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ABSTRACT

Eight papers are presented from the 1994 CAUSE conference track on information as a strategic resource in higher education institutions. The papers include: (1) "Development of an Electronic Information Policy Framework," focusing on developments at the University of North Carolina at Chapel Hill (William H. Graves and others); (2) "Strategic Information Resources: A New Organization," which discusses the merger of the Computing Services Department and the Library at Gettysburg College (Pennsylvania) into a single division (Dennis Aebersold and Gordon A. Haaland); (3) "Distributing CWIS Information Management," which focuses on the Dartmouth College (New Hampshire) Campus Wide Information System (Robert J. Brentrup); (4) "A Small School Ventures into the World of the CWIS," which examines the development of a campus wide information system (CWIS) at Kenyon College (Ohio)(Bev Actis); (5) "Providing Access to the Scholars Work Environment (SWE)," focusing on CWIS development at California State University, Los Angeles, (Donald Carder and James Penrod); (6) "Serving Students Well Serves Us" which describes CWIS at the University of California, Berkeley (W. Russell Ellis and others); (7) "Decision Support at Stanford: Partnering with Users" (Joy Mundy and Warren Thornthwaite); and (8) "Implementing a Kiosk-Based Campus Information System at Community Colleges: Three Case Studies" (Stephen Jonas and others). (Some papers contain references.) (MDM)

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New Opportunities for Partnering

CAUSE 94

TRACK III

INFORMATION AS A STRATEGIC RESOURCE

Coordinator: Martin Ringle

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DEVELOPMENT OF AN ELECTRONIC INFORMATION POLICY FRAMEWORK

William H. Graves, Carol G. Jenkins, Anne S. Parker
University of North Carolina at Chapel Hill
Chapel Hill, NC 27599
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The University of North Carolina at Chapel Hill, like many other universities, is attempting to manage an unprecedented demand for electronic information in myriad forms. The dispersion of organizational responsibilities makes it difficult to address the confusion and contradiction arising from issues of availability, responsibility, and confidentiality. An early policy study led to a report on major issues and the formation of a management council with membership representative of units having management and budget responsibilities for pan-university information technologies -- library, networking, and computing organizations, for example.

This report summarizes the strategies and rationales employed in creating the council and in developing a policy framework articulating the electronic rights and responsibilities of the university community and the public. It describes the "case testing" strategy currently being used to evaluate the framework and the plan for continuing its development, garnering support for it, and implementing it. This paper also explores the potential interactions of this policy with those of other agencies.

The purpose of this paper is to report the evolution and current status of a "A Policy Framework for the University's Network: Electronic Rights and Responsibilities at the University of North Carolina at Chapel Hill" (UNC-CH), developed by a partnership of information technology, library, and administrative leadership. This description of the framework and the processes that shaped and continue to guide its implementation may prove useful to others who recognize new, technological windows on old issues in the following scenarios:

* A teenager dials into a machine at a university in his city. From that connection, he establishes a connection to another machine at a distant university. This machine allows him to establish an Internet connection and thereby a connection to alt.sex. His father and the press in his city express outrage that the two universities separated by miles have conspired electronically to lead America's youth astray.

* The FBI, suspecting that a nefarious hacker has broken into a machine in the physics department at a university, demands a copy of that machine's fixed disk from the department chair. The chair seeks legal counsel and is advised to comply with the FBI's demand. The FBI now has a copy of many files that are considered private by their creators in the department.

* A state auditor advises a university chancellor that the university should have a special university policy to guide the personal use of university-owned computers and related electronic property, including e-mail. The tenor of the advice is 1) that all personal use should be prohibited, even it adds no incremental cost and possibly contributes to professional development and an environment of open expression, and 2) that digital technologies demand special personal-use policies different from those formulated for other university-owned property.

* An administrator finds himself having to respond to requests for large amounts of data from administrative data files, for public use, in the format requested. How can he cost effectively respond to such requests, mandated by law, while doing his best to provide data that accurately describes the university, is not misleading, and protects individual privacy?

* Libraries and other university agencies have leased network access to commercial databases. How can licenses for access to such databases reflect the broadest access possible to meet information needs of university users, avoid costly duplication, and be enforced and supported through user support services?

* University administrators from units all over campus search for information to support reaccreditation and find that institutional data was not readily available when the need arose.

* Individual departments and schools create World Wide Web home pages because the technology is available. Little, if any, consideration is given to the quality of the information, how it will be maintained or what standards should be incorporated.

Each of the above scenarios is based on an event that informed or continues to inform UNC-CH's work on the policy framework. In fact, new examples supporting the need for a coordinated institutional policy arise almost daily.

An Overview of UNC-CH's Policy Framework

The policy framework developed by this partnership is appended to this report in its present form. It describes the nature of the University's network and proposes a set of overarching University-wide rights and responsibilities for both consumers and producers of networked information. The overall goal is to make information needed by the University's various constituencies as accessible and useful as possible. The document is only a policy framework, a statement of philosophy, but it should be read with the understanding that unit-level producers/providers of information resources will be required to develop policies and practices consistent with this University-wide framework. The framework document implies several directions that depart from current practice at UNC-CH:

* The University will have ultimate responsibility for all official, institutional information generated at unit levels. Current policy, in contrast, places this responsibility solely at the unit level. The University will expect units to act as responsible stewards of the information that they generate. Stewardship will include the responsibility to prepare and manage information in compliance with University-wide standards and practices.

* The University will expect the units to "publish" institutional information in a comprehensive manner on the University network with enough searching, browsing, and "mining" capabilities to provide aggregate information about the people and other resources of the unit. Such information includes, for example, information about students, faculty members, unit expenditures, and other fiscal activities. Many units will choose to use electronic publication to provide information about the content and direction of their academic programs and activities, but academic work remains the private property of individual scholars, students, and staff members except as dictated by external funding agencies, state and federal policies, or various contractual arrangements. The intent is to "open" official, institutional information at the unit level to all members of the University community and to anyone who has Internet access from anywhere. Current practice, in contrast, exhibits much less openness. The formats of the electronic presentation of information will be carefully designed to be broadly useful, permitting the University, within the scope of the law, to reject requests for information in other formats that are not easy to accommodate.

* Information embodied in University-owned digital storage and transport media will be considered private property except when specifically intended to be an official University communication or record or when otherwise treated by a contractual arrangement or federal or state laws. This includes non-official electronic mail, which presently is not consistently viewed as private.

The first two directions are an attempt to open the University's "official" institutional records to a broader audience, especially within the University. Open access to information is increasingly important to the University's competitive position at a time when intellectual capital is encroaching on physical capital as the driving force in the world economy and order. Indeed, openness is becoming the expectation in North Carolina, as this recent statement from Governor Hunt suggests: "Members of the public and the media need to have access to this computerized information about their state government, and we should make those records as accessible as possible." In contrast, the third direction is an attempt to put a "privacy" stake in the ground in an area where the law is unclear and is often uninformed on the nature of the digital revolution.

Nor is the University immune to the pressures forcing all institutions -- public, non-profit, and commercial -- to become more accountable and cost-effective. Academic governance for years has modeled the "flat" structures touted today by the corporate world as essential to competitiveness. But the effectiveness of the flat model is dependent on the open flow of information. Now for the first time, paper-moving impediments to openness can be mitigated by capturing, storing, and sharing information across digital networks. The new technologies can advance educational quality in a timely, cost-effective manner by improving collegial decision making with the support of nimble administrative and business processes and an open information policy.

Evolution of the Policy Framework

In 1992, the University's Advisory Committee for Information Technology (ACIT), responding to events such as those described in the opening scenarios, appointed a subcommittee to outline key issues and considerations that a University-wide information policy could help address. (The University's two chief academic officers -- for academic and health affairs -- created the faculty- based ACIT to advise the associate provost responsible for the University-wide network and the University's central investments in academic computing and classroom technologies.) The subcommittee drew upon campus expertise as well as the experiences of other universities.

During the subcommittee's deliberations, the two academic officers and the University's chief financial officer created the Information Resources Coordinating Council (IRCC) to coordinate the management of pan-University digital information stores and technologies distributed across organizational boundaries that intersect only in the Chancellor. The Council includes library leadership, academic and administrative information technology leadership, and the chair of ACIT. ACIT then decided that the work of its subcommittee on information policy was more appropriately the domain of IRCC. The following is an accounting of the issues and methods that led to the current draft of the policy framework, beginning with the key issues defined by the ACIT subcommittee.

Issues to be Considered in an Institutional Information Policy

An information policy should acknowledge that there are complex legal, ethical, technical, governance and economic issues that need to be addressed. Defining these issues does not necessarily mean that the way to deal with them is clear. Networked access to electronic information is still a new phenomenon to many users and

institutions, thus an institutional policy should provide some guidance, but be flexible enough to allow the lessons of experience to mold practice. Some basic assumptions and operating principles set the stage for defining the University's role. These may ultimately be incorporated into official policy, if they are supported by the University community. With these assumptions and operating principles in mind, the subcommittee then defined issues in three key areas: legal/ ethical, technical, and governance/ economics.

Basic Assumptions
Four basic assumptions provided the foundation for defining our key policy issues:

* It should be possible to provide timely access to needed information to members of the University community from a desktop workstation, regardless of its location and format. This assumes the availability of a network infrastructure, including distributed computing resources and communications and also assumes external and internal compatibility.

* It should be possible to find a balance between the rights of individuals, as authors and as users of information, and the responsibilities of the institution to make information available to support scholarship and service. This is a fundamental balance between privacy and access.

* It should be possible to adopt universal standards of data access and integrity to help achieve this balance.

* It should be possible to define different classes of users of institutional information with different access privileges, and to regulate such access accordingly.

Operating Principles
Three operating principles define how the University will behave in fulfilling its policy obligations:

* The University will define the information which it is responsible for making available electronically, putting itself in the role of electronic publisher/distributor. This role requires (a) access mechanisms such as network infrastructure and policy governing who uses it; and (b) availability of the information over the network.

* The University itself will not regulate access to information for which it is not responsible. This will be the responsibility of the author. However, the University should support unregulated access to information under conditions specified by its authors.

* The University will define access privileges to its information for classes of users.

Legal and Ethical Issues
The key legal and ethical issues revolve around concern for protecting an individual's right to privacy, and protecting the rights of authors and distributors. The policy must enforce individuals' privacy and identify classes of information protected by law and federal regulation. It must recognize protection currently in place in federal grants involving human research subjects, for instance.

The policy must also be sensitive to the needs of its community of both knowledge creators and users, protecting the legal rights of authors/distributors, protecting contractual agreements in software licenses, and facilitating and complying with archival requirements. Many of these questions are currently being debated nationally, in an attempt to find a common ground for ensuring that information in electronic form can be made readily available to support scholarship and discovery in a manner which protects the ownership rights of authors and distributors while taking advantage of opportunities for improved access via networks.

The policy must represent the basic rights of authors and distributors as well as protect access to confidential or sensitive information. These are ethical as well as legal issues. Authors and distributors have the basic right to acknowledgment, the right to privacy, and the right to determine the form, manner and terms of publication and distribution of one's own work (these are spelled out in the EDUCOM code, for example). An institutional information policy should provide mechanisms for safeguarding these basic rights. Further, the policy will need to define the institution's role in protecting access to sensitive or potentially objectionable information, versus its role in supporting an individual's right of free expression. These are some of the most difficult issues to tackle in an

environment which at present allows highly unregulated access to academic information, while tightly controlling access to most administrative information.

Technical Issues
The institutional information policy should support the adoption of technical standards and practices which ensure appropriate accessibility and security of data, and appropriate data integrity. The policy must ensure that data is reachable in a usable format by authorized users. Standards for connectivity will address access to data through both direct (e.g. ftp) and indirect methods (e.g. sneakernet). Standards for authorization will suggest methods for authentication and encryption of data, to protect its accessibility by eligible users. Standard data formats should be recommended by the policy, to ensure the widest possible readership. To assure quality control and data integrity, the policy must ensure that data is stored, backed up, and transmitted according to standards and protocols that preserve data integrity. Standards and responsibility for archiving and accurately transmitting institutional data should be guaranteed.

Governance and Economic Issues
If the institutional information policy defines the University's role as publisher/distributor of certain kinds of information about the University, then it also should identify which units in the University are responsible for guaranteeing access to that information. Some of the key questions about governance include:

* Who is responsible for ensuring appropriate access to institutional information? This role includes the legal, ethical, and technical responsibilities outlined above, to promote appropriate access to and availability of institutional information. It also includes educational and consultative responsibilities to promote the appropriate use of institutional information. In addition, it includes fiduciary responsibility for providing and maintaining information resources. This information policy framework suggests that University schools and departments which are responsible for the content of information can also be responsible for all of these aspects of access to that information, given a strong policy and infrastructure.

* What is the University's responsibility for access to non-institutional information? The policy framework suggests this responsibility rests with the author, not with the University.

* Who determines the rights and privileges for different classes of users? This includes addressing the question of whether access to electronic information should be free or fee-based.

Developing the Policy Framework

These key issues and guiding principles articulated by the ACIT subcommittee shaped the first policy framework document. After discussion and revision, IRCC then "proofed" the document by applying test cases to the key concepts. The test cases included discussion of current electronic mail problems and practices, a meeting with the University Registrar to discuss the fit with current practice and planned direction for student information, and a meeting with representatives of a grass roots staff initiative aimed at coordinating and developing standards for document imaging initiatives. The policy framework was demonstrated to be highly compatible with the desired directions in the areas tested. Thus far, the only omission exposed by case testing is a lack of archiving considerations. Some current practices for electronic mail contrast with the philosophy stated in the document and may require specific policies if the framework is officially adopted.

The resulting version of the framework was then presented to a group of University vice chancellors -- those responsible for University academic, research, and business matters. The vice chancellors voiced strong concern about protecting the privacy of academic research conducted over electronic networks. They agreed that using the term "institutional information" would initially clarify the distinction between public and private information, while recognizing that many of the difficult issues would surface again during implementation and the evolution of a governance structure to resolve disputes. The meeting ended with an agreement to obtain feedback on this policy framework from deans, faculty, administrative officials, and perhaps the Employee Forum.

Garnering Support and Gathering Feedback

Four focus group sessions have been conducted to date: a group of ten faculty members or their representatives, the deans in Health Affairs, the deans in Academic Affairs, and a brief meeting with the Executive Committee of the Faculty Council. Well in advance of each meeting, each participant received a copy of the draft policy framework and a letter describing what was to happen and why such a policy was important. A few days before the meeting, they received a list of potential benefits and a list of questions to consider for the discussion.

Reviewers thus far have generally accepted the policy framework and have agreed on the need for and utility of a set defining principles to guide development of future policies and procedures. They have also recognized that early involvement at the highest levels of the administration would encourage more sound and consistent policy decisions in the future.

All except the Faculty Council group had difficulty separating the policy framework from the issues which will have to be resolved during implementation. Concerns from all groups fall within three primary areas: 1) financial, training, and other infrastructure support for implementation of such a framework, 2) definition of "institutional" data, 3) concerns about privacy.

Given the budget constraints of departments and the University, some faculty questioned whether the expectations raised by the policy framework were realistic, while others, noting the growing amount of institutional data already on line, wondered about the need for such a policy. Many faculty wondered if they would be able to utilize on-line resources without time, incentives, and support from department chairs and deans to familiarize themselves with new technologies.

Many participants wanted a specific definition of "institutional" data to be provided to them -- an example of participants' difficulty in separating conceptual framework from implementation. In response, IRCC members reiterated their hesitation to try to determine what should and should not be "published" online without input from departments during the implementation process.

In addition to echoing these concerns, the deans also indicated a desire to see the central administration adopt a pan-University "vision" of the use of electronic information and were very receptive to the idea of the Internet as a marketing tool for their programs. Some also worried that more available information would increase individual workloads through requests for more details or requests for services. The deans clearly want to have high level involvement in determining what is institutional data, and high level commitment to addressing the cost issues. They agreed that this is not a technology issue alone.

Privacy and appropriate use issues were discussed, but did not seem to be as pressing a concern to most faculty members. Most agreed that a proactive stance on these issues would help guide the University's decisions on policies in the future, and would place the University in a stronger position in the case of a legal entanglement over these issues. There was, however, strong agreement among the deans that faculty and other University employees need to be made aware of the unique qualities of electronic mail as a means and store of information. The deans expressed concerned that many people still look at email as a secure and highly protected medium.

Future of the Policy Framework

At this point, the policy framework has received general support from the groups contacted, though many have expressed significant concerns about the implementation issues and the process for determining how implementation will proceed. The remaining groups, staff from business and finance divisions and other academic support staff, will likely be concerned with the same issues and have similar problems in responding to the framework. Some of these difficulties will be addressed by modifying future focus group sessions.

In general, people have a hard time "getting into" a discussion about something that is abstract and outside their experiences. The scenarios presented in advance of the discussion help, but not enough. More stage setting could help people understand why information policies are important as might a vision statement. It might also help to craft some futuristic scenarios to balance against the present day scenarios we have now: What would it be like if this framework were in place? Providing participants with a brief summary of the issues (legal, ethical, technical, governance) that will need to be addressed may also help focus discussion on the framework itself. The remaining

difficulty in past sessions is that participants have focused almost exclusively on departments as providers of information, rather than consumers. In the future it would be worthwhile to specifically inquire about departments' data needs.

After completing the focus group and feedback sessions, IRCC will modify the framework document and continue the effort to increase awareness, gain further acceptance, and define an implementation process. The council will also undertake additional work in specific policy areas such as those surrounding access and use of academic information such as library information, intellectual property, and personal use of University equipment.

The overall goal of the policy framework is to make information needed by the University's various constituencies as accessible and useful as possible. This goal is only possible if the policies and practices of the individual units are guided by a consistent philosophical framework. The development of such a framework in a highly decentralized and complex environment is possible only through a partnership with library, information technology, physical plant, and faculty members.

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A Policy Framework for the University's Network

Electronic Rights and Responsibilities
at the
University of North Carolina at Chapel Hill

The University develops and manages a physical and social *learning infrastructure* to the economic, social, and cultural benefit of the state and the nation. This learning infrastructure increasingly depends on information in digital form and on digital technologies for communicating, sharing, and analyzing such information. Indeed, digital infrastructure is fast becoming a prerequisite, not only for a more effective and efficient University, but for a better informed and more responsible citizenry.

For example, a centrally supported digital network provides a means to *publish* much of the University's official, institutional information for the benefit of both the University and the public. The University, acting through its central administration, is responsible for this information, but centrally coordinated infrastructure and guidelines for publication shift the locus of responsibility for publication and stewardship to the academic and administrative departments that are the sources of most of the information. Similarly, the central administration and academic and administrative units share responsibility for the hardware and software used by the University community to analyze institutional information and other information accessible through the network. Digital infrastructure thus becomes a primary medium in a *federal* model for balancing responsibilities and encouraging collaboration and public service.

This federal model enables, and the University is committed to, an open flow of information within the University and between the University and the public. The Information Resources Coordinating Council, as the font and guardian of this philosophy, coordinates the development and management of the implied centrally supported digital infrastructure and related services. The Council also formulates the institutional policies that frame the related *rights* and *responsibilities* of the institution, those who serve it, and those whom it serves. All members of the University community are responsible, along with the institution, for good citizenship and informed stewardship in a digital democracy. The Council prepared this document to describe these institutional and individual rights and responsibilities and to provide a framework for governing the University's digital infrastructure and implementing the operational practices that determine its utility to the University and the public.

I. THE NATURE AND PURPOSE OF THE UNIVERSITY'S NETWORK

The Network

The University of North Carolina at Chapel Hill operates, through its central administrative offices, a wide-area (inter-building) digital transport network that interconnects local-area networks operated by academic and administrative departments that have agreed to adhere to the University's Uniform Wiring Policy and to the network management policies coordinated by the Office of Information Technology. The resulting network of networks is the "University's network." It is one of the institutionally-operated networks that make up the global Internet and that adhere to the open standards and protocols adopted by the Internet Engineering Task Force. In addition to an Internet gateway, the University's network also includes a gateway to the North Carolina Information Highway. Through its gateways to the Internet and the North Carolina Information Highway, the University's network becomes an extended global network that provides access to information and information processing technologies, only a fraction of which is under the stewardship of the University. This extended network and the resources accessible through it serve two primary purposes in the framework of the University's mission.

To Enhance Institutional Effectiveness and Efficiency

By having access to the University's network and its resources, to include its gateways to the Internet and the North Carolina Information Highway, the faculty, the staff, and the student body can communicate and collaborate among themselves and with their counterparts elsewhere who can connect to the Internet or the North Carolina Information Highway. Network connections are a starting point for internal collaboration and efficiencies, for extending the reach of the University, and for expanding the resources available to the faculty, the staff, and the student body. But the University's network is a powerful lever for institutional effectiveness and efficiency only to the extent that network connections are easily established and broadly available, are accompanied by easy-to-use services and

accessible and reliable mission-critical information, and are based on the standards that guide the development of the Internet and the North Carolina Information Highway.

To Publish Institutional Information about the University

The network's gateways to the Internet and the North Carolina Information Highway are the primary means by which the University meets its responsibility to the public to *publish* much of its institutional information in useful digital formats. By publishing this information via the University's network, mostly in the form of institutional databases, the University not only meets a public obligation, but serves its own goal of continuous quality improvement in a distributed management model that depends on the free flow of information and that is essential to academic effectiveness. Institutional information, whether for the public or for internal purposes, therefore is published on-line in an open, democratic framework designed to encourage 1) consistent and ready, affordable access to digital information, 2) stability and reliability from the inquirer's perspective, 3) integration among disparate databases with minimal duplication in capturing, storing, and maintaining these databases, 4) useful, unifying perspectives on the University's programs and resources, and 5) information literacy and the use of institutional data in decision making.

II. CONNECTIONS TO THE UNIVERSITY'S NETWORK

Centrally Supported Connections for the Faculty, the Staff, and the Student Body

Members of the faculty, staff, and student body have the right to connect to the University's network and, through it, the Internet and the North Carolina Information Highway. This right and the resulting right to the University's information services and applications described in section III carry the responsibilities that attach to the use of any University resource. Any revocation of any of these rights, in whole or in part, is subject to the normal due process available to any member of the faculty, staff, and student body.

The University centrally provides two fundamental modes of connection for the faculty, staff, and student body: (1) *direct* connection via Internet protocols through reasonably convenient, centrally supported computer labs on campus and (2) *dial-up* connection via a centrally operated pool of modems connected to the switched public telecommunications network through Southern Bell's Chapel Hill Exchange -- to accommodate those who have a computer, a modem, and telephone service and who find themselves in circumstances that do not allow direct connections.

Departmentally Supported Connections for the Faculty, the Staff, and the Student Body

The University's academic and administrative departments have the right to connect their computers and local-area networks to the University's network provided that they agree to adhere to the University's Uniform Wiring Policy and to the Internet-compliant network management policies coordinated by the Office of Information Technology. Departmental connections provide an additional route by which some members of the faculty, staff, and student body connect to the University's network. Those eligible to exercise such rights of connection as are granted by a department assume responsibilities imposed by the department, which must include the responsibilities described in the first paragraph of this section as applying to those who employ centrally provided connections.

Centrally Supported Connections for the Public

One of the reasons that the University operates gateways to the Internet and the North Carolina Information Highway is to provide mechanisms for the public to connect to the University's network, primarily to give the public a standards-based interactive digital path into the University's published institutional information. This means that anyone anywhere with a connection to either the Internet or the North Carolina Information Highway, whether through a commercial on-line service or otherwise, also has a connection to the University's network and thereby has access to a vast collection of the University's institutional information in a useful digital form. The University, however, has no obligation, beyond that to its faculty, staff, and students described in the preceding two paragraphs, to connect individuals and organizations to the Internet or the North Carolina Information Highway.

III. INFORMATION SERVICES AND APPLICATIONS

Information Services and Applications for the Faculty, the Staff, and the Student Body

Members of the faculty, staff, and student body who connect directly or through one of the University's dial-up lines to the University's network have the right to, and easy access to, a collection of centrally supported, standards-based network applications and services for 1) communicating with others via the Internet (using Internet-based e-mail and news groups, for example) and 2) locating, retrieving, storing, publishing, and analyzing the University's published institutional information on the University's network. These centrally supported standards, applications, and services are deployed to provide ease of connection and use and to comply with, and contribute to, the direction of the Internet and the North Carolina Information Highway. This maximizes the probability that any resource on these extended networks will be readily accessible through the University's network to any member of the faculty, the staff, or the student body who is eligible to use it. It also helps to ensure that the University's resources will be accessible, as appropriate, to other networks and computers connecting to the University's network through the Internet or the North Carolina Information Highway. The University thus draws on the resources of the larger networking community and contributes to it.

The University's network is a large capital investment incurring very substantial continuing operating costs. Nevertheless, the marginal costs of centrally providing a connection and basic services to any member of the faculty, staff, and student body are currently negligible, and so the University centrally levies no individual per-use charges. Accordingly, connections and basic services are provided to the faculty, staff, and student body in a context not unlike that defining the use of University-owned telephones to make telephone calls within the Chapel Hill Exchange area. Basic connections and services 1) are reasonably convenient and free to responsible members of the University community and 2) are the portals to extended services, some of which incur individual per-use charges that are paid in a variety of ways.

Information Services and Applications for the Public

The University also grants access rights on an as-is basis to its published institutional information and to selected software resources on its network to anyone anywhere with a connection to the Internet or to the North Carolina Information Highway. Such information includes, but is not limited to, 1) information about the University and its policies, resources, demographics, and management as maintained in institutional databases and 2) selected academic resources in digital form, to include the catalogs of the University's libraries in the form of the On-Line Public Access Catalog operated by the Triangle Research Libraries Network. To advance the University's mission, other digital information and resources also are available on a selective basis to anyone with a connection to the University's network, but the University has no general responsibility in this regard. Access to information may be constrained, for example, by commercial licensing agreements. At the other extreme, free access to information may derive from cooperative arrangements between University departments and federal and state agencies. For instance, all official documents of the Clinton administration currently are on-line on the University's network as a service to the global Internet community.

The University is aggressive in publishing its institutional information and other important information resources on its network for public access. Within the terms of software licenses and other resource constraints, the University also chooses to provide access to standards-based software tools that allow inquirers to locate, display, capture, and analyze published information. In designing and publishing its digital databases, the University makes every effort to comply with the law by protecting that information which by law is protected from disclosure and by disclosing that information which by law is public. In designing data formats and applications for publishing information on-line in a way that optimizes the usefulness of vast stores of raw digital data, the University makes no distinction between access by the public and access by members of the faculty, staff, and student body. The design philosophy seeks to provide any inquirer with relational flexibility in aggregating data and spotting trends but, through aggregation, to protect data elements that by reasonable management and community standards would be considered private -- an individual's salary, for example.

Any University-owned computer or local-area network connected to the University's network provides a means to share mission-related digital information or resources with the public through the gateways to the Internet and the North Carolina Information Highway. The University assumes the responsibility for ensuring that such information is published in digital form by requiring its departments to assume responsibility for the institutional information that they generate. As the steward for institutional data that it collects, a department must comply with the University-wide standards and implementation guidelines overseen by the Information Resources Coordinating Council.

IV. PRIVACY, CONFIDENTIALITY, AND FREEDOM OF EXPRESSION

The University expects members of the faculty, staff, and student body to become familiar with individual and institutional responsibilities to protect confidential information and with the risks to privacy inherent in digital technologies. Good citizenship implies familiarity with the possible states of dynamic digital streams sent or received via the University's network and static digital files stored on University property. For example, digital streams constituting e-mail communications might traverse public and private networks over which the University has no authority, and they might be broadcast or duplicated by a recipient without the permission of the sender. Just as with printed documents, the University owns and archives digital communications having the official sanction of a department. Otherwise, the University considers static digital files and dynamic digital streams to be private and does not disclose their contents, except as required by contractual obligation or state or federal law. To ensure reliability, however, the University reserves the right to employ backup, storage, and recovery systems throughout its digital infrastructure.

University departments that serve as stewards of an information resource available to the University community at no charge and without contractual obligations have the right, within the limits of prevailing laws, to store the details of any inquiry to, or use of, the information resource. This right can be practiced, however, only if the inquirer is notified at the time of connection of the intent to store any identifying details of the would-be transaction and is given the option to disconnect immediately with confidentiality preserved.

The University respects encryption rights on its network and may itself encrypt information and transactions when secure confidentiality is an obligation.

All existing guarantees of freedom of expression extend to those who use the University's network as a medium of expression.

Strategic Information Resources: A new Organization

Presented by:
Dennis Aebersold
Vice President for Strategic Information Resources

Gordon A. Haaland
President

Abstract

The President and Provost of Gettysburg College decided at the end of 1993 that, given the importance of technology in the strategic plan for Gettysburg, they would make the bold move of merging the Computing Services Department and the Library into a single division called Strategic Information Resources. The new division was to report to a newly created Vice President position, which would in turn report to both the President and Provost and serve on the President's Council. This paper describes the steps to date of the process which was used to effect the merger.

I. Why Merge?

In response to what we see as the way of the future, Gettysburg College has been and will be devoting significant resources to information technology as it is known in such functional areas as the Library, Computer Services, Telecommunications, Management Information Systems, and the Print Shop. These are all areas responsible for helping members of the college community gain access to, store, retrieve, and analyze information.

A liberal arts curriculum has proven remarkably effective in helping students master new technologies and synthesize new material. Gettysburg College intends to continue to develop strategies to promote the use of advanced information technologies in the College's instructional programs. We have already built an enviable computer network, an achievement recognized by CAUSE in 1993 when we received honorable mention for the CAUSE networking award. It is increasingly clear, however, that the information network is just a prelude to the larger information world.

The increasing availability of information in electronic form and the ability to analyze that information on the computer will dramatically change the way we teach and learn. By the twenty-first century electronic information technology will have transformed the workplace, nationally and internationally. If we are to meet these transformations and provide our clientele with superior service we knew that our information structures have to change. Our instrument of change is the integration of the Library and Computing Services into a single Division: Strategic Information Resources. This Division has been placed under the direction of Dennis Aebersold, Vice President for Strategic Information Resources and formerly Associate Provost for Computing and the Sciences. Our approach is intended to provide students and faculty members with the best possible support as they work in an environment shaped by the "information revolution" that is already upon us. This step is one that we

believe all institutions of higher education must take eventually. We expect that the timing of this move will contribute to our competitive advantage as an institution in a crowded educational marketplace.

Predictions are risky, but it is already plain that, rather than waiting months for the latest research to appear in printed form, scholars will have electronic access to (research) as soon as it has passed the test of peer review. The printed materials to which that research refers will also increasingly be available over the network in electronic form. Large collections of primary texts are already available electronically or will shortly become so. Standard reference materials can already be

purchased on CD-ROM and accessed from an appropriately-equipped desktop computer. Sound, images, and other non-print media can also be transmitted electronically. Only to gain access to rare books and manuscript materials will one be compelled to visit a traditional
library, and even some of these materials will be available in digital form, just as they are now available on microfilm.

II. Aligning Strategies

The merger of library with computing services falls in line with the strategic goals of the College. Recognizing that technology will continue to play a major role in education at all levels, with special implications for the way teaching and learning happen at the college level, Gettysburg has set as primary goals 1) to develop the best possible computer-based information resources and programs; 2) to promote exploration of the curriculum and co-curriculum using technology and 3) to provide appropriate access to these resources.

As we looked at the service demands of our community, the rapid pace of change of technology, and the direction we wanted to take, we realized that the existing administrative structure did not suit or support our vision of the future. In the interest of dramatically improving operations in the new division Gettysburg embarked on a 6 month program

intended to enable us to define the strategic direction the new division should take and to articulate the changes to process, organization, people and technology required to make our vision a reality.

Our vision is, simply, to create one information service organization on campus. Before, the Library and Computing Services were competing as providers, creating redundancies in information provision, some overlap of skill sets, and constant battles between old and new ways of operating. Among the benefits of a combined organization are the elimination of unhealthy competition between departments, the effective utilization of complementary skill sets, and the ability to build a more flexible and responsive organization.

While we are still in the project planning phase, we do, realistically, anticipate certain results. First, we believe this is the way of the future and that our efforts will situate the College in good competitive position in the future. Second, we are being very careful to align the strategies for Information Technology and the new Division with the strategies of the College. Third, we will make more resources available to faculty and students and eliminate inefficiencies in operations.

III. The 'How' of Change

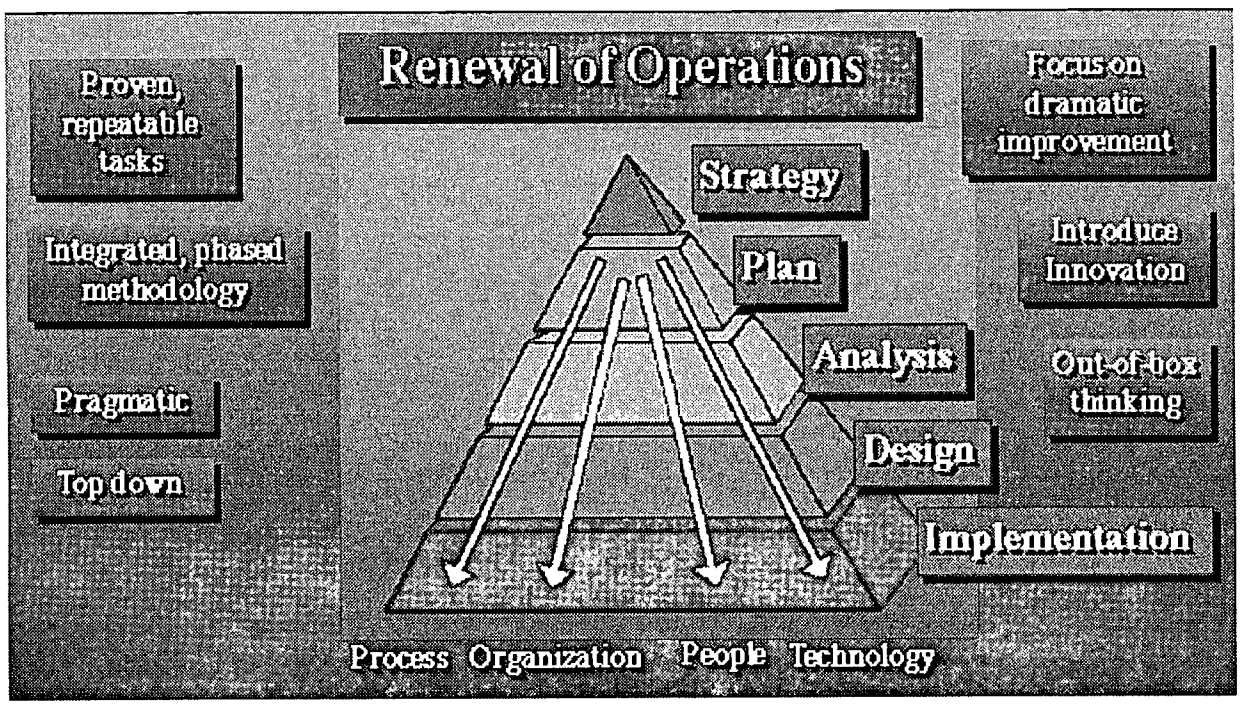
With the help of the Business Process Renewal (BPR) evaluations we will eliminate redundancies in the things we provide. We plan to decrease cycle time, or the time it takes to do such things as acquire a new book, catalog it, or install a computer. Through increased efficiencies we will lower costs, improve competitiveness and hopefully delight our customers.

The merger was announced in January 1994; in February 1994 the Vice President moved his office to the Library to get a better understanding of the culture, to get to know the Library staff, and to signal the start of the merger process. Merging the two divisions has clear advantages from an operations standpoint but it has brought on other expected issues on the human resource side that are not easy to work out on paper. Differences in job expectations, for example, work habits, and the cultural environments in computing services and the library polarized the two groups initially. The announcement of the merger had left the librarians and the hourly employees in the library feeling very uncertain about coming events. There was no open hostility but there was considerable distrust and some feeling that the administration had not approved of employee performance and was sending in troops to whip them into new shape. To clarify what the issues were, we conducted a cultural assessment survey of both staffs, which produced surprisingly positive results. The study showed the two departments to be 180 degrees apart on questions like "do you exist in a 'Reactive...Proactive' organization?"; "Open to Change...Resistant to Change? "; "flexible work environment... strict work environment"? When the two groups were asked where they would like to be in the future, the alignment of the cultures was almost perfect. It was at this point that we knew that a true merger of the two organizations into one division would be possible. We began the merger process in June, 1994.

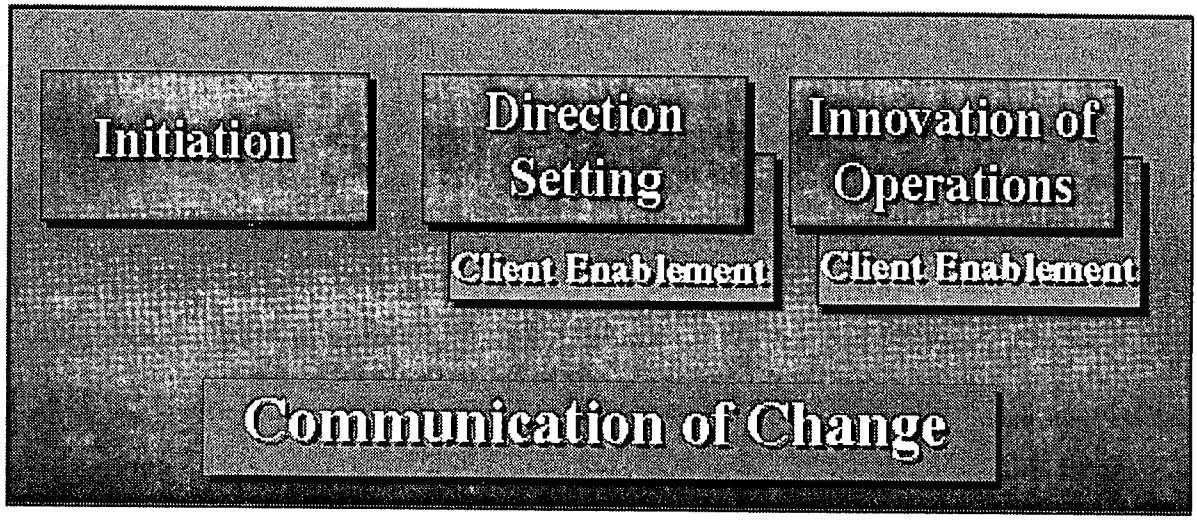
We demanded radical change in both organizations. We were looking for flexibility that did not exist in the library, and we had to increase the speed of service and the quality of service in the computing area. We intended to cut costs but we did not start with a mandate to cut employees. Our methodology for change was Business Process Re-engineering which we chose to call "renewal". Michael Hammer defines BPR to be "The fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service and speed."[1] Thomas Davenport defines re-engineering as process innovation. He states "Process innovation initiatives start with a relatively clean slate, rather than from the existing process. The fundamental business objectives for the process may be predetermined, but the means of accomplishing them is not. Designers of the new process must ask themselves, "Regardless of how we have

accomplished this objective in the past, what is the best possible way to do it now?"[2]

Our approach did not start with process but rather with strategy. We felt it important to build a foundation for the new organization where employees had a deeper understanding as to what we were trying to create and that was tied to a mission, with strategic and tactical goals. We also felt it of paramount importance to have a measurement architecture in place that would allow us to know how well we were achieving our goals. Our approach was top down (work through a core team) based on strategy and considered in parallel, people, organization, technology and process, which we believe to be all parts of a single whole.



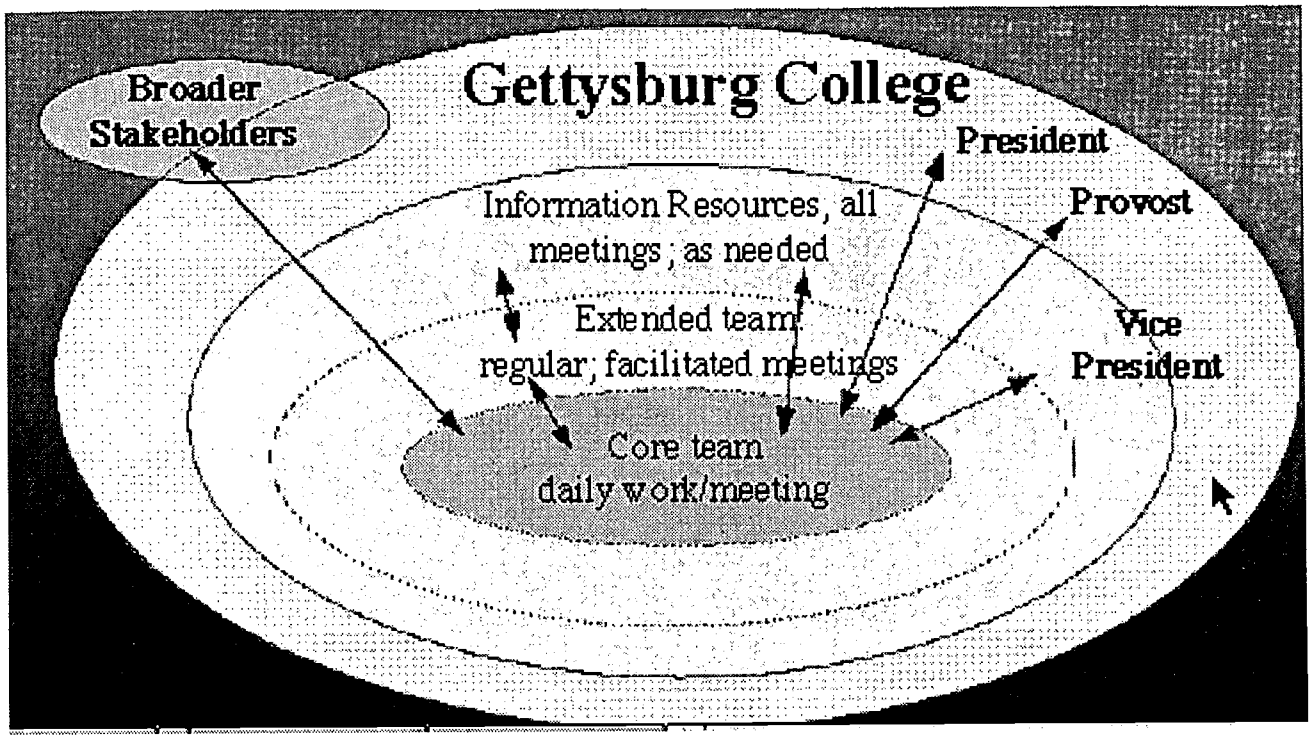
We developed a three-phase plan that started with initiation and moved through direction setting to innovation.



IV. Time Lines and Expectations

The BPR project was designed to span five months starting in April of 1994. We actually started in June and will be finished just before Thanksgiving. Upon commencement of the project a core and extended team was set up to undertake the creation of project deliverables and manage project communication and process.

The core team was comprised of three staff members plus the Vice President who shared in the input, analysis and interpretation of business process renewal (BPR) phases. Communication with the rest of the division was established from the beginning as a critical aspect of the project. We established concentric circles of communication, with the core team at the center, an extended team comprised of eight staff in the next ring, and the rest of the division staff at the periphery. The extended team's job was to update and solicit input from the division staff and interpret the work of the core team. Each extended team member conducted small group meetings with a prescribed group--and each group contained members from the library and computing services staff. At the height of discussions over the summer, the core and extended teams met weekly, and small groups met every other week.



The core and extended teams developed mission and values statements at the start of the project which were then presented to the entire division for discussion. The final revised statements served as the foundation of change and imparted to staff a sense of the culture and climate of the future organization.

Mission Statement:

The information resources division develops and provides information services and resources needed for the learning environment at Gettysburg College.

Values Statement:

The division fosters an atmosphere of open inquiry and continuous education for all staff. This demands a highly qualified, flexible and team-oriented IR staff committed to excellence and the values of the educational experience.

Following completion of these, lengthy discussions about what the new organization would actually do and what improvements we wanted to make on current service led us to distill three major goals for the organization. The goals simply state what we want to do and how we want to do it.

Goals:

1. Provide Information
2. Enable Organizational Success

3. Maintain a top-quality organization, consistent with customer needs

Goal setting based on our vision of an innovative, wall-less, fast-service organization brought us to the next phase of innovation: activity modeling. An activity model will represent at a high-level all of the activities necessary within the scope of the project and provides the opportunity to eliminate cumbersome, redundant, and other non-value adding activities from the future organizational design. Cataloguing a book, for example, or installing a computer are both means of providing access to information. Once these types of connections were made, all activities could be defined at higher levels and then related to the goals. If an activity did not fit, it brought into question its usefulness as well as called attention to the comprehensiveness of our goals. The cross-checking exercise helped us ask questions like: is it the role of the division to do X? What value does activity X have to the organization? Do we still want to do this?

Some 45 activities comprehensively described the organization and all its functions, from personnel management to equipment maintenance and information resource expansion. In order to plan for the future, the core team's charge was to identify the key cycles of tomorrow's organization: this would provide the structure for organizing the future division.

What constitutes a cycle? An event that triggers a chain of activities--such as a request for a book. Mapping out cycles brings into focus business processes and provides some of the real substance of organizational change. As we discussed a book request, for example, we moved through acquisitions, cataloging and circulation and revealed a larger picture. These access tools were essentially delivery systems. The goals to provide information and maintain a top-quality organization made us question whether or not we wanted to deliver this information in this way, and how quickly we wanted to deliver to best benefit the learning environment. The question brings into play the role of people and technology in the process of delivering information, and how they would relate in the new organization--people, organization, technology, process--bringing us back to the pyramid. In almost all cases, the successful completion of a strategic cycle will result in value added to one of the stakeholders--faculty, students, administrative staff--of the College. The cycle model is evaluated in terms of time and/or value added that it provides to the organization.

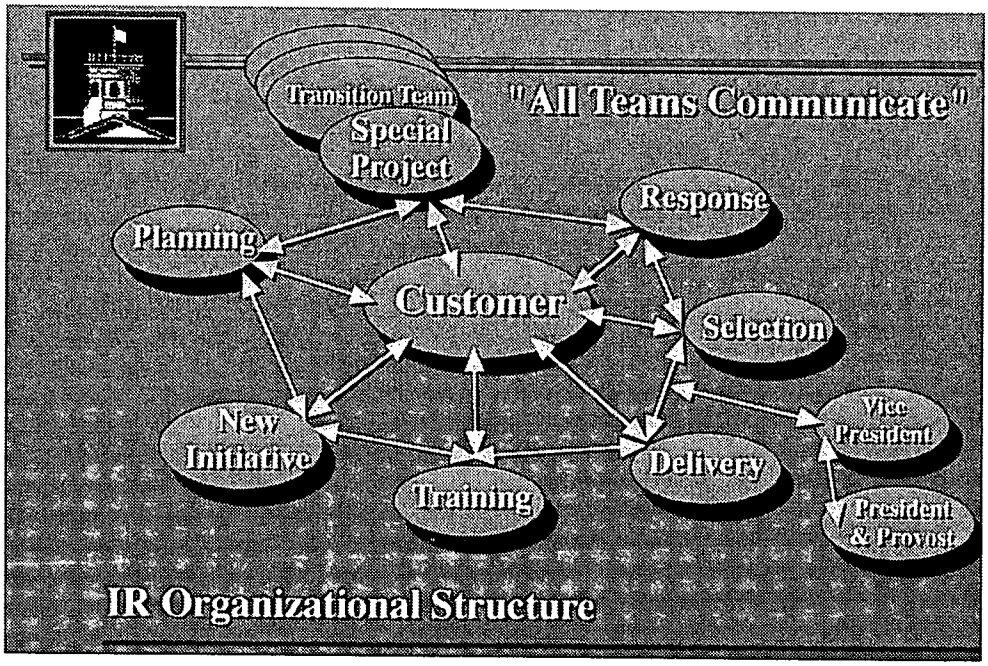
Organizational structure begins to emerge from the cycle and activity models, after they are grounded in internal cultural criteria, such as create an atmosphere of open communication and promote a learning organization that encourages self-development. From the cycle model, logical units of work and organizing criteria form the basis for preparing organizational structures.

In order to allocate resources into the structure, activities need to be defined in terms of the knowledge, skills, abilities and personal characteristics (KSAPs) of the people who will be performing them. Process, not task, becomes the focus. While this sounds eminently logical, it is not trivial. In our case, we spent a session with the entire staff matching 'KSAPs' to activities. Not surprisingly, many people had a hard time conceptualizing job functions not described as specific tasks, such as "cataloging serials", but rather as activities, such as "select acquisition". Nevertheless, KSAPs provides the basis for placement of staff in a new organization.

What are some of the personnel problems that arise in such a process? Most are predictable. "Where does my old job fit in the new organization?" produces one form of anxiety. Another form corresponds to identity. People still identify themselves as library and computer services staff and take an 'us versus them' attitude toward their new colleagues. Fear of change sparks rumor about which heads will role and what jobs will be eliminated. Everyone knows that anything and everything is open for restructuring and this fuels resistance to change. Communication helps to dispel most of these problems, but it is also clear that not everyone will be happy with new arrangements and we expect to see some fall-out.

V. Transition and Change management

Change is managed by the adjustment of resources--people, organization, technology, process--around a strategy. Not only do we need to create a new organizational structure, but we need a transitional structure because not all change can happen at once. We plan to integrate 3 BPR teams in the next months, and another three by the second quarter of 1995. The first teams to be formed are Planning, Response and Training. The next three will be New Initiatives, Operations and Selections.



The teams will receive extensive training on team work and self management. The organization will have no bosses; the transition team will help coach the other teams through difficult new procedures like evaluation and rewards. We believe we will begin to reap benefits but June 1995 and we hope to be operating comfortably and efficiently by Jan. 1996.

1. Michael Hammer and James Champy, *Reengineering the Corporation* (Harper Business,1993) p.32.

2. Thomas H. Davenport, *Process Innovation,* (Harvard Business School Press, 1993) p.11.

CAUSE '94
Distributing CWIS Information Management

Robert J. Brentrup
Dartmouth College
6028 Kiewit Computation Center
Hanover, NH 03755-3523

Abstract

A campus wide information system is only as good as the information in it. Once a CWIS is in place a tremendous amount of effort is needed to "stock the shelves" with information. Removing obstacles in the data maintenance path is just as important as making the data accessible to users. Placing full control of the data in the hands of its "originators" increases the quality and quantity of information available.

The Dartmouth College Information System (DCIS) has developed a number of tools used to enhance the information publishing and maintenance process. A locally developed client-server database update system provides easy to use links between standard personal computer applications used to develop and maintain databases and the database delivery systems. Automated format conversions, integrity checks and update authorization are the principal features provided by the update system.

Distributing CWIS Information Management

The Context

Dartmouth College has been developing an extensive Campus Wide Information System (CWIS) for the last four years[1]. This client-server system is widely and heavily used and operates in an environment where virtually all faculty, students and staff have a networked Apple Macintosh® computer. The system hosts highly structured data that can be located and retrieved through sophisticated database managers. The retrieved information can be displayed with extensive typography and embedded images (eg. Figure 1). The CWIS is much more than a shared file server, as it answers complex research questions for users.

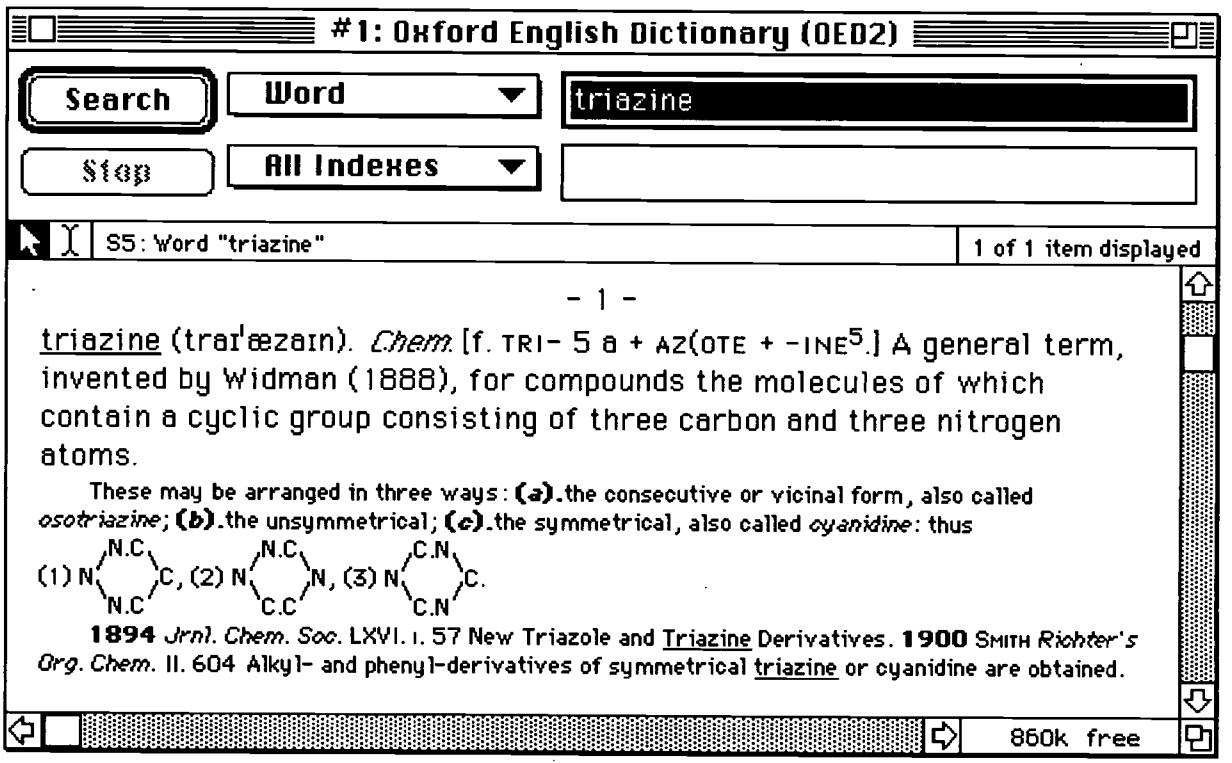


Figure 1- Online Library

The Dartmouth College Information System (DCIS) servers have been adapted to a number of different database management systems using commercial and academic software. Access to local information such the Oracle based administrative systems and gateways to other services on the internet are provided. DCIS is portable and installed at several other institutions.

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[1]Robert J. Brentrup, "Building a Campus Information Culture", *CAUSE/Effect* , Vol. 16 No. 4 Winter 1993, pp. 8-14.

The two database management systems most frequently used at present to "publish" information in DCIS are the BRS[2] and PAT[3] commercial systems. Both of these systems run on UNIX computers. At Dartmouth these UNIX systems are now workstation-class computers with expanded disk storage capabilities.

The Problem

One of the primary factors limiting growth of DCIS was the rate at which new information sources could be developed and the amount of labor required to keep existing ones up to date. The computing staff at Dartmouth is small. As DCIS became more popular we found ourselves facing a long list of requests for assistance to place some portion of the institutional information base on line. Our ability to respond to these requests became a bottle neck and source of frustration. Even if adequate staff resources existed, their skills are best deployed on further extensions and development of the system.

It became apparent that it is crucial to decentralize the development and maintenance of new information resources. At Dartmouth and probably most campuses, many offices and many people already generate and update valuable information. Harnessing that diffuse manpower in an organized way is the key to the continued growth of a CWIS. The primary obstacle to remove at Dartmouth was the complexity of "publishing" on the UNIX-based DCIS servers.

Current Publishing Practices

Many administrative departments are in the business of publishing information. In many cases the source data are already prepared and maintained on desktop computer systems. Periodically the information is printed and distributed. The CWIS is another and increasingly popular method to "publish" information. Its greatly enhanced distribution speed is the most important reason. By publishing on the CWIS the most current information is always available and it is easier to locate specific sections. In some cases the cost and labor associated with paper delivery can be avoided. There is, however, a need to identify the structure of the data in more detail to permit the computer systems to index and display the data more intelligently.

Unfortunately the desktop systems used to enter and maintain the original information generally lack both the software and the processing power to provide database services to large numbers of users. For example DCIS typically supports thousands of database sessions daily and several hundred simultaneously. The workstation systems that can solve these problems are however more difficult to use and need to be relatively closely controlled to

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[2]a product of Dataware Technologies
[3]a product of Open Text Systems Inc.

ensure high reliability and data security. For example, users would need to learn to use the workstation operating system and have accounts, while system managers would have to create and maintain these accounts. To resolve this dilemma DCIS has developed a new database-update system which enables the originating offices to add to and update information resources almost as easily as the rest of the campus uses these resources.

Variations on the Theme

Although not called a "campus wide information system" at the time, Dartmouth has had elements of this idea in the computing environment since the first computer systems were installed on campus in the 1960s. The Dartmouth College Time Sharing system (DCTS) supported a number of institutional databases and provided shared libraries of programs. In 1985 a large AppleShare file server capable of supporting several hundred simultaneous users was implemented on the DCTS hardware. Known as "PUBLIC" this server is a distribution center for the entire campus for programs and general administrative and academic information. This worked for Dartmouth because the campus also standardized on the Macintosh computer so everyone had access to this "CWIS"[4] and knew how to use it once they knew how to use the Macintosh Finder.

These predecessors of the current client-server environment particularly the PUBLIC file server, had some interesting attributes when looked at as an "information publishing" tool. PUBLIC was the first place one would look for information. It had a very simple interface for users and information providers: you simply copied files from or to the server as you would with any other Macintosh disk. Locating information on PUBLIC is accomplished by manually opening and closing each folder or by using the Macintosh Finder's *Find File* functionality with which you can search for files by name. You typically browse through the various folders until you find what you are seeking. As the amount of information grew larger, this approach became more difficult and time consuming. But the simplicity of the PUBLIC file server, particularly for information maintenance, allowed it to be easily used by most members of the Dartmouth community.

Locating information can be greatly enhanced by going beyond the shared file-server model. The primary step is to provide content indexing. While some information sources fit very nicely in the file-server model, there is another class of databases (eg. library catalogs and reference works) that are too large and complicated for this approach to be reasonable. This is the class of information that DCIS first addressed four years ago. The files are large, in most cases, and

[4]For many other institutions their first experience with this kind of shared information resource was the Gopher system. For Dartmouth the main appeal and use of Gopher has been to share information with the world outside the campus.

internally highly structured (ie. fields and records or tagged elements define semantic structure and display attributes). This structure allows users to formulate detailed questions and receive quite specific answers to their inquiries.

An example best illustrates this point. "Rental Housing Alternatives" was originally a program to which one connected on the time sharing system. You answered a few predetermined questions, such as "Are you interested in apartments or houses? summer or year round?" Based on your answers an appropriate portion of the "database" was selected and transferred to your terminal. You then read through the list to identify the items of interest.

Taking this same data and describing the regular internal structure of it for a database manager allows the user to ask specific questions such as "find furnished houses in town X and price range Y to Z" and subsequently end up with a list of items matching only those criteria. Such specific results are possible because of the additional effort invested in providing more structure and some uniformity in the data and having software that can use multiple indexes and value comparisons. Retrieving the whole list is still easy.

Project Objectives and Results

The goals of the updating tools project were to make the database creation and update process as simple as possible, to empower users with moderate computing skills to be able to control the process, to eliminate the need for knowledge of "mini/mainframe" database maintenance tools, to eliminate the administrative overhead of creating and maintaining accounts on server systems and most importantly, to eliminate the need for continued assistance from the software development staff.

The solution DCIS developed is another client/server system that allows staff who are not computing professionals to "publish" their own structured information on the CWIS. The update client application runs on the same desktop computers used to prepare the data. Several other tools were developed to streamline the process of preparing, checking and transferring updates. Together these tools create an efficient link to move the data from the originators' desktop workstations to the CWIS central computers. The update clients and servers are now in production use and spreading rapidly.

Some of the current examples include:

- Student phone directory
- Career Services, leave term jobs
- Student newspaper
- Art History department slide collection
- Computing newsletter
- Photo records catalog
- Instructional Services media catalog

- Rental housing alternatives
- Student employment opportunities
- Used computer equipment for sale

Design Considerations

The inspiration for this solution was motivated by having to handle these requests and be involved in the update process. After a while a pattern of usage emerged. We attempted to automate regularly repetitive tasks in order to make the process as simple as possible.

We wished to address three important aspects of database maintenance. For *reliability* it is important to not allow incorrectly formatted data to be added to the database. For *security* it is important to prevent unauthorized modifications and to limit update access to approved personnel. To insure the *integrity* of the database it was most desirable to have its creator in control of its maintenance. The database creator is the best judge of correctness and timeliness.

A number of different Macintosh software packages are being used to prepare the databases depending on their requirements. The most popular at present is Claris FileMaker®. By adding an export script to the FileMaker database, the export process is accomplished in one command. The Acius 4D™ application is another popular tool used to create departmental databases. Export procedures can be programmed in 4D, and it has built-in functionality to produce single table output in common forms for export.

On the CWIS server side a number of different database managers are being used. Each database manager has some specific strengths from which certain types of data sources benefit. Each has a required import data format that needs to be accommodated and specific loading programs to build the database and create the index points. These details of the database management system should be transparent to the update user.

The database update requirements vary as well. Some of the files are added to on a regular basis (eg. the campus computing newsletter and the student newspaper). Others are periodically republished in their entirety. It is also desirable to be able to easily fix data errors in a previously posted update. This requires that identifying the proper portion of the information be straight-forward.

How DCIS Update Works

The database creator prepares the source data on his or her Macintosh. Some use a Macintosh database manager such as FileMaker as an input tool. Other applications use a word processor or even a document editor such as

Aldus PageMaker®. Next the database creator exports the data from these applications into text files. Then he or she converts the export files to the input form of the database manager used to publish it. This step describes the internal structure to the database manager. This operation is typically a mapping of database field names or the addition of SGML[5] tags. Several Macintosh utility applications have been developed by DCIS to perform or assist this step. One converts FileMaker export files to the BRS load format. The file converter provides a table driven field mapping. Another checks the integrity of an SGML markup. The SGML analyzer has user configurable markup symbols, lists the nested tag structure of the document, the entity references used and the extended ASCII characters in the file. Structure errors are diagnosed and located by line number and context.

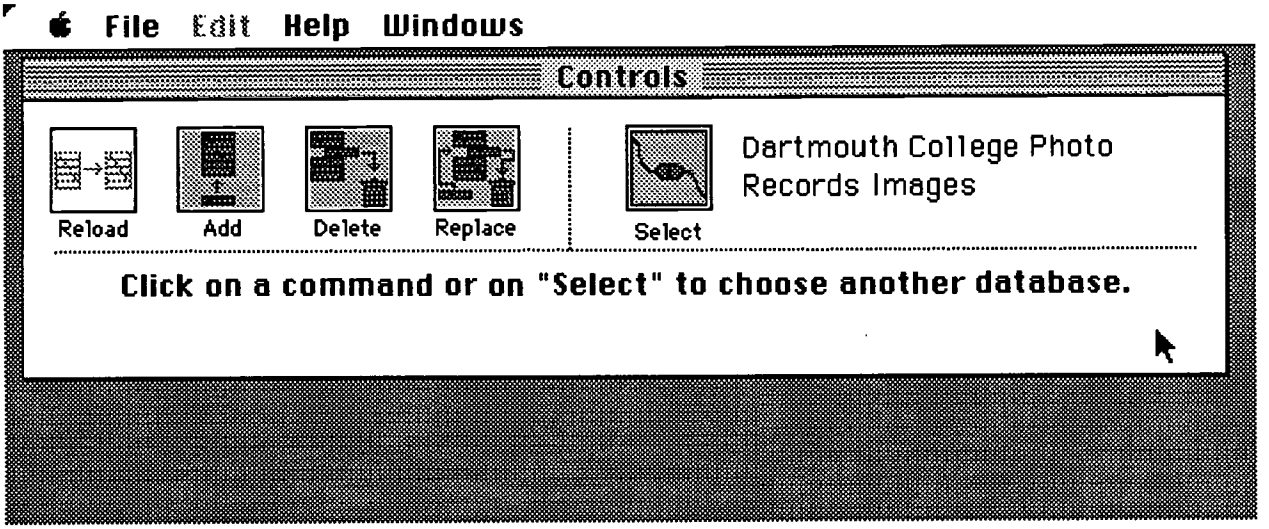

Figure 2- DCIS Update

The database provider then runs the DCIS Update client (Figure 2) to transfer the data to the server. The update client connects to the update server and gathers the list of databases available for update. The client prompts the database provider to select the database they wish to update (Figure 3). The client then checks the identity of the user to determine which of the databases available are open to updates from this individual. The person is authenticated by entering their network services password, which is checked against the campus wide "Dartmouth Name Directory." Tables in the update server list those people who have been given "write" access to a database.

The database provider then selects the update function desired from the available buttons. The system supports reload, add, delete and replace operations, which are enabled depending on the needs of the particular information source and the functionality of the underlying database manager. The update program

[5]Standard Generalized Markup Language

prompts for any other information it needs, generally just an identifier for the update set and the data file to use. Only appropriate data file types can be selected preventing another possible cause of errors. The data file is transferred to the appropriate server machine, which starts to run the update script.

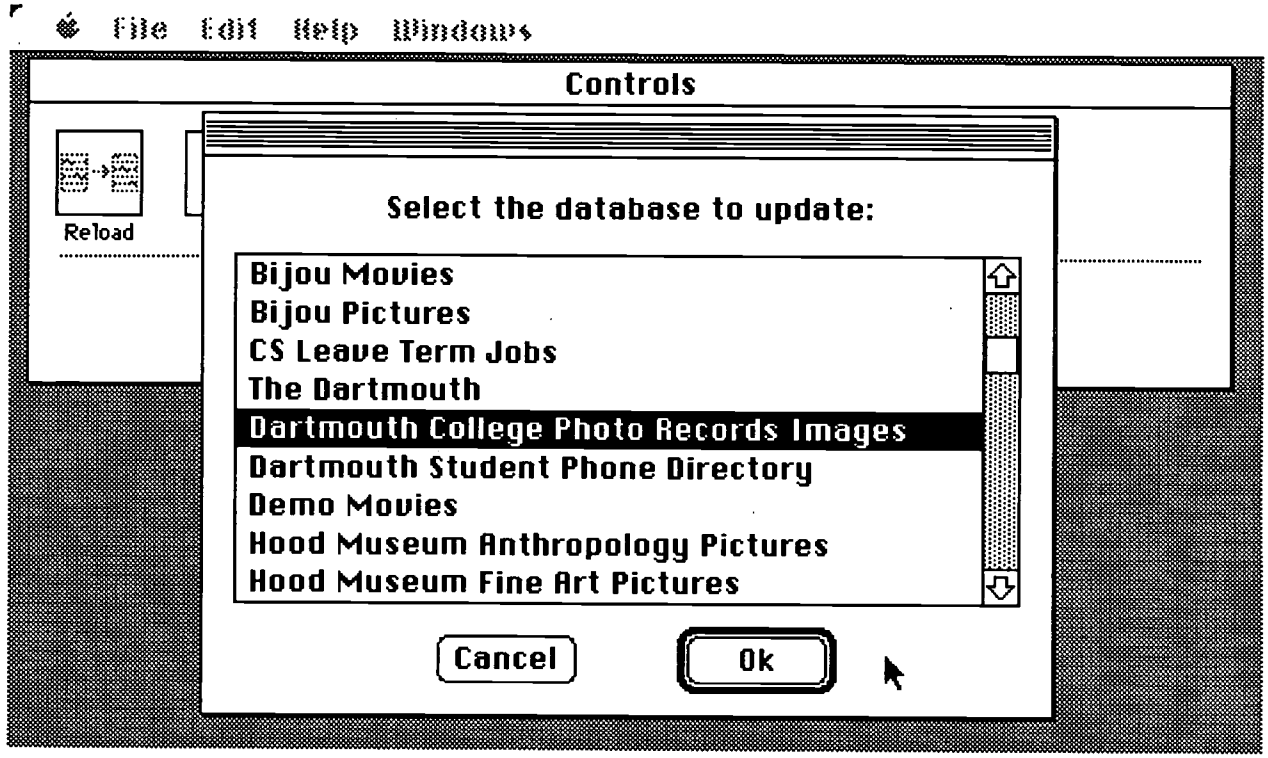

Figure 3- Database Selection

The update server runs a script to handle the requirements of a particular database. The script handles both consistency checks and runs the various vendor-supplied server database maintenance utilities needed for this update. The update script first verifies the input data, often running a format checking program which must succeed in order to continue the process. Next the script attempts to process the update transaction. In some cases several periodic updates are merged into a single file. Next the script runs the database manager's loader or index building programs. A log window shows progress and provides diagnostic messages. Finally the success or failure of the operation is reported (Figure 4). The log messages can be mailed to a DCIS staff member for diagnosis in case there is a problem. On-line help is available.

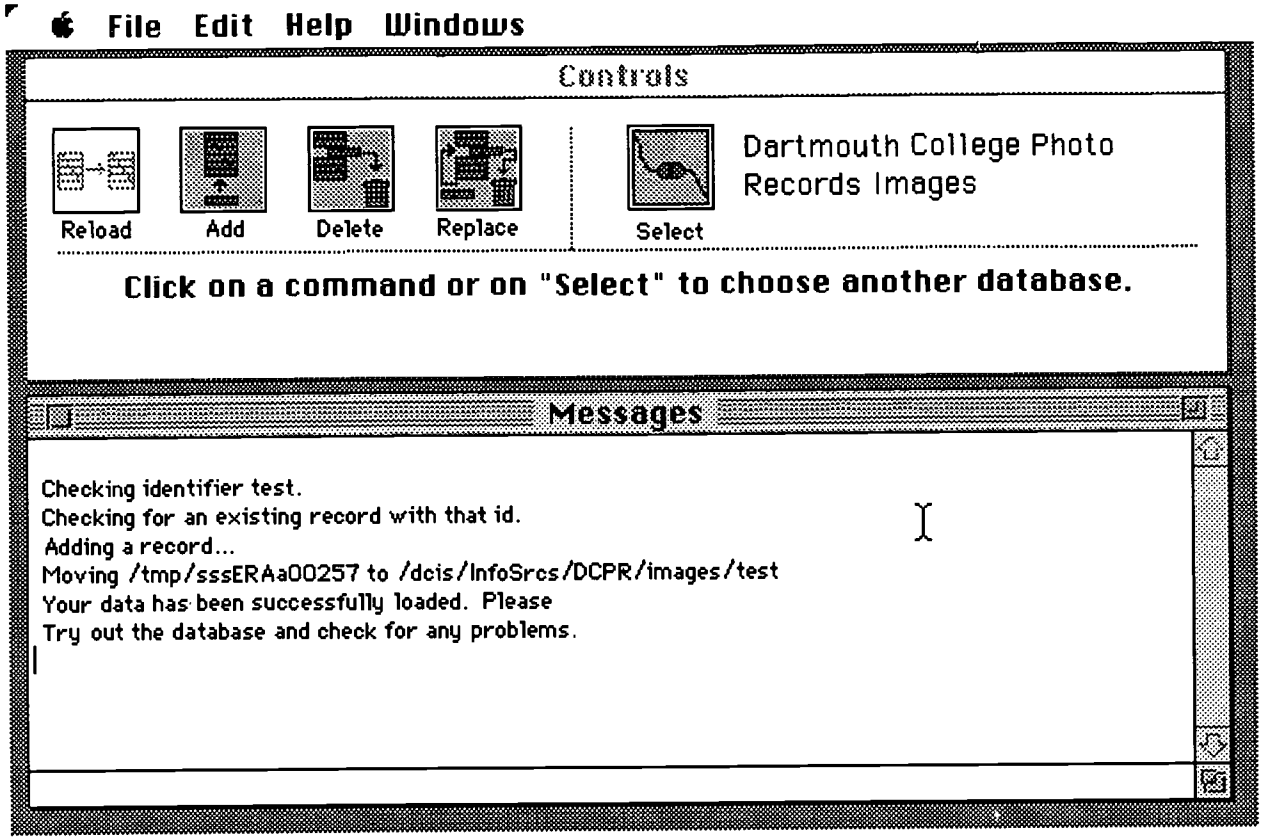

Figure 4- Update Complete

Evaluation

The DCIS update system has proved to be quite popular and has successfully accomplished the task of transferring the ongoing maintenance of the database to the originating office and freeing up the DCIS development staff. Several of the databases are being updated on a daily basis. Others monthly or as the need arises. Prior to this project "regular" updates were not getting processed on a regular basis. Some of the databases supported by the update system are among the most popular resources on DCIS.

As the DCIS system continues to expand, an increasing number of uses for the update system are being identified. The client will run on almost any Macintosh. The servers are small, fairly portable and adaptable to other database systems. The system has also been easy to configure for additional databases. This project has measurably increased the usage and local satisfaction with the DCIS effort.

A SMALL SCHOOL VENTURES INTO THE WORLD OF THE CWIS

Bev Actis
Kenyon College
Gambier, OH 43022

In late 1992, Kenyon College in Gambier, Ohio, had just completed its campus network infrastructure. This new environment provided an institutional "integration" that enabled Kenyon to consider the possibility of a campus-wide information system, or CWIS.

Kenyon began its planning by investigating many other CWIS on the Internet. In the process, the most important issues to be addressed in launching a successful CWIS were identified. This paper discusses those issues and provides a guide to other small schools in getting started.

A SMALL SCHOOL VENTURES INTO THE WORLD OF THE CWIS

By the fall of 1992, Kenyon College, a liberal arts school of 1500 students in Gambier, Ohio, had just completed its campus network infrastructure, which provided network access to virtually all campus buildings. The campus community was communicating via email and beginning to share much information electronically. The time was ripe for Kenyon to consider how to utilize this new environment to more fully integrate its wide variety of information resources into a campus wide information system, or CWIS.

At that time, a task force from Information & Computing Services (ICS) began looking, via the Internet, at other campuses with a CWIS. Since Kenyon's financial situation allowed very limited personnel and financial resources for such a project, ICS had to find a way to build a CWIS at the "right price."

At that same time "gopher" was beginning to become a hot topic on the Internet. It was the gopher software developed by the University of Minnesota that gave us the breakthrough we needed to proceed with our CWIS, since gopher was not only free, but also enabled us to provide both local and Internet resources to the campus.

We began planning for KCInfo (as we called our CWIS) by collecting from the Internet all the information we could find about other CWIS, so that we could learn from their strengths as well as their weaknesses. We contacted many CWIS managers for ideas on how to go about getting started. By sifting through all this information, we were able to identify a dozen issues that had to be addressed by ICS before launching KCInfo. These issues included:

* Needs & Resource Assessment
* Ownership Issues
* Access & Privacy
* Personnel Needs
* Content Standards
* Policies & Policy Boards
* Main Menu Design
* Marketing Strategies
* The Coordinator's Role
* Sponsors & Information Providers
* Ongoing Development
* Evaluation

The following discussion of these issues is meant to provide a general "game plan" to help other small schools considering a CWIS to take those first steps in getting started.

DO WE REALLY NEED A CWIS?

The first question we asked ourselves was, "Do we really need a CWIS?" In our present situation of budget restrictions, would the service a CWIS provided to the campus really be worth the money, time, and work required to develop it? What compensating benefits could it offer?

Our conclusion was that KCInfo would greatly improve access to a broad range of college information as well as Internet resources. It would organize in one central location information that would be available anytime and from any workstation connected through the campus network or via a dialup modem.

As an alternative to printed information, KCInfo could significantly reduce the use of paper on campus. Although it would not completely replace paper, hardcopies of electronic documents would be printed only at the user's discretion; thus they would not be wasted on users who had no real need or desire for them.

NEEDS AND RESOURCES: FINDING A MATCH

Our next task was to assess our current resources to determine what we needed to make KCInfo a reality. Kenyon's all-campus network was our biggest asset, since it provided universal access to computing resources. The network was connected to a cluster of DEC VAXes connected to workstations, half of which were terminals and half microcomputers. With half the campus still using terminals, we realized that the software to run the CWIS would be have to be installed on the VAX mainframe to be accessible to all. In the future, as we evolved into a microcomputer-based campus, we could migrate to a distributed system with connections to a dedicated machine set up as our gopher server.

Using a timeshare environment for our gopher server was not ideal, since it might put a strain on the VAX cluster when usage became heavy. A separate, dedicated machine would have been preferable, but was not possible at the time, so we plunged forward on the VAX to get started. Should system overhead present a problem due to the growth of the CWIS, relatively cheap add-on memory and disk storage could be purchased as needed.

Because of budget and personnel limitations, we couldn't afford to allocate staff time for developing our own CWIS software. Given these limitations, the increasingly popular "gopher" software seemed to be the perfect solution for Kenyon, since the software itself and its maintenance would cost us nothing.

Gopher's simplicity of design and protocol made it very appealing, and it had already become a standard on the Internet. It offered an easy-to-use hierarchical menu structure and a minimum of keystrokes for the user to learn. Information retrieval was simple because the user wasn't required to know the location of the information. It could easily be expanded by

simply linking up to another "server," either locally or remotely.

Gopher had other important features that made it seem the right choice for Kenyon. It provided access to all kinds of Internet resources, regardless of their type or location. These resources included: WAIS and Veronica search tools; Archie and anon ftp archives; gateways to online library catalogs; multimedia using RFC1341 MIME email extensions; SQL interfaces to databases; and links to thousands of other gopher servers worldwide.

Besides hardware/software considerations, we took into account the intangible yet real time savings and productivity increases that a CWIS could offer. Anyone seeking college-related information could find it more readily. College departments were able to update and distribute their information more efficiently.

OWNERSHIP ISSUES: WHOSE CWIS IS THIS ANYWAY?

In talking to individuals who had implemented a CWIS at other campuses, we learned that information "ownership" had been a big issue. Because of possible legal implications for Kenyon, it was important to make a clear distinction between the role of the institution and those who sponsor the information in the CWIS. The college simply provided a vehicle (KCInfo) that acted as a "collector and storer" of the information, similar to a library. The role of the sponsor of the information is that of "author/editor/publisher." By not editing the information stored in KCInfo, Kenyon would not be responsible for information that might later be found to be illegal, such as copyright and privacy infringements, libelous or derogatory information, etc.

Therefore, as "owners" of the information, the sponsors assumed full responsibility for the accuracy, quality, legality, and appropriateness of their information. ICS insisted that each sponsoring group create its own internal process of review and approval of any documents provided to KCInfo. The sponsors were charged with selecting a representative to become their "information provider," who would be responsible for the editorial management of the sponsor's documents (which covered writing, formatting, proofreading, posting, and deleting documents).

To identify ownership, every document in KCInfo was required to have a header at its beginning, containing the name of a contact person responsible for the information so that questions and problems could be directed to the proper source.

ACCESS AND PRIVACY

A gopher-based CWIS is available not only to campus users, but to anyone with Internet access. It is important that sponsors understand this concept of open access before they begin to plan their information. There are different ways in which gopher software can

restrict access to certain files and menus (and also by IP address). But since KCInfo was set up to improve information sharing among campus members, it was not to be used for confidential or restricted information.

Regarding the issue of privacy, ICS had to address two concerns: user privacy and data privacy. We had to be careful, in any analysis of usage statistics, that the data would not be used to identify individual access of documents. Libraries have long been aware of the need for user privacy in the area of book selection, and Kenyon had to be sensitive to this as well in regard to electronic documents.

Data privacy considerations in light of the FERPA act require that personal information (such as an individual's home address and phone number), not be made available for public access without giving that individual an opportunity to withhold it. This had to be discussed with potential sponsors who might inadvertently include inappropriate personal information in their KCInfo documents.

PERSONNEL NEEDS: WHO'S GOING TO DO THE WORK?

The financial climate at Kenyon was such that there was no chance of hiring additional personnel for KCInfo, so the time involved in implementing and maintaining it had to be carved out of ICS staff time. It was imperative that ICS train those who would be responsible for providing the information to be as self-sufficient as possible. After contacting several other schools about their CWIS personnel needs, we mapped out a tentative personnel "duties" list. (The actual time spent on KCInfo development and maintenance is also included here as well):

* System administrator: Manages the CWIS software and hardware; performs upgrades, migrations; customizes as necessary. Estimated time per week: after the initial installation/test period, 1-2 hours ongoing. Upgrades and any special streamlining "tools" would take additional time periodically.

* Coordinator: Marketing and public relations work; design of CWIS main menu; day-to-day management of CWIS development; training & support of information providers; recordkeeping. Estimated time per week: about half-time for first several months of development; then 5-7 hours ongoing.

* Sponsors: Responsible for information content; define and organize information; develop internal review and approval process; select information provider(s) to post and maintain their information. After initial planning process, additional time would be required only as new menus and documents were planned.

* Information Providers: Responsible for editorial management of documents; after initial learning period, the time needed for preparing documents for KCInfo should not be more than required for most paper-based documents.

CONTENT: MEAT AND POTATOES OF THE CWIS

Although it may seem obvious, the selection and organization of the information (content) is THE most important consideration if the CWIS is to be well-used. It should contain information that is informative and even entertaining because it has to motivate the user to want to explore it further. The menu structure must be organized in such a way that the novice user can find the needed information intuitively. One of gopher's nice features is that the same information can be accessed from multiple locations in the menu structure, thus providing users with more than one logical "path" to follow.

Defining and organizing information requires time, and it cannot be rushed. Getting sponsors to understand the importance of this planning phase is the key to the success of the CWIS. Information that is not well-written or menus that are poorly organized will simply not be read, and the CWIS will be bypassed.

By making the sponsors and information providers responsible for all aspects of the "content," ICS did not have to spend staff time on proofreading, formatting, or posting the information to KCInfo. As mentioned earlier, each sponsoring department or organization determined its own internal review and approval process for information targeted for KCInfo. Questions about the information were directed to the contact person identified in the document header and so they did not take up ICS staff time.

If we had not distributed responsibility for content, ICS would never have had the staff resources to handle the CWIS implementation or its ongoing management. We trained the sponsors and information providers to be as self-sufficient as possible so that we could then concentrate on the system management responsibilities that only ICS could perform.

Early in the project certain content and formatting standards were established before any information was allowed to be posted to the CWIS. Some of the standards set for the Kenyon environment were:

* Appropriateness: Appropriate information was defined as information that may be of general interest to members of the Kenyon College community. Advocacy, commercial advertising and sales, libelous or derogatory information, and confidential information were deemed inappropriate.

* Currency: Information providers must review and update information regularly; otherwise, it could be deleted after notification to the provider.

* Accuracy and Quality: Documents were to be error-free in terms of spelling and grammar. The quality of workmanship should be the same as that of paper-based information.

* Copyright: Existing copyright and privacy laws must be honored; sponsors were required, if necessary, to obtain copyright approval from the author.

* Format: Standards were set for converting wordprocessed documents to ascii format, which was required by gopher; conversion procedures (from WordPerfect to ascii) were established.

When these standards were decided upon, the coordinator included them in the Information Providers Handbook which was used in the training workshop. (This handbook can be found in KCInfo at gopher.kenyon.edu by following the menu path: About KCInfo/Interested in Posting Information to KCInfo?).

POLICIES AND POLICY BOARD: GUIDE, WATCHDOG AND REFEREE

Other campuses had experienced many problems when setting up their CWIS because they had no clear guidelines to follow and no means of settling the inevitable conflicts that arose because of differing opinions. Examples of these issues were: disagreements on the design of the main menu; personnel responsibilities; copyright, privacy, and other legal issues; ownership issues; lack of content standards; access issues, etc.

ICS decided that a policy document and a broadly-based forum to oversee KCInfo would be good "preventive maintenance." We set up an ad hoc committee to write a policy document that would be in place before KCInfo was opened up to receive information.

The policy document defined the membership of the policy board, which represented the various college constituencies. This board would oversee the development of KCInfo, enforce the policies set by the policy document, and settle conflicts. (A copy of the KCInfo Policy Document is available in KCInfo at gopher.kenyon.edu under the main menu topic "About KCInfo").

DESIGNING THE MAIN MENU

Before any information could be posted to KCInfo, the main menu had to be designed. Deciding upon the main menu topics was critical because they had to be broad enough in order to include the wide range of information to be made available to the campus. Looking at many other institutions' main menus and deciding which categories were most appropriate for ours was a helpful start. Listing all the various departments and services that the college

offered also gave us a good idea of what kinds of information we had to work with and how we might best categorize them.

Once the topics were set for the main menu, we set up a "prototype" menu. We wanted feedback about the appropriateness of the topics. Were they broad enough, inclusive enough to cover the information to be posted by the many and varied campus groups? The main menu remained flexible during this test phase, but after a limited time, it was then "frozen," ready for posting information.

This prototype menu was skeletal, with a very limited amount of information in it, but what it had was useful or entertaining enough to draw the reader into browsing through it. The local information that was put in already existed, either on paper or online somewhere else: campus directories, newsletters, calendars of events, computing and library information, announcements, course listings, etc. Putting this information into KCInfo made it much easier to find, which served to illustrate its potential as a "one-stop" information resource.

Since gopher enables one to browse the Internet, we included several Internet resources as enticements, such as the U.S. Weather Service, White House Press Releases, the Internet Hunt, and other interesting gopher sites.

MARKETING STRATEGIES

For a project of this kind to be successful, we had to market the idea to several audiences: first, to the staff of ICS, since they would be responsible for a new resource that required much cooperation and support among the staff to get it started; second, to the upper management of the college, since their support was necessary to motivate the sponsors to get involved; and third, to the campus in general, so that they could see the value of KCInfo in providing them with readily available, easy-to-find information.

We used the KCInfo Policy Document itself as an important marketing tool. To obtain approval for the document and the proposed KCInfo Policy Board, we had to go before the senior governing board of the college to present our "vision" of KCInfo, answer their concerns, and ultimately gain their support. The policy document was a symbolic statement that we saw this resource as an invaluable tool for all constituencies of the college and intended it to be developed in a purposeful, responsible manner.

In the beginning it was important to create publicity and interest in whatever way possible: an initial college-wide email news release with an invitation to attend a demonstration of KCInfo; introductory meetings and workshops for potential sponsors and information providers; articles in college newsletters describing its features; monthly email messages describing new information areas; personal contacts with key department heads to persuade them to participate, hoping that by doing so they would encourage other departments to do likewise.

THE COORDINATOR: CHEERLEADER AND TRAINER

Once the groundwork was done, the next step was to select the right person to manage the day-to-day development of the CWIS. There were several important qualities to look for in a coordinator, among them excellent organizational skills. This person would assist the sponsors in organizing their information and selecting an appropriate location for it in KCInfo.

Especially important was having a "vision" of a fully integrated and operational CWIS, and being able to communicate this vision to the campus. Much of the preliminary work involved marketing and cheerleading, but they were necessary in getting the campus "hooked" on a CWIS.

The coordinator had to develop good recordkeeping tools to keep track of the growth of the menu structure and the information providers. Good records were essential in troubleshooting problems effectively. They were also important in developing tools to streamline the operation of the KCInfo.

The coordinator was also responsible for the training and support of the information providers. This included: developing a training workshop for them; writing a handbook of guidelines; developing ways of streamlining the preparation and maintenance of documents; and phone consulting.

KCInfo itself had to be monitored regularly. This meant spot-checking the documents for inaccurate and out-of-date information. When first beginning, information providers will need reminders to review their documents. This can be done with a monthly email message, which can also be used to request feedback from the information providers.

INFORMATION PROVIDERS: THE WORKER BEES

As mentioned earlier, the information providers were given responsibility for the editorial management of the information for a particular sponsor. They had to be trained in formatting, updating, and posting documents to KCInfo, and deleting them when they became obsolete.

All information providers were required to take an initial training workshop for this purpose. There were NO exceptions to this rule. This workshop covered: job responsibilities; standards; a demo of KCInfo; help in organizing information and setting up a work environment; and instruction in preparing and maintaining documents. The Information Providers Handbook was written for this workshop and contained all the above information for later reference.

ONGOING DEVELOPMENT: KEEPING THE WAGONS ROLLING

KCInfo passed through some distinct phases in its development. In the preliminary or "evangelistic" phase, the coordinator had to work hard to motivate potential sponsors and to interest the campus in using KCInfo.

After some initial training workshops were held, there was a very gradual growth during the next six months, as a few of the key departments came on board. But by the end of its first year, the number of documents in KCInfo had grown to nearly 1,000 and the number of connections to it per week increased to nearly 10,000. As more information was added, the usage increased and as usage increased, more potential sponsors came on board, as they began to realize its potential. It became difficult to keep up with the demand for workshops and menus.

It is important to keep in mind that it took about a year for KCInfo to become truly useful, when the point of "critical mass" was reached. This was the point where people began to consider KCInfo as an integral part of campus life. The pendulum had swung, so to speak. During this phase, good recordkeeping became especially critical in order to keep the growth organized and under control.

The coordinator must continue to remain "tuned in" to new developments on the Internet affecting gopher and to new resources that might be added to the CWIS. Regularly collecting and organizing information from the CWIS-L listserv and other Internet newsgroups helped us to incorporate important new features into KCInfo.

As KCInfo grows, so will the need for new tools that will streamline and even automate posting and file maintenance. Some of these tools have already been developed at other gopher sites. Some examples are: automatic expiration of documents; document conversion into ascii format; automated transfer of information into the CWIS; reports on "what's new" in the CWIS; document access statistics for information providers; programs that identify "dead" links to other servers, full text and keyword search tools. Many of these are available upon request. The UMN gopher or the CWIS-L listserv are good sources of help.

EVALUATION: LOOKING FOR FEEDBACK IN ALL THE RIGHT PLACES

As with any new project, it is important to get regular feedback in as many ways as possible. This can be done, of course, with periodic surveys and questionnaires. Patterns of growth can also be plotted from gopher usage logs, which also can provide document access statistics to information providers.

Some of the most valuable feedback is less formal: suggestions from users via a "comments" box on the main menu; followup with information providers; email from remote viewers; the CWIS "image", revealed subtly in references to it in conversation and campus publications.

Even negative feedback is valuable in providing ideas and impetus for improvement.

CONCLUSION

The explosion of information in our society today requires that we, as information technology experts, find the most efficient tools for accessing that information and presenting it in a meaningful way. KCInfo has become that kind of tool, providing access to a broad range of information at a relatively inexpensive cost to users wherever they are and whenever they may need it.

Although KCInfo was intended as a supplement to other forms of information distribution, it has already replaced some kinds of paper-based communication and promises to significantly reduce the use of paper over time. One of its biggest benefits is that it has greatly improved access to information for the campus and has increased communication among all groups: students, faculty, staff, alumni, parents, and friends of the college. And as it has grown, it has been instrumental in promoting a greater "cohesiveness" in the life of the Kenyon community.

Providing Access for the Scholars Work Environment (SWE)

Donald Carder and James Penrod

California State University, Los Angeles

California

California State University, Los Angeles provides a common interface for all academic PCs, MACs, Clones, Workstations, etc. connected to the campus backbone. This encompasses all full time faculty, many academic staff (approximately 1400 user nodes), and 34 academic labs. This fully distributed system has some 27 network servers, 18 subnets, and supports nine different operating systems. The SWE interface appears on any desktop machine when it is booted and provides icon and pull down menu access to the many digital resources (*Information Resources*: reference, text, numeric, image and relational databases; *Computing Resources*: application, print, file, timeshare and client/server services; *Communication Resources*: mail, bulletin boards, electronic conferences, network news and list servers.) available through the campus, CSU, regional, and national networks. This paper will discuss the longer term goals, conceptual objectives, primary technical barriers that had to be overcome, the network design, an incremental development plan, and the academic utilization of the releases of SWE.

INTRODUCTION

In 1985 California State University, Los Angeles (CSLA) created an information resources management (IRM) division headed by a vice president as chief information officer (CIO) for the institution. The resulting organization encompassed all computing, communication and network units and policy responsibility for all information technology on campus. The CIO was initially charged to plan, develop and implement (1) a campus-wide communication system and network, (2) an academic computing environment, and (3) an integrated administrative system that would meet the needs and help prepare the university for the educational challenges of the twenty-first century.

By the early 1990's the basic infrastructure for the accomplishment of these broad based goals had been built. A digital telephone system and fiber optic network had been installed. A fully distributed academic support system with 34 computing laboratories, 27 network servers, and 18 subnets supporting nine different operating systems was in place. And, integrated administrative systems developed in DB2 were operational.

One very important contributing aspect to this progress was the adaptation of a strategic planning and management methodology to the decision making processes of the institution. In early 1986 CSLA selected the Shirley Strategic Planning Model[1] as the best alternative for implementing a strategic planning process campus-wide. In addition to the university strategic plan, some nine institutional tactical (action) plans, including an IRM plan, were designated to be developed and directly coupled to the budgeting process of the campus.

GOALS FOR SCHOLARS WORK ENVIRONMENT

The Shirley methodology was specifically modified to accommodate information technology planning[2] and the first draft of a *Strategic Plan for Information Resources Management at California State University, Los Angeles* was issued in July 1986. The following quotation from that initial planning document pointed to the eventual development of a scholars work environment (SWE) for the academic community at CSLA.[3]

> Planning for student and faculty access to information resource technologies at Cal State LA is inexorably linked to curriculum planning and development. Curriculum methodologies must be appropriate to the desired educational objectives; namely, literacy in content and literacy in discipline specific tools and techniques. Information resources technologies, essential tools and techniques required in all professional fields, must be learned concomitantly with the content of one's own field. ... Timely and adequate access to these appropriate "educational tools" are becoming a standard expectation of both students and faculty alike in all academic disciplines. Areas which

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[1] Robert C. Shirley, "Strategic Planning: An Overview," Successful Strategic Planning: Case Studies, *New Directions for Higher Education,* No. 64 (San Francisco: Jossey-Bass, 1988), pp. 11-12.

[2] James Penrod and Thomas W. West, "Strategic Planning for Computing and Communications," *Organizing and Managing Information Resources on Campus.* (McKinney, TX: Academic Computing Publications, Inc., 1989) pp. 117-137.

[3] *Strategic Plan for Information Resources Management,* California State University, Los Angeles, July 1986, p. 29.

formerly depended solely on access to large mainframe systems are now committed to the selection of computing power and software appropriate to the instruction and learning of each course.

By January 1988 the IRM plan endorsed a California State University (CSU) System needs assessment declaring that faculty needs for desktop computers uses included: (1) facilitating the development and updating of lecture, laboratory, and self-instructional materials, (2) enhancing the management of courses, (3) promoting the effective integration of computing into courses (by facilitating the preparation and pretesting of computer-based materials and student assignments, allowing students and faculty to interact as the students work on those assignments, and making easier the development and sharing of data bases and innovative courseware), (4) enhancing student advising, (5) providing means for instructional and scholarly activities such as data acquisition and analysis and bibliographic searches, and (6) facilitating the deliberations of university committees.[4] The full design model for SWE was completed and set forth in the 1991 IRM plan. It had seven primary goals.

Human Factors Design. The organization of the system interface (what you see on the screen and how the resources of the network are presented) is based on the way people work and the intellectual tools being applied.

Client-centered Work Environment. The network resources are to be organized around the work environment and the logical center of the work environment is the individual. Each individual can organize the available resources to construct a unique work environment and the logical system of the network will recognize the individual and reconstruct the "virtual" work environment at each session.

Heterogeneous Network. The network resources are to be supplied by multiple vendors and the adoption of "open systems" standards is to allow for procurements to be based upon price/performance criteria.

Hierarchical Compute Platforms. A range of computer resources are to be available across the network. This allows network clients to assign compute and file service tasks to the class of machine appropriate to the job(s).

Distributed Network. The resources necessary for the session are localized. The resources of the network are distributed throughout the system on the basis of utilization. The unique resources are available across the system.

Fully Integrated System. The information technologies for support of academic programs are integrated into a campus-wide network which appears and functions as a unified resource.

Transition Strategy. The aim is to move from the existing environment to the target environment without loss of system functionality or a devaluation of client (faculty or student) expertise.[5]

The primary objectives then in developing a SWE were to make information resources available to the entire academic community, to lesson the learning curve to negotiate a complex network, to provide an easy way for scholars to know about available resources, and to economically provide a wide range of instructional and research applications to an extensive and varied academic audience.

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[4] Donald Carder, "Faculty Access Requirements," *Strategic Plan for Information Resources Management,* California State University, Los Angeles, CA, January 1988, pp. 38-39.
[5] Donald Carder, "Design Strategy," *Strategic Plan for Information Resources Management,* California State University, Los Angeles, CA, July 1991, pp. 25-26.

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NETWORK DESIGN AND TECHNICAL CHALLENGES

The majority of computing resources used for instruction and research at Cal State LA are part of a campus wide, distributed network known as the Instructional Support Information System (ISIS). The ISIS network includes public access facilities with desktop machines for academic computing; data communications systems providing access to local, regional, and national networks; large computers and servers providing shared computational, storage and printing services; and digital messaging services for student/faculty and peer communications. In the framework used for the design of SWE, the computing,

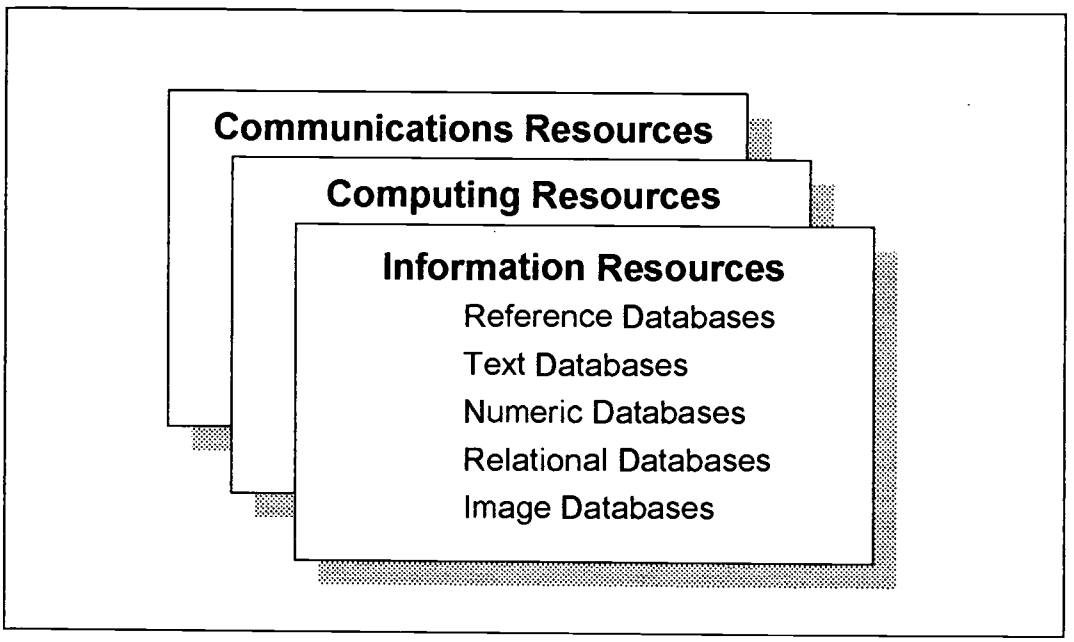

FIGURE 1. RESOURCE SCHEMA FOR ISIS

information and communications resources (see Figure 1) of the system are known as the *resource schema* and the purpose of SWE is to provide a map of those resources.

The backbone for the ISIS network is a FDDI ring. Each of the academic buildings is connected to the backbone via a router which can support up to 12 Ethernet subnets and two FDDI subnets. The ISIS servers are UNIX systems, ranging in size from a mini supercomputer to Intel based systems. The majority of servers are SunServers. The primary servers used for the student and faculty /home accounts are large SunServers and are being attached directly to the FDDI ring via the FDDI subnets. Approximately 10 percent of the desktop workstations are UNIX machines, 20 percent are Macintoshes, 30 percent are Intel machines running MS-DOS, and the balance or about 40 per cent of the academic desktop workstations are MS-Windows based machines. Virtually all of the 1400 workstations are connected to the network via an Ethernet subnet. Some 600 of the workstations are in faculty offices (all full time tenure track faculty) and the balance are in open access labs and computer classrooms.

In addressing the design of the SWE, the primary objectives for SWE (previously listed) had to be balanced with the need to make the operation and management of the ISIS system as efficient and economical as possible, from the perspective of the system administrators. The critical factor in accomplishing both the objectives for SWE and the management of the ISIS is to achieve coherency i.e., to ensure that the ISIS system as a whole has logical integrity and consistent behavior. For both the end user and the systems administrator the structure of the system has to make sense and the way tasks are to be accomplished has to be consistent and predictable. However, the perspectives of the end users and the systems administrators as to what would give the system coherency were initially very different.

From the systems administrators perspective, the ISIS was made up of a set of distributed systems hosting heterogeneous resources. This view of the system derived from the functional definitions of and relationships between the ISIS system components. To achieve coherency, in this view of the system, the implementation of the enabling technologies used to deliver network services has to be rational and the operation of the system as a whole has to be predictable. The systems administrators view of the system (or the way the system is defined and operated at the network and operating systems level) is known as the *logical schema*.

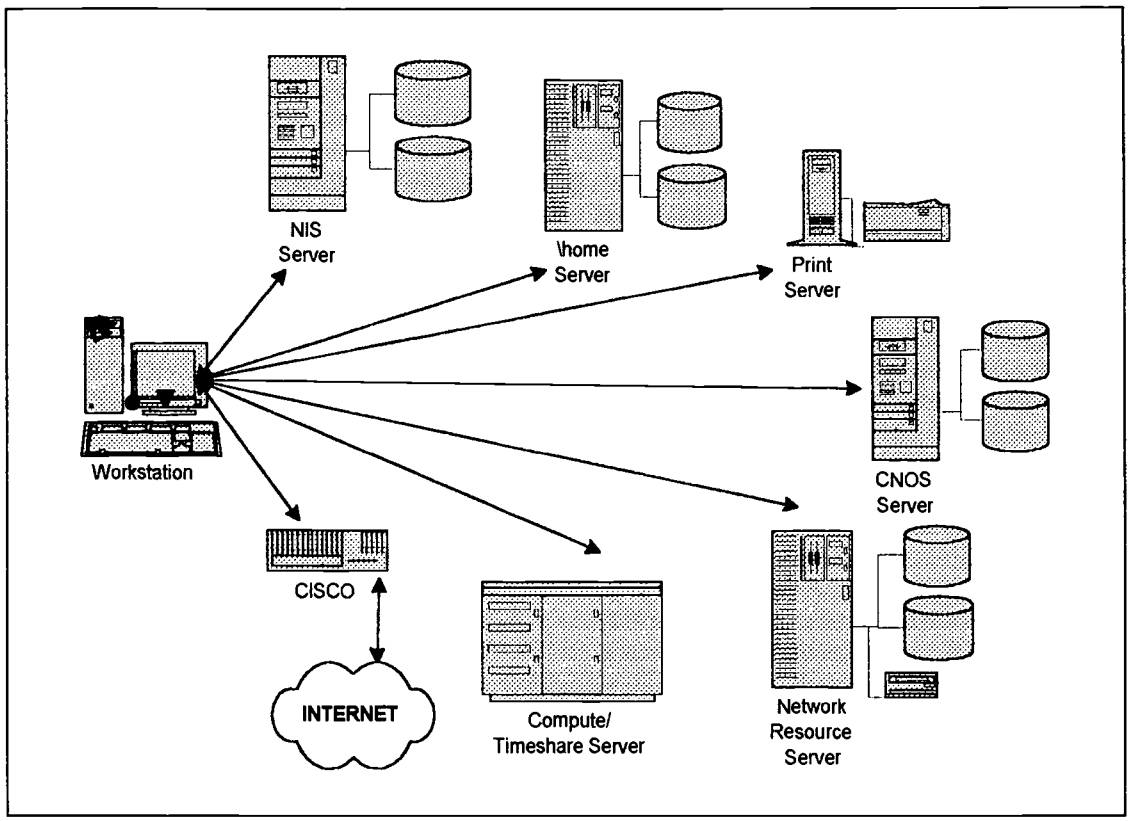

FIGURE 2. A VIRTUAL WORKSTATION IN A DISTRIBUTED COMPUTING ENVIRONMENT

From the perspective of the end users, the ISIS system was a complex array of distributed computing, information and communications resources accessible through an even more complex and often baffling network technology. Frequently, users had no idea nor did they care what system they were on or how they got there. To achieve coherency and make the resources of the ISIS useful from this perspective, resources must be presented in such a way as to make them readily accessible and applicable to the pursuit of academic activities. The end-user's view of the system, or the way the ISIS is presented to the end-user is known the *systems architecture*. Together, these three views, *resource schema, logical schema,* and *systems architecture* provide the model for the design of SWE.[6]

The technology used to implement the logical schema is Sun Microsystems' Domain Name Service (DNS) and the Open Network Computing (ONC) suite of service and protocols. The network services elements which make up the ONC suite are; (1) the Network File System (NFS) which provides access to remote

[6] Frederick P. Brooks, Jr., *The Mythical Man-Month* (Reading, MA: Addison-Wesley, 1975) p. 45.

file systems; (2) the Network Information Service (NIS) provides authorization and authentication services and the ability to automatically mount and unmount resources for network computing; (3) the Network Lock Manager which allows users to coordinate access to common information by providing file and record locking across the network, and (4) REX (Remote Execution) which allows users to execute commands or programs on remote systems.

The ONC technologies enable a microcomputer on the network to operate as a "virtual workstation," (see Figure 2) attaching to resources such as printers, disk drives, and CD-ROMs as though they are part of the local machine. One early problem was that the *systems architecture* provided by the ONC services was inadequate for a complex information environment and required a level of expertise beyond that of most users. For those who could master the network technology, there was the additional hurdle of knowing and keeping track of what resources were available. The task, then, was to develop an additional layer for the *logical schema* which would make the resources readily accessible and map the *resource schema* to a *systems architecture* which would be meaningful to the scholar.

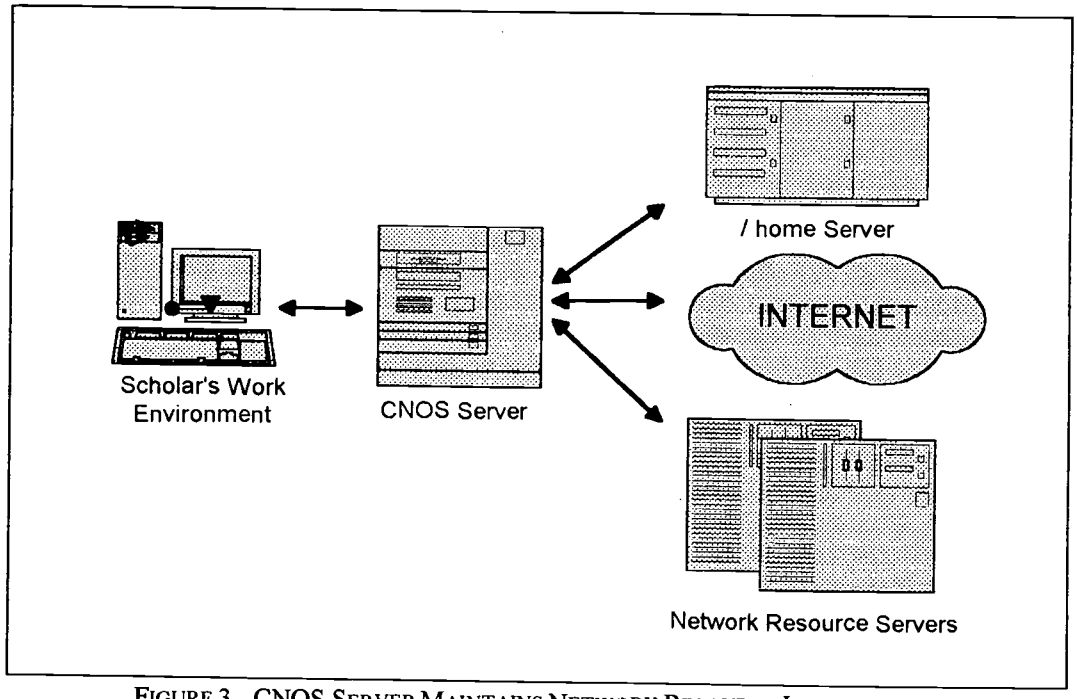

FIGURE 3. CNOS SERVER MAINTAINS NETWORK RESOURCE INFORMATION.

Since the desk top computers of the ISIS have heterogeneous operating and presentation environments, client/server technologies were chosen to present the *resource schema* in the metaphor of each native environment. In this model, the client software is the *systems architecture* or SWE, presenting all of the resources available to the "virtual workstation" as a coherent whole. The server technology maintains the intelligence about where and how to access the resources of the ISIS (see Figure 3). The server software is known as the Campus Network Operating System (CNOS). In the design framework, CNOS is an additional layer of the *logical schema*. CNOS resides on the UNIX servers. SWE applications have been developed for MS-DOS, MS-Windows, UNIX and a Macintosh version is currently in development. To accommodate the different needs of the end user and the systems administrator, and to ensure coherency and logical integrity for the *logical schema* and the *systems architecture*, the design responsibilities were divided. The SWE team focused on the needs of the user and the CNOS team focused on the "backend" or the enabling technologies.

The objective for the SWE design team was to create an electronic work environment which facilitates the integration of SWE resources into the information handling processes of the teacher, learner, and

researcher. The organizing principle of the design was to be the practices of scholarship. The design had to accommodate the way scholars work, supporting the flow of scholarly activities as a unified process. It should reflect the following:

- scholars acquire new skills based on existing skills;
- scholars identify and seek out diverse pieces of information (documents, data sets, sounds, and images) on the basis of commonly known and meaningful attributes;
- scholars organize their work, materials, and information around their own knowledge;
- scholars seek and find information in the larger universe (all available sources) of information and move it into a personal collection which is relevant to their work.

The flow of information into the work environment is complimented by the flow of analysis, commentaries, new theories and ideas back out to the community at large (see Figure 4). Accommodating the flow of information into and out of the scholar's work space is a critical function which must be supported by SWE.

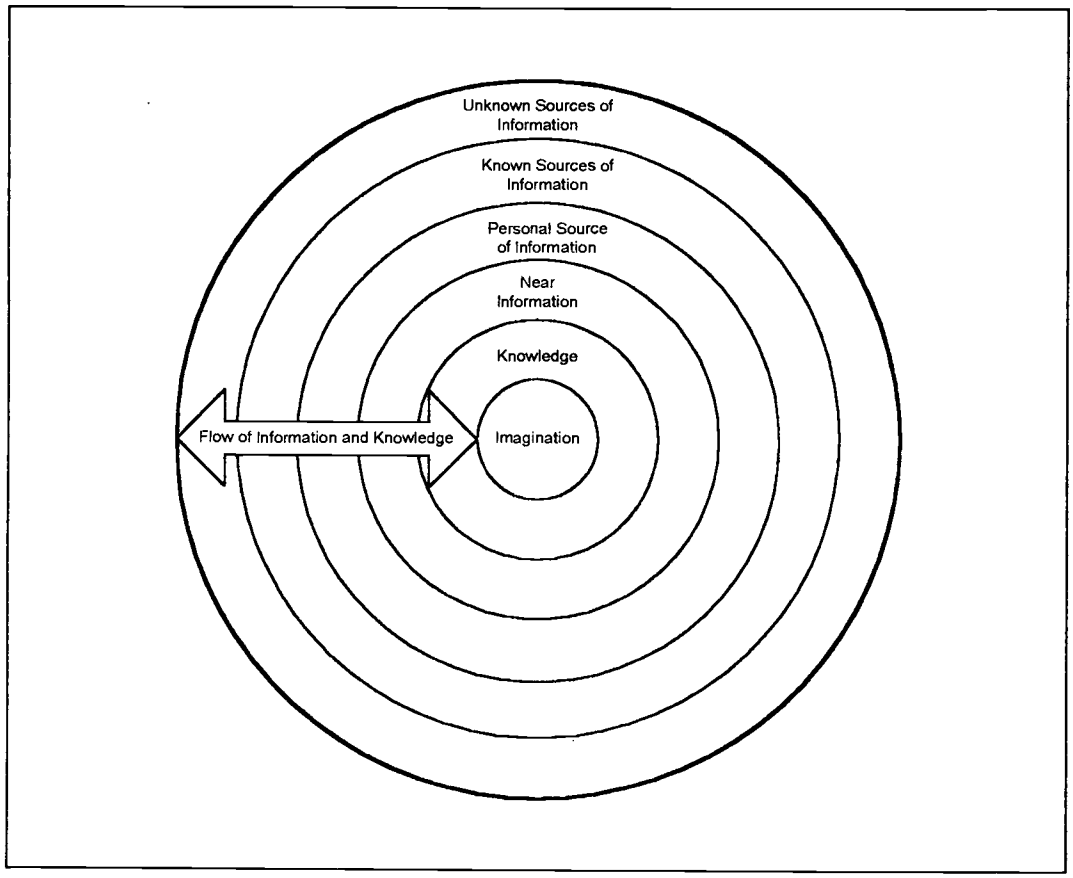

FIGURE 4. FLOW OF INFORMATION INTO AND OUT OF SCHOLAR'S WORK ENVIRONMENT.

The principle challenge to the CNOS design team was to make the system dynamic. There were four fundamental conditions in the academic computing environment which could only be addressed with a dynamic system. First, the relationship between the resource schema and the presentation technologies had to be dynamic. One of the critical problems which had to be addressed was the broadcasting of meta information. SWE had to pick up information about new resources available via the network dynamically. Second, the system had to be user sensitive. Students do not have personal workstations on campus. If the goal for a "client-centered" work environment was to be met, the system had to support the dynamic configuration of virtual workstation based on the unique needs of an individual at any desktop workstation

accessible to students in any laboratory. Third, the system had to be workstation sensitive. The desktop environment was heterogeneous. The system had to match the capabilities of specific machine to software versions and devices. And fourth, the design had to be location sensitive. To reduce network traffic and optimize performance, the system had to connect workstations to the closest appropriate server and avoid unnecessary routing over the backbone.

In summary, the academic computing environment at CSLA must include all of the computing, information, and communications resources relevant to scholarship. The system should be established as a distributed, fully integrated work environment. Access to the distributed resources should be possible from all environments in which scholarly activities take place. The distributed resources available through the network should be presented to the individual scholar as a coherent whole. The presentation of the whole system at the scholars work station should be done in such a way as to make it possible for the system to become an integral part of the teaching, learning, and research processes. The electronic work environment and the scholar's workstation should facilitate the free flow of information and ideas between teachers and learner and their peers. Finally, the system should operate efficiently and economically.

IMPLEMENTATION STRATEGIES

To initiate the SWE/CNOS project, it was decided to develop prototypes for the subsystems software. The intent was to address the most critical service needs and to validate the feasibility of the foundation technologies. A fairly simple methodology was adopted for the first prototypes. A set of preliminary design goals were developed for the whole fully featured system. Implementation objectives were established, and analyzed in terms of their order of dependencies and based on those dependencies a schedule for development was established. This established a preliminary implementation plan for a series of subsystem prototypes. Over the course of the project, progressively more complex prototypes (prerelease's to the fully featured product) were developed, tested, and installed as operational modules.

A more complex methodology became necessary to maintain progress on the project. There were several serious tactical problems in the design and implementation of the SWE and CNOS which had to be accommodated in the methodology and management practices. First, the size and scope of the project relative to the limited availability of human resources made it necessary to have a prolonged life cycle; for all intent and purpose it was open ended. It took two years to deliver a product which met the initial design goals and implementation objectives. Second, the ISIS system at both the resource and the logical level was constructed using "off the shelf" proprietary technologies which were evolving and changing over time. The detailed specifications of the subsystems technologies could not be known until the final phases of each implementation cycle And third, many of the service problems this system was intended to solve were critical and had to be addressed as quickly as possible. It was necessary to deliver functional modules over the course of the project to address the most critical service problems. And, these modules had to be incorporated into the long term design. In summary, this was a large, complex, and long range project targeted to solve pressing problems using technologies which were not fully known.

The length of the project life cycle combined with continued changes in the enabling technologies was a threat to the logical integrity for the logical schema and systems architecture. Several techniques were used to address this problem. First, "open systems" standards were adopted. These standards were incorporated into the IRM plan in 1987. Second, the analysis and design process was done iteratively, key to the release of prototypes. Each iteration included: a re-assessment of the service needs and priorities, an analysis of the enabling technologies, testing compatibility for integration in the ISIS, and review and modification of design goals and implementation objectives for CNOS and SWE. And finally, responsibility for the systems software on all workstations attached to the network was assumed by the Academic Technology Support (ATS) unit. This included the operating systems, presentation management packages such as MS-Windows and X.Windows, network software, and SWE. These packages were bundled into a product known as the System Software Suite and distributed in releases which had been tested for compatibility.

ACADEMIC UTILIZATION OF SWE

The academic utilization of SWE has two perspectives. The first is institutional. It is imperative that the academic community understand how to operate in a complex distributed network to find and use the numerous available resources. Therefore the training that is provided from Academic Technology Support focuses on acquiring the basic skills needed to comprehend and utilize the SWE (which enables easy identification and utilization of desired resources). This is supplemented by the Library which has chosen to use the Environment section of SWE as the organizing principle for the training they offer to faculty and students. They also provide discipline specific training focusing on specific network resources appropriate to different sectors of the university.

The second perspective is individual. Some faculty use SWE to organize and specifically identify network resources for student usage. For example, to create an icon for a particular class which directly connects to resources required in that class, e.g., databases, a bulletin board, etc. Others may wish to focus the use of SWE as an access tool to the various databases and information repositories available on campus and off. One professor has eliminated the use of a readings text altogether in a graduate seminar that explores current issues in the field.

FUTURE RELEASES OF SWE

The most recent release of SWE (just being implemented) includes *Explore*, a facility allowing a scholar to "click" on a pick or an icon and pull down one page of information describing the resources available. It will also provide direct access to World Wide Web (WWW) and other significant search elements on the Internet. Future releases will move to an object-oriented interface for the workspace, introduce *Near Information* which will integrate personal information management tools with annotation, note taking, and theme development tools, enable frequently used picks and icons to be dragged from the Environment into personal workspaces, and introduce the ability to automatically publish resource locations in the Environment. CNOS will be expanded to keep track of each scholars unique configuration and to provide it wherever that individual signs on the system.

MATCHING THE ORGANIZATION TO THE SYSTEM

The organization primarily responsible for the development, administration, and support of the ISIS system, including SWE and CNOS, is the Academic Technology Support unit. ATS has been reorganized six times since its creation in 1986. Part of this was due to growth; the organization has grown from one manager and two full time staff with approximately 20 student and graduate assistants to two managers and over 30 full time staff with some 50 student and graduate assistants. But the primary reason for the reorganizations (and the growth) has been the need to adapt to the entity being created and supported. Currently, there are six work groups.

- The Administrative Office Group which is made up of two clerical and two managers and is responsible for fiscal, personnel, and user support.
- The Instructional Technology Group which is made up of nine facilities managers, trainers, and consultants and is responsible for user support.
- The Network and Distributed Systems Group which is made up of five network and systems administrators and is responsible for the UNIX servers, network management, and the development and maintenance of CNOS.

- The Network Information Services Group which is made up of four analysts and software specialists and is responsible for the development and support of information services, the systems software for workstations, network applications and administration of SWE.

- The Systems Development Group which is made up of five systems analysts and programmers and is responsible for procurements, product and project management.

- The Technical Services Group which is made up of five equipment technicians and is responsible for the wiring plant, facilities installations, and workstation maintenance.

A continuing challenge for ATS is organizational integration reflective of and comparable to the integration attempting to be achieved with the systems being installed. During the initial growth period, when the focus of the organization was development, the primary instrument for organizational integration was project management. The Systems Development Group drew upon the personnel resources of all the work groups to put together project teams to bring up new systems and to develop the administrative procedures to support those systems. On completion of a project, ongoing support and administration was turned over to the work groups. The ATS organization is flat and the management of the work groups is dependent upon informal communications systems such as Email and a BBS, but the management tools are fairly traditional. The creation and growth of the other groups were driven by development and support issues.

As the system matured, however, projects have ceased to be the driving force for integration and adaptation. It is the responses demanded by increased systems utilization and user input regarding the effectiveness and efficiency of the systems architecture which are driving the refinement of systems and services. The project managers are involved in changes to the system much less frequently and the group supervisors tend to have a much more vertical perspective of the system and lack the understanding or sensitivity to the whole system to ensure true systems integration and coherency in the systems architecture. A solution for this problem is not offered, and it is believed that the current method for managing operations is not as effective as it needs to be. A decision has been made to experiment with the techniques of total quality management. The emphasis on crucial processes and service outcomes, which translates into coherency for CNOS and SWE, are very intriguing.

CONCLUDING OBSERVATIONS

During the course of development, implementation, operation, and evolution of this system some lessons have been learned that are seen as important and worth sharing.

"Whole Systems" View. The system must be viewed as a whole. This was anticipated in the early stages of the project which was dominated by design and development. The system had to be viewed as a whole to achieve logical integrity in the design. As the project matures, it has been learned that maintaining a "whole systems" view is equally important for administration. In the first three weeks of the 1994 fall quarter there was at least a 50 percent increase in utilization for the system as a whole and a 100 to 150 percent increase in load for some of the larger servers in the system. This demanded treating ISIS as a dynamic, fluid system. It was necessary to begin "floating" or redistributing services on a daily basis to balance the load across the whole system. This was possible because the system is viewed by the user as a whole, *vis a vis* the SWE interface, and is viewed by the systems administrators as a whole by virtue of the fact that they could match the complete inventory of services to all resources within the system with minimal interruption of services.

A Single Solution Strategy. The development of the Scholar's Work Environment and the Campus Network Operating System have become the organizing principle to all of the ATS organization's attempts at offering technology solutions to the university. Initially, the use of SWE as the avenue for

offering services to the campus came from the ATS organization. Increasingly, however, the use of SWE as the organizing principle for the definition of needs has come from the academic community. Faculty, librarians, and student organizations have all asked to contribute to the extension of SWE services.

In fact, SWE is a wrapper for a fully integrated, heterogeneous, distributed computing system. But faculty and academic planners do not think in terms of "fully integrated, heterogeneous, distributed computing systems." SWE has become a metaphor for describing the information, computing, and communications resources needed to carry out scholarly activities in a complex information environment. It is much easier for students and faculty to define their needs in terms of new services they would like to see as picks from the SWE menus. As a consequence, the focus of all of the ATS work groups is increasingly being driven by extensions to and enhancements of SWE.

"... [T]he real power of technology is not that it can make the old processes work better, but that it enables organizations to break old rules and create new ways of working..."[7] It is believed that the SWE is creating new ways of working for researchers, educators, and students at CSLA. Although quite promising, it is too soon to declare a breakthrough; however, the hope is that this technological enabler will soon contribute to far more efficient and effective outcomes for the community of scholars who are utilizing it.

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[7] Michael Hammer and James Champy, *Reengineering the Corporation* (New York: Harper Business, 1993) p.90.

SERVING STUDENTS WELL SERVES US

Vice Chancellor W. Russell Ellis, Undergraduate Affairs
Tim Heidinger, Computer Services Manager, Undergraduate Affairs
Bjorn Solberg, Director, Student Information Systems
University of California
Berkeley
California

The University of California at Berkeley is taking important technological steps to dramatically improve access by students, faculty and staff to student information. Using mainframe, client/server, and voice response technology, students can enroll in classes, find out their grades, or check their financial aid by telephone, and soon can look at their records from computers at campus kiosks, labs and dorms. This case study of how we got there profiles forces of centralized versus distributed computing that threatened derailment and coalesced into partnership.

SERVING STUDENTS WELL SERVES US

Vice Chancellor W. Russell Ellis:
The first two years in my position as the head of student services on the Berkeley campus I was focused on the issues and concerns of Undergraduate Affairs and its relationship with the campus as a whole. I eventually turned my attention to technology because we were confronted by a number of forces that challenged our traditional methods of providing service to students. My contribution to the implementation of technology within the Division has been to focus the collective expertise, energy and money. Looking back on it now, I see that the forces which came together in the early 1990s forced the evolution of the roles and partnerships between Undergraduate Affairs and Student Information Systems as we wrestled with adversity, change, and technology.

Let me tell you a little about our setting. The University of California, Berkeley, is the oldest campus in the nine-campus University of California system. Situated across the bay from San Francisco, we have a rich legacy of tolerance, diversity, student activism, faculty governance, and independence as exemplified in the decentralized nature of computing on the campus. The campus organizational chart shows the complexity of the administrative structure.

I had been a Professor of Architecture before becoming Vice Chancellor for Undergraduate Affairs, a division which consists of 21 service and administrative units that support the educational mission of the University. These services include administrative activities such as admissions and record management as well as programs providing tutoring, student orientation, summer activities, and teaching improvement. The division works closely with its diverse collection of client groups: faculty, undergraduate and graduate students, staff, and the campus administration. The division's highest priorities are to invigorate students' educational experiences and to facilitate their academic progress, from developing their interest through early outreach, to optimizing their ability to perform in the classroom, to helping to prepare for graduate school or careers.

But by 1991, the campus and Undergraduate Affairs was besieged by a number of trends which I anticipated would become more intense and which could not be ignored.

- budget cuts
- increased student fees
- staff decreasing rapidly as a result of early retirement programs and layoffs
- increased work loads
- the general societal environment was becoming less friendly towards the university
- basic changes in K-12 education due to inadequate financing, overcrowded classrooms, the array of social problems, cuts in college preparatory

> curriculum and high school counseling services which was having its effect on what and how the university provided services

I knew that we had to use technology as a tool for making significant strides forward. Technology had been used for years to automate many of the processes associated with selecting, financing and registering students. We had been making progress at providing students and staff with accurate and timely information, but my vision of technology was not automation. My desire was for students and staff to incorporate technological advances into their view of their roles and positions in a changing world.

In the Fall of 1990, I appointed a Divisional Computing Committee with four objectives:

- Establish a set of goals and directions for Divisional computing to achieve during the next five years
- Establish priorities for use in allocating computing funds during the annual budget process
- Increase the level of awareness by Division managers about computing issues
- Create a division wide commitment to address student service computing needs

The following spring, the committee completed a report about issues and computing priorities for the division. Another committee charged with implementing recommendations of the first committee was appointed. At about the same time, I implemented an overcut in the division's budget to create a computing reserve in order to fund computing initiatives.

In January of 1993, I appointed the Computing Implementation Group, consisting of five persons, chaired by Tim Heidinger, who at that time was the lead programmer in the Office of Admissions and Relations with Schools. My instructions to Tim were to:

> "translate the various reports. . ., the needs of the Division, and other developments on the campus into specific projects which will guide our computing efforts in the immediate future and provide the framework for changing the way we work in the division."

Basically, I wanted divisional staff to be better prepared to provide quality service to students in an increasingly technological world and to work smarter, better and faster.

Tim Heidinger:
I accepted the assignment as Chair of the Computing Implementation Group with great anticipation. However, because all my previous computing experience centered around meeting the needs of a single office, I made a few erroneous assumptions. First, I assumed the Vice Chancellor for Undergraduate Affairs, who after all was my boss's boss's boss, would have much more authority over the Student Information Systems, the department which was synonymous with computing for student affairs units. The second assumption I made was I understood the nature of the assignment. In fact, the reconciliation of the Vice Chancellor's vision for technology with the operational realities of providing service to students is something that challenges me to this day.

On the Berkeley campus the Office of the Registrar, the Financial Aid Office, and the Office Undergraduate Admission rely on centralized computing support for their functionality. Student Information Systems (SIS) provides this support with a combination of mainframe systems development, training, consultation and standard and ad hoc reporting. The offices of the Registrar, Financial Aid and Undergraduate Admission report to the Associate Vice Chancellor for Admission and Enrollment, who in turn reports to the Vice Chancellor for Undergraduate Affairs. SIS on the other hand, reports to the Vice Provost for Systems and Technology under the Provost for Research. As a result, the application of technology to the delivery of service to students has always meant collaboration and dependence between people who do not share a common boss, who may not have the same priorities and who face different organizational cultures and pressures.

The relationship between UGA and SIS is not unlike the relationship between a popular restaurant and its customers. When customers in the Division have computing needs they look to SIS to fulfill the needs. The menu and the number of tables that SIS has to offer however is not limitless and much of the time there is a wait for a table. The relationship works most effectively with advance planning, either in terms of making a reservation or anticipating how long the wait usually is.

I have never liked the idea of waiting for tables at restaurants, even really good restaurants, so early in my life I resolved to learn to how to cook. Not unexpectedly then, when I arrived at Berkeley I quickly became very uncomfortable with how computing support was structured, especially given the volatile nature of the admission process at the time. I started looking for ways to gain more control over my dining options.

I reported to the Director of Undergraduate Admission whose main concern was the timely delivery of management and operational information, not the method by which they were delivered. At the time however, SIS was making preparations to replace our out dated Tandem admission system with a new system that was part of an integrated student database on an IBM mainframe.

Naturally during this transition, resources for new development on the old platform were scarce. In the true spirit of collaboration and while SIS was looking the other way, I began to implement new functionality on the Tandem mainframe. The mainframe functionality that was added, however, was only the routine delivery of raw data, local desktop machines did all the necessary manipulation. With direct access to the kitchen we now had the option to wait in line and be serviced or do our own cooking. In addition, we were much better able to satisfy our craving for between meal snacks. and dishes which were not on the regular menu.

The idea of using desktop machines to manipulate student data was not unique to the admission office or new to SIS. In fact, SIS encouraged the use of extracts and was providing them upon request. In addition, SIS was making plans to further exploit this trend by making all student data available with client/server technology. Not withstanding the technological issues of this new client/server environment, the Division was ill prepared to benefit from it. Never the less, the model was successful in the admission office and I assumed that it was that success which lead to my assignment as the chair the Computing Implementation Group.

In preparation for my first meeting with the Vice Chancellor, I envisioned a discussion about the delivery of a system. A system to provide all the offices in the division with the reports, lists, and labels they needed to provide more efficient and accurate student services. Much to my surprise, the Vice Chancellor was not interested. His concerns were electronic communication, positioning for the future and implementing the recommendations of the Divisional Computing Committee. While I understood what the Vice Chancellor wanted, I could not see how it would help the division provide better service to students.

In hindsight, I was expecting the Vice Chancellor to embrace the idea of opening a fast food restaurant. A different type of restaurant from the one provided by SIS, one which delivered meals much faster and cheaper, but a restaurant never the less. Vice Chancellor, on the other had, did not want his staff to remain customers. He wanted a staff of cooks, believing this to be the best solution to the problem of satisfying their hunger. "Teachers perform the strange magic of doing something important while doing nothing tangible." (Stuart Serman, "Time and teaching, teaching in Time," The University of Chicago Magazine, October 1994: 31)

Indeed, given the direction of technology to a client/server orientation, a new partnership needed to be formed between SIS and UGA. In this new client/server world SIS would no longer be the restaurant, it would be a grocery store. SIS would not be providing meals but the food stuffs necessary to create the meals. It was imperative then, that UGA follow the vision of the Vice Chancellor and learn how to become cooks.

Over the last almost two years now, the Implementation Group has struggled with ways to prepare the division for its new partnership with SIS. Two constraints we had to work under were:

- We had responsibility but no authority. We could recommend, we could discuss, we could train, we could set standards, but no one had to do any of the things suggested.
- We had some money but no staff

Given these constraints, here is a brief summary of the types of activities the Computing Implementation Group has pursued:

- Make recommendations about hardware and software standards as well as providing a central point for questions, referrals and review of departmental technology proposals.
- Implement policy to fund network access for all offices
- Implement policy to fund software training courses for all staff.
- Foster communications by maintaining division wide and specific e-mail reflectors.
- Identify and coordinate the usage of all new types of computing resources available on campus.
  Coordinated specialized training session with the office responsible for computer training.
  Coordinated implementation of divisional usage of e-mail and gopher serviced offered by new central UNIX computer.
- Occasionally, develop something which does not/cannot exist elsewhere on campus. For example, a way to update our gopher server with email.
- Investigate the application of new technology. For example, we have been fostering the development of World Wide Web servers within the Division.
- Explore the security and confidentiality issued involved with the new client/server access method.
- Foster collaboration between the computing staff within the division.

As a result of these activities, the Division hopes to foster an environment where effective conversations about computing can occur, collaborative decisionmaking and sharing of information about computers can be promoted, and the Division can become an effective lobbying group for campus computing. Additionally, with a competent staff who know how to be cooks as well as customers, we look forward to a new partnership with SIS. - each partner accepting responsibility for their part in the world where computing will be delivered within a client/server architecture.

Director Bjorn Solberg

POISED FOR THE FUTURE: Technological advances in central systems

While Undergraduate Affairs was undergoing change in the computing area, SIS was also in the middle of a major shifting in frames of reference and our relationship to the campus. And, although one of SIS' biggest clients, Undergraduate Affairs was only one of several constituents which we were trying to serve.

Currently, at the University of California at Berkeley central student systems are well positioned to meet current and future campus computing needs. Student data are consolidated in an integrated IDMS Student Database. All systems reside on a single hardware platform. Central student systems are interactive and widely used on campus. All central student data are stored in the IDMS Student Database, and most central student systems use this database. From a user perspective, we have a single image system, with data being sharing between systems and virtual elimination of system interfaces. This was not always so. Dramatic advances in upgrading and improving campus student systems has occurred in the last seven or eight years.

HOW THINGS WERE

Central student systems used to be fragmented, reflecting a lack of overall planning. Systems were developed in response to the needs of individual central student service offices. Systems didn't interact effectively, because interfaces were not emphasized in the original designs. The systems were essentially stand-alone systems that were meant to serve a narrow function. Each system had its own files, and there were inconsistencies and redundancy in data between systems. Data were collected by individual systems, requiring students and staff to enter the same data multiple times. At least four different student identifiers were used, complicating interfaces between systems. Systems operated on more than one hardware platform, making it necessary to ship data back and forth between different computers to synchronize data in different systems.

There was disagreement about the future direction of student systems. Proponents of the Tandem minicomputer wanted student systems to operate on the Tandem, and others argued for consolidating student systems on the campus IBM mainframe computer. Student systems operated on both machines, making it necessary to establish a two-way communication between the two machines in order to try to synchronize student data. There were numerous problems associated with this arrangement, including data inconsistencies, confusion about where the most accurate and up-to-data was stored, and the need to do a lot of processing that was aimed strictly at trying to synchronize the data on the two machines. The feelings on both sides were intense, culminating in the

equivalent of a religious war on campus about computing. The dispute interfered with planning and was an impediment to progress.

Two different committees reviewed campus administrative computing and issued critical reports. There was dissatisfaction with central administrative systems. The Student Information Systems (SIS) Department was created as a result of a reorganization of campus administrative computing. When SIS was formed in 1987, we recognized that things had to change in order for the organization to be viable. We attempted to learn from the past mistakes of the central administrative systems department and made the following changes:

-Encouraged collaboration with users
-Emphasized the service role of our department
-Improved productivity by emphasizing development and shifting resources from maintenance
-Initiated a long range planning effort in partnership with users
-Changed the governance structure for student systems giving users the authority to set work priorities for SIS projects

SIS management devoted much time and effort consulting with users about student systems planning and attempted to build a consensus for student system projects.

EFFORTS TO ACHIEVE CONSENSUS

A needs assessment conducted by SIS and representatives of user offices in 1987 concluded that current systems reflected a lack of overall planning. In order to remedy this problem, SIS and Undergraduate Affairs began to do long range planning for student systems. As a result, in 1990 the Student Information Systems model was published, in 1991 the Five Year Systems Plan was issued, and in 1993 the Five Year Systems Plan was updated (available from the CAUSE Information Resources Library-CSD0924). We are working on the 1994 version of the Five Year Systems Plan, which will be published in December.

SIS's strategy for getting agreement on a long range plan consisted of documenting current problems, preparing an objective assessment of current systems, and preparing a plan that was realistic and would solve major system problems. Our plan called for developing an integrated IDMS Student Database, consolidating all central student systems on a single hardware platform (IBM 3090 mainframe computer), and converting to a single student identifier.

NEW GOVERNANCE FOR STUDENT SYSTEMS

In 1989, while working on the development of a new on-line add/drop enrollment system, we started using a new governance structure. A project steering committee chaired by a faculty member (Dean of the College of Letters

& Science Advising) and comprised of representatives from affected offices, faculty, and students was established. The committee was large and had broad campus representation. The steering committee was responsible for determining system requirements and setting work priorities for the SIS project team. This model was very effective and has been used on subsequent system projects. This approach is now always used on systems that have campus-wide application. SIS has benefited from this governance structure, because we are getting clear directions about what is wanted by the campus.

COLLABORATION OF SIS AND USERS

One major reason for our success and progress with student systems is the strong support we have received from users. Early on, the Associate Vice Chancellor for Admissions and Enrollment offered encouragement and support for our planning activities and system proposals. He recognized that a partnership between his units and central MIS had the potential of benefiting the campus. He encouraged other units on campus to participate, leading to the involvement of the College of Letters & Science. We have learned that the combination of the central computing organization and the major student service organizations on campus has been effective in getting campus support for new student service initiatives. The combination of different offices has been more effective than individual offices acting alone. Evidence of this is provided by the fact that the campus approved this fiscal year approximately $612 K in funding for three campus student service initiatives: Tele-BEARS (the touch-tone telephone based enrollment system), DARS (a new degree audit reporting system), and Bear Facts (Berkeley's version of the Mandarin technology based system developed by Cornell University). New funding is hard to get when the campus is facing overall budget cuts.

NEW DIRECTIONS FOR CAMPUS STUDENT SYSTEMS

DARS is a new system that SIS is in the process of implementing. This system is based on a application system package purchased from the University of Miami at Ohio. We are working on integrating the Miami package into the Berkeley student systems environment. For example, we are creating an interface to the IDMS Student Database to obtain student transcript, profile, and enrollment data for the audit report. Degree audit reports will be available on-line as well as in printed form. Since degree audit reports are now prepared manually, the implementation of this system will save much staff work and improve service to students. We are aiming to go into pilot production with this system next summer.

Bear Facts, Berkeley's newest student system, is being developed using the Mandarin technology created at Cornell University with funding from Apple Computer and IBM. In our version of the system, student data will be extracted and downloaded from the IDMS Student Database to a server machine running

ORACLE. The downloaded data will be stored in a relational database using ORACLE, and this database will shadow the IDMS Student Database. The server database will be refreshed on a nightly basis. Students will be able to access their data on the server database using Macintoshes or PC's. Screens providing information about various deadlines, locations of student service offices, transcripts, final grades, billing status, financial aid applications, and current enrollments will be offered to students. Initially, limited updating (e.g., student addresses) will be supported. Most activity will be to display data, with an option to print on a connected printer.

Bear Facts will provide a new way for students to access central student data and will supplement the access to central student data provided by our touch-tone telephone system. It will also provide SIS with a new alternative for future systems development. As we gain experience with the client/server environment, we will assess whether we want to add functionality to the server-based system or shift functions from the IDMS system to the server. We are seriously thinking about the possibility of migrating some services from IDMS to the server machine. We are excited about the prospect of experimenting with different options. This offers us the opportunity to try out a client/server architecture in a situation where risk can be minimized.

Computing technology is developing at a rapid pace. Distributed computing is growing, and this is reflected by the increasing numbers of programmers in user offices. A campus survey completed last year indicated that only about 43% of the staff holding programmer classifications work in the central computing organization. Most programmers are now working in departments. Much of the departmental activity is dependent on using centrally stored data.

SIS encourages user offices to extract and download centrally stored student data, minimizing duplication of work that already has been done. For example, departments do not have to collect data from students since it is already stored in the central database. The central IDMS Student Database continues to be the official student record for the campus, containing the most up-to-date and accurate information. The new ORACLE database will provide a new and more convenient way for users to access central data.

We plan for users to access the ORACLE server database to generate their own reports. Point and click types of front-end tools that generate SQL queries to generate reports will be used by our customers. A convenient means of generating ad hoc reports has been missing in the IDMS mainframe environment, so we are excited about the prospect of being able to offer this new service to our users.

What did We Learn?

- Technology in and of itself cannot resolve "computing" problems; communication and dealing with people effectively are the key to managing this area
- Ask users to help define the problem, issues and solutions
- Working in collaborative partnership can be very effective
- New environments require new adaptations
- In order to move forward, we need both tangible and intangible goals
- By achieving the goal of serving students well, we eventually also serve ourselves

Decision Support at Stanford: Partnering with Users

Joy Mundy
Senior Business Analyst
Information Distribution Services
Stanford University
Stanford, California
Joy.Mundy@forsythe.stanford.edu

Warren Thornthwaite
Program Director, University Data Warehouse
Information Distribution Services
Stanford University
Stanford, California
Warren.T@forsythe.stanford.edu

Abstract

Stanford University has been developing its Decision Support System (DSS) and associated Data Warehouse since the summer of 1992. The primary mission of the team is to significantly improve the University's data-based decision-making capability. We've taken an opportunistic approach to developing a decision support system by focusing on high-value, high-profile problem areas. After a brief context and history of the University Data Warehouse, this paper describes a major partnering project between the University's Budget Office and the DSS team, and ends with a discussion of the lessons we are learning from the project.

Decision Support at Stanford: Partnering with Users

I. Context and History

The Changing Nature of Managing University Business

Schools are businesses. They have revenues and expenses, assets and liabilities, products and consumers. For example, the "market" for research, one of Stanford's major product lines, has been declining in recent years. As a result of this and other factors (such as the Loma Prieta earthquake), Stanford is in the middle of the same kinds of cost cutting efforts that many major enterprises are facing. As resources become scarce, decisions on how to allocate them become more difficult to make. Management at Stanford is inspired to take a new approach and require quantitative as well as qualitative decision making. The following excerpt from a 1993 Board of Trustees presentation sums up the urgency of improving decision making capability:

> "In today's unforgiving economic and regulatory environment, Stanford cannot afford to base decisions on guesswork or partial information. We have immediate needs for reliable, integrated management information to support critical decisions being made right now. At the same time, Stanford must not become so preoccupied with today's pressing demands that we neglect to plan for the future; solutions for today's information needs must be flexible enough to meet tomorrow's needs as well."

Stanford is a major enterprise by all measures (except profit, of course). Our total expenditures across all business units is closing in on $1.5 billion annually. The University has close to 14,000 students and 1,380 full time faculty in 7 schools including a major teaching hospital. We also manage 8,180 acres of campus, retail and office park real estate and a $2.5 billion endowment.

As one would expect, Stanford generates a lot of operational data and is typical in its systems evolution. Many of our legacy systems are "stovepipe" in nature. Although they do a fine job collecting the data needed for their function, maintaining that data and reporting on it, it is very difficult for a business user to combine data from two or more different systems. Stanford's legacy systems use at least five different identifiers for people and three different identifiers for organizations. A report on faculty activity should draw data from the faculty, student, finance and sponsored research systems, but these systems do not communicate with each other. As a result, many major decisions have been made without the help of complete information.

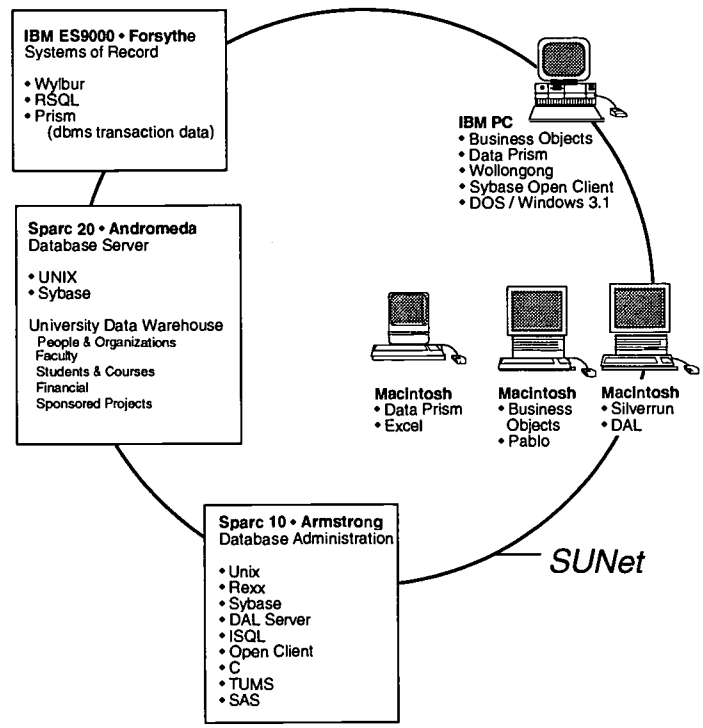
The DSS Project

Two years ago, the Director of the Data Center proposed to the Provost and the Board of Trustees that the University create a Decision Support Systems (DSS) team. Motivated by a history of success with DSS in the Medical School and an understanding of the need for analysis, the Provost's Task Force for Information Systems funded a pilot project to demonstrate the feasibility and value of a

University DSS. This successful pilot project resulted in a charter DSS group charged with the following mission:

> Significantly improve the University's data-based decision making capability by
>
> - providing tools for end users and IS to support ad hoc data access and DSS applications development,
> - providing a single, integrated authoritative source for university decision-making data, and
> - providing examples, expertise and training to help build the University's analytical capability.

DSS Hardware / Software Platforms



The Warehouse Foundation

The Initial Base

Given the emphasis on value, the DSS project has taken an opportunistic (almost mercenary) approach to implementing the Warehouse. Our focus has been on high value problems. We designed an initial framework for the warehouse, then prioritized its development based on the requirements and interest level of several key clients, mostly in the Provost's office.

The initial development of the warehouse's foundation was driven by client requirements, so each new application meant a large behind the scenes effort to create the data structures needed to solve the problem. We relied on business analytical expertise in our group to work with the client in defining the problem. This person would then work with the data team to ensure the available data met the need, or to specify any additional data required. As the base grows larger, the incremental effort for each new use has decreased significantly – in some cases from weeks to minutes.

The Platform

Part of the original charter of the DSS team was to help pioneer the University's use of open, client/server based technology. The Warehouse is Sybase based, running under UNIX on a SPARC 20 (see figure 1). This open client/server systems approach offers the advantages of:

- *mixing and matching off-the-shelf, industry standard, commercial products*—allowing the University to respond more quickly and economically to changes in

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information technology and allowing users to have more choices in selecting the software tools they prefer.

- *separating data capture needs from data access needs*—systems can be optimized for transaction processing at the data capture end and for decision support and analysis at the data access end, without either end needing to compromise.

The desktop platform mix in our user base is about 60% Macintosh and 40% PC compatibles.

The Data

Before we could answer any significant questions, we had to build a database. Drawing from the Medical School's experience, we extracted a core set of data from the University operational systems. A significant amount of data work took place during the extract process: person identifiers were mapped to a unified set, data was aligned by time and organization, history was kept, and certain calculations, aggregations and filters were applied to give the data a business orientation. (See figure 2.)

Operational Systems vs Data Warehouse

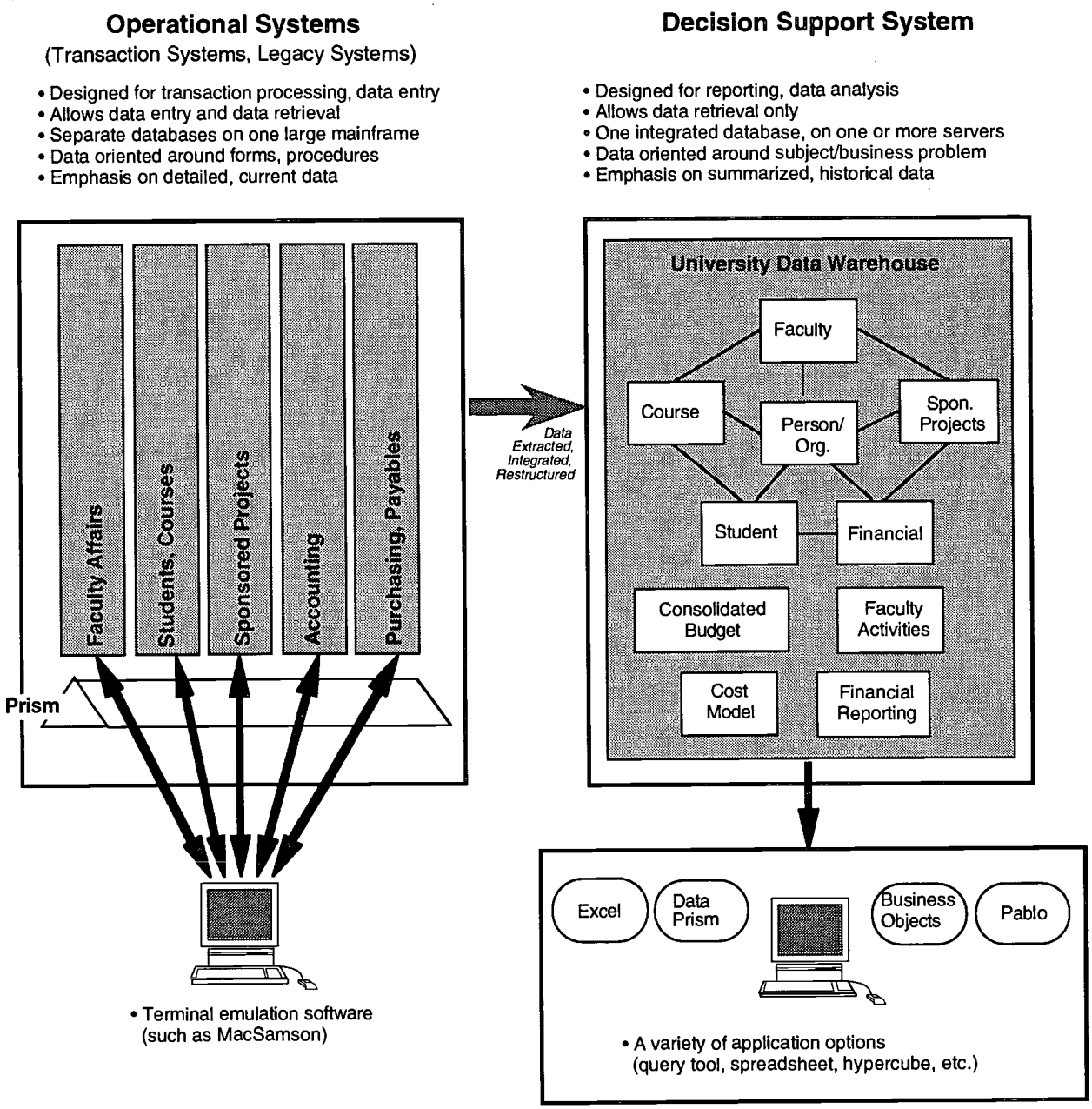

Figure 2

The DSS team built and populated databases containing information about student status and activities, faculty status and activities, sponsored projects, courses and instructors, fund balances, budgets and expenses. In addition, and more importantly the team developed and verified the logical links between these disparate clusters of data. The University Data Warehouse is now the only place at Stanford where there is a generalized way to link information about the same person in different systems. (See figure 3).

University Data Warehouse Contents (as of 8/94)

This diagram includes base tables only, and it does not include decode tables. There are many possible linkages across sectors which are not shown here; e.g. Faculty could be linked to Course Instructor or Major Advisor.

Years Included: FY91..FY94

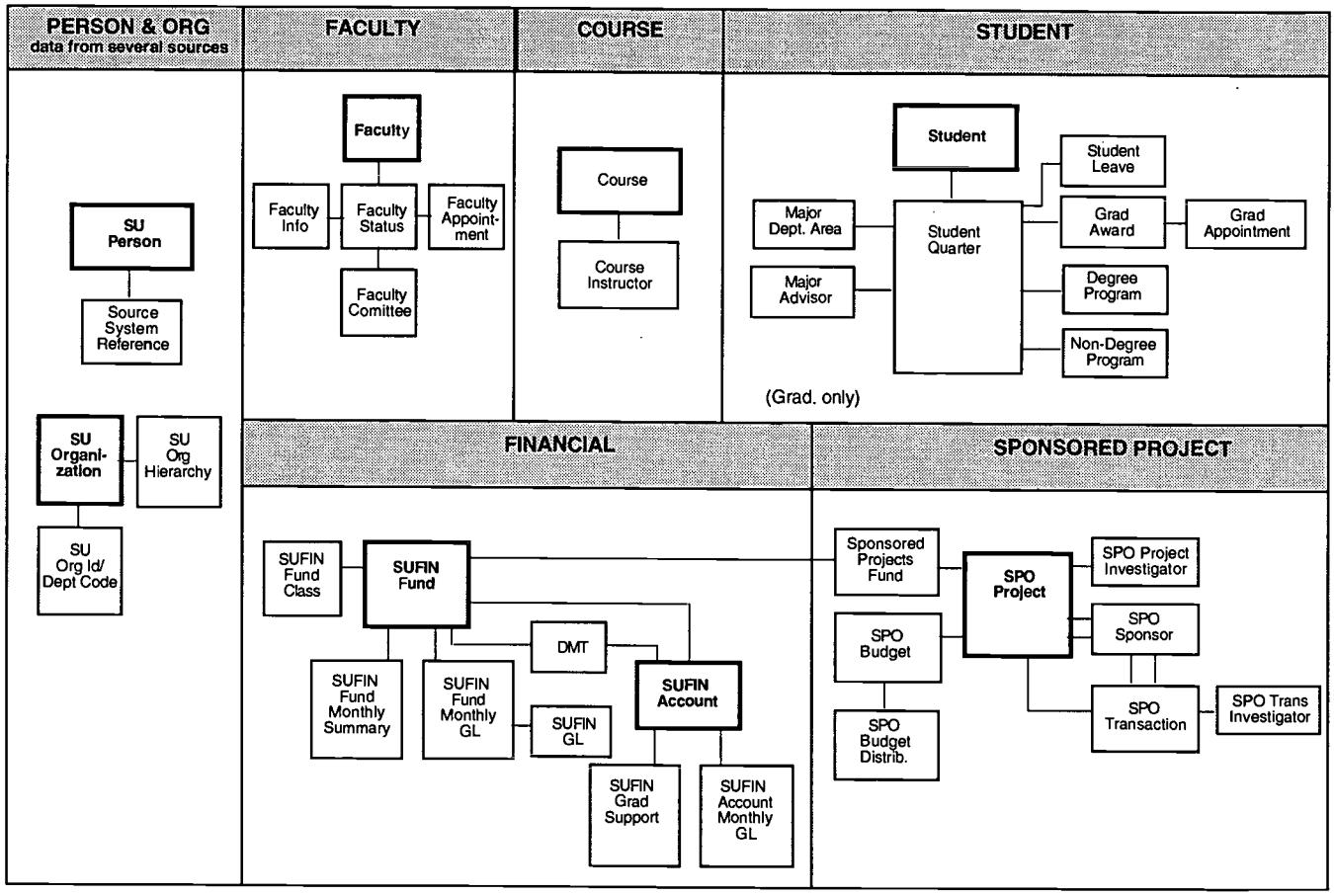

Figure 3

Data Access

Once the University Data Warehouse was populated with tables and data, we tested data access tools for users. We are currently supporting three data access tools: BusinessObjects, DataPrism, and Pablo. The first two tools are supported for both the Macintosh and Windows platforms.

User community

We are in the midst of launching the Warehouse to an initial user community, targeting users in Central Administration, the Controller's Office, the Budget Office, and School and departmental administration. We hope to convince users that new tools will:

- help them to explore the data,
- remove some data "drudgery" from their current reporting requirements,
- encourage creative thinking, and
- be easier to use than legacy systems.

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To succeed we must develop extensive training and documentation, simplify the database, educate users about the data, and make sure the users and database have adequate computing power. The database simplification and data education pieces are much more difficult than one might expect. Simplifying the database reduces the range of questions it can answer, and the search for the 20% of complexity that answers 80% of the general questions is a difficult one. The University is a complex place, and the data it generates matches that complexity. Stanford's academic environment seems to be more prone to complexity than a for-profit institution, and the distributed business environment has led to systems that accommodate many different modes of management. We are still trying to determine if our DSS can be a true end-user environment, or if the complexities of our business, the state of our tools, and the multiple roles that our users play will require us to rely on technically skilled users who act as intermediaries.

The University has invested significantly in the systems that create the source data for the DSS. This source data is essentially a fixed asset and the marginal cost of using that data to enhance the decision making process is relatively small. As we cautiously enter the roll-out phase of the Data Warehouse, we are working with small groups of users who share an interest in a specific subject area, such as sponsored research or graduate student data. Wherever possible, we will capitalize on this interest to motivate users to climb the learning curve associated with querying a complex database.

In many ways, the Consolidated Budget project described in the next section is just this kind of starting point. It is a critical project, so people are motivated to learn; it is similar to existing activities, so the logical leap is not too great; and it is small enough to manage.

II. The Partnering Project: the Consolidated Budget

The projects that the DSS team has undertaken in the past two years span a wide range of analytical complexity and breadth of access. The projects most visible to senior management have required complex transformations of University-wide data, yet the deliverable may be simply a report. We have found that projects at the other end of the spectrum, which deliver flexible access to base data for a broad set of users, are a greater challenge. The project that we will discuss in detail here—the Consolidated Budget project—requires that we work closely with business analysts to provide flexible, accessible data and analysis tools.

Statement of business problem

Stanford has centrally budgeted and controlled only a subset of its activities. The "Operating Budget" of about $450 million covers only 40% of the University's expenses, and encompasses what is generally thought of as the general instruction and operation of the University. Senior management has set out the charge that the University develop a process to forecast, plan, and budget the entire activities of the enterprise, which includes $500 million in sponsored research, and $150 million of expenditures from gifts and endowment that are managed locally.

The analytical problem is that both sponsored research and management of restricted funds are extremely decentralized at the University, as individual faculty members conduct research and control many gift funds. Forecasts and plans, by

contrast, must be developed at the Decanal level, with input from departments who in turn communicate with their faculty. The key ingredients of a good forecast are a clear understanding of past activities, and a reasonable guess about how those activities will change in the future. No application or data can answer the "future directions" question, but helping Deans' and Vice Provosts' administrative staffs better understand their organizations' current and past operations is the DSS team's charter for the Consolidated Budget project.

The data problem has been that the source financial systems were built to manage the University's day-to-day operations, and are designed to report on a relatively narrow set of activities at a time. There is no *technical* reason that the needed reports and analyses could not be generated directly from the source system. Rather, the problems are related to flexibility, ease of use, and scalability, as the Deans' administrative staff explore the financial data, develop ad hoc reports, and run those reports for each department in their School. For example, one of the Consolidated Budget reports would require users to run 6 reports in the existing systems and combine the results.

The DSS and Consolidated Budget support

The DSS team is supporting the Consolidated Budget project for 1994-95 by providing School and VP area administrative staff with data, tools, and training. The base data are five years of detailed yearend financials for each area, and are largely unchanged from the systems of record. We have developed data collections especially for the project, that rationalize, transform, and pre-aggregate some slices of the data. We have developed flexible structures to easily aggregate up and drill down through the different dimensions of the data.

The Consolidated Budget users access the data through an off-the-shelf query and reporting product. Their view of the DSS database is limited by this product to the data collections that were designed specifically for the project. Our users are finding this view of the data useful for a broader range of questions than just the Consolidated Budget.

DSS team members developed a formal training program on the tools, techniques, and data for the users, and we spend a lot of time in ongoing consulting and support. Helping our users understand the tools and data, and to use them effectively, is the team's greatest challenge.

III. The Partnering Process: Working with Clients

Unlike most operational systems, DSS is a service that users may choose to use or not use. As a result, it is particularly important to work directly with the users in all phases of a DSS project, including the fundamental decisions about what data elements and periodicity of data to warehouse. Although it is necessary to receive input, and get buy-in, from a wide range of users, it has been critical to the success of the Consolidated Budget project to work closely with a high-level project owner: the University Budget Office which staffs the Provost. The DSS team relied heavily on analysts in the Budget Office during the design and development phases of the project, and they are lending their expertise during the delivery phase as well.

Application design: Help clients think outside current boundaries

One of the first lessons that the DSS team learned is that users' views of what they want are strongly coloured by what they have. A user who is adept at extracting data from the source systems and who is reasonably facile with desktop spreadsheets, will ask that DSS simply provide an easier way to download 10,000 rows into Excel. Others request that we replicate the standard reports, but make them faster and easier to run. The DSS tools and data can easily accomplish both tasks, but we would be squandering resources if DSS were merely a big database.

Because users are not familiar with the technology, they must rely on Information Systems (IS) staff to propose specific plans for transforming general requests—"I want to explore my financial data"—into an application. The key implication of *users'* lack of familiarity with the technology is that the IS staff in DSS must be hybrids; they must have skills in both business analysis and systems analysis. During the Consolidated Budget project, a DSS analyst met weekly with the Budget Office and target users for two years, in order to learn the details of the business problem that DSS was committed to help solve.

Another lesson we've learned is that in order to provide analytical flexibility, IS staff must develop a toolkit of standard enhancements to base data: standard approaches to slicing, dicing, rolling up and drilling down through the data. Further, this toolkit must be customizable, if not by the users themselves then quickly and easily on their behalf by IS staff. This point follows directly from the earlier statement that users tend to want different instances of something they have already. As soon as you give them a new way navigate through their data, they'll want a slightly different version of the same thing.

The Stanford DSS team developed a generalized approach to building hierarchies atop atomic data as the center post of its data enhancement toolkit. Hierarchies help users to navigate through data, they provide natural paths of aggregation and drill down, and they become subtotal lines in canned reports. The DSS team has developed tools that make it quite easy to develop new hierarchies, and we have even had some success in having users design their own hierarchical structures.

The design phase of the DSS Consolidated Budget project consisted largely of determining upon which atomic elements in the financial data to build hierarchies, and choosing the tools with which to deliver the data.

Application development: Prototyping is the key

Once you've chosen information delivery tools and developed your data enhancement toolkit, prototyping is not just key; it's most of the work. In our experience, DSS tools are well suited to prototyping, and the iterative cycle is easy to manage. Rapid prototyping and development reaps the investment in infrastructure and data alignment that underlies a production Data Warehouse.

The Consolidated Budget project supported the development of many important pieces of the DSS infrastructure, especially the development of the hierarchy tools. Once those pieces were installed, the user access applications were developed over the course of six weeks. We anticipate that future application areas can be developed even more quickly.

A DSS application must balance the need to simplify users' views of complex data and minimize the chances and negative outcomes from "bad queries" with the requirement that the system support ad hoc querying. User tools provide some assistance here, although there's always a tradeoff. We've found that users have difficulty with (1) navigating through the tables and columns of the database; (2) joining tables correctly; and (3) remembering to aggregate when requesting a sum or count. Our choice and use of data access and analysis tools has been driven by our commitment to help users avoid these pitfalls.

Application delivery: Training, documentation and rollout

Training and documentation are absolutely vital, and involve more than just "how to use the system." The training program must educate users about the tools, the data, ad hoc querying and reporting. Users who previously have accessed information only through canned searches and reports may not be familiar with all the dimensions of their data. We have learned that the "value added" information such as our DSS hierarchies were initially confusing to many users.

The DSS team has not been impressed with the quality of documentation that arrives with data access products purchased off the shelf. We have found it necessary to expand upon, or even rewrite, that documentation. As wasteful as such an endeavor sounds, it pales in comparison with the waste of resources that would result if users avoid DSS because they can't drive the tools.

Rollout is considerably more challenging than in the mainframe environment, as anyone who has dabbled in client/server architecture will attest. As a vanguard client/server application at Stanford, we have tackled more than our share of general connectivity and distribution problems. We have found that choosing an access tool that keep most or all of its knowledge about the application (its metadata) on the database server itself is extraordinarily valuable.

IV. Critical Success Factors

The work of the Stanford DSS team over the past two years has led us suggest the following critical success factors to colleagues who are considering building a Decision Support System of their own.

Project value Developing a Decision Support system is expensive; the projects that provide the initial impetus for the system must provide significant value.

Client involvement

- Partnering is mandatory, since DSS is optional.
- Identify a business partner to be the project owner. The person must be engaged and excited about the project, and ideally cannot do her or his job without this application.
- Clients know what they need and how it should look.
- IS staff must work with users to deliver a flexible product in the best way possible.

Client analytical ability — The business partner, and other future users of the application or system, must recognize that ad hoc querying to perform "decision support" is not easy, even under the best of circumstances. If the clients do not have the analytical skills and knowledge to use data that are raw enough still to be flexible, then IS will have to deliver a less flexible and more costly product.

Trustworthy data — The data upon which DSS applications are built must be

- available within a single system,
- clean (error-free, with referential integrity), and
- aligned across the various sectors.

Technology — DSS applications should use off-the-shelf products that adhere to industry standards. The technology in the user access area is changing rapidly, and everything you design and build should be modular and reusable.

V. Next Steps and Challenges

Users

Our biggest challenge is user acceptance (another phrase for organizational change). Downsizing over the last few years has hit the administrative community hard. Fewer people are trying to do the same amount of work, and any new tool with a learning curve must have a major obvious payback in terms of time savings in the long run. With DSS, this payback is not always obvious (or it would have been seized by now). The real return comes in making decisions or finding problems that are not even on the table today.

Education is a big part of gaining acceptance. Documentation on the data and use of the tools is weak. We are working hard to fill it in, but the task is massive. We also need to investigate alternative delivery vehicles for this information. The World Wide Web has several advantages, like a single set of source documents, and multi-platform readers developed by third parties. It also means converting our documentation into HTML.

Data

As we expand our user base, we will continue to expand the contents of the Warehouse. We are in the process of reverse engineering a user-driven logical model for the DSS database that we'll use as our guide to filling out the database contents.

Infrastructure

Early on, we built a metadata driven utility called Table Update and Maintenance System (TUMS) on the UNIX side which drives our current loading process. Over the next 12 months, our challenge is to automate the full data load process, combining the mainframe piece and the UNIX/Sybase piece into a single job stream.

We have been disappointed with the immaturity of current job control products that bridge the two environments.

In general, we need better tools, both for the data access side, and the data management side. There are literally dozens of data access tools available. Many of them have useful features. Most of them are in the process of growing up from desktop roots—they do not handle many of the enterprise issues well. Capabilities like distribution and management of reports, security, version control and so on are difficult or impossible with most of today's data access tools.

Data Administration

The need for a Data Administration function became clear when we began to develop a data warehouse. Many of the source systems collect information without proper data edits in place. In many cases, these were actually removed to improve the transaction time because they were not critical to the system's function. Many others are free-form data entry, and need to be manually aligned with other data sources. Stanford has recently adopted a set of Information Systems Principles which call for operational systems to recognize their requirement to meet broader University data needs as well as the specific needs of the business function. Some day, our source systems will generate data with the same codes and references. Meanwhile, we continue to clean up after ourselves.

Security

The warehouse faces the same general security issues as all client/server applications. The data has to be secure both at the source, and across the network. The warehouse also has the added complexity of protecting confidential data from a broad range of users at all levels in the University. Stanford is very careful about who can see what data. Implementing security in the warehouse has not been easy. At this point, we are confident about our security set up, but its administration will become an increasing burden as more users come on-line.

Part VI. Conclusions

In the initial phases of our project, our group provided extensive analytical expertise so that we could understand problems from both a business and technical point of view. We must continue to be responsive to the requirements and capabilities of our user community or we will fail. We know the textbook formulas —that is, we are familiar with the checklists and guides and seminars on how to build a data warehouse. These are helpful, but success will ultimately depend on organizational culture and individual attitudes. In our case, economic realities are forcing a cultural change. If we can help people handle that change better, we will be successful.

Partnering is critical to the success of any DSS/data warehouse effort. If users are not brought into the process, they will not use the product and they will not be able to articulate the value of the system. Without an understanding of the value, one of the University's largest assets will "rust" away unused in the back rooms of the computer center's disk farm.

Implementing a Kiosk-based Campus Information System at Community Colleges: Three Case Studies

Dr. Stephen Jonas
Vice President for Administration
Sinclair Community College
Dayton, Ohio

Mr. Stephen Megregian
Vice President
Brevard Community College
Cocoa, Florida

Mr. Gary Wenger
Executive Director, Computing and Information Systems
College of DuPage
Glen Ellyn, Illinois

Dr. Judith W. Leslie
Senior Vice President
TRG, Inc.
Phoenix, Arizona

Ms. Darlene Burnett
Senior Consultant
IBM Corporation
Durham, North Carolina

This paper presents case studies of three community colleges that implemented a campus wide information systems (CWIS) using touchscreen kiosks. The three colleges cumulatively offer students approximately 20 kiosk encasements on campus for access to the CWIS. Although the three college executives who participated in the development of this paper have differing responsibilities, each assumed an important role in the CWIS's implementation. Because each institution had a distinct rationale for implementing the system, each college's CIS has unique features. This paper will describe the complete implementation project, from involving various administrative departments to define the CIS's functionality, to reporting on its effectiveness. The paper also includes the featured institutions future plans for the system.

Introduction

I. Purpose

We experience changes in our environment on a daily basis. As the warm sunlight fades each day, we adapt to the coolness of dusk. As the seasons evolve throughout the year, we find pleasure in each period's renewal. We welcome the brisk days of Fall, the serenity of a light snowfall, and the renewal of a colorful Spring. Because we have experienced these environmental transformations, we are able to prepare for and adjust to them. Our preparation enables us to experience the changes without feeling disrupted by them.

However, when we sense impending changes in our professional lives, our anticipation is sometimes embedded with anxiety. Is our anxiety the result of not having yet experienced what the change will bring? Could it be that because we are not certain how the change will affect our lives, we are reluctant and sometimes resistant to the change? Is it because we do not know how to prepare for what we have not yet experienced? All of us can acknowledge that, just as the time of day and the seasons change, the institutions at which we work change. Because our work environments change, our professional lives change. To decrease the stress related to the changing seasons in the workplace, we need to gather information and knowledge regarding what the change will be. By preparing for our professional changes, we may even welcome the evolving season.

The colleges and universities that have emulated many of the characteristics of the industrial model of organization are beginning to adapt to a different season. Some of the more important change catalysts are as follows: (1) the emergence of "consumer diversity and sovereignty," (2) the dwindling and shifting portfolio of financial resources, (3) the exponential expansion of information, (4) the imperative to achieve a higher quality quotient, and (5) the insatiable appetite for more and better technology.

It is not the purpose of this paper to determine which of these change catalysts was first and/or is more significant. What is relevant is that these factors interactively result in a barometric change that signals a new season for colleges and universities. The purpose of this paper is to share information that illustrates how three institutions -- College of DuPage in Glen Ellyn, Illinois; Brevard Community College, in Cocoa Florida; and Sinclair Community College in Dayton, Ohio -- are anticipating and adapting to this changing season. In particular, the paper will describe how the community colleges have employed the strategy of optimizing the use of information and technology-based tools as one of the ways in which to prepare for the new environment.

II. Rationale

The authors prepared this paper based on the premise that the more information that is shared among higher education institutions, the better we can envision the new environment and anticipate the next season. The featured institutions share many common characteristics with other institutions that have implemented similar systems. However, their efforts and results differ because of the unique combination of a set of characteristics that are described as follows:

A. Common Mission: The mission of higher education institutions is focused upon instruction, community service, and research. Within higher education, community colleges' focus their mission on instruction and community service, and are particularly concerned about student development and retention. Accordingly, the featured institutions employed technology to focus primarily upon service to students. In some cases, the institutions also involved students in the design and testing of the system.

B. Collaboration: The featured institutions employed a collaborative methodology both internally and externally. The institutions planned and executed the projects internally through a collaborative effort that joined employees from multiple departments who had not previously worked together, and at some institutions, students. They also planned and executed the projects with two external business partners: TRG, Inc. and IBM. They acquired *TRG-Intouch*, TRG's campus-wide information system, and services. Some also implemented IBM's kiosks and RS/6000s.

C. Technology Integration: The featured colleges based the project on the integration of technology with many different capabilities. These include communication between PCs, servers, and hosts over the network; access to student information systems on a variety of hosts; and the ability to access Gopher servers. The technology also varied in the presentation of information with formats such as textual, graphic, animated, and multimedia. The integration of technology also featured the inclusion of capabilities such as printers and touch screens. Some of the featured institutions also plan to integrate card readers to increase the number of business transactions that students and other users can conduct.

D. New Uses of Information: The taxonomy of capabilities resulting from the information contained in the system is broad, encompassing for example: the passive viewing of information regarding programs, personnel, facilities and services; interactive searching and matching of personal characteristics to resources such as scholarships; and iterative answering to adaptive questioning to provide a customized recommendation regarding a course of action. One of the featured institutions pioneered the design and integration of an expert system for advising. Representatives of this institution collaboratively worked with counselors, advisors, and students for a two-year period to identify the numerous factors that they needed to consider when advising students. They focused on areas in which students frequently request assistance such as how many credit hours to take and which major to select.

E. New Information: The featured institutions are utilizing a component of the *Intouch* software that records utilization statistics and generates reports. Using this information, the institutions can collect information about their students. For example, the institutions can better understand the types of information that students most want to access, and the frequency, dates, and locations at which they access the information. One institution also has done a demographic analysis of the students who access information using the kiosk. Thus, while providing a service to students, the institutions are able to collect information about their students. Institutions can use the reports to continuously plan what information should be available to students and in which locations. The information also has assisted one of the institutions to develop a cost justification for the system. For example, they can compare the number of hours that the kiosk provides

information compared to the number of hours that staff can provide services and information. They also can then equate the cost of staff providing information versus a kiosk providing information.

F. Enhanced Professional Roles: The featured institutions also were concerned with limiting the number of routine tasks required of their staffs to serve the institutions' increasing student bodies. Their intent was to "free-up" staff from providing access to routine information so that they can focus upon the specialized needs of students in a "consultant" role rather than an "information intermediary" role. Some counselors suggest to students that they first visit the kiosk and use the counseling module before scheduling a formal meeting. Because the system provides preliminary information, it frees counselors and other staff to meet with students who really need or want human interaction.

G. Student-Enabling: The final characteristic shared by all three colleges was their interest to provide a solution that enhanced service to students. The institutions also found that the kiosks enabled students to become as pro-active as they needed and/or wanted when accessing information about themselves, their courses, and other institutional categories. The colleges recognize that many of their students may enroll in classes at their institutions and have very little interaction with counselors and other staff. The reasons may be that the students have busy schedules with work and home responsibilities; that the students might have had an unpleasant prior experience; or that they are uncomfortable meeting with "strangers." The institutions wanted to use technology to provide students with another option for accessing information.

III. Featured Case Studies

Although the community colleges featured in this paper vary in size and location, all share the mission *to effectively employ technology to address issues affecting higher education*. Each institution has uniquely introduced a campus wide information system (CWIS) using touchscreen kiosks. They represent three different stages along a continuum from planning to fully implementing and evaluating.

The College of DuPage acquired the *Intouch* software in February, 1994. Since that time, they have used a committee approach to plan and implement the project. The authors will describe DuPage's current status to illustrate to other institutions how one methodology is working to begin the continuum. Brevard Community College (BCC) purchased *Intouch* in June, 1992 and is in the piloting phase of implementation. BCC will share their results to this point in time as well as how they plan to move to full implementation. Sinclair Community College (SCC) began a unique project in 1990 which resulted in acquiring *Intouch* in December, 1992. SCC has implemented the software, expanded the number of kiosks, and has robust plans for additional enhancements. The authors will concentrate on SCC's success with the project which has provided new insights to other institutions into the changes that may occur when implementing a CWIS.

Case Studies: College of DuPage

I. Rationale

Located in Glen Ellyn, Illinois, the College of DuPage (DuPage) acquired *TRG-Intouch* software and IBM hardware in 1994. There were a number of factors that contributed to DuPage's interest in implementing a campus wide information system (CWIS). First, with five regional centers, DuPage needed to provide convenient access to information from multiple locations. Second, recognizing the capabilities of a CWIS, DuPage determined that they could integrate information from a variety of sources and make it accessible through kiosks. Third, with a relatively small staff to serve DuPage's large student body of approximately 36,000 students, DuPage wanted to find other ways for students to directly access routine information. To address these identified factors, DuPage organized an Information Distribution Task Force (the task force) with the following mission: *"To develop a plan for information distribution on and off campus to provide easy access to information for faculty, staff, and students."* The task force reviewed all forms of information distribution, both on and off campus. To help determine the information needs of faculty, staff, and students when arriving on campus, the task force distributed a campus survey.

The results of the survey defined a lack the following information tools: an appropriate campus maps and signage, a campus directory of staff and departments, and a single point of information for campus events and activities. These results provided a focal point for the task force to address the needs of DuPage's student and community residents with the following recommendations: signage on all campus buildings; campus maps at high traffic entrances; information kiosks at all entrances; and computer-based kiosk in high traffic areas. In addition, the task force recommended a five level kiosk design for the various entrances at the college. The levels range from level one that features a floor plan of building to level five that features a floor plan, a wall directory with campus brochures, a computer-based kiosk, and a staffed information booth. Through the recommendations of the task force the college included the computer-based kiosks in the Information Technology Plan. DuPage budgeted for four kiosks in the high traffic areas of the campus in the first year and plans to evaluate the kiosks' effectiveness to determine future needs.

To initiate the task force recommendation of implementing a computer-based kiosk, the MIS department evaluated commercially available CWIS based on design, architecture, functionality, vendor support, and costs. The department also investigated the option of internally developing a system. When they evaluated TRG, Inc.'s solution, they found that they were able to combine the strengths of commercially maintained and enhanced software with the internal creativity and expertise of DuPage's Information Systems staff. DuPage purchased a single license of *Intouch* in February 1994 as a model to prepare various application examples to determine the campus "fit" for the system. DuPage's intent was that their staff would continue to develop the applications using the same development environment and architecture as *Intouch*. Two information systems staff were selected to receive training in ToolBook, the base language for *Intouch*. After training they assembled a team to work with TRG to install and develop the model applications which included access to the IBM mainframe student system, human resource system staff directory on a LAN, and campus maps with graphics. This provided the information systems staff a base to

develop additional applications. In June 1994, the system was demonstrated to the Information Distribution Task Force.

II. Implementation

Following the successful demonstration to the initial Information Distribution Task Force, DuPage employed the implementation model of collaboration by establishing another task force to focus on the implementation of *Intouch*. This committee is composed of thirteen members that include all the key institutional support areas. They first met in July 1994 to receive a demonstration of *Intouch* and to determine the project activities and time frame. The activities included the definition of a menu structure and the type of information to offer students. In addition the group determined the kiosk locations and the design of the kiosk enclosure. They also prioritized the tasks and assigned responsibilities for each of the major activities. The committee reached a consensus built at each critical milestone.

Over the next several months, the committee then engaged in the process of identifying the type of information to make available to a maximum of four levels on the kiosk. The first level included the following: Academic Information; Admissions, Registration, and Records; Advising, Counseling, and Testing; Calendar and Events; Campus Maps and Directories; Community Services; Employment; Financial Aid; Health and Special Services; and Student Activities. The committee currently is prioritizing these ten menu items to determine the order and time frames to implement this information. The committee next defined the next three levels of each menu of the CWIS. They currently are defining the type of application information to include behind each menu selection.

III. Future Plans

DuPage plans to make *Intouch* available to students and community residents by Summer, 1995. Later this Fall, students will have the opportunity to enter a contest to name the new system. DuPage will install four kiosks, located in the following settings: the entrance of a new addition to the Student Resource Center that is currently under construction; the existing Student Resource Center; and the Open Campus Center which is used for community and business events. The committee is confirming the location for the fourth kiosk and is considering either the Instructional or Art Center.

DuPage also has planned for completion of an enterprise network by the Summer of 1995. This network will tie together DuPage's five regional sites and central facility. DuPage is building the infrastructure to provide easy access by high schools and public organizations within the district. DuPage selected this type of design to permit the placement of kiosks at the various locations. Since the college has upgraded its initial purchase of one *Intouch* license to a full site license, DuPage will be able to provide campus wide access from all faculty and staff offices, and student labs. DuPage also plans to take advantage of the system's capabilities to provide generalized access to many different types of information to improve campus communications. DuPage plans to install four kiosks per year. Ultimately, DuPage will make *Intouch* available at locations throughout the whole county that it serves. DuPage plans to provide information on these kiosks

that expand beyond their current CWIS to include all relevant student-related information that the committee determines is appropriate.

Case Study: Brevard Community College

I. Rationale

Brevard Community College (BCC), serves more than 14,000 students at four campuses located in Cocoa, Melbourne, Titusville, and Palm Bay, Florida. The driving imperative to acquire a campus-wide information system (CWIS) was to support the recruiting process. To do so, BCC will make the software available at numerous convenient locations, including employer sites, shopping malls, and surrounding high school guidance counselor offices. By providing comprehensive information about BCC in an appealing and convenient manner, BCC anticipates that they will be able to attract many additional students.

II. Implementation

BCC used a prototype model for initial test implementation. Using TRG's *Intouch* software as a base, a talented programmer developed a prototype customized to BCC. Various college departments reviewed the prototype. BCC incorporated the suggestions from the college, as well as new ideas gleaned from other external sources into the software. BCC completed the initial phase of the project and installed the prototype kiosk at the Student Center of the Cocoa Campus in the Spring of 1994.

III. Results

Once the prototype was in place, BCC asked kiosk users for input and reviewed screen utilization statistics. BCC's executive staff found the feedback to be very valuable because it provided specific suggestions for enhancing the way students and other users accessed information from the kiosk. For example, the college learned that a bigger touch screen was needed, that the processor needed to be faster, and that the kiosk itself needed to be more attractive. Subsequently, the college upgraded to more powerful PCs with a larger touchscreen and purchased attractive kiosk cabinets. Shortly after the start of the Fall 1994 semester, the college installed the enhanced personal computers in the new kiosk cabinets at the Student Center of all four college campuses.

IV. Future Plans

BCC's next milestone for its project is to install kiosks at the local public school system. BCC's executive staff are currently in discussion with a local high school and anticipate that the first BCC kiosk will be in place at this local high school within the next 60 to 90 days. When this installation is complete, BCC will have realized its initial goal of providing convenient access to comprehensive information in an appealing manner to attract additional students to the institution.

BCC's plans expand beyond its initial goals. BCC is confident that the *Intouch* system has the potential to open up a new era of information dissemination at the college. For example, BCC has

stored over 8,000 lines of information in the system that students are able to access. BCC will add five to ten kiosks per year to increase the number of locations where students can access *Intouch*. Another dynamic new capability that BCC plans to add to its CWIS is to incorporate video disk capability and feature short clips of the various performers appearing at BCC's performing arts center. BCC's next release will build upon the presentation of video clips by interacting with card reader technology. This will enable students and others to use their credit cards to buy tickets for the performances that they had just previewed. Since *Intouch* can interact with printers, the kiosk will then instantly print the purchased tickets.

Case Study: Sinclair Community College

I. Rationale and Implementation

Of the three featured institutions, Sinclair Community College (SCC) is at the most advanced stage of the continuum. SCC's initial goal for its campus-wide information system was to augment the college's ability to advise its diverse and growing body of 20,000 students. Its student-to-counselor ratio of 1000 to 1 motivated one counselor to investigate other options. His investigations resulted in a project referred to as CWEST (Counseling with Expert System Technology) that eventually became integrated within TRG's *Intouch*.

During the first few years of the CWEST project, a group of volunteers led by artificial intelligence specialist, Dr. Kathryn Neff, and counselor, Mr. Gordon Robinson, developed a prototype of the system. Taking the information that counselors consider when advising students and how counselors weigh the different factors during the session, the team reformatted that information into an expert advising system featuring two advising modules. As the team progressed, they recognized that other modules could enhance the services offered by the advising modules. Since SCC's policy is to not write its own software, the team decided to find an external partner that marketed a system that would complement their counseling modules. In December, 1992, SCC formed a partnership with TRG, Inc. TRG's team worked with SCC to integrate the functionality of *Intouch*. SCC launched the new system during the late Summer of 1993. An imperative of SCC's executive staff was to have a sufficient number of kiosks so that students would be able to find them anywhere on campus. SCC initially acquired six IBM kiosks and now has 13 kiosks located throughout the campus. In summarizing the project, SCC notes that it was driven by users, not information systems staff, to ensure that "need," not technology, was the focus.

II. Results

Quantitative data show that SCC averages over 1,500 users per month per kiosk. According to the observations of SCC staff, it appears that most people will select two or three main menu items in one session. SCC's utilization statistics and transactions counts measured from April 1994 through October 1994 are featured in the **Appendix**.

SCC conducted a demographic analysis of SCC's kiosk users during the Spring 1994 term. The study concluded that *Intouch* kiosk system is reaching a broad spectrum of students: men and women of all ages, ethnic backgrounds, majors, and academic disciplines. The report titled, "Who's Using the Kiosks?" notes that 6,480 different students, representing 35% of the institution's total Spring enrollment, accessed their personal records (from SCC's student information system) at least once during the term. The utilization statistics revealed that the kiosk users were slightly younger (age 28.4 compared to 32.8 for all SCC) and more likely to be male than the average student, although the system has been accessed by students ranging from age 13 to 83 with 36% of the kiosk users over age 30. The report demonstrated that all ethnic groups are well represented and, in particular, SCC's African-American population. Additionally, the statistics showed that kiosks seem to attract students who are somewhat more dedicated and academically successful than the overall student population, as indicated by kiosk users having slightly higher grade point averages and higher credit hours loads than the general student population. An actual kiosk user distribution breakdown by major closely parallels that of SCC's overall breakdown by major.

To provide a basis for judging the cost effectiveness of *Intouch*, SCC has attempted to compare kiosk costs with human academic advisors and with printed items such as catalogs and brochures. SCC determined that a kiosk costs approximately $600 per month: about one third the cost for people to do the same tasks. Also, each kiosk is available for use about 390 hours per month (15 hours per day, 26 days per month).The annual cost of the kiosk system can be broken down to $2.16 per student or just $.30 per interactive session. Compared with the costs of delivering information and advisement through more traditional channels, for example, catalogs ($1.58 each); brochures ($1.00 each) or 30 minute sessions with an academic counselor ($11.75 each), kiosks are proving to be very cost effective.

During the nearly one and a half years that the kiosks have been used on campus, student usage has increased dramatically More than 6,400 students requested information via *Intouch* in the spring quarter, 1994. SCC is observing other positive results that that are not directly cost-related. These include the convenience for students since no appointment is needed to use the kiosks and they are available at all hours and at multiple locations. SCC also had found that there is a consistency in the information provided that is more up to date than printed materials. Also, the information is provided in a manner that is unbiased with respect to race and gender. Additionally, SCC officials believe that the frustration students can feel when they are caught in administrative red tape is reduced when they get assistance immediately from a kiosk. By SCC's being more responsive to student needs, the College feels that it has made the campus a better learning environment.

III. Future Plans

SCC recently has expanded the applications available from *Intouch* to include textbook listings and an interactive quiz regarding distance education/independent learning. SCC's plans to add the following additional functionality to the system: online registration, credit card fee payment, course recommendations, degree audit program requirements, transfer information, course planning guide, financial aid status, textbook ordering system, and campus ID card applications. SCC also plans to incorporate the State of Ohio Bureau of Employment Services job opportunity

database, JobNet. To increase feedback from students, SCC plans to incorporate functionality for students to complete mini surveys, "opinionnaires," and log complaints. SCC also wants to serve students and other users by adding the ability to access employee applications and personnel-related documents. Longer term, SCC plans to incorporate access to a Gopher server, voice recognition, desktop conferencing, and the presentation of information in multimedia formats. SCC plans to reach new students and community members with its enhanced *Intouch* system at off campus sites including malls, Wright Patterson Air Force Base, high schools, and neighborhood centers.

Summary

The three institutions featured in this paper represent how colleges can collaboratively use information technology to anticipate and prepare for change. Equally important, the College of DuPage, Brevard Community College, and Sinclair Community College are helping to create the new season. Although representatives from the institutions experienced challenges throughout the processes, they are making important advances in creating a student-centered environment. The following is a sample of benefits that they have noted to date and anticipate experiencing in the future.

A. Student Success: By installing a CWIS on their campuses, the featured colleges have provided students with access to a large volume of information in a convenient manner that adapts to the students' schedules. By reducing students' frustration over standing in long lines to conduct transactions and overall administrative "red tape", the colleges are using CWIS's to help create an environment for their students to succeed. By using kiosks, the colleges are able to expand the "points of service" for their students. Because the colleges want to decrease the potential of drop-out due to financial reasons, the colleges are providing students with access to information regarding college costs, financial aid, and scholarships. The featured colleges also are interested in assisting students to navigate effectively through institutional processes, such as registration, add/drop, and graduation. To accomplish this goal, the colleges are providing information regarding campus events and institutional policies and procedures. To help new students better assimilate to the college experience, the colleges are providing them with easy access to locations of classes, faculty offices, and services. This information is being made accessible in a manner that is both consistent and unbiased with respect to ethnicity and gender.

B. Employee Professional Development: The featured colleges also are striving to create a work environment that enhances their employees' professional development. For example, representatives from their technical staffs became trained in new tools and the latest technology to creatively design and develop unique applications and additional *Intouch* applications. They also are gaining experience in the RISC technology with IBM's RS/6000 servers, in card readers, in multimedia, and in ToolBook. In addition, staff who are not directly related to the implementation project are also experiencing a positive change in their work environment. Since the kiosks are able to address many of the routine requests that staff who provide student-related services formerly answered, these staff members are able to reallocate more of their time from information access and dissemination to student consultation activities.

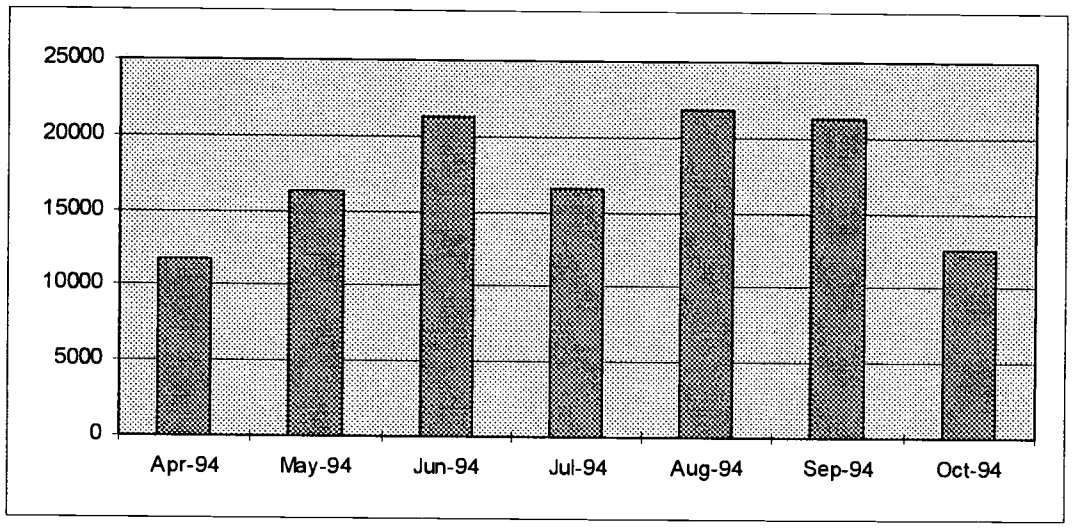
C. Institutional Competitiveness: Another benefit that the featured institutions are realizing is in the area of institutional competitiveness. Because the colleges are striving to quickly and conveniently serve all of its student body, they hope to use their CWIS to enhance their ability to attract and retain students. When new students visit their campuses, the colleges are able to reflect a progressive image with touchscreen kiosks. The featured colleges also are investigating additional off campus sites to install kiosks for access to *Intouch*. Shopping malls, local high schools, major employers, military bases, and city libraries are just some of the locations that the featured colleges are investigating to attract students and increase awareness about their offerings. Since the colleges are generating utilization reports, they can use the reports to tailor the CWIS features to best serve the various target audiences. The colleges also are using these reports to provide more informative documentation to the administration regarding how the institutions are expending their funds to serve their students and communities.

Although the College of DuPage, Brevard Community College, and Sinclair Community College are pleased with the outcomes to date, they recognize that the continuum is infinite and that there are many significant steps ahead. The colleges plan to create further changes when they use the technology for additional purposes. They plan to conduct even more business transactions through *Intouch* such as registering students; paying for tuition and fees; ordering and paying for textbooks; selecting, paying, and obtaining tickets; inputting applications; and initiating transcript transfers. When the colleges use voice and multimedia technology more extensively and interactively, institutions also will gain additional new insights. As the featured colleges join with some of TRG's other *Intouch* partners who are providing their users with access to information from Gopher servers and in the future from World Wide Web servers, the students at the featured colleges will have universal access to the Internet and their available information resources will exponentially change. In conclusion, the environment serves as a catalyst; information is the resource; technology is the tool; new processes are facilitators, and people are the creators.

Special recognition is extended to TRG, Inc.'s Maureen Tuskai, Manager of Corporate Communications for her editorial assistance.

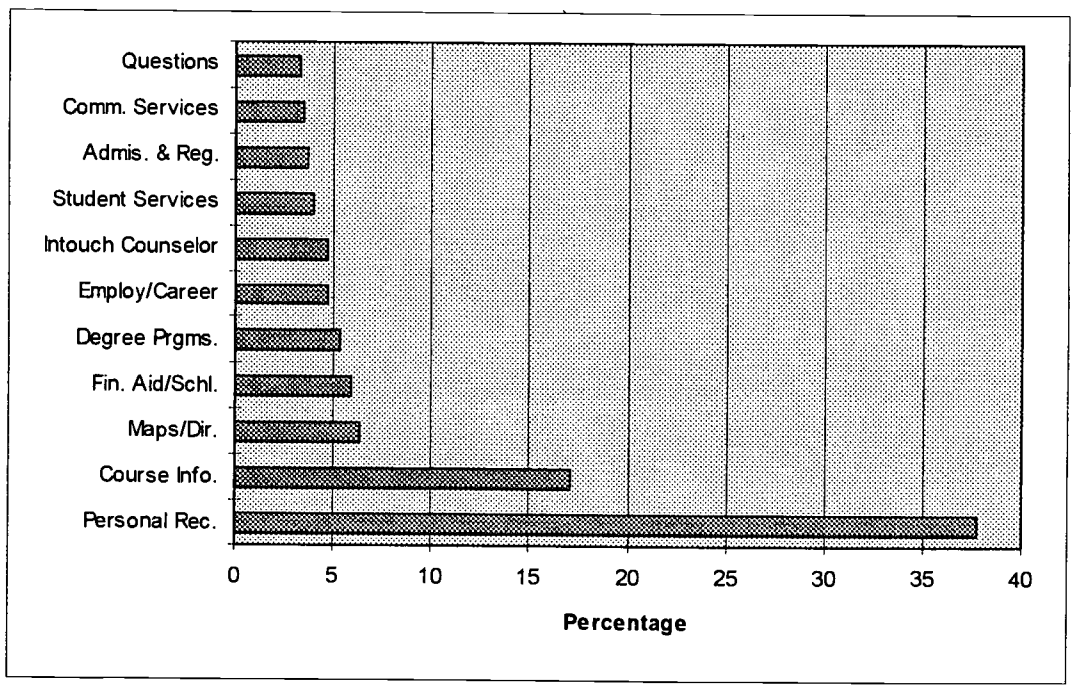
Appendix

Sinclair Community College's Kiosk Utilization Statistics - Total Transaction Counts from April through October 1994



note: April - 10 kiosks on campus; May - 11 kiosks on campus; June to October - 12 kiosks on campus

SCC's Kiosk Utilization Statistics: Average Percentage of Menu Items Selected from April through October, 1994



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