Moressi, W.J., Laster, B.M., Mitlin, L.R., McFadden, C.B.. "Towards Negative Entropy: A Strategic Plan" Proceedings of the 1989 CAUSE National Conference, San Diego, CA.

TOWARDS NEGATIVE ENTROPY: A STRATEGIC PLAN

William J. Moressi, Director
Academic Computing Center

Betty M. Laster, Director
Management Information Services

C. Brown McFadden, Systems Engineer
Academic Computing Center

Laurance R. Mitlin, Assistant Dean
Library Services

Winthrop College
Rock Hill
South Carolina

ABSTRACT

A fundamental concept of nature is that living systems without adequate "information flow" will utilize large amounts of energy (resources) while tending towards disorder. Our campus is such a living system and it has been the objective of a five-member campus team, with the support of administrative officials, to reverse this process.

After defining the "disorder", we have devised "A Strategic Plan for Communications at Winthrop College." This plan has two major goals: (1) to establish Information Technology standards on a campus-wide basis for information system network service centers and for end-users wishing access to and support from the network service centers, and (2) to install a campus-wide infrastructure network optimizing connectivity and interoperability between and among information processing systems while providing comprehensive end-user access. Our tactics and strategy will be provided together with accomplishments to date. This is a real-time activity with plans calling for budget and specifications by August of 1989.

Presented at The Proceedings of the 1989 CAUSE National Conference, San Diego, CA

INTRODUCTION

By way of introduction, we would like to provide a conceptual framework from which we can view the information resources and communications within our campus organization. We find it useful to think of our campus as a living system, analogous to single celled organisms, humans, or societies. We then may apply, by analogy, certain ideas from the fields of systems and information theory, and thermodynamics to such a system.

We use the term "system" as a set of units with common properties. The interactive relationships between the units are ones of constraint, control, and dependence. The "campus as a living system" is therefore all internal organizational units, from the academic departments to the office of the president, that function towards common goals in a predetermined structure or hierarchy. This living system is comprised of individuals and groups who process information for the system. In this article, information is considered a measure of the ***order*** or ***form*** of communicated or transmitted media and not the media itself. The "media" is considered to be that matter/energy which is able to be transmitted and assimilated and includes such forms as data, voice, video, graphics, and security signals.

The law of "Degradation of Energy" or "Second Law of Thermodynamics" suggests that disorder, disorganization, lack of patterning or randomness is the natural progress of a system from ordered to disordered states. Information is a negative index of uncertainty or disorder. For an organization to progress in an orderly fashion towards common goals; individuals, groups, and units within the organizational system must be able to acquire meaning or significance from processed information. It is through meaning and acquired knowledge that living systems change their processes to adjust to changes in their environment. Without information, media will be utilized, but no meaning or knowledge acquired. Information provides the power of organization, lack of information results in natural disorder, and the subsequent degradation of the organization.

Winthrop College has as its mission two fundamental aims: (1) the fullest possible development of each student as an educated person, and (2) the preparation of students for professional careers. Education is the effective transmission of knowledge and skills to students. If the college, a living, open system in competition with other similar systems, cannot process information effectively and efficiently within its internal units, it will not be able to reduce the internal strain that such systems experience. The system's organizational and operational integrity will diminish to the point of dysfunction. Biologists associate this progressive systems failure with aging and mortality.

We at Winthrop College are attempting to provide the means by which various media may be effectively ordered and communicated to maximize the transmission of information. We plan to do this by (1) establishing standards for the control and transmission of media as information and (2) creating a campus-wide communications infrastructure for its transmission.

The vehicle for effecting this change is Winthrop's **"Network Project Team."**

Genesis of the Network Project Team

The committee that ultimately gave rise to the Network Project Team had its beginning in 1980 when Winthrop went in-house with administrative computing. Appointed by the president and named the "Computer Coordinating Committee," it had as its mandate "to ensure that all administrative units desiring computer assistance would be served."

By 1983, campus computing resources, especially microcomputers and microcomputer software, were expanding significantly. In an attempt to manage this rapid expansion of computing resources, the appointed committee was re-commissioned by the administration. The committee was to scrutinize the personal computer purchase requisitions and consult with those departments making requests that did not appear to be cost justified. Having no formal authority, the committee was not regulatory and had no effective role in controlling purchases.

In 1986, the President appointed a "Computer Utilization Committee," which was comprised primarily of the members of the previous committee. Moressi, Laster and Mitlin were asked to serve again, along with three other persons. No explicit directives were provided except by way of the name of the committee.

At our first meeting, in December 1986, there was a consensus from the group that we needed some definitive objectives the committee could attain. While exploring possibilities, we got into a rather animated discussion about the great difficulty the campus information resource centers experience in trying to provide services beyond their immediate physical domain. We also recognized that we were not even able to share resources because of the absence of standards between systems.

The committee decided it would define the problems and do a preliminary analysis of data communications, or lack thereof, on campus. The study would define the ***scope*** of the project, identify the ***information service centers***, and address the issues of ***standardization of services*** and ***campus communications***. With this information in hand, we would recommend to the President a course of action for the committee: plans for the establishment of a campus-wide network for Winthrop College.

The President and other senior officials became convinced of Winthrop's communications problem. We were directed to begin a feasibility study and to search for practicable options for networking the campus. At this juncture, there was no stopping us! Our next move was to identify ourselves as a group with a specific purpose. We adopted the name "Network Project Team."

Evaluation of Campus Disorder

In preparing the feasibility study, we found that information technology disorder fell into two categories: technical and non-technical. We further observed that the non-technical disorder, which can be defined as lack of coordinated control, resulted in the technical disorder.

- The three computer centers on campus use different computers and dissimilar communications protocols and transmission media. Sometimes there are three types of cable covering the same route.

- Communication line facilities evolved as opposed to being the product of design; there are no provisions for growth or change. There is no allowance for the integration of such communications media as voice, data, security systems, graphics and video.

- There is no single source to identify what communications lines and conduits exist and where they are located.

- Telephone lines have to be used for local connections because of the absence of conduit or other forms of direct connection.

- The telephone system and its administration operates independently of the computer centers. This arrangement precludes careful planning for multi-media transmission.

- Special lines outside of the telephone switch must be requested when attempting to communicate on or off campus with computers or terminals.

- An inordinate number of personal computer hardware/software systems have been purchased for use by Winthrop personnel. Service center resources cannot begin to support the great variety of hardware and software systems.

- No guidelines or standards exist for the acquisition of personal computer hardware and software. Thus, users are often left unsupported and unable to properly utilize their systems.

- Without controlled coordination of the information technology function, each of the existing service centers make independent attempts to communicate and share resources. The processes employed are usually complex and circuitous.

- The absence of standards impacts functionality, service and budgets.

DEFINING THE CAMPUS ENVIRONMENT

Another component of the feasibility study was a definition of the campus environment.

Two important factors that must influence the formulation of systems objectives are *organizational constraints* and the *people who use the system*. A term currently being used does a good job in describing these factors. It is called "organizational culture." Organizational culture addresses issues of money, people, time, and facilities and how each are allocated. In other words, the organization defines its priorities by the very nature of its existence. It follows that an understanding of this "nature of existence" is paramount to planning for change.

Because of this maxim, a determination of the culture of our campus was in order. Our starting point was the identification of campus-resident providers of computer services, and consideration of the niche or placement each occupied in the organization.

We defined three information system service centers: Academic Computing, Management Information Services and Library Information Systems. Each utilized a combination of mini-computers and micro-computers representing multiple vendors and had no protocol or media compatibility with each other. Each center was located in a different building.

The Academic Computing Center's primary role is to provide the tools needed by students and faculty for course-work requiring computers. We found that another important role has emerged and is growing in the area of faculty and student research. The Academic Computing Center also provides management of curricula and other functions directly associated with academics. Communications with other colleges and universities are made possible by communications links through the Academic Computing Center.

The role of Management Information Services is to provide computing resources for administrative functions common to all colleges and universities. The scope of services has been extended to include the administrative functions of the academic units.

The Library Information Systems center exists to provide a computerized public access catalog and internal library record keeping. Provision is made for access by author, title, subject and keyword.

As for the organizational placement, each of the service centers resides in the fourth layer. The Academic Computing Center and Library Information Services are aligned under the Academic Vice-President. Management Information Services is controlled by the Vice-President of Finance and Business.

Given this organizational structure the three centers have had no common ground for achieving unity of purpose.

The remaining component in defining the campus environment was to determine what other isolated computer uses existed, if any, and what functions were being performed by the computers.

To accomplish this a one page Information Technology Census form was prepared in summer of 1987 that asked each department to list the number of terminals and "intelligent" devices located and utilized in their area. We asked for manufacturer, model, and description.

Analysis of the data revealed that the campus used 6 types of display terminals and over twice as many types of printers. We had at that time 365 personal computers representing 13 different vendors in 24 buildings.

Since the display terminals were connected to the service centers, we knew what functions they were performing. We also knew that 170 of the personal computers were in PC laboratories. Exactly what was being done with the remaining 265 personal computers was unknown to us.

STRATEGIC PLANS

Our strategic plans are for the development of an Information Resource infrastructure at Winthrop College. The plans have two primary goals: (1) the establishment of campus-wide standards for information resources, and (2) the installation of a campus-wide communications network infrastructure.

GOAL 1: to establish Information Technology standards on a campus-wide basis for information system network service centers and for end-users wishing access to and support from the network service centers.

Objectives: Plan of action to:

O(1): *Provide network software standards.*
Timeline: July, 1990

O(2): *Provide network architecture and hardware standards.*
Timeline: July, 1990

O(3): *Provide specifications for a data exchange standard between computing systems.*
Timeline: July, 1990

O(4): *Develop standards that will define resource services the information service centers provide.*
Timeline: July, 1990

GOAL 2: to install a campus-wide network infrastructure optimizing connectivity and interoperability between and among information processing systems while providing comprehensive end-user access.

Objectives: Plan of action to:

O(1): *Define the campus's information resource service facilities.*
Timeline: December, 1988

O(2): *Define the campus's communications environment.*
Timeline: January, 1989

O(3): *Evaluate several networking technologies that could meet the needs of Winthrop College.*
Timeline: August, 1989

O(4): *Compare networking alternatives on a cost-benefit basis.*
Timeline: August, 1989

O(5): *Recommend establishment of organizational structure(s) for the support of the communications network.*
Timeline: July, 1990

O(6): *Develop proposed system specifications.*
Timeline: August, 1989

O(7): *Implement system in phased approach.*
Timeline: 5 year installation.

PLANS vs REALITY: Accomplishments & Adjustments

GOAL 1: Establishing IT standards

Standards are to be:

- developed with consideration of the finite resources of the service centers.
- developed with consideration of the average user.
- maintained and updated on a regular basis to reflect current and anticipated changes in technology and needs of users.
- flexible enough to allow for information systems development and expansion, and for changes in user's requirements.

O(1): Establish network software standards.

We are considering standards that are not only compatible with currently used technology, such as the International Standards Organization (ISO) Open Systems Interconnection (OSI) and Transmission Control Protocol/Internet Protocol (TCP/IP), but those that would ensure flexibility with future technological advances.

O(2): Provide network architecture and hardware standards.

Hardware interfaces must be selected based on the current equipment and near term hardware expansions of the service centers. We have yet to decide on an appropriate architecture and hardware interfaces.

O(3): Provide specifications for a data exchange standard between computing systems.

The three service center directors are coordinating the effort to establish standards for communications between our host computer systems. In addition, the committee is considering such systems as minicomputers, microcomputers, telephone circuits, video systems, security and emergency systems to determine their capability to adopt a data exchange standard.

O(4): Develop standards that will define resource services the information centers provide.

Standards will be developed for the three campus information systems and users of such services. These should clearly define the hardware, software and systems consulting and support source(s) and resources to be provided by the centers.

GOAL 2: Install campus-wide communications network infrastructure

O(1): Survey campus for Information Resource service facilities.

This has been accomplished. The three major information service centers on campus have been identified: The Academic Computing Center, Management Information Services, and Library Information Systems. Considerable detail has been accumulated on end user systems and data entered into database systems for analysis.

O(2): Survey campus for all existing communications lines and services, including telephone.

Most buildings on campus have been surveyed and data has been recorded as to the number of voice lines both in place and required and the number of data lines in place and required. Data has been entered in a database system for analysis.

O(3): *Evaluate several operationally feasible networking technologies that may best meet the needs of Winthrop College.*

Several vendors have been invited to informally review Winthrop's networking needs and provide some viable solutions. Members of the NPT have also visited several sites where networks of interest were installed.

A hybrid data switch/LAN is visualized. We have already had several companies demonstrate data switching capabilities on our campus.

O(4): *Compare networking alternatives on cost-benefit basis.*

We have not settled on any unique alternatives to provide definitive costs, although we have made some estimates based on a hybrid data switch/LAN.

The college's administration informed us of a possible "Step 12 Formula" funding for the network through the South Carolina Commission on Higher Education. We applied for this funding, estimating costs for using a data switch with existing telephone wires as opposed to rewiring the campus for a LAN configuration. On a projected basis, it appeared to be more cost-effective to eventually rewire the campus thus giving us the option of using a full LAN or a combination switch and LAN.

O(5): *Organizational structure for support of network.*

Two preliminary steps were taken in this direction:

1) in our proposal for network funding to the S.C. Commission on Higher Education (6/89), a budget allocation was made for campus network staff.

2) we reviewed campus Information Technology coordinating problems with the vice President of Academic Affairs and President (9/89).

O(6): *Develop proposed systems specifications.*

We have inventoried most all types of computing and communicating equipment on campus, identified most all buildings needing communications down to the room level in need of communications, located communications conduit in existence. For each of the service centers we have analyzed the current data traffic flow and expected traffic flow. With this data we have listed a number of specifications for service center and end user requirements.

O(7): Implement system in phased approach.

The *first phase* of the LAN implementation will be twofold: (1) to provide for all *existing* end-users, service to the host-systems through the network, and (2) to install a fiber optic backbone between existing host-processors with standard protocol software. The *second phase* will be to expand LAN facilities and install network software to provide for complete campus connectivity and interoperability.

SUMMARY

Conceptually, we relate our campus organization to a living system; a system that utilizes energy to do useful work. The better organized a system is, the greater is its so-called "information content" and its ability to use energy to do constructive work.

Our actions over the past two years have been to develop a plan and specifications for a more ordered structure for media such as data and voice; and for an appropriate means of transmitting these media both within and external to the organization.

We have set the plan into action and accomplished such tasks as defining major information resource centers, surveying the campus for central processors and their associated major software systems, and for communications equipment. We surveyed for voice and data lines on a room-by-room basis in most campus buildings. We surveyed for existing underground conduit and subsequently developed AutoCAD diagrams of the campus graphically depicting our results. We have invited interested vendors to present their networking strategies and made site visits to academic institutions and corporations. All this was done in an attempt to help us better define our information resource "problem" or disorder.

The data have been analyzed, problems identified, and the structure for solution(s) provided. We have submitted analytical reports and provided communications demonstrations to the upper administration. We developed a strategic plan for campus information resource standards and a communications infrastructure, and submitted a proposal for funding of the project to the State of South Carolina.

We plan, with the continued support of our administration, to be able to effect changes in our organizational environment that will allow us to progress to a state of "negative entropy." With these changes we may continue to grow in functionality, productivity and complexity with the ever increasing information demands made on our organizational units.