issues. A formal model was identified and utilized to provide a sound structure for the formulation of the *IRM Strategic Plan*. The generic model, originally developed for higher education, was adapted to IRM. It called for an analysis of strengths, weaknesses, and environmental trends to feed a matching process relating external opportunities and constraints to internal strengths and values. The matching provided the basis for development of an extended mission statement, the delineation of clientele, the development of goals and objectives, and the establishment of an appropriate program/service mix. These parameters then formed the basis for guiding the development of individual unit plans.[6]

The last major force to take shape, but perhaps the most important, was the development of a campus strategic planning process. The CIO at Cal State L.A. plays a key coordination role in the process for the President. The campus through a deliberate, consultative process determined that the adoption of a formal planning model would best serve its needs. Again, the basic methodology selected was the "Shirley model" which was then adapted to Cal State L.A.[7]

These diverse forces have evolved over time so that all the separate planning requirements for IRM have been accommodated in one meaningful process. They have culminated in a results-oriented "living" plan which has become an effective management tool. In 1985/86, the IRM program was new, setting forth 35 stated objectives and completing 94% of them. As the process matured, the number of stated objectives grew and, in 1986/87, 83% of the 81 IRM major objectives were completed. During the 1987/88 fiscal year, stated objectives grew to 117, with a completion rate of 90%.

One key to successful strategic planning and management is the ongoing use of evaluation. An evaluation process is most effective when it is developed as an integral component of the program. As a strategic tool, the evaluation process can monitor user satisfaction, track unanticipated accomplishments, identify both the most and least effective employees, and help identify problems with process, procedures, and policy. At Cal State L.A., user satisfaction is solicited and evaluated monthly. The results of this ongoing evaluation are acted upon by each responsible unit head and results are reported back to the user community regularly. Annual evaluation is done of all information resources management accomplishments including those anticipated and those that were unanticipated but resulted from strategic opportunities arising during the year. During the last fiscal year thirty-one accomplishments, that were not part of the original work plan were documented. Certain of the unanticipated outcomes were classic synergies such as the center of excellence m 'oned in the **Introduction**. Formal evaluat.ons of IRM unit personnel are integral to aligning personal performance with institutional objectives. At Cal State L.A. all managers annually evaluate each other against a predetermined and agreed-upon set of criteria. IRM units and managers are evaluated against their individual work plans and their contribution to completing IRM objectives. Each supervisor discusses individual evaluations, noting strengths and weaknesses and sets forth improvement strategies for the coming year's personal agenda.

The essence of planning is creating an environment in which the organization outlines where it is going and prioritizes the resources, including the budget and human capital it needs to get there. Inherent in this approach is the ability to recognize opportunities along the way and to capitalize upon them.

Background and Assumptions

As mentioned in the introduction to this paper, the second point in defining an IRM approach was a list of several characteristics that warrant further explanation. The first is to define the IRM concept in the context of Cal State L.A. In October 1988, the campus published its first *Strategic Plan for the California State University, Los Angeles* which set forth the institutional context for IRM. "The University ... supports the use of new technologies to enhance and enrich the instructional process and prepares students to understand cultural diversity and to serve the changing needs of a global society." [8] The strategic plan goes on to detail a more specific role of technology with the goal, "To advance the teaching, research, and public service missions of the University through the application of state-of-the-art technology and information management, thus providing a model for comprehensive universities." [9]

While information resources management can be loosely defined as the management of the resources concerned with supporting and servicing information, a much more specific mission for IRM was fashioned. One of the primary management goals is to integrate planning and management systems. The implementation of the IRM program is based on four tenets: (1) planning for information technologies should be directed by the fundamental values and purposes of Cal State L.A.; (2) the use of technologies for instruction, research, and in the management of the University is a necessary condition for advancing to a higher level of excellence; (3) the attraction and adoption of technology should strengthen the instructional, research, and management functions and promote the intellectual and personal interaction of faculty, students, staff, and administrators; and (4) a commitment to service must be one of the cornerstones of the IRM organization and therefore the *Strategic Plan for Information Resources Management.* [10]

The second characteristic is to establish governance for the management of information resources. IRM has developed a participative organizational decision structure composed of four interrelated committees. The **Information Resources Management Steering Committee** assumes a fundamental role in providing representative, campuswide advice on IRM strategic planning, policy, procedures, and standards at Cal State L.A. The **Faculty Information Resources Advisory Committee** is charged with providing advice and guidance in the development of information technologies in support of curricular activities. The **Information Resources Management Administrative Advisory Committee** provides advice on all administrative projects. The **Information Resources Management Advisory Committee** (IRMAC), an internal IRM committee, is composed of most senior managers. This committee structure, employing Likert linking pin theory, has been used and fine-tuned over a period of years and is designed to facilitate formal and informal communications. [11]

The third characteristic is to understand and articulate the desired target environment for information resources. The goal at Cal State L.A., formally stated in the *Strategic Plan for Information Resources Management*, is to establish an environment, by the early 1990s, that will place the user, student, faculty member, or staff member at the center of his or her information resources universe. A networked workstation will provide individual computing and access to more powerful layers of computing capability, data, and summary information--the level needed to enable the individual to perform the specified academic or administrative task for which the use of information technology was initially sought.[12]

To translate that vision into a unique design for the information architecture of the University is the fourth characteristic. The resultant information infrastructure includes a campuswide digital telecommunications system and backbone network, integrated administrative systems founded in a relational data base, and layered academic systems to support the instructional/research mission.

Today Cal State L.A. is in the process of implementing the integrated information infrastructure. At the heart of the new infrastructure is the new digital network. In November 1987, a contract was awarded to Centel Communications Systems for an SL-1 XT PBX, Infotron INX 4400 data switch, Proteon Pronet-10 fiber optic data network, Microvax 3600 system management computer, and Digital Sound Voice Server. Project implementation began in January, with installation in late August 1988.

The vision for administrative systems rested on an integrated relational data base environment. The new environment would include student records, financial systems, human resources management, and alumni development components. The modules would by tied together logically permitting the most effective use of technology in the management process. A new administrative system to achieve this vision is now under development. The first phase, a student records system, utilizes IBM hardware and Information Associates software. An IBM 4381 mainframe computer was installed in September 1987 to support Information Associates integrated Student Information System. The second phase, beginning in December 1988, will incorporate and enhance current SIS functionality in IBM's DB2 environment.

The academic technology system under development is in transition from a "closed systems model" for computer architecture to an "open systems model." This model permits logically configured sub-systems of each local system to be viewed and used as a network resource from across the whole environment. This new environment is being driven by the convergence of six technological developments: (1) dramatic increases in the power of desktop computers; (2) greatly increased capacities for mass storage; (3) new and more powerful multi-tasking and multi-user operating systems (i.e. OS2, UNIX); (4) icon-oriented graphic interfaces based on the needs of human intelligence; (5) common communications protocols (TCP/IP); and (6) the adoption of standard open systems utilities (NFS-Network File System and RFS-Remote File System).[13]

This open systems model will enable the academic computing planners to develop a technological environment in which the individual becomes the center of the system rather than the machine. Over the past three years Cal State L.A. has increased student access workstations by almost 500 percent, provided microcomputer-based workstations for about one-third of full-time faculty, wired every faculty office and many classrooms for network access, and introduced a number of new technologies.

The final characteristic is to establish appropriate technology policies and standards that would allow the desired environment for information resources to be realized. Significant progress has been made including campuswide procurement policies, networking protocols, maintenance agreements, etc. This area is rapidly changing and requires ongoing reassessment and fine-tuning.

Integrative Management Techniques

There is some debate developing in the literature as to the longevity of the information resources management approach. Much of the debate centers on the creation of a Chief Information Officer or CIO. It is important, therefore, to set forth some assumptions. First, having a position designated CIO does not necessarily imply the creation of an IRM environment. Second, it is the IRM environment that is the critical element. Third, it is difficult to imagine an information resources management organization being as effective as it might be without a policy level officer of the organization to spearhead it.[14]

There are several reasons for this. The approach envisioned is supportive of "institutional strategic goals" not self directed, self serving goals, imposed by a supreme technological monarch. Indeed, self directed technocracy would create a backlash of technological anarchy. Rather than being a despot, the CIO should be a leader who is a relationship builder, understands motivation, and knows how to inspire people. A leader needs patience, regardless of the urgency of the task at hand, and must listen, negotiate, collaborate, and cultivate. [15]

There have been numerous references to the CIO as a "computing czar." Herein lies a source of confusion. If the CIO in an organization exhibits czar-like tendencies, then chances are very good that the institution does not have (nor is it likely to have) the kind of IRM approach the authors envision. [16]

These leadership qualities set a very different managerial tone which can be amply supported with integrative management techniques. These techniques are most effective when employing an administrative model that embraces the concepts that management primarily derives its authority from knowledge, skill, and achievement. Ideally, decision making--rather than being the sole prerogative of administration--is most effective when it occurs among people closest to a particular activity. A participative committee structure can be used to provide overall guidance for implementation of major projects and enhance communications and understanding of the IRM program. A matrix approach to problem solving can often be very effective. Planning that leads to goals and measurable objectives appropriately evaluated enhances credibility through accountability. Teamwork within the unit and with other organizational units is essential. The importance of role definition, a balance between organizational and individual needs, rewards tied to productive performance, and the necessity for personal integrity are recognized as elements integral to good administration. Conflict resolution must be addressed and can be enhanced by an "open door" policy and the use of ombudspersons. [17]

By using some of these techniques, the creation of a new and different organizational culture can be accomplished. A critical component of the new culture must be acceptance by the IRM organization that responsibility to its clientele is inherent. The idealized culture could be described as an environment where all individuals are treated with courtesy and respect, an atmosphere of professionalism is maintained, individuals accept the responsibility of contributing to the solution of problems, the organization provides equitable and consistent service at defined levels, the security and integrity of campus data bases are maintained, and observing sound fiscal procedures is standard operating procedure.

Lessons Learned from Initial Implementation

The most important element in the overall infrastructure strategy at Cal State L.A. is the timely installation of the campuswide network. This project has provided important examples of synergistic occurrences resulting from the mix of planning, organization, project management, and technology.

One example involves the acquisition of voice mail as a component of the telecommunications system. Three years ago when the RFP was being drafted and the focus was on priorities (assuming somewhat limited funding), voice mail was given a low priority by the senior administration. Not wanting to drop it from the RFP, the telecommunications procurement team included a baseline voice mail unit as a mandatory option. Due to a well-written cost justification and fortunate timing, funding for the project turned out to be more than anticipated, enabling the purchase of the mandatory options in the RFP. The fiscal dean in the largest school recognized how useful voice mail could be to his faculty and agreed to purchase additional disk space for the voice mail system. Given these occurrences, the President authorized usage of vear-end savings to further augment the system, and over 600 voice mail boxes are now active with the expectation that the number of subscribers will soon double in size. Needless to say, it is one of the most popular and usable features of the new telecommunications network.

Project OASIS (Online Administrative Student Information System), the administrative systems joint development project involving three CSU campuses, IBM, and Information Associates provides another example.

The project requires as much cooperation and coordination between the three campuses as is possible. Initially, there was concern as to how feasible this might be given that the campuses are different in many ways, including their academic calendars and academic terms. Such differences naturally lead to needs and priorities that do not match, yet it was necessary to derive an overall implementation and training schedule. Policy, operational, and technical level task forces were established to address the resultant issues and to monitor the progress of implementation. Although not entirely without difficulties, the diversity of the campuses has proven to be beneficial in ways beyond initial perspectives.

Due to different campus priorities and academic terms, modules have been installed days or weeks apart on the three campuses. The task forces have found that these anomalies are helpful by providing stimulation and questioning during training, bringing about more cooperation since one campus can learn from what has just happened at another, and allowing "bugs" or misperceptions to be identified more quickly than would be possible with a single campus.

A final example of technological synergies comes from the academic area. The campus has had an excellent working relationship with AT&T over the past few years, which brought an opportunity to present a proposal to them. The Academic Technology Support (ATS) unit, which has campuswide responsibility for coordinating and leveraging academic projects, initially approached the Department of Mathematics and Computer Science to draft a proposal to AT&T. Noting that both this department and the Department of Economics and Statistics had National Sciences Foundation grants with some monies earmarked for advanced workstations, the ATS Director discussed with them the idea of pooling resources and developing an advanced technology laboratory. All agreed that it was worthwhile to pursue. An Engineering and Computer Sciences Enhancement Grant was submitted to and funded by The CSU Office of the Chancellor. Additional funds were secured from the Academic Affairs Planning and Resources office, IRM, and the School of Natural and Social Sciences. The AT&T proposal was funded and a new advanced technology lab with two AT&T 3B2/400 minicomputers, nine Sun advanced workstations, and about 80 AT&T 386 workstations all connected on an Ethernet LAN supporting AI, CASE, mathematics, economics/statistics, and operating systems applications came into being. For each department involved, the capabilities of this lab significantly exceeds anything that could have been possible by the single unit.

Summary

The ability of an organization to maximize synergistic occurrences requires a special environment--one where there is vision, where individuals are empowered by the organization, and where information content and technology are envisioned as a strategic resource. These qualities, which are characteristic of an IRM approach, are not created overnight. First, the strategic vision for IRM must be defined in the context of the institution where it is implemented. Second, technology goals must be aligned with university goals. Third, the vision must be reinforced with policy and procedures. Fourth, the various diverse units have to be molded and integrated into a new organizational culture, a culture where there is a focus on integrating individual and organizational objectives in an atmosphere of accountability and flexibility.

Strategic planning significantly helps in fully realizing a synergistic environment. An effective process provides a mechanism for public relations, is a forum for collecting and sharing information, serves to build consensus, and establishes organizational direction and control. The public relations function builds external awareness. By providing a forum for information sharing and analysis, elements of the planning process serve as a sort of group therapy. It is a consensus building process even where participation does not result in major changes. Having been involved, having had the opportunity to voice opinions, participants "buy in" to the resulting strategies and play a role in communicating them and legitimizing them. The stakeholder is then prepared to set a direction for organizational units that corresponds to the institutional vision.[18]

Organizational leadership intent on encouraging synergistic activities is key to creating them. The leader may be a CIO but most certainly is not a "computer czar." To bring about an organizational focus where synergies can flourish requires being a major player in overall institution decision-making. The individual needs institutional leadership qualities such as being a relationship builder who listens, negotiates, collaborates, and cultivates; being a motivator of his/her own staff and others; and being a team player who applies technological vision to institutional problems, opportunities, and priorities.

Technology has advanced at a rate faster than organizations can change. Even individuals can accommodate technological change far faster than organizations. Organizations, their structure, functions, and culture have fallen behind what is needed in accommodating technological change. Organizational development and revitalization are greatly needed. When this occurs, an environment that accomodates synergy development is more likely to exist.

Creating synergies, like good management, is more art than science. A synergistic occurrence is a symptom that the organization is healthy. Synergies between technology and the organization are characteristic of a new type of organization serving the networked society now evolving. Those who activelv seek to create synergies, and are successful, will gain a competitive edge and will help to enhance the standing of their institution.

REFERENCES

1 *Webster's New Collegiate Dictionary* (Springfield: G. & C. Merriam Company, 1973) p.1183.

2 Ray, Mel, "Information resources management: four cornerstones for implementing IRM," *Information Management Review*, Fall 1986, p.9.

3 Penrod, James I., and Dolence, Michael G. "IRM in Higher Education: A Case Study." *Information Management Review*, Fall 1987, p.12.

4 Bryce, M., "IRM: The Prophecy," *Management Visions*, Vol. IV, No. 3, June 1988, p.2.

5 Sullivan, Cornelius H. Jr., "The Changing Approach to Systems Planning," *Journal of Information Systems Planning*, Summer 1988, p.8.

6 Shirley, Robert C., "Identifying the Levels of Strategy for a College or University," *Long Range Planning*, Vol. 16, No. 3, 1988, p.94.

7 Penrod, James I. "A Report to the Campus: Strategic Planning at Cal State L.A." (Los Angeles: California State University, 1986), p.4.

8 *Strategic Plan for California State Universyt. Los Angeles*, (Los Angeles: California State University, October, 1988) p.4.

9 *Ibid*, p.12.

10 *Strategic Plan for Information Resources Management*, (Los Angeles: California State University, January, 1988) p.4.

11 *Ibid*, p.24.

12 Carder, Donald, "Draft Unit Plan for Academic Technology Support,"(Los Angeles: California State University, September, 1988) p.3.

13 *Ibid*.

14 "Chief Information Officers: New and Continuing Issues," *The EDUTECH Report*, Vol. 4, No. 3, June 1988, p.1, and Vol.4, No. 4, July 1988, p.4.

15 Sinetar, Marsha, "The Informal Discussion Group - A Powerful Agent for Change," *Sloan Management Review*, Spring 1988, p.62.

16 In point of fact, it would probably be very difficult to find a single example of this scenario. Yet it is very possible to find those who perceive the existence of this model.

17 *Strategic Plan for Information Resources Management*, (Los Angeles: California State University, January, 1988) p.13.

18 Langley, Ann, "The Roles of Formal Strategic Planning," *Long Range Planning*, Vol. 21, No. 3, 1988, p.47.

AUGMENTATION QUOTIENT

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A Changing World

All of us have witnessed the phenomenal growth in computing resources in the last decade. We have gone from being appreciative of having access to computers for problem solutions to the state of not being able to perform a job in a functional manner without adequate computing resources. We are now in an age that we need to make sure that we fully exploit computing resources for greater creativity and productivity. To that end, this paper presents computing concepts and resources that we all need to be aware of.

Computing as a Tool

Every tool augments or extents human capabilities in some way. The hammer extends the power of our fist; the automobile extends the stride of our legs; and the computer augments our memory, computation and reasoning power. Intelligence is the combination of a person's abilities to learn to deal with the circumstances of living. Experience and knowledge contribute strongly to intelligence. The metric AQ, or Augmentation Quotient, is proposed as an estimate of the actual Knowledge work accomplished by a person with a given computer divided by the knowledge work accomplished in that same time period by the person alone (Knowledge work is the mental equivalent of physical work). The computer is a tool that, when properly used, can augment our intelligence considerably (Doherty, Pope 1986).

The concept of Augmentation Quotient was further illustrated by Doherty and Pope by the following description. Many persons, including Thomas Jefferson, have noticed what might be called the intelligence of a group. Jefferson further postulated the notion of negative intelligence in the following way. Suppose a group of people had a certain group intelligence brought about by the synergistic interaction of its members. If a loud-mouthed dullard entered the group, Jefferson concluded that the group intelligence would decrease because more of the group's time would now be spent in dealing with ideas of lesser merit. The group's new member had introduced negative intelligence to the other members.

Similarly, the AQ of some computing environments can be less than one. This implies that people working in such an environment work less efficiently with a computer than they would without it. In some cases during the first thirty years in computing, people have automated functions before they understood them well enough to take that step. This caused inconvenience and inefficiency for the users. However, in today's workplace many of these barriers have been overcome and we are now starting to operate in computing environments where the AQ is greater than 1 and growing. The use of computers by non-data processing professionals, "end users," is one of the most significant developments in corporate computing in the last decade. It is of growing strategic importance to many corporations and the challenge for managers to satisfy the demands of users while evolving end user computing (Henderson, Treacy 1985).

AQ>1

Many of us have viewed this changing world of computing resources with constant dismay and frustration. We rapidly moved from batch to interactive processing and now distributed processing with personal computers. We've seen the mainframes get larger, computing become decentralized with Mini's and micro-computers, computer power taking monumental leaps with Mini-Supers and Super-Computers and the emergence of computer communication with wide and local area networks. The augmentation factors that contribute most to productivity are:

Response Time
Software Tools
Hardware Functions
Information Exchange
Information Delivery
Reliability of Systems

To get a better feel for these factors let's review some trends and developments in computing technology. A study by G. N. Lambert at IBM's San Jose Laboratories in 1982 brought light to the fact that sub-second response can increase programmer productivity by a factor of one hundred percent (appendix graph 1 and 2). In fact the more skilled a programmer (or end user) is with computing technology, the greater the productivity will be with faster response time. To achieve increased productivity, you will need to review the host computer you are using, the communication links to the host and the workstation being utilized. There are some 15 million personal computers on desktops which has dramatically changed workers ability for information exchange and delivery. By the year 2000, noted Computer Scientist James Martin has predicted (Appendix graph 3) that most white collar workers will have one or more micro-computers on their desks. The power of these workstations and communication capability will be critical to productivity. Power workstations with sub-second response time for office applications executing on the micro-computers will be mandatory.

Our communication links of today are typically 9.6KBS with a growing number moving to 56KBS. Local area networks are leap frogging into more functional transmission capability currently at 2.5MBS to 10MBS and expectations of the next generation operating at 20-100MBS. These rates can be achieved economically over a limited distance and should be planned for greater utilization of local computing devices. The concept of Electronic Emancipation can only be achieved with maximum connectivity of computing devices. Local Area Networks (LANs) will be the first step toward this goal. The critical mass of office computing devices is now in place to fuel an explosion in electronic collaboration. To achieve greater productivity we must insure that connectivity is of the highest priority in our strategic plans. New

SMART (proper wiring and communication infra-structure for voice/video/data) buildings, fiber optic networks and local area networks are essential to achieving this goal.

Ducan Sutherland coined the term "Officing" as providing an environment for performing knowledge work and communication to happen seemlessly. Of course the appropriate hardware and communication resources are necessary, but the move toward "Groupware" or Computer Supported Cooperative Work (CSCW) is a growing phenomena tnat is contributing to an increased augmentation quotient. Their are a variety of software packages designed to help people work together more effectively. Some examples are: Collaborative authoring tools, project management, electronic mail, computer conferencing, calendaring, and shared knowledge bases. Since most productive work is a product of multiple individuals, it is important to fully utilize communication that involves computers. Computer conferencing and electronic mail will be a common tool in the modern office. A statement by Chess and Cowlisha is right on target. "Given the vast capabilities of the computer for general-purpose information processing, the use of computers as communications intermediaries has the potential to start a communications revolution fully as significant for the future of business and industry as was the first industrial revolution. In higher education we already see networks such as BITNET, NSFNET, SURANET, CSNET, SPAN, TELENET and TYMNET as essential tools to correspond with our colleagues on educational and technology matters. Many organizations are also establishing computer communication links with commercial enterprises for applications ranging from Financial Aid needs accessment and loan information to delivery of purchase orders. There is already a prediction that by 1990 the amount of mail handled by the US Post Office will start a gradual decline by two percent each year due to the growth in electronic communication (appendix graph 4). Groupware gives an organization the opportunity to share knowledge in an expedient manner. The availability of the proper hardware function and software tools that the end user workstation requires will increase the augmentation quotient for cost effective benefits. Word Processors without enhanced functions such as spell checkers, thesauruses and document conversion utilities can be considered a dullard to the end user. The proper software should be carefully analyzed to fit the end users needs. However, sufficient hardware and software will not overcome an end user that is not properly trained. Information Centers, Help desks and training programs are essential augmentation to create a productive end user. Common software for an institution is also important to reducing overhead for staff training, sharing knowledge between workers and creating an environment that workers can readily exchange information about software skills.

As we go about our daily decision making to implement information resources, it is important that we consider maintaining an AQ>1 for our workplace. The most important factors to consider are:

- Easy Computer Access
- Rapid Response Time
- Software Tool Boxes (Groupware)
- Information Centers, Help Desks, Training programs
- Value Added Network Access
- Colleague Connectivity

Cited References

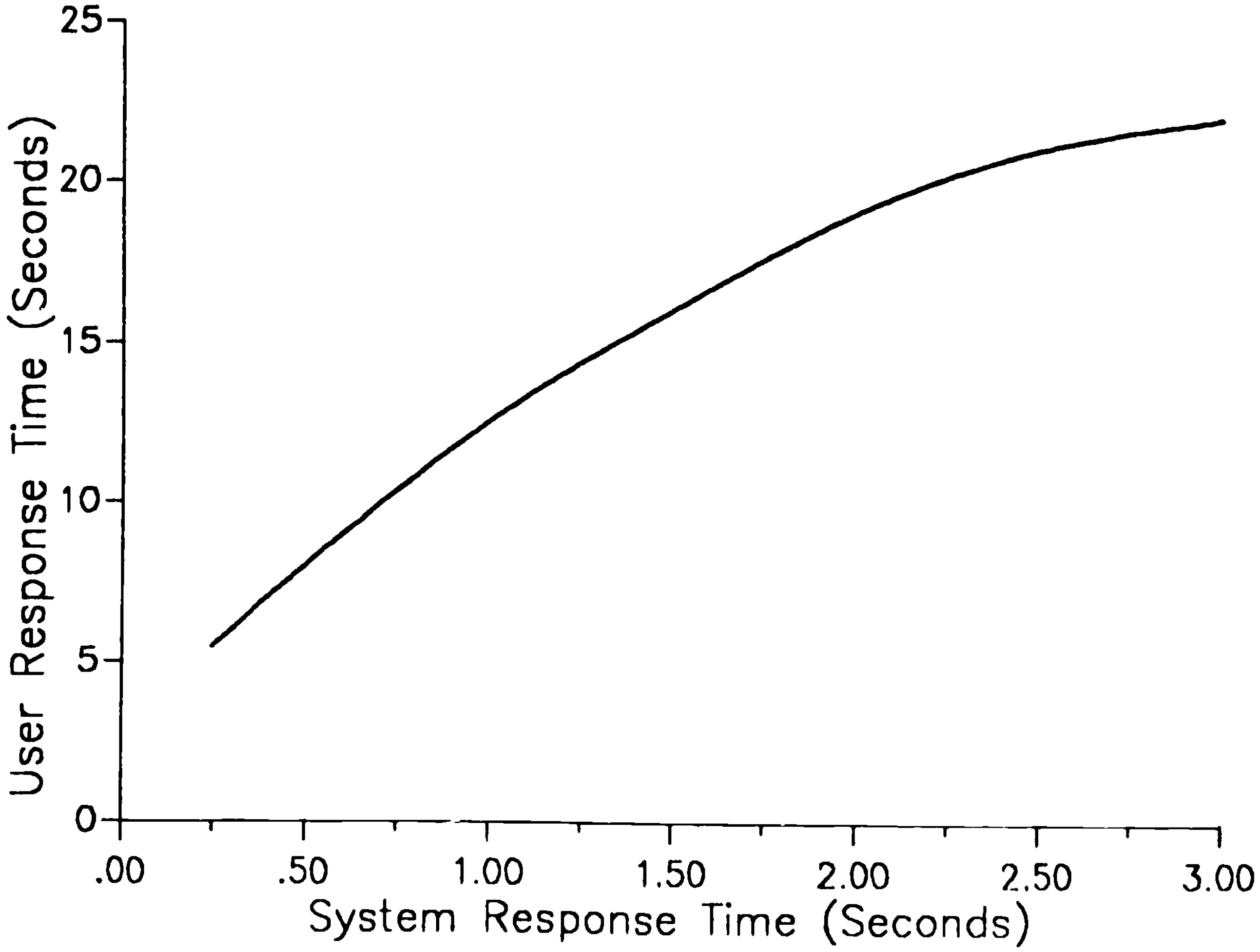
Doherty, W.J. and W.G. Pope Computing as a tool for human augmentation. IBM Systems Journal, Vol 25, Nos 3/4, 1986

Henderson, John C. and Michael E. Treacy Managing End User Computing. MIT Center for Information Systems Research, CISP WP no. 114, Soan WP no 1565-84

Lambert, G.N. A Comparative study of system response time on program developer productivity. IBM Systems Journal, Vol 23, No. 1, 1984

Martin, James Modeling Technology for the 21st Century. PC Week, November 14, 1989

Wood, Robert C. A New Look at the Office. High Technology Business, October 1988


25
20
15
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User Response Time (Seconds)
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1.00
1.50
2.00
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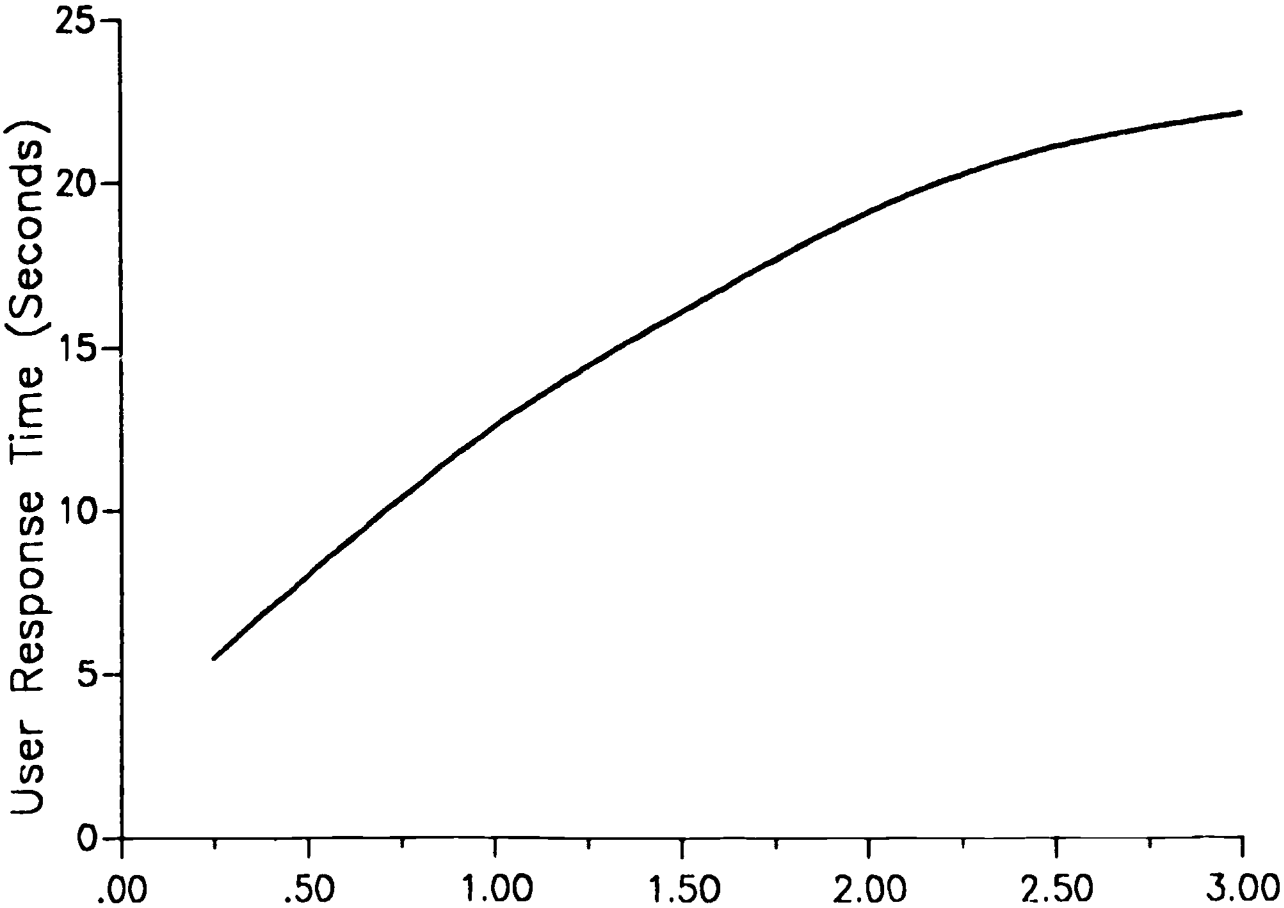
3.00
System Response Time (Seconds)



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User Response Time (Seconds)
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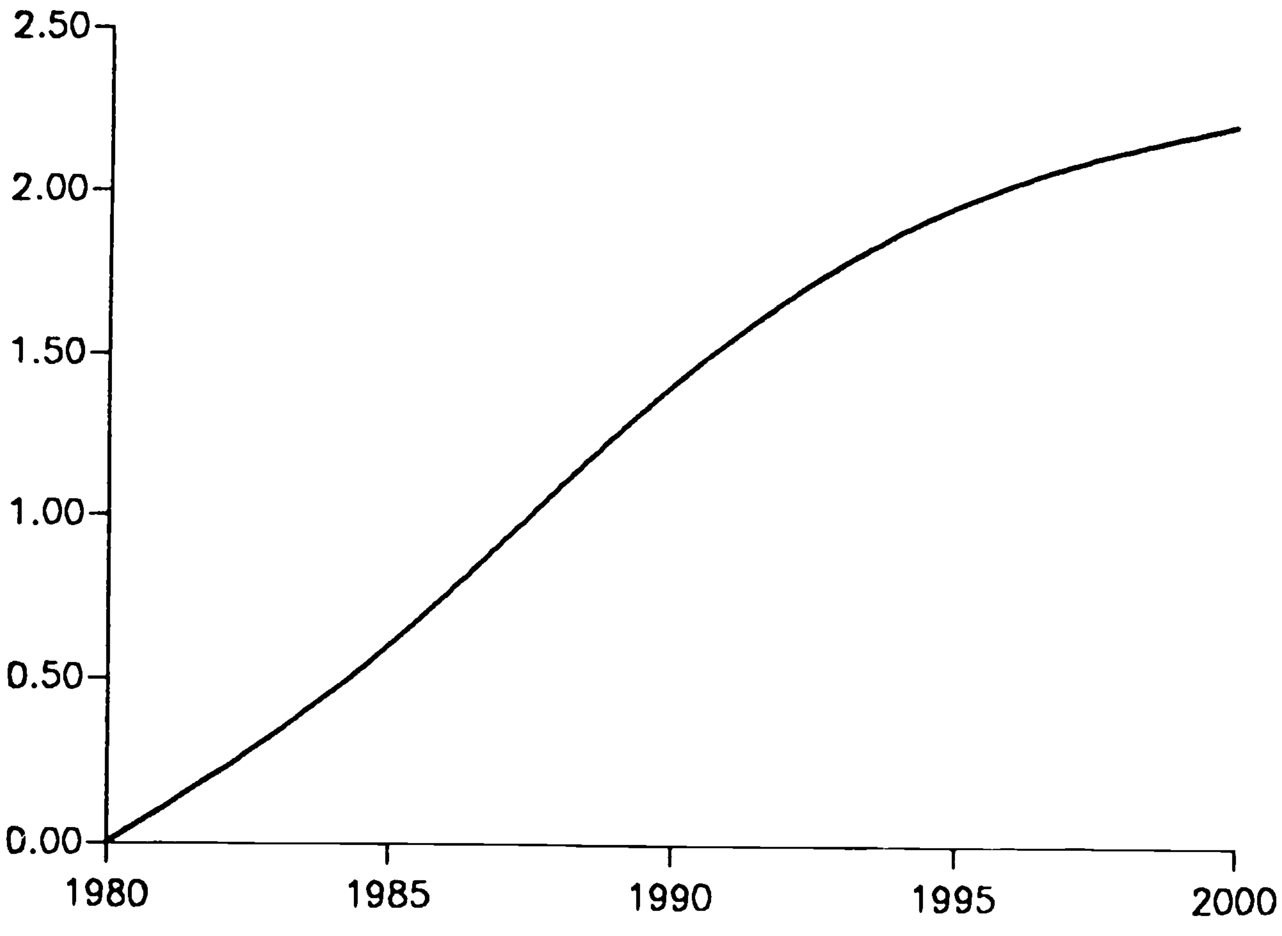
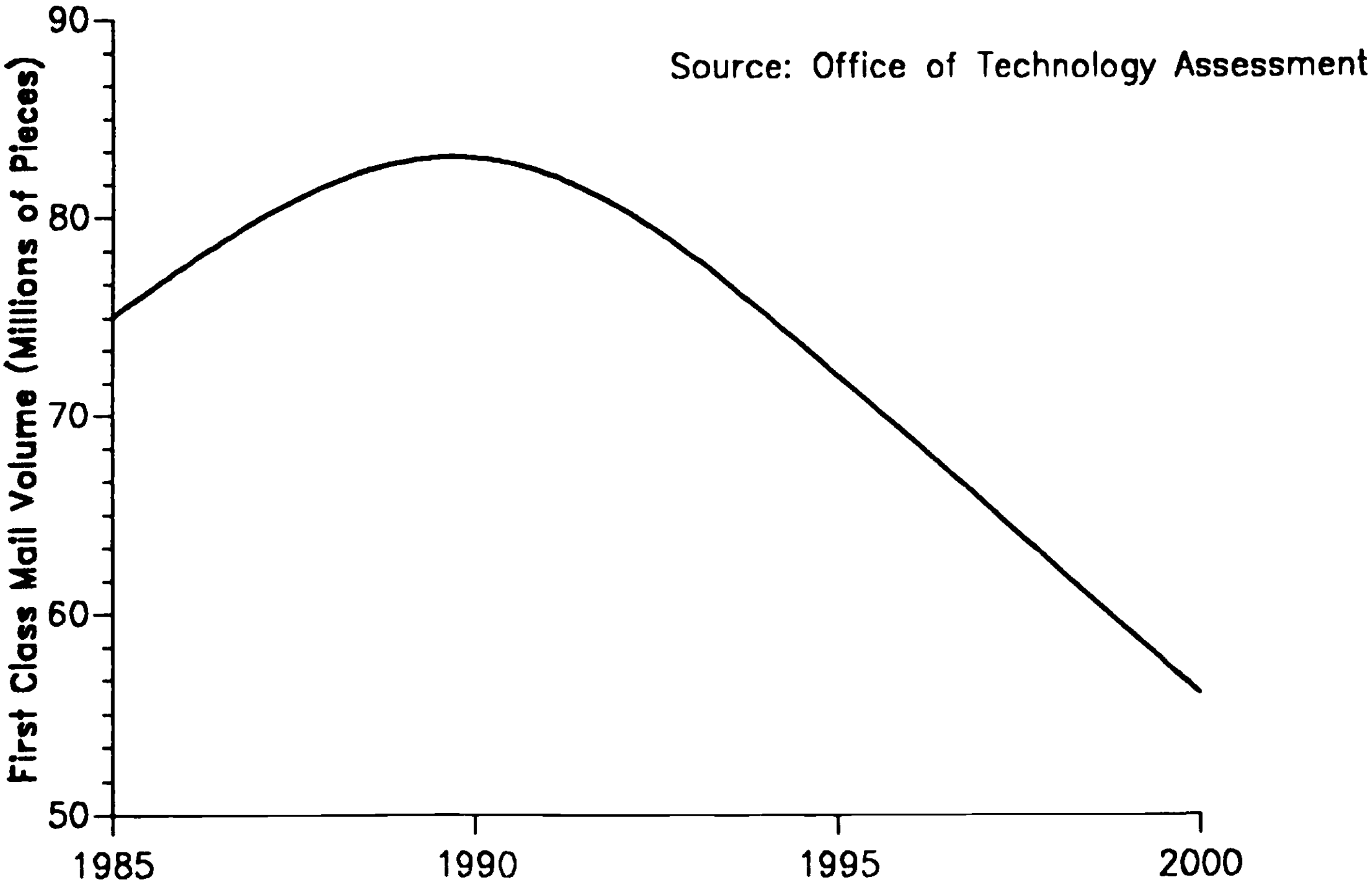
System Response Time (Seconds)

NO. 2



Number of Personal Computers per White Collar Worker

MAIL GOES ELECTRONIC, THE POST OFFICE DECLINES



Step 2: Of Bridges & Gateways
The Linking of Winthrop College's Novell NetWare LANs

by

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--- ABSTRACT ---

In the Fall of 1986, the Academic Computer Center at Winthrop College installed three Novell NetWare LANs for instructional purposes with strategies to further develop the system if proven successful (CAUSE,1987). The LANs have proven very successful and we are now engaged in the second stage of our plans. This phase is the enhancement of "system connectivity" to provide greater access to computing resources and to facilitate systems management of the network(s).

In doing this, we have (1) linked the three LAN laboratories via fiber optic cable and (2) installed a gateway to our host processor(s). Connecting our LANs required both physical and logical conversions from the three independent LAN-unit configuration to a single multi-unit complex. Outlines of our procedures and schematics of our LAN designs will be illustrated and discussed.

I. The first step: a brief review

By the Fall semester of 1986, the Academic Computer Center (ACC), in coordination with two faculty committees, was to provide:

- a laboratory environment for the teaching of computer literacy across a broad base academic curriculum.
- general access to a variety of expensive equipment to achieve economy of scale.
- access to major application software systems and databases from central source(s) while maintaining security control over such resources.

We have since met these objectives very successfully with the implementation of three microcomputer based LAN laboratories[1,2,3].

A. The hardware

The ACC purchased and installed 3 Quadram QuadNet IX networks with NCR PC-8/AT (2048 Kb) microcomputers as fileservers. The fileservers originally had 30 Mb hard disk subsystems. Each of the three on-line fileservers has an Uninterruptible Power Supply (UPS) to protect the systems from temporary (less than 15 minute) power outages. A fourth NCR PC/AT was purchased as a backup fileserver.

For workstations nodes, we used Leading Edge Model-D microcomputers (640 Kb) with STB enhanced graphics cards and Amdek 722 high resolution color monitors. The number of workstations on each of the three networks range from 24 to 35. Main printers on our networks are Okidata 2410's, two of which attach to each of the three main fileservers. Our CAUSE87 paper[4] gives a more detailed list of the originally installed hardware.

In the last two years, we have made a number of additions to our LANs: bridges and a gateway being the most significant enhancements. In one of our laboratories, 8087 co-processors have been installed in the workstation PCs. "Bootable" ROM chips have been installed in workstations to allow them to come on-line without network "boot" diskettes. Two laboratories have at least two workstations with provisions for 5.25" to 3.50" diskette conversions. Each fileserver has an extra 44 Mb hard disk storage subsystem; total storage capacity is now at 74 Mb per fileserver. We also have extended the LAN

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[1] Leveraging Information Technology. Proceedings of the 1987 CAUSE National Conference (Tarpon Springs, FL.), p. 551.

[2] Barbara A. Price, Clark B Archer and William J. Moressi "A Successful Approach to the Computer Literacy Course." Association for Computing Machinery SIGCSE Bulletin 20(2) (June 1988) p 13

[3] "Winthrop's School of Business Administration Commended for Design of Innovative Computerized Curriculum" BUSINESS UPDATE (Rock Hill, SC), April 1987, 4(4).

[4] Leveraging Information Technology

beyond the class room with connections to faculty conference rooms and managers' offices. For some of these connections we are using ARCNET. Users also have access to printers and a plotter outside of the classroom. Much of this has come about by user requests for increased services.

The ACC is responsible for the maintenance of all LAN equipment. We do cursory diagnostics and minor repairs. This involves, for example, splicing broken wires, replacing faulty disk drives, memory chips, and controller or communications cards. We have several vendors under contract for both general maintenance and time and materials repair of our LAN hardware. We do not carry on-site maintenance agreements with our vendors for repair of micro LAN hardware since this arrangement proves too costly. It is more cost-effective for us to purchase spare units and parts for replacement, and deliver units in need of repair to the vendors.

Maintenance and repair costs are constantly monitored. In many instances, the outright purchase of a new component with its included warranty is more cost effective than the repair.

B. The systems software

The originally installed systems software had many valuable features. Novell Advanced NetWare/286 2.0A supported up to three parallel and two serial network printers per fileserver and 255 nodes in a ring-of-stars topology. The system is token passing, updating the token list for new users automatically. It has multilevel security protection for both users and files. In addition to the high data transfer rate (Proteon, 10 Mb/S), features such as memory-to-memory data transfer and disk directory hashing and caching have contributed to the high performance of the LANs.

Our current Advanced NetWare network operating system (SFT 2.12) gives us enhanced security, data access synchronization, directory and file services, messaging, and software protection, and accounting. An excellent technical report on these features is provided by Novell[5].

C. The applications software

We have 63 software packages on the LANs and 82 courses using the laboratories in structured classes. Table 1 provides some information on the kinds of application software used by the academic departments. Information on software originally installed is provided elsewhere[6].

Major software applications are included and categorized as spreadsheet and graphics (SSG); database management (DBM); word processing (WP); business and business games (BBG); compilers and interpreters (CI); and communications (COM). Various campus agencies and students make use of our walk-in facilities. The major academic departments with structured laboratory instruction are Management (MGT); Marketing, Economics, and Fashion Merchandising (MAR/ECO); Accounting and Finance (ACT/FIN); and Computer Science and Quantitative Methods (CSC/QM).

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5 Ronald E. Lee Advanced NetWare Theory of Operations, Provo, Utah Novell, Inc., (1987)

6 Leveraging Information Technology.

Each entry in Table 1 represents the number of software packages used by category and department. Some overlap exists in the specified categories. As an example, several of the software packages listed in the spreadsheet category are template-oriented with direct business applications. Many miscellaneous software applications are not listed.

Table 1
Software packages by academic department and category

Software Category		Managment MGMT	Marketing MAR/ECO	Accounting ACT/FIN	Computer Science CSC/QM
		- - - - Academic Department - - - -			
Spreadsheet and Graphics	(SSG)	3	3	5	1
Database Management	(DBM)	1	1		1
Word Processing	(WP)	1	1	1	1
Business and Business Games	(BBG)	4	7	1	2
Compilers and Interpreters	(CI)	1			7
Communications	(COM)				3

II. What's happened since: usage growth and problems of success

A. Usage statistics

With the announcement by Novell of an accounting facility in their revision, SFT 2.10, we chose to wait for this option rather than acquire an OEM accounting package. After installing the system software revision this Fall, we encountered a problem with the accounting function. The current upgrade to SFT 2.12 appears to correct this. However, we have not had the time to properly reassess this function since it involves reinstalling all accounts.

Since the first implementing our LANs in the Fall of 1986, we have recorded, manually, data on laboratory usage by having student operators make head-counts hourly in walk-in laboratories. We record course enrollments for classes scheduled in instructional laboratories. Winthrop College's Continuing Education Center makes use of the microcomputer LAN laboratories on an as-available basis.

Other special activities such as faculty-run computer camps also use these resources. Most of this data has been recorded. Both head-count and instructional lab enrollm◦· + data is reduced to student-hours per laboratory per semester and included in Table 2.

Table 2
Student-hours usage of LAN laboratorie.

Semester		---- Business ---- Lab 1 (WI)	Lab 2 (IL)	-- Computer Science -- Lab 3 (WI)	Lab 3 (IL)	TOTALS
		28 wkstns		*29 wkstns*+		
Fall	1986	9,831	10,000		13,789	33,620
Spring	1987	12,915	8,477		11,676	33,068
Summer	1987++	3,318	2,692		50	6,060
Fall	1987	[illegible]	7,512	5,101	12,927	34,831
Spring	1988	12,245	5,636	3,483	11,026	32,390
Summer	1988	2,381	4,490		1,126	7,997
Fall	1988+++	11,998	2,875	5,603	11,875	32,351

\+ Other workstations (wkstns) are connected to file servers, but not located in the labs These are not included in the lab counts
++ Estimated value based on relative walk-in, instructional lab use
+++ Projections were made from November 1, 1988 to the end of the Fall 1988 semester

B. Coping with growth and success

Some of our greatest problems are those associated with increased user demands on our current facilities. Impacts have been on all LAN components: hardware, systems software, and applications software. And, as with any user service, our personnel haven't been spared the effects of resource demands by the users

Network hardware. During the Fall and Winter semesters, users place heavy demands on the microcomputer LAN laboratories. It is not unusual to have students waiting to get into the laboratories before scheduled opening and to have them request extended hours after closing. Students share their class passwords with their peers adding to the load. Faculty and staff who have student assistants send them to the laboratories to handle work assignments. Many faculty, especially those who teach using the micro labs, have PCs without hard disks and printers. Access to the labs is a necessity for them.

To try to alleviate this need, we extend our hours and allow instructional labs to be opened for walk-in use. PCs, printers, and other devices are connected outside of the laboratories in conference and terminal rooms to provide more work sites.

System software. While we were happy with our original version of the Novell system software (Advanced NetWare/286,2.0A), it lacked several desirable features, one of which was internal accounting. We have proceeded to upgrade our systems software and with each upgrade came the usual problems associated with revisions. A particularly perplexing problem was encountered when we attached 3.50" drives to some of our workstation nodes. The then version of our operating system software was incompatible with an upgraded DOS 3.30. This problem was not immediately evident at the systems' level and manifested itself in random problems with the application software.

Our current version of Novell NetWare (SFT 2.12) offers many valuable features. These features are all administered by network servers running the operating system software. There are 25 technical manuals and 49 program disks associated with our last revision. The software is so voluminous and complex that subtle hardware problems in the fileservers can prevent it from being loaded. Working with the system software requires a dedicated, technical person or persons.

Application software. There has been a plethora of requests for the installation of software applications on the networks. The ACC is removed, and justifiably so, from making decisions on the relative merit of academic applications used on the LANs. These decisions are handled in the academic arena and requests are almost always granted. Our decisions on installing software are based on the technical and administrative side: does it work in the network environment and do you have a license or permission to use it? Resolving these two issues is difficult. On many occasions, software is purchased or acquired from associates or textbook vendors and the ACC is requested to install it "today," before either technical or administrative issues can be resolved.

Another problem is worth mentioning. It pertains to maintaining software standards on the LANs. This problem arises from requests to install major application software package look-alikes. We do try, as much as possible, to limit comparable software packages to one-of-a-kind. On many occasions a faculty member will be given some special "add on's" to a similar application in order to have us use another vendor's spreadsheet or database. We are thus continuously trying to enforce standards on types of software packages. We would otherwise be duplicating many major software packages for the sake of a few non-essential features.

Personnel. Demands on our personnel resources are tremendous and we have not been able to acquire full-time staff beyond that reported previously[7]. We rely heavily on student assistants. A major problem now is that the complexity of our operation has grown considerably beyond what we can expect from student help. The learning curve is such that capable students are ready to graduate by the time they become proficient in networking operations.

[7] William J. Moressi and C. Brown McFadden, "Students as Academic Computer Center Personnel," CAUSE/EFFECT, 10(4) (July 1987) 14

III. The second step: expanding LAN connectivity

Two issues became evident to us after installing and implementing our three LANs: (1) our management and operations of the LANs were inefficient and (2) our use of available software and hardware resources was not optimum.

LAN laboratories are in two different buildings, one of which is the Academic Computer Center. With three separate LANs, we had to process updates to application and system software and install accounts at all three sites. Also some software and hardware resources are not available on each of the fileservers. Bridging of the LANs would improve the optimization of operations and existing resources.

Also, desirable, alternate computing systems (non-Novell) were not accessible to users on the LANs. As an example, one of the LANs is conveniently located adjacent to our host minicomputer system. Microcomputers on this LAN are connected to the host minicomputer outside of the network via serial communication ports. Network workstations nodes did not have access to the host minicomputer computer. This access is especially desirable since our host computer, in turn, communicates with the mainframe computers at the University of South Carolina (USC) via a SNA interface.

Additionally, since the University of South Carolina is a BITNET node, any user connected to the host minicomputer has access to USC's mainframes and thus to BITNET. A gateway connection to the host minicomputer would increase, by way of synergy, the functionality of the LANs for all users.

Our next step was a natural consequence of optimizing the use of our original microcomputer based LAN facilities. This step was to provide

- distributed data processing beyond the scope of the laboratory environment.
- access to a greater number of computing resources for a user at a specific site.

Bridges and gateways were the instruments for obtaining synergy in the use of our resources. We use the term "bridge" to connote a connection between similar systems, as when we "bridge" our three separate Novell LANs. The term "gateway" is used to connote the connection of dissimilar systems, as when we provide a "gateway" from the Novell LANs to our host super minicomputer system (Eclipse MV8000).

A. Internetwork bridges: connectivity between LANs

The interconnection of our three microcomputer networks is realized through the provision of local bridges. Local bridging is automatically performed by the Novell network operating system.

Logical organization. Where we once considered reducing the duplication of software on interconnected networks, we decided on an approach providing greater reliability. This approach has been to make much-used, application software redundant on all three fileservers. Less critical software applications would be maintained on one or, at most, two fileservers. The cost of this increased reliability is, of course, more use of disk space.

The effect of this decision was to make each of the three networks capable of independent operation while working as a functional whole through the internetwork bridges. Figure 1 is a schematic illustration of this logical arrangement.

The decision to implement this type of arrangement proved most prudent a month after we completed the project. Lightning effects took down two of the three fileservers in mid-semester operations. We were able to shift immediately most applications and workstations to the one remaining server in another building. We installed an alternate PC/AT as a fileserver using the Alloy back-up tapes. We did have to wait some time for the return of the other two repaired units. However, we were able to restore most functions almost immediately thanks to the network design.

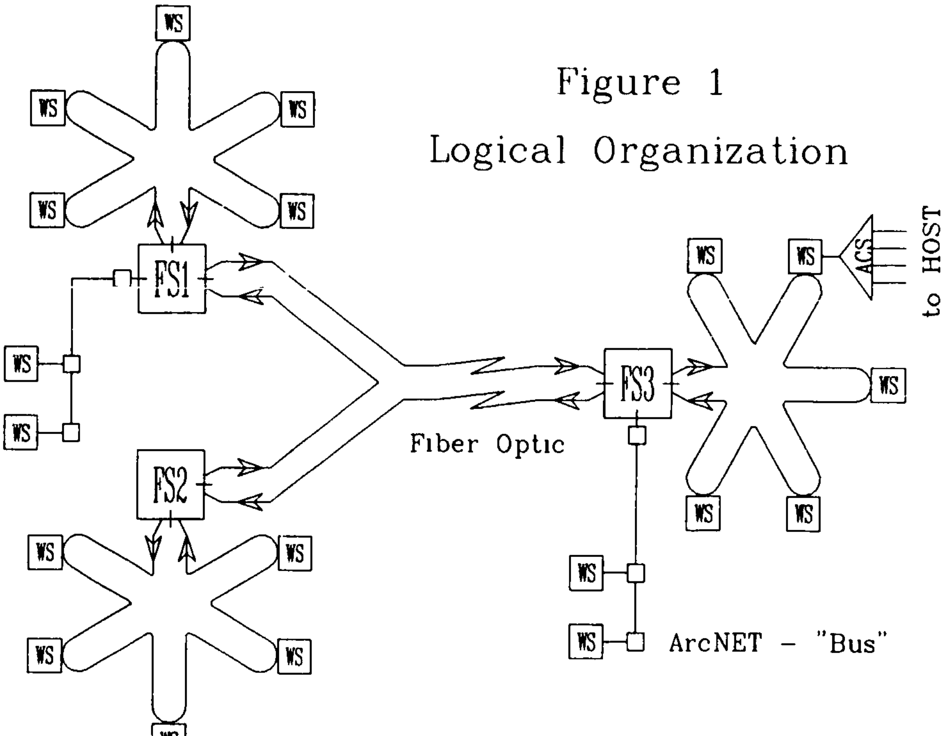
Physical organization. Network links are illustrated in Figure 2 and show the fileserver and cable layouts. Note that we have included ARCNET extensions in our diagrams. We alluded to this previously as "reliefs" to pressure from users for access to network facilities other than through the laboratories.

The two LANs adjoining each other in one building are bridged conveniently through respective fileservers. These LANs are subsequently bridged to the third LAN in the ACC building via a fiber optic cable. While we brought in a consultant to overview our plans, we did install the fiber optic link ourselves, - with extreme care.

All physical connections are operating excellently. We still have the one major problem of users dislodging the twisted pair wires attaching individual workstation nodes. We also seem to have temperature related problems in our laboratories with both heat (>85 degrees Fahrenheit) and cold (<68 degrees). Securing the wiring in Panduit and maintaining temperature with separate control units in each lab keeps these problems at a minimum.

Figure 1

Logical Organization

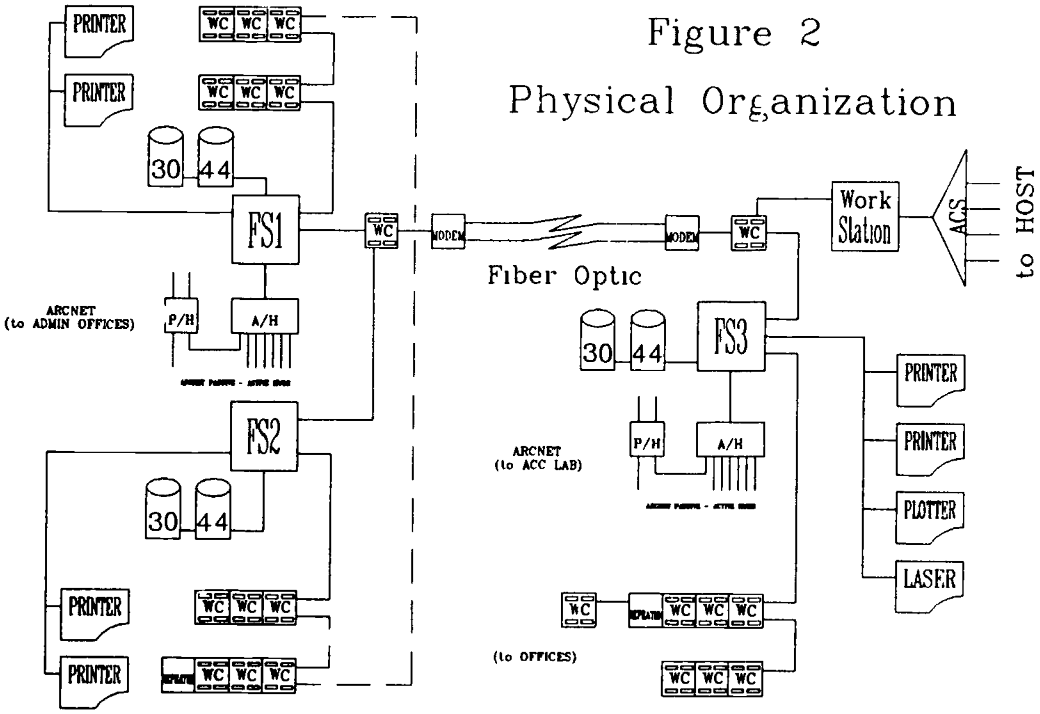


ProNET 10 - "Ring of Stars"

Lab 1 (WI) - 28 Stations

Figure 2

Physical Organization



Lab 2 (IL) - 28 Stations

Lab 3 (IL/WI) - 29 Stations

B. Gateways: connectivity to host system(s)

As of this time, Winthrop College does not have a campus-wide LAN, nor do we have any coordinated campus standards for use of information technology facilities. At local levels, each campus service center is making separate attempts to intercommunicate and share resources. The ACC's current move in this direction is the use of a "gateway."

The strong need for this connectivity is with us now. Faculty and staff involved in using the network are requesting access to our host computer via the network - with subsequent access to the mainframes at the University of South Carolina. Linking the micro LAN to our minicomputer would make a greater number of user sites accessible to the host systems.

We are now implementing the micro LAN-to-host computer "gateway" connection (Figures 1 & 2). Our first attempt at this connection was to install an Asynchronous Communications Server (ACS), consisting of four active communication ports, in one of the workstations on the LAN located in the ACC. Our ACS may have up to 16 communications ports, each of which may be connected to a modem or directly connected to minicomputer, mainframe computer, or remote workstation. (The ACS is the gateway that will allow us to communicate with our host minicomputer system and to the mainframes at USC.)

While the ACS functions well, the first software communications package (NetWare ASCOM IV, v. 1.46) we used did not. It was user-unfriendly. A user had be familiar with asynchronous communications parameters and had to address individual ports should one or another be busy. He must typically attempt to address all available ports until he succeeds at entry. This is not the type of user-friendly software we want to use on our system.

An upgraded communications software package, NetWare Asynchronous Communications Server (NACS, v.2.0) is now available from Novell that would appear to solve most of these problems. A Name Service in NACS allows network users to request access to a communications port by either a general or specific service name. If a port is not available with that general service name, the user is informed that one is not available. This Name Service allows the system to retain detailed information on specific resources (ports) when requested by the user. To date, we have received only one of several modules of the software and, thus, have been unable to test it out.

IV. Conclusion

A. Where we stand now: the connected LANs

All three independent LANs are linked (bridged) into a functional multi-unit complex. At the expense of disk space and three extra network cards, we opted for increased reliability by making each LAN laboratory functionally independent in addition to being part of the whole LAN complex. Any work station node may address any fileserver or any other node in the integrated complex. Should any one fileserver fail, an alternate on the network with similar software may be addressed. With the type of activity we encounter in the academic environment -- tightly scheduled classes and exams and special assignments; we are well served by this arrangement.

At least one course uses the LAN microcomputer workstations to access services on our host computer. There is also a growing demand to access our host system via the workstations on the micro LAN complex. At present we have installed a four port asynchronous communications server as a gateway to our host computer. It is functional, but we are dissatisfied with the communications software originally available. We have on order an upgrade to that software which is to ameliorate the problems of concern to us. If, after testing, we are happy with the hardware-software functionality, we will begin immediately to expand our gateway. We see this link as critical in providing expanded services to meet the ever growing needs of our users.

B. Where we're going: the Campus LAN

In 1986 a campus committee on computer utilization was formed under the President's office. Several faculty, a representative from the library, management information systems, and academic computing were assigned to the committee. With the President's concurrence, the committee chose to attack the problem of information technology standards on campus by way of proposing a campus LAN. We have since surveyed the campus for existing central processors and communications equipment, invited interested vendors for presentations, and visited outside LAN installations.

The committee is putting in place a set of generic specifications that involves the use of a computerized data switch (to take advantage of existing wiring in buildings) attached to a campus wide LAN. We expect to use fiber optics as a backbone with either a token ring or Ethernet topology - or a combination of both. Winthrop College must try to coordinate the use of existing and future information technology resources in order to provide its faculty, staff, and students with the necessary tools to aid them in their respective instructional, administrative and learning processes. The campus LAN project with the major information service centers (library, management informations systems, and academic computing) at its core is the primary vehicle to accomplish this very difficult task.

Figure 1

Logical Organization

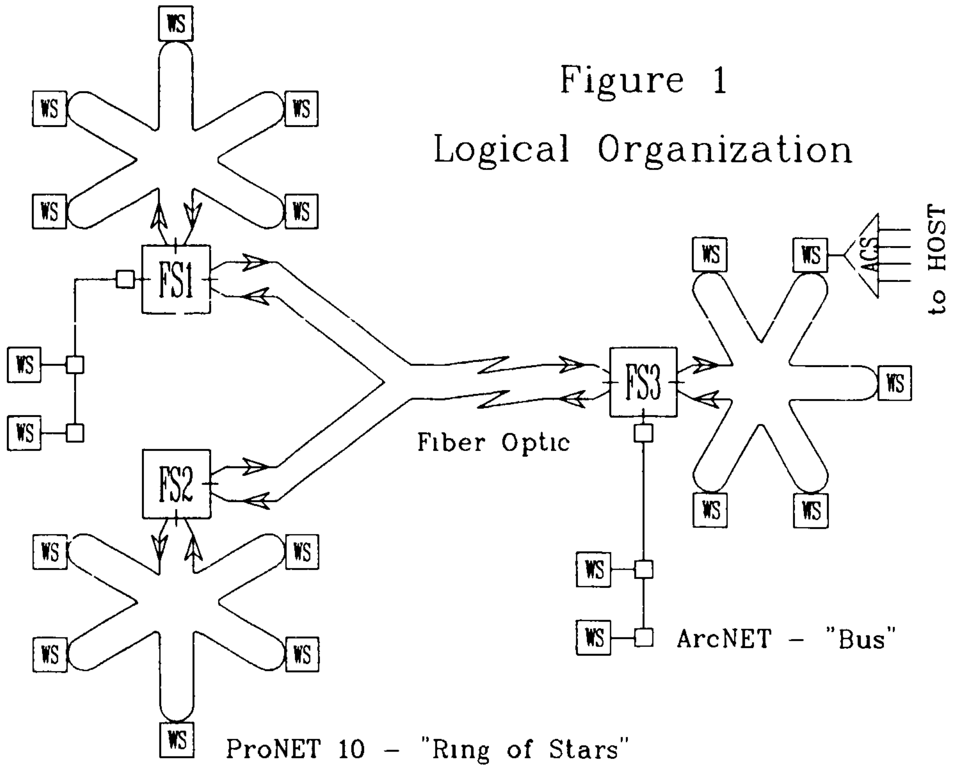
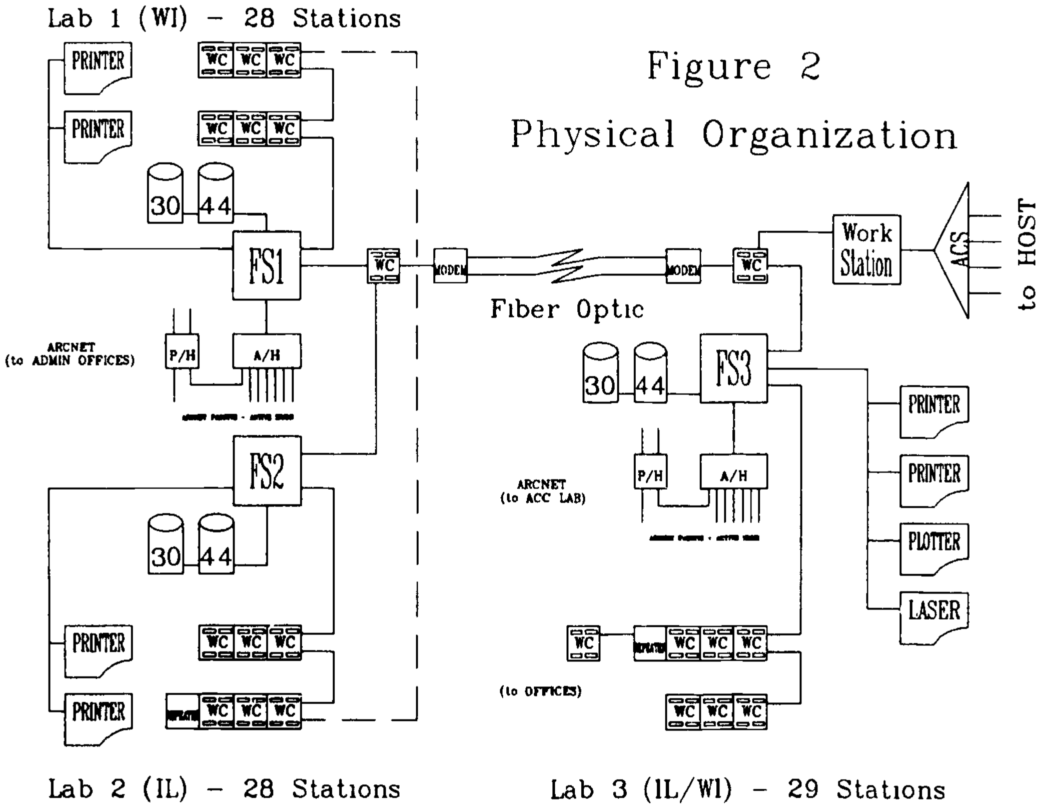


Figure 2

Physical Organization



WHICH COMES FIRST - THE PLAN OR THE SYSTEM?

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ABSTRACT

For the past eight years, Baylor University has been moving toward an integrated information system. During this time the target system has continually been moving with new technological developments ranging from microcomputers and networks to relational database systems. Baylor has adopted a strategic view of our computing future which allows for change. An empowerment staffing process is being used. This involves concentrating on getting superior performance and developing strong, capable leaders. The development of the network has allowed for some unique opportunities, including the use of the MacWorkStation software to access mainframe information. An ethernet system that ties into departmental AppleTalk networks has been set in place and provides the necessary connection of workstations to information and LaserWriters. More functionality and communications capabilities are being added based on the University's strategic needs, opportunities and technological advances.

WHICH COMES FIRST - THE PLAN OR THE SYSTEM?

Introduction

In 1980, Baylor made the decision to begin an upgrade of its mainframe computer systems. This was followed in 1982 with a decision to purchase a Micom data switch and in 1984 with a decision to invest heavily in microcomputers. These decisions, although they were considered to be the major decisions at the time, were really no more important than other developments in the expansion and use of technology that have since taken place. These other developments are very appropriate topics for the CAUSE '88 Conference, "Information Technology: Making It All Fit." Key terms used to define the CAUSE '88 Conference include: change, integrate information technology, workstations, strategic use of information technology, vision of technology and risk. All of these have been important in Baylor's technological development.

This track on how policy planning, implementation and organization affect strategies for hardware, software and networking is an appropriate place for us to share our developments. Baylor is making major changes in these areas. In making these changes the question has been asked, "What is our strategy?" I would like to discuss this first.

In 1980, the microcomputer was not taken as a serious alternative for the desktop workstation. In 1984, when our microcomputer revolution started, the network was still seen as twisted pairs of wires connected to a data switch. A traditional planning process, which requires that we need to know where we are going, our destination, in order to get there, would not have served us well in that it would not have allowed for the microcomputers that now outnumber computer terminals on our campus or the ethernet network that is essential to meet our present needs. We never know when new technological opportunities will arise.

In a sense, we are much like nomads in the desert. Each morning we get up, look at the sky, the weather, the grass, consider the season and decide whether to stay another day or pack up and move on. Which way we move depends on what we have learned from the past, what we see today, what we guess about tomorrow and our ultimate desire to survive. For us, the destination which we cannot see, or define, is not what the counts most, but the journey - a journey into unknown lands with unanticipated results.

In order to deal with this uncertainty and change we have adopted a strategy like the strategic view that is described by Robert Heterick in the recent CAUSE publication, **A Single Systems Image: An Information Systems Strategy.**[1] He states:

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

This concept was also set forth by John Morris in a presentation at EDUCOM'88 where he used the term strategic thinking. He said, "Real strategic planning seldom occurs through formal planning processes that embrace all issues. It occurs though problem solving, planning that addresses one of the critical issues that is important and changing. ... Enemies of strategic thinking for information technology are organization, politics and process barriers, not technological barriers."[2]

As a physicist, I am reminded from time to time that the discoveries that have lead to Nobel prizes in physics have not come through planned experiments, but through unplanned observations and accidental discoveries. Likewise, the major advances that will come to our technological developments will come through this type of strategic thinking, not through the normal strategic planning process.

I would like to summarize the three issues that are important to our strategic view and then discuss them in more detail. They include leadership, the staffing process and advancement.

1. Leadership: If we want to be a leader in making information technology of strategic value to our institution, we must make advances in its use. Being a leader involves being willing to take risks. How would you like to be known as the person who purchased 250 DEC Rainbow microcomputers? That is risk taking. The low risk decision was to purchase 500 IBM-PCs for resale to students and faculty, six weeks before IBM dropped their prices significantly and the bottom fell out of the PC prices. It is easy to tell the leaders from the followers in these situations, they are the ones with the arrows in their backs.

2. The Staffing Process: Advances in a rapidly changing technological environment are made through creative exploration and experimentation, not through planning processes, and the key to these advances is the staff.

3. Advancement: The two developments that are now playing the major role in our advancement are the workstation and the network.

Leadership

Campus leadership in computing technology varies from what several years ago was called a computer czar, who at best is a benevolent dictator, to one at the far end of the spectrum who is only a moderator over a totally participatory democracy where everything is decided by committees and consensus. The computer czar has the advantage of being able to respond instantly when new opportunities arise, but as David Stonehill has noted, the only thing shared in common with a czar is the potential to be assassinated.[3]

The moderator offers great potential for politically acceptable decisions whose timeliness will, on occasion, leave us a generation behind in our developments, or when consensus cannot be reached, allows everyone to do his own thing in his own way. It is a great way to win the battle, but lose the war. How many campuses that let each department or individual choose their own microcomputer and word processing software several years ago are now trying to get everyone together so they can communicate with each other? The old western saying put it this way, "If you want to head the Indians off at the pass, you have to get there before they do."

Our leadership methods need to operate somewhere between these extremes in order to have acceptance of decisions that affect others' work places, and they need to be able to respond in a timely way to technological opportunities in order to prevent future problems.

Three characteristics that are needed in todays technological leadership are a willingness to take risks, an entrepreneuerial approach to problem solving and the ability to instill a vision of what is needed.

The Staffing Process

The one area where we cannot afford failure is the staffing process. An excellent staff can make up for hardware and software mistakes, but the best hardware and software systems can fail without a quality staff. Computing developments on campuses have changed from needing an organization that stresses productivity and efficiency to one that must have superior performance. The term that has been used to describe our staffing process is **empowerment**. It has six characteristics.

1) **Selection**: Staff members must be aggressive, technically competent, have an excellent education, additional educational potential, thrive on responsibility and be able to work as a team member.

2) **Delegation**: Our delegation of responsibility must be clear and focus on ends, not means. We must clearly state what needs to be done but not how it is to be done. We must accept risks and allow our staff to make mistakes and fail. Most of us learn more from our failures than from our successes.

3) **Vision**: It is essential that we give our staff a vision of what can be. This vision will help establish the need for and acceptance of change. This vision must become their obsession.

4) **Development**: The staff must be given opportunities to continually develop their technical and management abilities. This involves coaching, teaching and providing new opportunities.

5) **Encouragement**: It is essential that we help staff members believe in themselves by giving them the feeling that they are worth something. We must communicate the belief that they can do what needs to be done and show them that we trust them by assigning them the responsibility of doing it.

6) **Support**: We must support their efforts to achieve, by accepting and even praising their failures, by criticizing as little as possible and by cutting the red tape that is normally the greatest hindrance to our making progress. We must help them build self-esteem.

It is important to realize that in order to obtain the best staff members we must pay a competitive salary. If you don't pay for the best, you won't get the best results. The university administration must understand that if technology is going to be of strategic value to the university's future, it must be treated as such, and the necessary qualifications and pay scales are not the same as those in the accounting area.

At Baylor, we have continually pushed our staff to advance academically. We first look for people who have a master's degree. If we cannot fill a position with a person at this level, then we employ a bachelor's degree individual who has the desire, initiative and ability to work on a master's degree part-time. The majority of our professional staff are either taking courses every semester or teaching classes in academic departments. This helps our staff continually realize that at a university the educational process is the bottom line.

Douglas Swords in a recent article stated, "In any senior leadership position, qualities such as leadership, aggressiveness and vision should be top requirements."[4] Providing the staff with a vision of what can be is a part of the strategic view that we must adopt.

One warning needs to be included concerning staffing issues. For a number of years, top management at Baylor has encouraged the use of management by objectives (MBO), and this last year a university-wide, personnel performance appraisal was instituted. The Senior Staff of the Center for Computing and Information Systems went through an Effective Management Program this past year which included training in a number of management areas. We were drawn into these processes, which sound good. I have, however, observed firsthand that these were a mistake, and I agree wholeheartedly with comments by Peter Kapsales from the AT&T Bell Laboratories who states, "Performance appraisals and MBO's sound logical, but unfortunately, in reality, they are destroying the competitive position in industry in the U.S." He adds that world renowned quality and management expert W. E. Deming, "includes performance appraisals and MBO's as two of the seven deadly diseases that thwart the productivity of companies."[5]

The word empower means to give authority to or to authorize. A synonym is enable. In summary, this empowerment process allows us to authorize an individual to do a job and to enable him to complete it and be successful.

Advancements

Universities have been striving for years to develop the ultimate information system. Baylor has purchased and installed a new Student Information System (SIS) from Information Associates and we are installing the DB2 relational database version of the College and University Financial System (CUFS) from AMS. We have in-house developed CODASYL database Alumni Development and Human Resources Systems. A MICOM data switch connects our terminals and microcomputers to five different mainframe systems. Two years ago things were looking good.

Then, just as we think we are getting things under control and beginning to see light at the end of the tunnel, we realize that the target we are shooting at has moved, again. The Macintosh microcomputer has shown up in great numbers, even in administrative offices, and everyone who has a microcomputer wants to download and upload information to the mainframes. The faculty want to communicate with colleagues at other institutions, access supercomputers, do desktop publishing (whatever that is!) and access the new on-line library system that is yet to be installed.

There are now two areas where rapid advancement is needed: the **workstation**, which is the window to the world from the desktop, and the **network**, which is the glue that ties everything together. These along with our mainframes and databases can provide us with easily accessible and timely information and functionality.

The Workstation: There are three fundamental characteristics of the intelligent workstation:

1) **Simplicity**: It must be easy to use without instructions. The true test is whether a new user can obtain the information he wants without having to use the help screens.

2) **One view**: The access to every different database or system should use the same procedures; that is, look the same: drop down menus for MACs or numbered menus, etc.

3) **Functionality**: Everything needed by one individual should be available through his workstation.

We certainly have not reached this goal, but with new microcomputer tools such as MacWorkStation we can begin to come close. We are now getting a good vision of what the intelligent workstation can do, and when the vision is clear, the results cannot be far away.

The Network: There are three requirements for our network:

1) **Transparency**: The network must be invisible to the user, who should only need to specify what type of information is needed. The workstation should navigate the network to the proper computer and system.

2) **Connectivity**: The workstation, through the network, should be able to provide or connect to all needed computer systems, information, electronic mail, word processing, databases, spreadsheets and supercomputers.

3) **Speed**: Appropriate transmission rates should be available for terminal activity, document transfer and graphics processing.

Some communications gurus are satisfied when they are able to move information around the network. This type of communications is only the foundation, however. Real networking is in place when the Dean of the School of Music can obtain the information he needs from the mainframe through his workstation, without assistance and with little training.

In order for these things to be possible, we should already have in place mainframes and systems that provide a rich variety of software tools such as: languages, database systems, 4 GL's, statistical and numerical packages and our data must be accurate, complete and timely.

Examples

There are several examples that will show our state of development and some of our successes in various areas.

Example 1: MacWorkStation

This past summer we began testing the MacWorkStation software. We had developed easy to use employee and student directories which use traditional terminal and menu access. Since more offices are beginning to use the Macintosh, we decided to develop a MacWorkStation front end for these directories, thus giving them a Macintosh view. It also makes downloading and manipulating the resulting information much easier.

One of the problems most universities deal with is the need to recruit additional qualified students. This is also true at Baylor. Each year we receive ACT and SAT scores from approximately 25,000 students who have expressed an interest in attending Baylor. Out of this number approximately 5,000 complete an application. For the most part, the remainder of these students are not contacted by the University. We have recently placed an ACT/SAT directory on the VAX computer system that allows academic departments to have on-line access to these names, addresses and scores. This information can be easily downloaded into a word processing system. We have now tested a MacWorkStation front end to this system that allows the department to access it as if it were on the Macintosh. When they select the students in which they have an interest, these can be moved into a database system such as FileMaker. This again allows a one view workstation.

Another MacWorkStation project that we have tested provides access to information on the Student Information System. In this case, the Macintosh accesses the IBM 4381 through the VAX 8700, which makes the Macintosh communications much easier and takes advantage of our IBM ethernet connection. This greatly simplifies access to student information.

Example 2: University ID System

Three years ago we reached the limit on the number of readers that could be placed on the Validine Student ID System. A committee was appointed to study the situation and bids were requested from vendors. The Center for Computing and Information Systems submitted a proposal to the committee for an in-house developed University ID System that would allow one card to be used for all purposes. For a cost of $100,000, we were able to offer more functionality and readers than what an outside vendor could offer for over $120,000. We now have an ID system that operates on a VAXstation 2000. It is connected to the VAX 8700, which contains an intermediate database that is updated on a regular basis from the IBM 4381. The system basically functions as a network distributed database system. It has fifty readers now, and plans are in progress to add another VAXstation that will allow another fifty readers and hot backup capabilities. At this time the VAX 8700 is a warm backup system for the VAXstation. The ID System is used for cafeterias, check cashing, book store charging, health center, sports events tickets, library privileges, recreation area access, controlled facilities access and parking lot access.

Example 3: The Network

The campus network is one of those areas where we have taken advantage of timely opportunities. With many Macintoshes on campus and the LaserWriter becoming the standard departmental printer, we have an immediate need to connect departmental microcomputers to LaserWriters. We are moving ahead with the installation of departmental AppleTalk networks, tying their microcomputers and LaserWriters together, and connecting these departmental networks to a fiber optic, ethernet backbone that also connects to the mainframe systems. The network gives the immediate advantage of being able to print to any LaserWriter from any microcomputer or mainframe. In addition, most departments are being set up with a hard disk file server with AppleShare so that we can install floppy disk based MACs in faculty offices and save a considerable amount of money. Print spooling is also provided. Since the LaserWriters are attached to the network, they also can serve as the standard printer for our MASS-11 word processing that is used on the VAX 8700 as well as IBM PC's, Zenith PC's and DEC Rainbow's.

Our new Student Information System was set up to print transcripts in a batch process on a line printer. This was a very inconvenient process for our students. We set up a LaserWriter on the AppleTalk network tied to the IBM 4381 that allows the on-line printing of transcripts in the Registrars Office. This provides high quality transcripts at the time they are requested.

To connect the DEC Rainbows to the network, we worked with Centram (who developed the TOPS networking software and hardware) to construct a board for the Rainbow and modify their software so that TOPS operates on the Rainbow. This was another opportunity that we took advantage of when a vendor was willing to work with us to develop a new product.

We also have been a beta test site for the Advintech ethernet system that attaches to the IBM 4381/MVS computer. This ethernet connection allows it to easily communicate with both the VAX and the IBM 4381/VM computer in the School of Business, where we have begun testing a BITNET connection through the primary Baylor BITNET node on the VAX 8700.

Example 4: External Network Connections

Two years ago we obtained a BITNET connection through the University of Texas at Austin using a 56 kb lease line. This lease line serves for both BITNET communications and a connection to the Texas Higher Education Network (THEnet). THEnet provides us DECnet connections with many universities throughout the state, including a connection to the University of Texas Center for High Performance Computing that provides CRAY number crunching capabilities for some of our research projects.

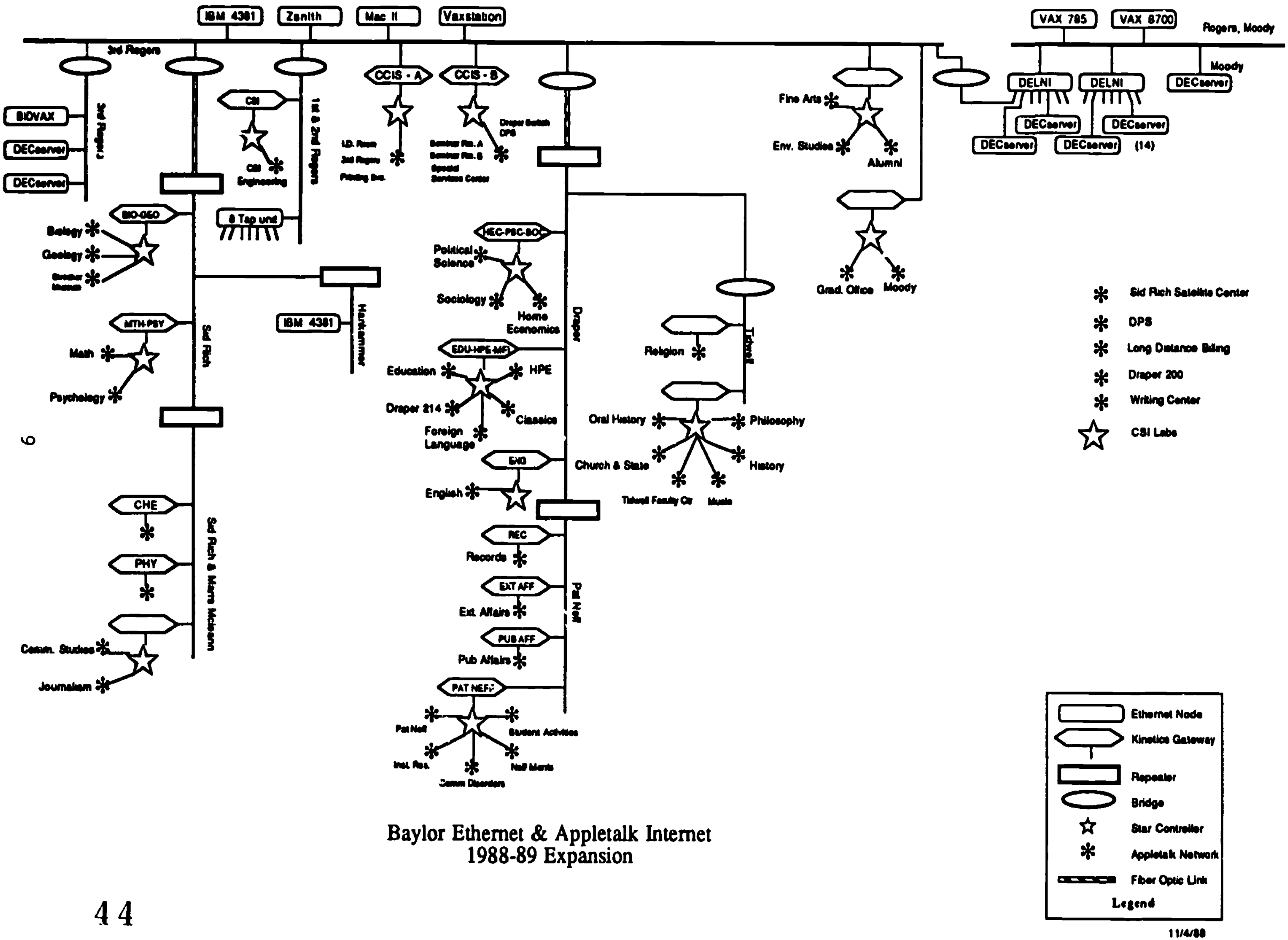
Three years ago Baylor needed to connect the microcomputers at the School of Nursing, which is located 90 miles away in Dallas, to our campus network. At that time we had started to operate our own long distance telephone network by purchasing wholesale long distance services from ClayDesta. We leased two 56 kb lines to the Dallas Nursing School which allow us to operate two voice lines and eight data lines. The voice lines tie into the Dallas telephone switch so that long distance calls placed from our campus switch to the Dallas area are routed over these lease lines. The eight data lines essentially operate free of charge on top of our student long distance sales.

Example 5: On-Line Library System

In 1983, a study was initiated to obtain an automated library system. The result of that study was a recommendation to purchase a library system that would cost $2.5 million. Because of limited resources, no action was taken. A grant for $300,000 was obtained from a foundation for us to begin the data conversion from our present CLSI circulation system to the proposed system. Since no progress was being made in obtaining funding, the Center recommended a year ago that we look for a library system that would run on a VAX computer. A VAX 11/785 was no longer needed to support student work and could now be used to support a library system. Another committee was appointed, which resulted in our selecting the multiLIS library system. This decision will not only solve many of the internal needs of the library but also give an excellent on-line, public access catalog. Since it runs in the VAX environment, it will be an integral part of our academic and office systems environment. Since any faculty member will be able to do a catalog search from his workstation, we will most likely develop a MacWorkStation front end to this system also. The total cost was reduced from $2.5 million to under one-half million dollars.

Example 6: Microcomputer Applications

There are several places where we have made good use of microcomputers tied to the network. For several years, we have downloaded class rolls to faculty members in either Lotus or Excel formats. In the Registrar's Office, we have tied an optical scanning system to a microcomputer, which allows easy input of grades which are then uploaded to the Student Information System. A microcomputer is used in the Student Housing area to provide better matching of roommates and for the assignment of rooms. Student names are downloaded to the microcomputer where room assignments take place, including dorm telephone numbers, and this information is then uploaded to the Student System.



Baylor Ethernet & Appletalk Internet
1988-89 Expansion

Example 7: Adopt Standard Products

A number of years ago Baylor had the opportunity to obtain attractive licensing prices from MEC, which developed the MASS-11 office automation products. We have continued a close relationship with this company and from time to time serve as a beta test site for their products. We use their word processing software, their dBASE type database software (on the VAX and on microcomputers) and are currently evaluating several of their new products. This close relationship with MEC allowed us to move into office automation very early, establish a university standard and provide campus wide training and support. When the Macintosh arrived, we adopted Word and Excel as the standard products and have since purchased the KeyWord product that allows us to transfer documents between MASS-11 and Word. This has allowed us to adopt a dual standard, one for the Macintosh and one for the VAX and PC. We are, therefore, trying to make all new products integrate easily in these two workstation views.

Example 8: Administrative Software

The decision was made in 1984 to begin an upgrade of our administrative computing systems and to move toward purchased software rather than in-house developed systems. A committee was appointed to select a system, which resulted in a contract to purchase the SIS/IA product along with a new IBM 4381 computer. The complete process will take approximately four years and it has followed a traditional planning model. It has expanded the functionality available for many offices on campus, but suffers from having a workstation or menu view that is different from our other systems.

Two years ago another committee was appointed to examine our financial system. The decision was made to purchase the CUFS/AMS software and we agreed to become the beta test site for their DB2 relational database version. From initiation to completion, this project will take approximately four years. It also has a different workstation view. The MacWorkStation product may remedy these different views.

Conclusion

It is important that our information system have strategic value to our institution. This is only possible if our strategy is dynamic, our staff is creative and our leadership is willing to take risks. Sir Walter Scott put it this way "One hour of life, crowded to the full with glorious actions, and filled with noble risks, is worth whole years of those mean observations of paltry decorum, in which men steal through existence like sluggish waters through a marsh, without either honor or observation."

1 Robert C. Heterick, Jr., A Single Systems Image: An Information Systems CAUSE Professional Paper Series, #1, 1988, p. 1.

2 John Morris, "Strategic Planning as a Process of Consensus Building," EDUCOM 88, Washington, DC, October 25-28, 1988.

3 Linda H. Fleit, "Choosing a Chief Information Officer: The Myth of the Computer Czar," CAUSE/EFFECT, Vol. 9, No. 3, May 1986, p. 29.

4 R. Douglas Swords, "Was Your CIO an Accountant?," Mainframe Journal, September/October 1988, pp. 94-95.

5 Peter Kapsales, Letters: "Management by Objectives Fosters Employee Discontent," Information WEEK, 8 August 1988, p. 2.

A HANDY GUIDE TO CAMPUS TELECOMMUNICATIONS

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ABSTRACT

Remember when Physical Plant handled "the phones" and the computer jocks did the data bit? All of this is changing. Campuses are encouraged to do their own thing. Are you ready?

This paper presents a layman's (simple words) view of how computer folks can look at the telecommunications revolution that is occurring. Key to the presentation will be rules of thumb and simple guidelines that will allow you to go away from CAUSE '88 knowing enough about telecom to be dangerous.

To make the concepts practical, Florida State University's telecommunications experience will be used for illustrative purposes. Data from twenty-two other universities is presented to allow you to make some comparisons to the your campus situation.

INTRODUCTION

A New Ball Game

Are you better off today, with regard to telecommunications, than you were five years ago? We were warned that there would be a period of "adjustment" after deregulation. We find that the American society is operating in a climate in which the bills for past rate excesses are coming due. Over the past four years, we have found that local service rates have gone up. There has been competition in long-distance service which has resulted in lower costs. Deregulation was intended to increase competition AND lower costs to the consumer.

But, the "consumer" did not get a vote in 1984 when Judge Greene made his famous ruling to bust up AT&T. We, the consumers, are left with the present situation of challenges and opportunities. Right!

Bah, humbug! It's a mess. And, for most of us it is just more work, more decisions, and more money. OK, so we need to have our attitude adjusted. What would a wise old man tell us?

> Life is short,
> the art long
> opportunity fleeting,
> experience treacherous,
> judgment difficult.
> --Hippocrates, 460-400 B.C.

A Difficult Judgment to Make

Five years ago, the judgment on campus was not as difficult to make. Your local telephone company provided ALL of your telecommunications services. You better believe they did. It WAS regulated and the law. Remember those good old days when the Telephone Coordinator down at the Physical Plant took care of getting phone service for us? And as for data, well, the guys at the computer center took care of ordering up data circuits. But, a lot has changed since 1984. The Deregulation of '84 has opened a Pandora's Box of decisions for you to make. Now, the judgment in telecommunications is difficult.

I was motivated to develop this **Handy Guide to Campus Telecommunications** as a result of my past two years of immersion in telecommunications. For the prior 20 years, most of my experience had been in computing and information systems. Sure, we computer people understand **data** and some of us have even been involved in microwave signaling. But, few computer managers have experience in the **voice communications** side of information resource management.

All of this is changing. Why? It is not solely because of deregulation. I believe that we have moved to a point in computing where **networking** is the real challenge of the '90s. Thus, we need to be a part of the planning, developing, and deciding about all three of the facets of communications. Yes, not just **data** but the voice and image components too.

Given this premise, I wanted to capture some of the important aspects of deciding about voice communications because those decisions will impact on the computing scene. And, to make a contribution, you will need to know something of the telecommunications industry to appreciate why they do things the way they do. As in computing, there is a vocabulary and jargon for the trade. So, we all have a lot to learn..

The essence of this "Guide" can be broken down into four parts. First, it will be helpful to review some historical highlights to appreciate the regulated **telecommunications industry** and the implications of deregulation that have an impact on the campus. Secondly, there is a need to understand the **switch** and whether a campus should buy one or rent the service from the local telephone company. Thirdly, there is the issue of **phones**. Since they are a campus responsibility now, how much do you suppose new ones will cost? Finally, **wiring** is another biggie. Do you need to rewire the buildings now that the local telco has given you this problem? And, how about digging up the campus to put in fiber?

It would be naive to represent that these four subjects make up the totality of telecommunications. One of the more difficult judgments that the university will have to make concerns people issues. So, as we go through the four major sections of telecommunications, expect to see some human resource issues interjected. Now, let's move to the subject of the telecommunications industry and its deregulation.

PART I -- DEREGULATION

The First Deregulation

Over the past decade, our government deregulated trucking, airlines, banking, and most recently telecommunications. Since Judge Greene's ruling in 1984, judgment has been difficult. The monopoly is gone and we have freedom of choice. We can now go to the market place and select from dozens of vendors. Before we settle down to reviewing our choices under this new freedom, let's take a brief look at history.

Did you know that 1984 was not the first time the Bell monopoly was dissolved? Almost a century ago, the Bell System patents ran out in 1894 and competition began to nibble at Bell business. Within three years, 6,000 telephone companies were established to manage 240,000 phones -- that's 40 phones for each company to manage.

Origins of Regulation

At the turn of the Century, the flourishing telephone business brought on advertising slogans like: "We have two ears, why not two phones?" But, several states began a piecemeal end to deregulation by setting up rate-regulating bodies and then Congress placed long-distance telephone operations under the jurisdiction of the Interstate Commerce Commission. Even before World War I, England and France had nationalized their phone systems. Woodrow Wilson was running on a platform that would have the Postmaster General operate a nationalized phone company. This actually happened several years later in 1918. Within a year, service had deteriorated so badly that Congress reversed itself and reverted the phone company to private ownership.

But, this period of regulation was one in which both the government and the phone company raised barriers to competition, when it was senseless to do so. Microwave radio transmission that was honed during World War II was a growth business but the FCC made non-Bell system growth difficult.Regulation moved from the ridiculous to the sublime when it ruled against plastic covers on public phone books as "harmful to the network and posing a safety hazard" to society. Yet, the force of technological advance was relentless. The Bell monopoly began to erode in the same piecemeal fashion that created it.

The Divestiture Agreement

The Antitrust Suit and AT&T Settlement

Seven years after filing its antitrust suit against AT&T, the Justice Department made an agreement with the company to drop the suit if AT&T would give up its 22 local operating companies of the Bell System. The settlement included the following points:

-- AT&T would divest itself of all exchange access and local exchange services.

-- No relationships could exist between AT&T and the divested companies.

-- The divested companies would have to provide equal access to all interchange carriers.

-- The 22 new companies would not be permitted to discriminate in favor of AT&T for procurement of products and services.

-- The divested companies would be able to provide basic services only.

-- And, watch for this "sleeper". AT&T is prohibited from being involved in the information services and electronic publishing industries until August 25, 1989.

Valued Opinions from Users

As most of you know, it gets lonely at the top. The recommendations that we pass on to top management represent our best judgment. But, these difficult judgments can be less lonely if the road we take is one that has been traveled by others.

So, throughout this "Handy Guide", some real-people experience and data will be inserted. For a national perspective, there will be survey data from Datapro, a McGraw-Hill subsidiary. It comes from a national survey published in September 1988 which represents the experience of over 300 businesses. A campus view is presented by a survey of universities was completed this month to give you some empirical data from 22 campuses.

For ease of recognition, the survey data will be set off by indentation and bold print.

PART II -- THE SWITCH

The Issues in Perspective

The freedom of choice gives a college and university one of the biggest dilemmas it will ever face. The dilemma is whether to (1) continue subscribing to Centrex service or (2) acquire a PBX or switch for the campus telecommunications services. In the first instance, the switch will be located in the local downtown telephone company office. Or, if it is campus owned, it will be in one of your campus buildings.

The switch industry is big business and getting bigger. And, the switch is only one part of the system. The wiring both in the buildings and underground are expensive capital assets. Then, if new phones are installed, the total system cost goes up another million or so. (Oops, need to tell you that telecom people call phones "instruments" and in turn instruments are grouped under a larger equipment category call "customer-premise equipment"). Keep in mind, that because these are multimillion dollar acquisitions, the process will generate great interest on campus, and among a dozen or more vendors wanting your business.

A Centrex is a centrex.

Now, let's begin to understand what is meant by the terms. Centrex is a business telephone service offered by a local telephone company (telco) from a local central office. It is basic telephone service delivered to individual desks, the same as you get at your home. But, it is offered to businesses with more bells and whistles or features.

Centrex service was first introduced in the early 1960s and targeted small and large users with enhanced features available to all, for a price. It is marketed by the BOCs under a variety of names over the years. The most recent name is ESSX. The independent telcos also use the centrex term, in its generic sense. Western Electric produced these central office switches for the BOCs up through divestiture. Now, the renamed manufacturing arm is AT&T Technology Systems. Before and after, the AT&T switches were called ESS (Electronic Switching System) and the model number is now up to five or "Number 5 ESS". Northern Telecom, GTE, and Siemens are also leading manufacturers of central office switching equipment.

Gee! My Own PRIVATE Branch Exchange

A Private Branch Exchange or PBX or switch is the other horn of the dilemma. A PBX is a business telephone system that provides efficient and economical inside calling among users within an organization and makes efficient use of lines that tie the PBX to the outside or the local telcos and long-distance carriers. It is private in the sense that it is in your building, run by your people, and serves your organization. The branch comes from pre-divestiture days when a PBX was like a branch of a Bell System central office but located on a customer's premises. By the way, this gives rise to the phrase **premise-based equipment**. A phrase that is commonly used in the industry. **Exchange** refers to electronic equipment that controls the connection of incoming and outgoing calls, in other words a **switch**. The term "switch" usually means something that central telephone offices have. But, the PBXs that campuses are buying today are like those of the central office. So, the words are often used interchangeably. Like the computer mainframe business, there are a number of manufacturers of PBXs. And, it has grown since deregulation to more than 30, offering over 80 models. But, three vendors dominate the market -- AT&T, Northern Telecom, and IBM/Rolm.

Get the Facts, First

Now that the choices have been defined, what is the next step? Remembering the first function of management, the simple answer is to

PLAN. The planning process includes: (1) problem identification, (2) gathering of the facts, (3) developing alternatives, (4) analysis of the alternatives, and (5) a recommendation. If, as in the case of Florida State University, the problem identification was easy. The switch was 13-year old and the regulated company threatened to no longer maintain. In many cases, the problem is one of economics or cost-effectiveness.

Ownership versus Subscription

As mentioned earlier, "freedom of choice" came as a result of "Computer Inquiry II" of 1980. From that date, new residential and business telephones, PBXs, modems, and other end-user (premise based) devices were detariffed. I can remember that we moved into a new central administration building at the University of Maryland the early 1980s. We bought all new phones and a PBX for the building. The low bid was ITT and we experienced our first "freedom" from the Bell System.

Yet, it was not until the '84 deregulation that breaking way from the local telco became popular. Note, in the table below, that 10 out of the 13 universities have bought their own switches since deregulation. But, the real pioneers were the three who bought before deregulation, as a result of the Computer Inquiry II ruling. The table also offer a feel for the different PBXs by "brand name". It is interesting that a somewhat random sample produced a list of 13 universities that now own their switch and 9 that have stayed "regulated" or subscribing to tariffed offerings. As a way of introducing the universities that responded to the survey, they are identified in this table. Hereafter, they will not be individually identified with their data.

UNIVERSITY SWITCHES AND THEIR ENVIRONMENT

University	Manufacturer & Model	Yr in Svc	Own/Reg	Nr of Lines
Emory U.	Northern Telecom SL-100	1985	Owned	9,000
Fla Atlantic U.	IBM/Rolm CBX 9000	1986	Owned	2,000
Fla State U.	Northern Telecom SL-100	1988	Regulated	7,300
Ga Tech	Northern Telecom DMS-100	1984	Regulated	6,000
Ga State U.	Northern Telecom DMS-100	1987	Regulated	2,000
Iowa State U.	AT&T System 85	1985	Owned	12,500
Miss State U.	Northern Telecom DMS100	1985	Regulated	6,700
N. Illinois U.	Northern Telecom SL-100	1985	Owned	8,000
Northwestern U.	Northern Telecom SL-100	1984	Owned	16,000
Oregon St. U.	Bell System Centrex	1976	Regulated	4,000
Ohio State U.	Northern Telecom SL-100	1985	Owned	17,000
U. Alabama	Northern Telecom SL-100	1985	Owned	7,500
U. Cal. LA	Northern Telecom SL-100	1983	Owned	18,760
U. Central Fla	IBM/Rolm CBX	1981	Owned	2,300
U. Florida	Bell System Centrex 5ESS	1982	Regulated	10,700
U. Maryland	Bell System Centrex 1AESS	198?	Regulated	8,000
U. Miami	AT&T System 85	1984	Owned	8,900
U. Michigan	Northern Telecom SL-100	1985	Owned	29,000
U. Nebraska	Northern Telecom DMS100	1988	Regulated	14,000
U. North Fla	Bell System Centrex 5ESS	1986	Regulated	800
Stanford	Northern Telecom SL-100	1986	Owned	15,000
Tennessee	NEC NEAX 22	1982	Owned	10,000

Some Financing Concepts

Since financing a multimillion switch becomes a very real issue, it is reported that:

- 62% were financed through a bond issue, repayable thru telecom income
- 22% used the normal university capital budget
- 8% used joint venture capital
- 8% used state financing

Revenue Streams

Whether you own or "rent" switch service, there is need for revenue streams. In the case of subscribing to local telco service, it may be important to supplement the rate structure fees with other sources of income for the overall telecom services. These other revenue sources can help provide income streams for rewiring the campus, developing networks, or expanding the infrastructure of the telco organization. In the section that follows, we will be examining several forms of income for the telco operation.

Rate Structures

Whether the campus is needing to pay the monthly telephone company bill or pay off a bond and/or keep the telecom office solvent, the university will need a rate structure for telecom services. It has at leasttwo components. The major portion of the rate is to cover the the cost of the switch, regardless of whether it is your cost or your mortgage payment for the telco's switch. The other is what you might wish to call telecom overhead, which is heavily skewed by salaries for the telecom staff.

The university rates that are presented below are provided to give you a basis of comparison. It was somewhat surprising to find that the prices of "regulated" offerings were that close to those of "owned" systems in the basic services category.

AVERAGE MONTHLY LINE CHARGES AT UNIVERSITIES

Basic Service Own	vs. Reg	Data Line	Extn	Campus Only	Maint.	Instr. Rental
$22.54	$24.77	$26.09	$8.54	$15.00	$2.50	$4.03 to $12.70

None the less, you and your telecom chief should find these numbers quite interesting because they are real and comparable. As an aside, you will probably pick up on some higher than average rates which are typically a reflection that the university is located in a metropolitan area. Yet, by and large, the rates reflect a surprising homogeneity.

Features Galore!

One difference between residential central office service and business service that occurred in the early 1960s was the announcement of Centrex Service with all of its "bells and whistles". These bells and whistles are actually tariffed features to provide better productivity in the office AND promote more revenue for the telcos. Well, you know how Americans love their gadgets. So, over the past two decades we have become accustomed to features. Even on the home front, we save the cost of another line and put in "call waiting", especially if there is a teenager in the house. But, these are really money makers since the direct cost to the telco -- yours or theirs -- is quite low. More and more features are being developed by the switch manufacturers. With each new software revision for a switch, the manufacturer announces a handful of new bells and whistles. For example, the latest software version offered in our Northern Telecom switch provides over a "gross" of features. Yes, over 144! The only higher number I've heard of is a 181-channel capable TV. Who can deal with all of those choices?

But, on a practical basis, it is interesting to note what features are the most popular. Said another way, you will want to know what features "sell" the best on a campus. Features are almost pure profit for a campus-owned switch.

When asked to list their top 5 features, our university survey produced the list shown below. And, for completeness, the next 5 most popular features are also provided.

THE 5 MOST POPULAR FEATURES AND 5 RUNNER-UPS

1. Call Pi up	6. Call Forward Busy
2. Ring Again/Camp On	7. Call Forward Don't Answer
3. Call Transfer	8. Speed Dialing
4. Call Forward -- Immediate	9. Call Forward Variable
5. Three-Way Calling	10. Call Forward Universal

Long-Distance Resale

The phrase "equal access" mentioned earlier in the divestiture agreement, makes it possible for universities to get into the long-distance resale business. As a practical matter, it could be an arrangement to reduce the cost of long distance to the faculty and staff. In other words, lower administrative costs. Yet, long-distance resale also has the potential of generating revenue. Many universities have installed or developed systems to provide this resale service to dorm students as a savings to the students AND make a small profit for the university.

The following real-life example will give you a feel for the numbers associated with an option like AT&T serving as a third-party provider of long-distance services.

AN EXAMPLE OF THE "MARGIN" FROM LONG-DISTANCE RESALE

Given 4,400 Students in Residence Halls
Assume 75% of the Students Subscribe to the Long-Distance Service
An Annual Revenue is Estimated to be $600,000
The University's Net Margin would be $100,000

Voice Mail

Another popular feature that is being offered by colleges and universities is voice mail or a voice mail box which is like an telephone answering machine. For less than 50¢ a message, calls can be routed to a personal "voice mail box" in the switch where a user's own voice asks callers to leave a message when he is not in. Subscribers can then retrieve their messages by dialing a special number.

The local telcos are gearing up to offer this service as part of their regulated offerings. Which is to say that you might not be able to offer the service to your campus, even if you wanted to do so. Yet, the pressure is building and, if price is not terribly important, your local telco can bring up this service fairly rapidly.

And, like long-distance resale, universities have an option to do-it-yourself, thanks to Judge Greene. The "system" consists of hardware and software. The third-party vendors that might be calling on you include: IBM/Rolm, Centigram, and Digital Sound Corporation, to name a few. The cost of these systems varies widely from $35,000 to $500,000 depending on the number of "mail boxes" and the sophistication of the service.

Telephone Registration

The concept of registering students for classes via a touch tone telephone and a scripted, voice response system is becoming quite popular and is a labor saver for both students, faculty, and staff. Called a **telephone registration system**, it is marketed by AT&T, Perception Technology, and others.

PART III -- PHONES

That Plain Old Telephone

Ever since Alexander Graham Bell called Watson in the late 1800s, Americans have "reaching out to touch someone". Today, there is a greater than 90-percent penetration of telephones in our society -- yes, that is 9 out of 10 homes in America have a phone. That makes it the top selling gadget trailed by television sets and automobiles which are at the 70-percent level. So, what do I need to know about them? For starters, we must appreciate that replacing ALL the phones on a campus is a costly decision. At a large campus, it is one of megabuck proportions. Now that I have your attention, let's discuss the basic types and some associated costs.

The POT

Now that we appreciate what a switch or a PBX does for us, we turn to "station equipment". The most recognizable piece of station equipment is the plain old telephone or POT as it is called in the trade. These **single-line** phones have a physical wire connection to a circuit in the central office switch. Whether at home or in the office, one phone equals one pair of wires and a unique 7-digit telephone number. These durable and reliable old phones last decades and are the most popular category of phones on campuses today.

Electromechanical Key Systems

Because many of our campus systems date back decades, it is appropriate to describe one of the old mainstays called **key systems**. To get around the problem of "one number, one phone", the Bell system introduced a **1A Key Telephone System** even before World War II. Featuring 6- or 10-button (key) desk telephones, these phones have advanced to the popular **1A2 key phones** (1963). Although GTE, ITT, and others manufacture look-alike phones, the industry gives them all the generic name "1A2". Behind these desk phones, rather expensive components are needed. Typically found in telephone closets, there is a key service unit (KSU), the key telephone unit (KTU), and the power supply (needed for the blinking buttons).

Types of "Signaling" Phones

It seems appropriate to interject at this point that there are two types of "signaling devices" used in our phones today -- rotary dial and **pushbutton**. The purists refer to these as "dial pulsing" and "tone pulsing". But more on that in a minute. To be generically correct, the latter type instrument is referred to as Dual-Tone Multi-Frequency or DTMF. But, we don't call these phones by any those names, do we? Like Kleenex, we refer to these phones by the Bell trade name touch tone.

Electronic Systems

Microelectronics found its way into the telephone industry in the form of **electronic key systems**. These systems offer lighter, less bulky equipment with high reliability. They have become so popular that the 1A2 is no longer manufactured. These electronic phones, as the name implies, are made with integrated circuit and chip electronics. Some electronic systems still use the 25-pair cable systems to the desk phone. But, many electronic key systems use two-, three- or four-pair wiring which cuts down on system costs and maintenance.

Proprietary Phones

After the "2500 phones", the most common type of station equipment is the **proprietary electronic telephone**. Northern Telecom calls its proprietary phones "P-phones". These types of phones conform to the manufacturer's specifications so that the PBX/switch and phone work as a system. Some of the PBXs, such as IBM/Rolm CBX, is designed in such a manner that only its phone works on its switch. How is that for a captive audience?

Proprietary Data Phones

More recently, with the advent of digital transmission and the popularity of PCs on the desk, **integrated voice-data phones** or IVD phones are becoming increasingly popular. With these phones, the "codec" or the coder-decoder is located in the phone itself and transforms the analog voice (speech pattern) into digital signals right at the set. When data interfaces are added to these telephones, digital voice and data can be carried over the same pair(s) of wire, simultaneously. By the way, most of these phones do use fewer pairs than the old key systems. The normal is two pairs, the number found in household wiring. Contrast this the electronic phones that require a separate set (two pairs) of wires for data transmission.

The Old 80/20 Rule

When trying to get a handle on the proportion of different types of phones that Florida State would need to acquire to go along with its new switch, I learned about the 80/20 rule. Explained more precisely, the manufacturer (Northern Telecom) said that it was its experience that their customers used 80 percent 2500-type telephones and 20 percent proprietary phones. When pressed about the use of data through the switch, it was conceded that 2 percent of the proprietary phones were of the IVD variety. So, to be precise, Northern Telecom has national sales data to demonstrate this rule of thumb.

THE 80/20 RULE OF TYPES OF PHONES

80% Plain Old Telephones
18% Proprietary Phones
2% Integrated Voice/Data Phones

PART IV -- WIRING

Introduction

Until recently, computer managers, systems analysts, and administrators, in general, thought little about wires, cables, and conduits. Like plumbing and lighting, we appreciated them but did not spend too much time thinking about them.

Several events in the past few years have moved the technology of wire and cables out of the background and into a more prominent front row. Consider the following aspects that have given rise to this situation.

With the AT&T divestiture, we have more choices than before, and probably more questions. The wiring in the buildings, like your home wiring, has become the user's responsibility. Campuses found that telcos were responsible for the copper in the ground but the university had to lay the new conduit in the ground.

Let's Talk Wire and Cables!

The data side of telecommunications has, for the most part, been piggy backed onto the voice side of systems of the telephone companies. By so doing, they have taken advantage of the existing networks and the maintenance organization for the system. Because the voice side was originally designed around analog signals, and most computers use digital technology, this has required the constant use of MOdulation/DEModulation (MODEM) devices. This force fit has meant that the computer industry has had to make wide use of twisted-pair wire technology since its earliest days.

Twisted-Pair Wiring

The oldest type of wiring in widespread use today is twisted-pair wiring that consists of 24-gauge copper strands covered with colorful plastic coating. It is still popular because of its low cost and flexibility. And, because there is such a huge installed base of twisted pair, there is a constant development effort to increase its speed and quality characteristics for data use.

Coaxial and Twinaxial Cables

Coaxial cables, like those used on IBM 3270 terminals, involve a pair of conducting elements. But, in this case, one of the elements is formed into a flexible, hollow, pipe-like shape and the other is flexible, circular, positively charged "rod" strung through the center of this much larger negatively charged conducting "pipe". Polyethylene disks every inch or so centers the rod in the pipe while other insulating material fills out the remaining space. This produces well insulated cabling capable of much higher data speeds and the higher frequencies of broadband data communications.

Optical Fiber Cabling

In the electromagnetic or metallic cabling discussed thus far, the type of wire, amount of insulation, and number of strands have to be evaluated against cost and environmental risk. Water and lightning are natural enemies of copper cabling. And, the electromagnetic fields become an issue as the quantity and quality of data transmissions rise.

Then along comes **fiber optics** or FO that multiply the carrying capability over copper by 1,000 fold. Optical fiber cabling is made possible by the development of especially transparent fibers with low light loss, and such ultra-small, concentrated, reliable light sources such as a **laser diodes** that are capable of trillions of bits per second speed or a **light-emitting diode** (LED) that is a cheaper and slower technology. A typical transparent fiber, thinner than angel hair on a Christmas tree, is measured in one millionths of a meter or **microns** and is surrounded by a layer of light-bending cladding made of glass or quartz, which is in turn surrounded by a protective coating. A light source, such as a laser, sends analog waves or digital pulses of light down the fiber to a receiving unit that may be either a repeater that renews the signal or the receiver where the light signal is transformed back into a electromagnetic signal for input to the computer.

CLOSING THOUGHTS

The People Issue

The glue that holds all of the technology together is the "P" word. Yes, folks, we need good People to make telecommunications happen on campus. And, as has been alluded to earlier, it is difficult to transition from a few phone order takers in the Physical Plant to a University Telecommunication Department. The difficulty might be gaining the approval for the positions. But, one of the major hurdles all of us face is the classification of the position to get and retain good people. Deregulation came on the campus scene so fast that the bureaucracy of the Personnel Department has yet to catch up. In the State of Florida, there are only three classifications that exist relative to our fledging Office of Telecommunications. Try putting together a new organization of 25 plus positions with such a limitation.

Some Words from the Wise

An apt way of closing this is to call on those who make their living in the trenches of telecom on campus. The final question of the survey was: "If you could give one word (or sentence) of advice to someone contemplating the acquisition of a switch and moving toward the setting up of their telephone company, it would be? And, as you will see, some used a word -- "Beware!" -- while others could not conclude in less than a hefty paragraph. But, they are truly some words from the wise.

> "**PLAN!** Be a telephone company!" (Florida Atlantic University)
>
> "Don't rush. Get all the facts." (Georgia State University)
>
> "Plan that you will, at least, double in size in cable plant and switch size."
>
> "Plan early to become your own telephone company. Plan to manage the project, the entire installation and on-going operations, before any contract is signed." (Stanford University)

PUBLIC INFRASTRUCTURE NETWORKS: the INdiana TELEcommunications NETwork case study

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A public infrastructure network is a telecommunications network that provides basic communication services on which public, e.g. education and government, organizations depend for their survival. An infrastructure network is distinguished from any ordinary communications facility because it is both pervasive and comprehensive! An infrastructure network provides the foundation upon which value-added (beyond merely transport and switching) information services can be exploited for competitive advantage or for service improvements.

This presentation will help its audience to:

1. Understand why current market and technological conditions motivate the creation of infrastructure networks
2. Recognize existing problems that motivate the creation of infrastructure networks
3. Describe the benefits, features, and constituencies of infrastructure networks
4. Define the services that already can and that will be supported by infrastructure networks
5. Plan, manage, and execute the activities leading to the successful creation of an infrastructure network

INTELENET, the INdiana TELEcommunications NETwork, will be used as a case study. Since 1984, the state of Indiana has been working toward the fulfillment of INTELENET which is currently being cut-over to serve its customers in Indiana government and education. INTELENET is a fiber optic backbone network that serves 16 concentration sites in Indiana where customers will access the network for transport and switching of their video, voice, and data services and to obtain other value-added information services.

WHY INFRASTRUCTURE NETWORKS?

Infrastructure networks are motivated by:

1. Communications industry changes
2. Technology
3. Shortcomings in communications infrastructure

Communications industry changes

Deregulation and new services are the major changes in the communications industry that motivate infrastructure networks. Deregulation of the industry has created a competitive climate that is compelling service providers to re-examine their pricing strategy. New services such as packet switching and other value-added features have created the prospect of considerably enhanced communications that require the foundation of a disciplined and robust network.

Technology

Technological progress in areas such as transmission and hardware has significantly improved the price-performance of network components. For example, emerging transmission media such as fiber optics possess both the capacity and other performance characteristics to substantially improve both the volume and the quality of transmission. Hardware innovations such as very-large-scale-integration significantly improve the economics of digital switching, multiplexing, and other communications functions.

Shortcomings in communications infrastructure

Shortcomings in communications infrastructure include:

1. Rising communications costs
2. Lack of enterprise-wide direction
3. Communications capacity constraints.

Communications costs have been rising dramatically. Since divestiture, the cost for local service has more than doubled! More significantly, the cost for leased long-distance private lines has gone up 10 to 30 percent at the same time.

Lack of enterprise-wide direction, i.e. no telecommunications architecture, results in duplicate carrier facilities. Nevertheless, the enterprise is still faced with limited expansion capability because the lack of planning makes it difficult, if not impossible, to forecast requirements.

For example, by 1986 inter-campus voice services provided by the Indiana Higher Education Telecommunication System (IHETS), a consortium of Indiana public and private universities and colleges, consumed a much larger proportion of its budget. As a result, IHETS was forced to cut in half the number of microwave channels it leased to transmit its video. As a matter of fact, voice services consumed more of IHETS' budget than video services.

Historically, IHETS and Indiana state government had collaborated in only a limited manner while fulfilling their respective communications needs. For example, IHETS operates the State University VOice Network (SUVON) utilizing leased phone lines. Independently, state government operates the Capitol Complex Phone System, a Centrex-based service utilizing foreign exchange and WATS services to connect the state capital with locations throughout Indiana. Within state government, a variety of heterogeneous data networks, e.g. Bureau of Motor Vehicles, Employment and Training, and Welfare, have evolved.

Simultaneously, IHETS leases a microwave network to distribute its video to Instructional Television Fixed Service (ITFS) transmitters throughout the state. This video network no longer has the capacity to incre... its programming.

Communications capacity constraints are caused by the use of obsolete technology. For example, analog transmission media have much less capacity than digital media. Furthermore, digital media provide much better transmission quality!

The IHETS video network is severely limited. Its geographical coverage is limited so that it cannot be received in every Indiana county. Its programming schedule is extremely crowded.

WHAT IS AN INFRASTRUCTURE NETWORK?

The infrastructure network concept

A public infrastructure network is a telecommunications network that provides basic communication services on which public, e.g. education and government, organizations depend for their survival. An infrastructure network is distinguished from any ordinary communications facility because it is both pervasive and comprehensive! An infrastructure network provides the foundation upon which value-added (beyond merely transport and switching) information services can be exploited for competitive advantage or for service improvements.

INTELENET is the consolidation of virtually all of the communications requirements of Indiana state government and education. This consolidation creates a critical mass, especially with the IHETS video, that generates economies of scale. This consolidation creates bargaining power that can be leveraged to win cost-cutting concessions from vendors.

INTELENET is also an integrated voice and data network. It uses digital switching as well as a digital transmission backbone that efficiently manages voice and data traffic.

INTELENET is also a distinct video network that uses a separate digital video switch as well as a separate digital transmission backbone.

Infrastructure network benefits

Infrastructure networks provide cost-effective access with stable prices. The critical mass of communications requirements fulfilled by an infrastructure network will encourage its provider to offer a fixed rate for all line costs for the life (at least 5 and up to 10 years) of the contract negotiated by the network customer and its provider. Conservatively, it is estimated that Indiana will save at least five million dollars during its initial 5-year contract term.

Infrastructure networks lower the entry barriers, in terms of both technology and price, for its users. The comprehensiveness of the network umbrella makes it unnecessary for individual users to bear the burden of either network implementation or network management. In addition to lowering the cost of services, an infrastructure can often also guarantee the capability to expand network capacity dramatically at predetermined costs because the initial infrastructure enables the provider to provide additional services at reasonable incremental cost and because the provider is in a favorable position to remain the provider of additional services.

Infrastructure networks focus attention on communications to help organizations to realize the strategic role of communications in serving customers or constituents and in delivering services.

Infrastructure network features

An infrastructure network is usually a backbone network with several concentration points where users will access network services. The backbone generally consists of transmission, multiplexing, and switching facilities that fall under the protective umbrella provided by the network provider. Infrastructure network services generally include integrated voice and data communications and often video services, as well. The motivation for integration of voice and data is efficient utilization of bandwidth as well as the opportunity for dynamic allocation of bandwidth. The motivation for video services is usually the creation of sufficient critical mass to generate economies of scale because video services require large amounts of bandwidth.

For customer support, an infrastructure network provides centralized network management and a central user help desk.

Infrastructure network constituencies

In order to be sure that an infrastructure network is managed efficiently as well as used fairly, it must be governed by a mechanism created by its constituents. For example, the INTELENET Commission was created by Indiana statute IC 5-21. Distinct from Indiana state government, the Commission is a body corporate and politic with the following responsibilities:

1. Fiscal and administrative services including:
   a. Budgeting
   b. Contract administration
   c. End-user billing
2. Telecommunications management
   a. Telecommunications planning
   b. User group interaction
3. Communications consulting services.

The Commission is composed of representatives of its customers, e.g. universities and state government, appointed by the Governor as well as selected members of state government including Indiana's General Assembly. The Executive Director appointed by the Governor is the Commission's chief administrative officer.

The Commission is a self-supporting organization that collects user fees to fund its lease payments to the INTELENET contractor and the Commission's operating costs.

The infrastructure network provider is responsible for operating and maintaining the network. The provider's responsibilities include:

1. Provide backbone facilities
2. Provide network equipment, e.g. switches and multiplexers
3. Coordinate user premise connections
4. Test and manage network
5. Maintain network
6. Generate billing

The infrastructure network customer must justify to itself any allocation of its funds to use network services.

HOW WILL INFRASTRUCTURE NETWORKS SERVE US?

At least, infrastructure networks provide basic transport and switching services. An infrastructure network is also the foundation upon which value-added information services can be implemented.

Initially, INTELENET will provide the following services with improved performance at lower cost:

1. Telephone network for Indiana higher education (SUVON) and state government
2. Video transmission service for Indiana higher education (IHETS) teaching Indiana business, health care, and other audiences
3. Private line circuits for various education and government computing networks.

INTELENET has the potential to do much more! For example, its data communication services could enable:

1. Document exchange among Indiana's libraries
2. Shared access to Indiana government and educational databases
3. Collaboration among pre-collegiate, collegiate, and corporate educators.

Video services could be upgraded to two-way, rather than one-way broadcast, capability to enable videoconferencing among government and educational personnel to reduce travel costs. Even geographical coverage could be expanded by providing gateways to national and international networks!

THE INTELENET CASE STUDY

Project history

The initial motivation for INTELENET was born in 1983 when IHETS formulated its "1990 Plan" for a significant upgrade to its analog microwave network that supported its ITFS broadcast video network. Realizing that it would be unlikely to get legislative approval for the capital investment necessary to construct this upgrade, IHETS enlisted the aid of Lieutenant Governor John Mutz who chaired a committee which recommended the creation of INTELENET. As a result, Governor Robert Orr established a steering committee and task force in early 1985 to examine Indiana's present and future communications requirements and to determine the feasibility of a consolidated statewide network.

After six months of study, this group concluded that such a statewide network was indeed technically feasible and economically justified. In early 1986, the Indiana General Assembly enacted a statute that created the INTELENET Commission.

The INTELENET RFP was released in March 1986. Proposals were received in June and the contractor was selected in October. February 6, 1987 was a significant milestone as the INTELENET Commission and GTE Telecom, Inc. (GTET) signed a contract. Network cutover was begun in March 1988 only one year after construction was initiated!

Defining requirements and feasibility study

The first steps toward INTELENET had the following purposes:

1. To collect and analyze data in enough detail to accurately compare communication capabilities and cost of INTELENET to those of existing systems
2. To provide traffic data necessary to estimate the cost of INTELENET
3. To provide requirements data for the procurement process.

As a result, several scenarios were offered in the feasibility report:

1. Current video, voice, and data requirements
2. Option 1 (above) plus additional video channels
3. Option 2 (above) plus 10% annual growth
4. Phase 1 (defined below)
5. Phase 2 (defined below)
6. Phase 3 (defined below)

Phase 1 includes all existing applications:

1. State-wide voice network
2. Existing data applications
3. IHETS broadcast video network

and the following locations to be served:

1. Universities
2. County seats
3. Locations served by long distance voice provided by state government's Capitol Centrex
4. Other locations with sufficient traffic.

Phase 2 includes applications requiring significant new development and funding:

1. Origination of video programming from other than higher education (IHETS)
2. State library and information database
3. Electronic document delivery system

and the following locations to be served:

1. Phase 1 locations
2. Most libraries
3. Major school corporations
4. Most law enforcement
5. Other locations with sufficient traffic.

Phase 3 includes applications, e.g. two-way video, that are dependent on advances in technology, user capabilities, and funding.

Government legislation

IC 5-21 defines the composition of the INTELENET Commission and grants it authority to:

1. Borrow money
2. Contract for a 5-year lease for services
3. Negotiate authorized user service agreements

Also, IC 5-21 specifically prohibits the Commission from owning the network!

Procurement

The steps in the procurement process included:

1. Preparing a request for proposal (RFP)
2. Evaluating the proposals
3. Selecting the contractor.

The RFP stipulated that the network would be owned and managed by the successful bidder. It specified a five-year lease that required no capital investment by the INTELENET Commission. It specified only inter-city services and requested pricing at both the option 1 and 2 levels described above in the feasibility scenarios.

Information included in the RFP included:

1. Switching hub location(s)
2. Concentration site locations
3. Voice, data, and video channel requirements at each site
4. Interfaces to be supported
5. Performance and availability requirements
6. Network management requirements
7. Contractual obligations.

These contractual obligations included:

1. Period of performance/Term of contract
   a. Acceptance procedures
   b. Conditions for termination
   c. Extensions of time
2. Equipment installation and usage
   a. Equipment site preparation
   b. Engineering changes

3. Maintenance
   a. Maintenance availability
   b. Spare parts availability
   c. Maintenance standards
   d. Service interruption credit

Evaluating the proposals was based on the following factors:

1. Technical specifications (30%)
2. Quality of proposed approach (40%)
   a. Soundness of technical approach
   b. Implementation planning
   c. Vendor qualifications
   d. Ratepayer impact
3. Price (30%)

Implementation

Implementation requires the following to insure success in schedule, budget, and operations:

1. Detailed planning that is reviewed and updated weekly
2. Detailed scheduling of resources that is reviewed and updated at least weekly and in the initial stages, on a daily basis
3. Detailed coordination of construction, procurement, installation, test, and cutover
4. Regular and persistent communication between the contractor and the customer to identify and to resolve problems as a team
5. Weekly meetings to check status toward network conversion
6. Weekly meetings to plan and to execute network cutover
7. Strict budgeting and accounting of manpower, time, and financial resources
8. Constant review of budget vs. requirements.

Management

Pricing network services

The INTELENET Commission has established the following guidelines for pricing INTELENET services:

1. The INTELENET pricing policy should maximize the Commission's flexibility to make future pricing decisions.

2. The INTELENET pricing policy should encourage wider utilization of its service.

3. The goal of a pricing policy should be to lower prices (rates) for all users in order to utilize the growth capacity as rapidly as possible.

4. Annual revenue should be sufficient to cover long-range operating costs, including administrative costs.

5. The INTELENET pricing policy should include the distribution of administrative costs across all users of the service.

Following these guidelines, the Commission has adopted the following pricing strategy:

The Commission employs discounted tariff rate pricing which offers a discount, from the prevailing tariff (where available) of common carriers, sufficient in the aggregate to recover the costs of providing the service according to IC 5-21-5-1(b).

Where a service has no prevailing tariff to use as the baseline for discounting, the aggregate revenue generated by that service must be sufficient to recover the costs of providing the service according to IC 5-21-5-1(b).

Marketing network services

When an authorized user decides to use INTELENET services, the Commission and that user negotiate a customer service agreement that contains the following:

A. Definitions

B. Duties of INTELENET

C. Term of agreement

D. Consideration
  1. When charges begin and customer pays
  2. Pricing services
  3. Installation fees
  4. Billing invoice
  5. Minimum purchase quantity

E. Installation and acceptance

F. Maintenance

G. Cancellation or termination

WHY IS INTELENET A ROLE MODEL FOR THE NATION?

At this time, INTELENET is still unfortunately unique! What makes INTELENET unique?

INTELENET is comprehensive! INTELENET serves an entire state. While other states have state-wide networks, no other state-wide network offers the wide range of services offered by INTELENET:

1. Broadcast video at DS-3 (45 Mbps) rates
2. Data services at a wide range (from 1200 bps to 1.544 Mbps) of rates
3. Voice service.

Other public service networks that may offer similarly broad services do not cover an entire state.

The INTELENET Commission is special! The Commission represents a coalition of state government and education that works in Indiana. IHETS creates the critical mass of communication bandwidth demand that generates the economies of scale to be enjoyed by all of Indiana government and education. State government has created the Commission to capitalize on this opportunity!

REFERENCES

1. INTELENET Feasibility Assessment Report. Available for cost of reproduction from the INTELENET Commission:

1 North Capitol, suite 310
Indianapolis, IN 46204
317/232-4978
Bitnet: TOMHO@ PURCCVM

2. IHETS Report for 1985-86. Available from:

Indiana Higher Education Telecommunication System
957 West Michigan Street
Indianapolis, IN 46223
317/263-8900

3. IHETS 1990 Plan. Available from IHETS (address above)