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ABSTRACT

Six papers from the 1990 CAUSE Conference Track VIII: Managing Distributed Computing are presented. Authors discuss the challenges and opportunities involved in providing user managers with direct access to institutional databases to support their decision making and planning activities. Papers and their authors are as follows: "Rendering an Academic Technology Vision" (Anne Knight and Phyllis Mitzman); "A Framework for Distributed Decision Support" (Lewis A. Carson, Richard D. Howard, Jeff N. Hunter, and Brian J. Kemerait); "Distributed Information for Decision Support: Standards and Processes (Summary of Panel Discussion)" (Richard H. Howard, Gerald W. McLaughlin, and Karen L. Miselis); "Coordination of Distributed Activities" (A. Wayne Donald); "Contiguous Information Systems at the University of Hartford" (Morris A. Hicks); "Campus-wide RDBMS: A Search for Partnerships (Abstracts of Panel Discussion)" (Daniel A. Updegrove, Robert L. Pallone, Drusie Sheldon, and Karen Miselis). (GLR)

Challenges and Opportunities of Information Technology in the 90s

Proceedings of the 1990 CAUSE National Conference

TRACK VIII
MANAGING DISTRIBUTED COMPUTING SERVICES

November 27 - 30, 1990
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NOVEMBER 27-30, 1990

TRACK VIII

MANAGING DISTRIBUTED COMPUTING SERVICES

Coordinator: Alice Hunt, University of California / Santa Cruz

User managers are demanding direct access to institutional databases to support their decision making and planning activities. The resulting distributed computing brings a unique set of challenges and opportunities, which are the subjects of the papers in this track.

Rendering an Academic Technology Vision

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ABSTRACT

Within a decentralized, academic environment, a central computing organization faces great challenges. It is expected to play the role of optional service provider, educator, facilitator, collaborator, persuader. Computing services are distributed unequally among Harvard's eleven Schools, and the central computing department plays a vital role in infrastructure planning.

This presentation will focus on how Harvard's central computing organization tries to clarify and identify an academic information technology vision for faculty. Three studies of Harvard's technology uses and needs conducted during the past two years lay the foundation for the vision. Recommendations and plans for providing computing support services based on these studies will be described. Existing technology-based academic projects at Harvard will be analyzed in order to identify commonalities in the development process, paths for collaboration, and areas where support is required. Collaborative efforts between central computing and the Schools serve to expose, inform, train, and support faculty who use technology for teaching and research.

Introduction

Taking the steps to render an information technology vision for an academic institution can be a straightforward process. In a decentralized institution, however, the task of getting people to collaborate and agree on a vision which will reflect the best alternatives for the faculty and students is extemely difficult. During the past two years the Technology Planning and Support Group (TPSG), a group of people associated with the Office for Information Technology, has been formulating a vision for Harvard University regarding computing services to support research and instruction. This vision reflects the findings of several studies and data collected from the computer using community.

This paper will describe the results of four studies, the vision the studies rendered, and one of the mechanisms for transmitting this vision to the Harvard community. (In this paper, *render* should be understood in several senses: to reflect, report, and deliver, to impart, and not least, to cause to be or become, as in architectural drawings where *rendering* means to flesh out a concept and give it substance.)

I. The Scenario

Founded in 1636, Harvard is the oldest institution of higher learning in the United States. Its decentralized, academic environment consists of 10 graduate and professional schools and an undergraduate Faculty, and covers a large geographic area (including Cambridge, Boston, and even some outlying communities). A federalist attitude of local control and autonomous management and decision-making persists. In 1990 Harvard awarded 17,230 undergraduate and graduate degrees. Supporting the student population are 3,600 full-time and part-time faculty members, 4,000 "other" faculty, and 8,500 non-teaching staff members.

The Office for Information Technology (OIT), constituted in 1970 as part of central administration, consists of approximately 200 employees engaged in the provision of computing, communication, and network services. A recently completed, campus-wide fiber backbone connects the entire campus in a network of interlinked, local- and wide-area networks connecting mainframe, microcomputer, and minicomputer users.

Harvard's planning and budgeting takes place in each School and Faculty before the central budget is compiled. As with all other aspects of University life, the way budgets are done affects information technology planning and implementation. Individual Faculties and administrative Departments have developed computing systems to meet internal needs and provide users with tools for data management. Services to support these computing environments are generally funded by departmental budgets, research grants, and modest user fees. The central computing services provided by OIT, on the other hand, are supported almost entirely by user fees, with very little core funding to finance general information services. This decentralized method of providing technology to users has left Harvard with a diversity of services provided by a wide range of workgroups and funded inconsistently. Expenditures in this area grew one year at the rate of 8 percent, according to one expense tracking effort.

According to the 1987 Long-Range Plan of the Office for Information Technology (OIT), "no University-wide framework for technology use exists at Harvard, and there are no University-wide standards and controls for implementation." The plan's objectives were, "in addition to identifying OIT's long-range goals and strategies, to begin a process for gaining consensus on these goals and to build awareness throughout Harvard of the University's future information technology needs."

The plan emphasized that information sharing tools are needed and that extensive training is equally important in order to upgrade individual technology skills. OIT's publications and its computer training program were established in their present form along with this plan. The information dissemination and training services are designed to raise consciousness about information technology in higher education and are intended to stimulate discussion and increase customer self-sufficiency in using information technology.

There is no central mandate about technology use and services at Harvard. Thus, OIT can only set some de facto standards through sales of a limited range of hardware and software at the Technology Product Center and by providing training for selected software packages. Individual Schools, Faculties, and workgroups set their own standards and may provide their own computer support structure.

OIT acknowledges the importance of the planning process by designating one of its divisions as the Academic and Planning Services division. Within this division, under the direction of Mary Grace Smith, a group of professionals meet regularly to implement a planning and education process. This Technology Planning and Support Group (TPSG), during the past two and one-half years, has been developing a vision of Harvard's academic computing environment and is trying to build consensus about a plan for delivering computing services more efficiently and cost-effectively to meet customer needs more satisfactorily.

Findings of studies done by TPSG indicate that an ideal computer support structure for Harvard would consist of individual units working together for mutual benefit. Any workable user services plan should recognize the value of discipline-specific support provided by individual workgroups and Schools, with general support provided by a central or coordinated service.

OIT recognizes the challenge of planning in a decentralized environment, since any university-wide plan must be consensus-based and locally implemented. Information sharing and education about the plan is necessary to build consensus, and this makes the process very slow. It is important to avoid deriving a "least common denominator" solution because such a solution would not acknowledge many existing solutions. Hence, four studies, conducted by TPSG, describe the foundation for an information technology infrastructure and the recommendations from these studies can serve as a guide to future technology planning at Harvard.

II. A Vision for Academic Computing Support

Since computing and network facilities exist or are being installed at Harvard, this paper will focus on the computing support or user services aspects of a proposed technology infrastructure. User services for the Harvard community have developed in an ad-hoc fashion; the services are widely distributed, not consistent in quality, and there as variations are due to the needs of the different constituencies.

A booklet produced by the Office for Information Technology summarizes the findings and recommendations from four recent studies of information technology uses and needs at Harvard. What emerges from the four studies and other projects can be consolidated into eight primary observations about Harvard's information technology infrastructure. These eight observations tell the "story" about computing and computing services, while describing themes, and raising questions and issues about a workable university-wide plan for user services.

As stated in the booklet, the studies, initiated for different reasons, were conducted "to determine the kinds of facilities and services required by the University community, and the findings represent a broad array of opinions. The results of these studies are being used to guide planning of future information technology directions of OIT and the University."[1]

For these studies, over 300 teaching and research faculty, administrators, and staff within the Harvard Faculties and Central Administration were surveyed, and in many instances, the findings complement each other.

- The <u>Faculty Research Computing Study</u> focused specifically on the research computing needs of faculty. Findings show that the faculty are generally content with their computing facilities but are dissatisfied with having to raise funds for equipment and with the availability of assistance and advice.
- The <u>High Speed Data Network (HSDN) Needs Assessment Study</u> surveyed a broad cross section of faculty, administrators, and staff concerning their needs for access to information

[1] *Summary of Findings From Recent Studies of Information Technology Usage at Harvard,* Harvard University, Office for Information Technology, April 1990.

and to electronic information processing facilities. Findings described applications desired over a network, including electronic mail and other utilities, library catalog access, and some basic archiving and back-up services.

- The Longwood Medical Area (LMA) Computing Study considers needs specifically in the Medical Area among Harvard Faculties and affiliated institutions. Findings described the information technology activities and organizational framework of the Medical Schools and Affiliated Hospitals, mostly regarding administrative applications.
- The Academic Computing Support Study examines the level of computer support provided within local organizational units and the issues faced by the service providers. Findings indicate that word processing is the most common application, with data analysis and data base management also prevalent across disciplines. Recommendations define a vision of OIT's and the University's role in providing computing support services.

The eight observations that follow are supported by findings and recommendations in the four studies, as well as data from other projects and surveys by OIT.

Observation 1: Many people at Harvard use computers and networks.

The wealth of information in these studies about how people apply computing and other information technologies documents that computer and network use exists in virtually every discipline among all Faculties and administrative departments. Word processing is by far the most prevalent application, but data analysis and database management are also quite common across disciplines by all categories of users. Other data that supports this observation are:

- The Technology Product Center (Harvard's computer store) sells more than 3,000 microcomputer units per year.
- The Office of Instructional Research and Evaluation, which regularly surveys students on several parameters of college life, shows in its 1988-89 surveys of undergraduates that 63% owned a personal computer and an additional 29% had access to one owned by a roommate — slightly less than one computer for each student.
- The service providers surveyed in the Academic Computing Support Study indicated that 40% of the faculty are served by them.
- An expense tracking project conducted by OIT in 1986 estimated University-wide expenditures at over $50 million an amount that grew at 8% annually. The small sample of support providers who responded to the question about expenditures during the Academic Computing Study last spring estimated that $2 million is presently spent on academic computing services.

Other evidence of computer and network use abounds.

Observation 2: Occasionally computer users need help or services of some kind.

Computer support and user services mean many and varied things to different people. The findings from the four studies supports the assumption that Harvard has many different kinds of computing environments and applications, as well as a diversity in styles of use and levels of technical sophistication among users.

Several different computing access models, which explain how people fulfill their computing requirements, were defined in the Faculty Research Computing Study. They are:

- Individual: The individual arranges for his/her computing needs without recourse to formal service providers.
- Lab or workgroup: A few individuals work together to maintain computing resources, usually without a formal support structure.
- Department: Some departments fund and supply computing resources and support.
- School: Within a School, computing facilities, network, and support staff may be organized.
- Other provider: Services provided by OIT or some other entrepreneurs include access via network or dial-up ports, as well as computing facilities, staff support, and ancillary services, funded by user fees and core appropriations.
- External: Services may be provided outside the University either because of specialized need or for convenience of collaboration with colleagues at other institutions

The range of support services that people say they expect varies according to technical sophistication and diversity of style. Support requirements are based on their needs to:

- identify what they need and find out where to obtain it
- install or configure something
- learn how to use something or how to make it accomplish some desired result
- fix something or otherwise diagnose and resolve a problem
- off-load some work that they do not have the time, skills, and/or staff to do themselves
- perform a function for which they do not have the proper facilities
- keep up with changes in technology that may affect them or present them with new opportunities.

Observation 3: There are many providers of support services at Harvard.

The Academic Computing Support Study identifies many support providers and hypothesizes three broad categories/models of support services.

- Informal: This model usually describes an expert individual who becomes the de facto support provider for a larger workgroup. Within the humanities, the support provider is a faculty member who is a self-motivated technology pioneer. Within the sciences, the provider is a faculty member or graduate student assigned to a research or instructional workgroup or lab.
- Staff: This model, the most common one encountered, is the one which providers identified similar issues and concerns despite varied levels of funding, authority, and endorsement. A staff position was usually created when computing needs crossed research boundaries, demanding more complex technology and a system manager. The people in the staff position have the same characteristics as the informal provider, except they become powerful gatekeepers and decision-makers.
- Formal: The formal computing services organizations are found primarily in the professional Schools where technology is critical to the mission of the School and its discipline. There is a great deal of variation between the Schools, based on computing applications needed, organizational structure funded, and the demands of the professional market. For example, the level of technology used for instruction in the Graduate School of Education is decided by the type of technology used in the K-12 public schools. Whereas the Graduate School of Design uses sophisticated CAD/CAM software and an elaborate network of computers and peripheral devices to train the design students.

The demands placed on these support providers are similar regardless of the model they fit. Technical expertise helped establish their authority, yet the quality of service was not uniform. Problems and issues identified included difficulty in retaining skilled assistants, lack of space for equipment and personnel, pace of technology changes, inadequate funding, lack of understanding of senior faculty members and administrators of the support demands of technology, increasing complexity of the technology used by a workgroup, the need to "fight fires" rather than being able to control the work demand, and the isolation from other support providers.

The ideal support structure identified by the providers is one where support remains decentralized, whereby first line support is efficient, flexible, timely, and most appropriate when it is discipline specific. A second line of support from a central organization or collaboratory is suggested to provide a variety of supplementary services. Certainly many network-based services warrant support from a centrally managed organization.

Observation 4: Sometimes there is a gap"between a consumer's needs or expectations of support and the services available to that consumer.

Several studies, especially the Faculty Research Computing Study and the HSDN Needs Assessment Study, contain specific feedback from members of the community on the availability and quality of computer support services. Additional evidence from OIT's mainframe computing Help Desk, OIT's User Services Customer Satisfaction Survey, and several anecdotes give rise to reasons why these expectations and quality gaps may exist.

For example, there are parts of the Harvard community that do not have staff or formal support providers. They do not have resources to provide adequate support services. People in these environments do not have anyone to call on for help. The issue becomes one of "entitlement" to a university-wide minimum level of service that should be routinely available to members of the entire community. The biggest question on this issue becomes one of funding by whom (users or core budgets) and for whom (faculty, staff, students, departments, and/or affiliates).

A gap in expectation and delivery of support arises when someone does not know the person to call on for help. Although there may be many providers, there is little coordination among them. An array of services may be available outside a workgroup but there is no central directory or clearinghouse of services available. Often routing of requests end up in a circular chain of referrals, which occasionally end up with an unhelpful "not my job" dead end.

Another gap arises when a person's regular provider is not equipped to respond to the particular need. Although support providers consider their technical expertise a critical success factor in doing their jobs, they have a finite repertoire of expertise as well as a limited capacity for handling the work load.

When customers become dissatisfied with the quality of service, they begin to expect low quality service and hesitate to request future service from that provider. Key dimensions of quality in delivering support services can be described as technical competence, responsiveness, feedback with status updates, accessibility, affordability, and personal attitude of the provider.

Observation 5: Among support providers, there are potential opportunities for collaboration to help reduce the support services gaps.

Some of the opportunities for collaboration and support for the providers include campus-wide user groups and regular meetings of computer support professionals to share information and to identify problems and issues in search of common directions.

It would be helpful to both providers and consumers to establish a convenient access or "triage" point for those not knowing where to turn. The characteristics of such a function are described under Observation 6.

Another way to provide needed support is to deliver supplemental services through a central service organization to fill gaps in expertise and skills needed by the community. Likewise, mechanisms to assure the quality of the service delivery should be put in place to improve services.

The Academic Computing Support Study lists recommendations in the areas of support structure, funding models, commitment to local support staff, community awareness, and instructional applications support that expand on ways to reduce the user services gaps. These recommendations, focused mostly on OIT, are summarized as follows:

- The support model proposed by the study and described earlier suggests that the local provider be the primary contact point, with second level help provided centrally or through some other coordinated fashion. The planning for this technology support structure, in order to build on existing services, should be facilitated and coordinated by OIT, with collaboration among the managers of technology support.
- Efforts are necessary to update financial and user data and analysis and to improve the measurement and monitoring of technology expenditures. Such data is necessary to back up the planning effort. As demands increase, the limits of the existing fragmented support mechanisms are exacerbated by current funding methods. Concern is increasing over costly duplication of effort and lack of coordinated responses to growing demands for increased funding for support. Any combination of the funding models described under Observation 8 would be appropriate, but they should be coordinated University-wide.
- Local support providers should work together and with OIT to improve communication and knowledge of resources available across campus and to build awareness of the value of support. Regular meetings of support professionals presently sponsored by OIT help reduce the feeling of isolation described by computing support staff.
- OIT should work to improve community awareness of technology and value of technology support through its publication and information services to the University community. Through its publication, *Technology Window*, OIT could build the visibility of support providers. More collaboration with academic Departments and Schools for the OIT colloquium

series may help increase attendance at these educational events. Better on-line referral services and directories will enhance community awareness.

- Efforts are necessary by Departments and Computing Services staff to improve opportunities for faculty to become familiar with instructional uses of technology and to support development of instructional applications for integration into the curriculum. The recent report of the Harvard Assessment Seminars notes that "an enormous number of faculty are eager to innovate in their teaching,"[1] but that a major stumbling block, when it comes to technology, is the lack of support to develop and integrate the technology into the classroom. "In the course where a technological expert is available to work with a professor, the curriculum changes can be dramatic." [2] A few efforts are presently under way within the Faculty of Arts and Sciences to support instructional applications, but OIT should foster others.

Observation 6: A computer support/user services function can be looked on as a system with several capabilities.
The capabilities suggested for a triage system are:
- ability to respond to a minimum set of support requests and issues on the spot (a telephone hotline)
- ability to dispatch or reroute a request to the right provider without further action by the consumer
- mechanism to capture information about the support transaction
- follow-up procedures on transactions that are not completed and closed on the spot.

Observation 7: The support services delivery mechanism can be improved.

The University's support services delivery mechanism is distributed and very diverse. Ways suggested to increase the efficiency and cost-effectiveness of the delivery mechanism are to reallocate current resources, improve collaboration in use of current resources, and train end-users to be more self-sufficient.

It is also possible to use the technology of expert systems to facilitate and automate the triage function. The University of Michigan has used its computer network to route questions, analyze the response time, and remind support people who do not respond in a timely fashion. Such an automated triage function is more cost-effective than a person-intensive tracking system.

Observation 8: There are generally three possible methods for funding costs of support services.
The three common methods of funding support costs are:
- *fee-for-service*, either on a per-call basis or through subscription/service contract
- an *overhead charge* included in the price of other services
- a *tax (assessment)* on the community in general.

Obviously, key issues are who pays for support services and how. In the aggregate, a large sum is already being spent for support as mentioned in the Academic Computing Support Study. Two million dollars of the over $60 million expended on information technology in FY90 was identified by the small sample of support providers as being spent for academic computing support. Are current resources being deployed effectively, what level of additional funding, if any, is needed to address support issues, and where should that funding come from? Everyone agrees that a combination of the methods described above may be appropriate to answer the need for greater and more equitable funding of computing support services. Whatever the solution, the implementation must be coordinated.

Several recommendations for the implementation of a technology support infrastructure for Harvard have been defined. Likewise several components of OIT's role in the planning and support process have been described. As a non-subsidized organization within central

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[1] *The Harvard Assessment Seminars: First Report* 1990, Harvard University, Richard Light

[2] *Ibid.*

administration, OIT provides optional computer services, which are usually fee-based. It also serves as facilitator and coordinator of meetings and events, collaborator on projects and vendor activities, advisor on technology developments, researcher and planner about technology use and support, and educator through its training program, sponsored educational events, and publications.

III. Publications in a Distributed Environment

The general function of publications is common knowledge: they are important for disseminating information, educating the community, and alerting readers about upcoming events. How important publications are in rendering an academic technology vision may not be as obvious, however.

Is it necessary to develop and implement serial publications to deliver technology at the university? Surely people who need telephones will purchase and use them, and those who require large amounts of number calculations will purchase major computers or computer services. Usually faculty, researchers, and administrators will also allocate money in their budgets for such items and learn how to use them when necessary. So why do we need publications to help render an academic technology vision, a vision in which communication and collaboration are essential elements?

Communication

People at a university are familiar with the importance of communication, the need to describe ideas in language, the need to put complicated thoughts into words. The university is a world where people are used to writing down their ideas and to reading the ideas of others. It is a world in which communication is essential, and in this world publications can be important windows of communication. Like windows, the ideas represented and described in publications can be made transparent (at least to the extent the ambiguities of language permit). Also like windows, publications can reflect trends or new ways of thinking, providing a specific framework for general perceptions.

In the world of computer technology, the idea of windows has taken on an additional meaning. It is understood as pointing to a specific visual reality: windowing environments, windowing interfaces, multiple windows, lending to the window concept the idea of ease of use and a clearer understanding or more "intuitive" way to access applications or files. Because language and word usage change over time, this new meaning for window has now become another part of how people understand the word. When I use the window metaphor for publications, transparency and reflectivity are understood, but so is ease of use. As windows to the university, publications can be quick ways to find out about events, people to contact for information, and telephone numbers for support and services.

In a distributed environment, especially one like Harvard, publications serve as a very important resource for gathering and disseminating information about various efforts in the many independent Schools and Departments that make up the University. There are a number of local publications issued by individual Schools, and there is one official campus newspaper, the *Gazette*, but before the Office for Information Technology (OIT) began its major publications effort some four to five years ago, there was no central resource for disseminating important technology information to the community.

Historical Background of OIT's Serial Publications

Today there are three major serial publications: *Technology Window*, a monthly tabloid distributed to every faculty and staff member and by drops to students, the *Information Technology Quarterly*, a scholarly technology journal with a national reputation, and *OIT Notices*, a quarterly how-to publication for people who use technology daily. Although the *Quarterly* was begun about nine years ago and was recognized then as valuable for its scholarly treatment of technology, only in the last few years has it developed a national following.

Each of the publications serves a different function at the University. The *Window*, with its circulation of 25,000, is the most visible of the three. Each issue contains articles that focus on different areas, disciplines, and Schools, in addition to regular features publicizing OIT efforts, an important statement from OIT's Director, a monthly calendar section, a question and answer column, and support and service telephone numbers.

The *Quarterly* usually highlights a single issue of current concern to people who use information technology. Fall 1990 was devoted to Distributed Computing, Spring 1989 covered the Senses of the Computer, and Fall 1988 dealt with Teaching with Computers.

About eight years ago, *Notices* started life as a publication very different from what it is today. At that time it was called *Computing Center Notices* and contained information only about hardware and software changes and updates on the OIT mainframe. It served the important function of informing people in administrative offices who depended on the mainframe for computing the type of things they needed to accomplish their tasks. The publication was issued irregularly, being driven solely by the need to disseminate specific update information, and had a restricted audience.

With the growth of OIT over the past four years, especially in the areas of telecommunications technology and networks, and the increasing importance of personal computers and local area and high speed networks at the University, there was a need for a more regular publication containing specific information about technology that was not restricted to the mainframe. Over the past four years, *Notices* has come to include information about every technology OIT supports: telephones, facsimile machines, copiers, the Technology Product Center (the retail computer and software outlet), training and informational events, information about new and existing local, regional, and national networks, software and hardware descriptions and tips covering microcomputers, minicomputers, and mainframe updates, as well as information about technology published in other academic newsletters around the country. In fact, *Notices* has even started to include think pieces about common technologies, how they are being used at the university and where they may be heading in the near future.

Publicizing the University Networks

With the installation of the digital 5ESS switch at Harvard, the University became the purveyor of ISDN telephone service to all offices and dormitories. The effort represented a major change in the way telephone service was delivered. Previously New England Telephone had been responsible for the telephone service, but the old analog system was becoming inadequate to University needs, and since more advanced technology was needed, it was decided to go with a system that could be developed, administered, and maintained "in-house." OIT, as the Department responsible for the Harvard Telephone Office and other types of central digital technology, was given the charge to develop, implement, and maintain the ISDN service. Shortly thereafter, OIT also embarked on developing and implementing a high speed data network. Both major efforts were viewed as parallel and were developed during the same period. For the projects to be a success, it was vital to have the cooperation and commitment of all areas of the University.

The OIT publications were used to inform the community at all stages of the projects: to describe what was about to take place, how and when it would affect people, University-wide efforts to discover what the needs of different Schools and Departments were, what the various components of the technology were and the different uses they served, and to provide updates about the progress of the networks at each stage. Not unimportant, although somewhat "low tech," was an article in *Window* describing each of the new telephone instruments that would be available to the community, including features, cost, and a photograph of each. It was an immediate, direct way for people to see what was being offered and for them to have an opportunity to think about the different options before having to make their decisions.

The *Quarterly* also devoted a major issue to the ISDN and HSDN networks coming to Harvard. It contained interviews with the major players, in-depth explanations of current technologies to be used in the projects and why they were chosen, advantages and implications for future growth, and a glossary of many of the acronyms and technical terms. The issue was so successful it "sold out."

Notices emphasized particular technologies, describing in lay terms how to use each, including a list of the new telephone training sessions for the various Departments and Schools, and how to become a network subscriber. It was in this publication that a simple, detailed explanation of which kinds of applications would be most suitable for the ISDN and which for the HSDN network appeared, and it was in *Notices* that a description and diagram of the TCP/IP suite of protocols were presented to the University community.

Regional and National Networks

When the BITNET network was the most popular one for communicating with colleagues both nationally and internationally, *Window* publicized information about who to contact for information in the context of articles describing particular academic efforts at the University: BITNET at the Center for Astrophysics, BITNET at the Cyclotron Laboratory, funding and organizational changes on the organization's fifth anniversary, as well as featuring a question and answer column describing how to use the store-and-forward network. *Notices* disseminated information about BITNET representatives at the University and the availability of a BITNET guide and cheat sheets for using the network from various Schools, each of which provides support for its own system.

In early 1989, when NEARnet, the New England Area Regional Network, was first formed, *Window* announced and described it to the University, and ever since the publication has followed NEARnet progress, both its acquisition of new members and hardware upgrades as well as articles outlining resources as they become available on the network. These include general research applications such as library catalogs and applications geared to particular areas or disciplines such as medicine and biology. With the acceptance of the New England proposal to be a network node on NSFNET, the national science and research network, an announcement in *Window* was considered a matter of course.

Today people expect to find such information about vital technology developments in the OIT publications: for those who know about it in advance, they look for details in *Window*; if the item is news, they scan the articles to see if the project is of interest and call the contact person who is generally listed at the end.

Information about the efforts of the Coalition for Networked Information, formed by EDUCOM, CAUSE, and the Association of Research Libraries (ARL), is also published in *Window*. The new organization's work to promote standards, develop joint approaches to knowledge management, and to lobby for a technology infrastructure to benefit national research and education was the subject of the From the Director column in December's *Window*, as were pilot projects being formed to use new digital printing technology across the University. In this feature, the publication serves not only to keep the community abreast of national networking efforts, it also publicizes new interdepartment pilot ventures and lists people for interested parties to contact so they can participate in the collaborative project.

The *Quarterly* devoted an entire issue to national and regional networking issues. Again interviews with important players were published, as were maps of the networks, in-depth pieces about the technology—current and future—as well as pending congressional legislation and a statement by Senator Albert Gore from Tennessee.

When NEARnet became operational in the summer of 1989, *Notices* described the connections then in use, the academic and research players, the network that was "going away" (ARPANET), and the technical details of the current connection. The article also detailed the supercomputing connections and the proposal for New England to be an NSS, or NSF node.

Important to the University was the early publicity of the various networking efforts, the contact people or facilitators for each piece, the updates and progress reports, and the general and specific catalogs of available resources. Nowhere else could the community find this type of information regularly, and the continuing publicity played no small part in the successful implementation and use of the networks—local, regional, and national—at Harvard.

The Libraries

Although the University libraries are a separate organization and independent of OIT, they do use the OIT mainframe for storing information for HOLLIS, the Harvard On-Line Library Information System. Articles and features in OIT publications regularly give publicity to the libraries' efforts to develop and implement the electronic catalog and to each new feature as it becomes available. Automation efforts for major individual collections are also described, not only to inform the community about the availability of electronic access, but equally important, to inform people about the varied resources in the collection. One such piece in the June 1989 issue of *Window* described Harvard's Judaica holdings, one of the premier world collections.

In addition to listing contacts for further information about resources accessible electronically, as well as particular technology efforts being spearheaded by the libraries, OIT publications maintain a close working relationship with key library people. The relationship is important for both parties. When there was a concern about network access to HOLLIS, we were able to play an informational and mediating role. When OIT recently upgraded its two IBM mainframes to one 3090 machine and carried out a series of operating system software upgrades that affected the libraries as well as other major Departments, the publications were important for communicating the upgrade and changeover information, the schedule at each stage, and the implications for those using the system.

The libraries know they can count on us to disseminate the information clearly and sympathetically to the entire community in a regular timely way. The editors of the publications know that whenever an item of significant technological interest occurs in the libraries, they will receive information about it. And of course, the Harvard community knows that such information is to be found in the OIT serial publications.

Most recently, *Window* featured an article about "Slow Fires," the major information preservation exhibit at Widener (the central University collection) starting in December. The article described the threat to books published over the last 100 years and some of the technology, digital and microfilm, now available to preserve and distribute information from the threatened volumes. As part of a pilot for the National Endowment for the Humanities, three Harvard libraries, the College Library, the Business School Library, and the Law School Library, will be engaged in a 3-year program to microfilm about 25,000 deteriorating books at the University. Coordinated by the Preservation Office, the effort is a national one, involving close cooperation not only among several internal Harvard Schools (a major feat), but coordination and collaboration with national library organizations such as OCLC (the Online Computer Library Center) and RLIN.

Cutting Across Disciplinary Boundaries

Because Harvard Schools and Departments are locally governed and administered, the term "distributed environment" refers to more than just technology at the University. The independence of each area creates a climate in which it is difficult or nearly impossible for a faculty member or researcher in one discipline to hear about parallel work taking place in another, even though it may be happening only a few yards away. Publications can bring people together by writing about individual efforts. An article in the May 1988 issue of *Window* about tiling symmetry and crystals at the Department of Visual and Environmental Studies proved to be of interest to people in computer science and in physics. A later piece in October 1989 describing computer efforts to "grow" quasicrystals brought in a researcher working in mathematics to this newly-formed network.

Two more recent *Window* features (September and October 1990) brought researchers in structural biology and in art conservation together. Both were using computers to analyze crystal structures: biologists were using the technology to study molecule scattering, art conservators were using it to determine the composition of pigments. It is surprising how researchers in different, totally unrelated disciplines can sometimes use the same or similar technologies to assist them in their work. For the quasicrystal and crystal studies, none of the researchers was aware of the work being done by the others until the articles appeared in the publications.

The reporter/editor discovered the value of the first feature when the Fellow in physics telephoned to thank her for publishing the information. The fact that similar technology was being used across disciplines became apparent in the course of the interview with the art conservators.

Upon realizing the potential use and general interest in computational programs for analyzing diffraction patterns, the editor suggested to the person responsible for organizing OIT colloquia and educational events that others might want to know of these efforts, and the conservator was invited to demonstrate his applications as part of a recent Faculty Forum on technology projects across the University.

Publicity and Support for Education and Training Within the Department

Since the inception of *Window* in 1986, it has been perceived as an important vehicle for publicizing the OIT education and training effort, which was then just getting underway. *Notices*, too, has been used to publicize these events. Each semester the OIT Training Catalog is published as part of the September and January *Windows*. Supplementary training events, such as special demonstrations or workshops, that are not part of the Catalog are listed in the monthly *Window* calendar and in a separate section of *Notices*. Colloquia, which are also part of the education effort, are not only listed in the calendar, if they seem to be of special community-wide interest, they may be prominently featured before the event occurs. In addition, a reporter usually attends the event and writes an article describing it for *Window* after the colloquium takes place. Most recently, December's issue reported on the colloquium about electronic communication and political freedom, with panelists Mitchell Kapor, Eugene Spafford, and Harvey Silverglate. In the same issue there was an article reporting on the Faculty Forum, another important OIT educational event.

Similar publicity is accorded educational efforts by other groups within OIT. The Applications Development group, under the leadership of Assistant Director Milly Koss, regularly holds monthly Special Interest Group meetings, which are publicized and often reported on in OIT publications. Equally important were publicity efforts for a new HUBS service (Harvard University Basic Services), an inexpensive, easier-to-use electronic mail system developed by OIT's Information Services Division. Not only was the service described in *Window* and *Notices*, but the schedule of demonstrations for the new interface was listed in the publications.

The Changing View of Technology at Harvard

From the perception that academics who wanted to purchase technology were on their own and had to find out what information they could from trade journals, occasional chance conversations, or trial and error; from the view that one purchased what one could afford at the time, and that training was unnecessary, and in any case, not included in the budget; from the sense that each School had to provide whatever informal or formal support it could; Harvard is beginning to change. Technology, like everything else, is not centralized, but the information technology providers and users are increasingly coming to feel like a community. There is consultation, support, and advice for major and minor purchases; Departments and Schools are being helped with planning for technology purchases, training, and use; and OIT education, training, and publicity efforts are becoming known as important and recognized elements of University life. In all these areas, OIT publications have and will continue to play significant roles to inform, publicize, and bring together a distributed community.

As the Harvard community collaborates with OIT to define its vision of academic technology further, a University-wide plan may evolve and be implemented in the near future.

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A FRAMEWORK FOR DISTRIBUTED DECISION SUPPORT

by

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In this paper, the development of a framework for distributed decision support at a large, public, research university is described. During the past six years, North Carolina State University has moved from an environment of several independent units providing decision support services in an ad hoc manner to a coordinated function. The key success factors have been effective implementation of advancements in information technology and the organizational relationship between institutional research and information systems. This arrangement has resulted in the development of data standards, the creation of information, and has provided users with reliable data sources and flexible tools for accessing the data. A case study approach is used with comments about future directions for decision support.

INTRODUCTION

North Carolina State University (NCSU) is a large, public, land-grant university which has extension programs in all 100 counties of the state. The 1990 fall enrollment was 26,683 and 4,212 degrees were awarded in the same year. Funding for research has increased significantly during the past ten years to over $158 million in 1990. The NCSU organizational structure includes ten colleges (the term college is used throughout this paper to refer to NCSU academic sub-units).

Paralleling the tremendous growth experienced by this institution has been an increasing demand for information, both internal and external to NCSU. This paper describes the development of a more distributed process for decision support through the changing relationship between institutional research (IR) and information systems (I/S).

The first section of this paper is presented from the IR perspective, which includes a discussion of the previous environment, decision support requirements, and the present organization. In part two, the technical elements are described from the I/S perspective; this discussion involves the following topics: an overview of the networking developments during the past two years, standard extract files, data management procedures, and future directions. Finally, a summary of key points is presented.

PREVIOUS ENVIRONMENT

At NCSU the development of application systems for decision making were typically a spinoff of external reporting requirements. Applications systems were developed independently, initially to support the reporting mandate. As the reports became a standard part of the routine data generated for IR, information was developed in line with the policies and guidelines of the University. This information was then provided to decision makers in hard copy reports. Programs were usually written in COBOL or PL/1 and required support from I/S to make changes. In general the decision support files were generated from the operating files upon request and over time did not provide a consistent picture of the University. Documentation was usually written for computer professionals. As such, end users were dependent on computer professionals for modifications or enhancements; all requests for changes were placed in the applications development queue.

This often resulted in inconsistent and/or incomparable information from year-to-year. Since ad hoc reports were generated from a queue through I/S, decision support information was often untimely. In addition, the resulting information was often not what the decision maker needed as the wrong question was asked or when asked correctly was interpreted incorrectly by either the IR analyst or the programmer.

DECISION SUPPORT REQUIREMENTS

A director of institutional research was hired to develop a University-wide decision support function. The first concern to be addressed was that of data quality. To accomplish this, the following were put in place:

- Reliable Data
  - Schedules for census file creation were developed for all operational data bases
  - Administrative and academic organizational structures were linked by cross-over tables
  - Independent application systems were linked by organizational cross-over tables
- Valid Data
  - Consistent definitions were developed across institutional organizations and application systems
  - All University reporting requirements were to be supported by these files
  - These files were the source for all institutional data and information used in University planning and decision making activities

Primary in the development of reliable and valid data and information is the consistent use of census files. Census files are a "snap shot" of the institution's enrollment, personnel file or any other operational file at a consistent point in time each academic term or calendar year. It is important to note for student related data that the time of the census file creation be consistent with the academic calendar. In all cases, it is critical that the time frames for creating these files be agreed upon by all parties and reviewed annually.

Critical to the functioning of the IR office is the ability to independently access the census files and manipulate the data. As such the Statistical Analysis System (SAS) is used for all data analysis applications. In addition, any new reporting systems or rewrites of existing systems is done in SAS. As all members of the IR staff are proficient in the use of SAS, minor modifications can be made in-house. The ability to move in this direction is the result of a dedicated resource from I/S to support the IR function.

PRESENT ORGANIZATION

In the present organization, the administrative application systems are the responsibility of I/S. Data Stewards, individuals on campus such as the registrar (student data), are responsible for approving access to the data and the quality of the data in both on-line systems and files extracted from these systems.

The delivery of data and reports to external sources is the responsibility of IR. These reports are prepared from the census files mentioned above. Improvements in the consistency and integrity of data published about the University have resulted from enhanced cooperation in the working relationship between I/S and IR. This relationship brought the analytical and technical staff of the University's decision support function together. The result was the development of systems that provided the needed flexibility to respond to the ever changing information needs of the University's administration.

RECENT NETWORKING DEVELOPMENTS

During the past two years significant work has been accomplished in the development of a fiber communications infrastructure. In the summer of 1989, the first inter-building administrative local area network (LAN) was implemented. Today more than 200 administrative users in seven buildings are able to communicate across a fiber backbone to access mainframe and LAN services.

The advancements made in the fiber and LAN technologies have provided a foundation for improvements in decision support capabilities. Users are able to download extract files from the mainframe much faster than before through channel-attached access. Standard extract files are also downloaded periodically to file servers on the LAN for processing by end users.

The administrative LANs use the Novell network operating system with a variety of application software, much of which is specifically designed for operation on a network. Paradox and dBase III+/IV are used for reporting and data manipulation.

STANDARD EXTRACT FILES

A set of standard extract files was proposed and studied in Spring 1989, with the programming and implementation in Summer and Fall of 1989. The intent of this system was to provide data from mainframe systems at NCSU in a format and size useable on a microcomputer. The major users included administrative staff in each Dean's office and some offices involved in central administrative support (eg, Budget Office and IR).

The data in the extract files is a subset of that available through the on-line, interactive systems, including student demographics, course rolls, admissions, personnel, financial, and facilities. Only the student demographics data is available in a census file format. The remaining extracts are generated from production systems which change daily. Users are cautioned to be sensitive to the source of data studied. After the appropriate security is authorized, processing of the extract files should be handled by a contact person in the Dean's Office of each college. Data distribution to departments and individual faculty members is handled through a central office contact person. Each record of each file contains an organizational unit code (a unique identifier for each department) for separating departments, where appropriate.

Access to these extract files is available from the administrative mainframe using one of two methods: 1) file transfer using Arbiter or 2) batch file transfer using FTP (TCP/IP file transfer). A microcomputer application, written and compiled in Clipper, is provided as a basic tool and a starting point for staff using the Arbiter option. This software is an automated, "user friendly" method of converting the data into a dBase file format for further processing by the end user.

This system of extract files is intended to be an evolutionary process that refines over time the data structure and delivery technique. This statement means two things. First, that the basic structure and definitions of new extract files must be compatible with earlier versions. Also, delivery methods may change over time as the University computing environment changes. Second, that there be a periodic, in this case twelve month, review for usefulness and completeness.

DATA MANAGEMENT PROCEDURES

A data management procedures document entitled Data Management Procedures (Ownership, Access and Security), was developed by I/S and approved by the Chancellor in January 1990. These procedures provided the vehicle by which full implementation of the extract files could proceed. All media (paper, microfiche, and computer readable) for distributing University data was covered through this document. The purpose of these new procedures follows:

"This data ownership and access procedure is based on the realization that North Carolina State University is critically dependent on its computer systems and the understanding that standards and procedures are necessary because of the storage of large quantities of information within a system and the ease with which such information can be manipulated, retrieved, transmitted, or compromised."

"Implementation and adherence to precise standards and procedures for electronic information processing operations are necessary for the protection of University information. The formalization of this data ownership and access procedure will provide the foundation upon which the necessary standards and procedures for protection of University information assets will be developed."

As part of this procedure, a "University/Data Access Compliance Statement" was created that places the ultimate responsibility for correct use of University data on the individual. The form lists specific items of data considered public information and reserves all other data as confidential. The form also describes violations and some possible penalties. The employee requesting clearance must complete and sign the form as part of the authorization process for accessing extract files and other University information.

FUTURE DIRECTIONS

During the next six months I/S staff will begin the development of a "glass house" which will include the capability for storing and accessing extract files from a server rather than the mainframe. The file server may also provide a solution for information requirements beyond extract files, such as the repository for an executive information system.

A major consideration in the development of this new capability is the availability of an SQL database server with multi-platform accessibility (eg, DOS and TCP/IP). The user interface for any executive information system must be simple and easy to use with quick access to an aggregated view of the University databases.

As part of this effort to develop an executive information system, users must be educated on how to access and interpret the data available to them. Effective training for all levels of staff involved in this process is critical. Better documentation and the use of on-line help facilities (we have implemented some of these capabilities using Folio Views) is also important to user education.

Regardless of the technology used, standard definitions of the data must be developed. Software tools which use standard methods of access and manipulation of data are also important.

KEY POINTS

Based on the experience at NCSU, the following key points need to be recognized:

1. Moving to distributed decision support is an evolutionary process that starts with an emphasis on data integrity.

2. Procedure(s) for data management - ownership, access and security must be developed.

3. An information technology plan must be developed in order to provide direction in the creation of distributed information.

4. It is very much a people process and natural tensions will surface.

5. All users have to be educated, committed and involved in the development of a distributed information function.

Distributed Information for Decision Support: Standards and Processes

Summary of a Panel Discussion at CAUSE90

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This session used a skit and audience participation to demonstrate a procedure for looking at issues related to providing distributed information for decision support.

First, the Information Circle, a five step model of information support was presented and briefly explained. This model has the steps of

(1) Identification of the measures,
(2) Capture and storage of data,
(3) Manipulation and analysis of the data,
(4) Distribution of the resulting information, and
(5) Influence and use of the information.

These functions form a circle where influence and use of the information should cause selection of the next set of measures. Next we presented a procedure for using the steps in the circle in a group process to discuss and analyze problems using the five functions, select the key problem, reanalyze for causes, and develop a strategy. After the brief explanation of the circle and the process, we then told the audience that they were to participate in a problems-solving process—a brief skit would present an information problem that included issues from the various steps in the Information Circle. They were given copies of the Information Circle and were asked to keep notes on the problems presented by the skit.

The skit illustrated issues which need to be worked through when information is developed from central data bases and distributed to different decision makers. Karen Miselis played the part of a decision maker at the college level and Richard Howard played the role of the central institutional research director. Gerry McLaughlin was the moderator.

At issue was the usefulness of an outdated teaching load report which still met the needs of the president but fell short of meeting the planning and operational needs of the college administration. Specific concerns which became apparent in the discussion between the two administrators included:

- timing of the availability of required data bases
- the utility of the report for different purposes by different components of the university's administration and requiring different variables from those that were currently available
- the level of computing expertise required to access the data for the development of useful reports.

The group was then led through the steps of the problem solving process in order to resolve the problems and issues which they had noted in the skit. Key problems, such as timeliness of the data, were identified and discussed. The presenters then summed up some of the issues whish they saw in providing data to distributed users and noted some possible solutions for these problems.

Coordination of Distributed Activities

by
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Information technology provides many opportunities for new and exciting initiatives on our campuses; however, a lack of proper management will only contribute to eventual failures. Distributed activities must revolve about a point of central coordination to ensure support for overall institutional goals. Distributed technologies should not be discouraged, but solutions created for specific areas need not, at the same time, diminish support of institutional systems.

This presentation reviews experiences with distributed activities for administrative systems at Virginia Tech, deficiencies that have emerged in administrative systems and the management process, and steps that have been taken to create an acceptable infrastructure for administrative systems. Administrative Systems Planning was established in early 1990 in the business and finance area to provide coordination and direction for administrative systems. The development of a strategic plan, encompassing methodology, standards, and a participative planning process are among the items covered in this presentation.

An Era of Change

Economic, political, and social transformations have caused significant changes in higher education during the past decade, and predictions for the 1990s are even more phenomenal. In terms of administrative functions, the escalating cost of higher education will force institutions to find ways to do more with less. Governmental involvement in funding activities and regulations will challenge institutions to meet specific demands that will require innovative solutions. With the always present concerns about demographic changes, aging physical structures, global competition, operating budgets, quality education, and so on, higher education is in for an arduous decade.

Many institutions are meeting these never-ending changes and demands by requiring that administrative areas be more efficient and effective operations. Organizational structures are changing in many institutions to simulate what has been happening in private industry for a number of years, that is, flatter structures with more point-to-point relationships.[1] Providing accurate and timely information is critical in day-to-day operations and in the decision-making process. Technology that is changing at a rapid pace provides institutions with opportunities to meet these many challenges with advanced, technological alternatives.

Information Systems Environments

Describing information systems in higher educational institutions today is difficult because of the diversity. The centralized environment has been prominent for years, and, with the emergence of the Chief Information Officer (CIO) in recent years, the focus rests on consolidating various information systems with media services, communications, and the libraries. However, the centralized environment may be classified with terms such as decentralized, distributed, and, more recently, downsized. The information systems environment is a combination of these types of environments at most institutions of higher education, and such a scheme will likely persist during the 1990s.

I would choose *distributed* as the key term in defining various activities associated with information systems since this term implies the idea of scattering, spreading out, or putting items in distinct places. Even though distributed computing is often used to describe an information systems environment, it is unclear whether distributed refers to processing, databases, development, or resources. In many cases distributed refers to a combination of these. Whatever function the term describes, the technology of distributed activities provides the institution the opportunity to design its systems to operate in the same manner it conducts its business.

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[1]Jim McIntyre, "Spinning Into The 1990s," NACUBO Business Officer, January 1990, pp. 24-30.

As institutional structures are modified to respond to changes in the 1990s, information systems will likewise be altered to serve the needs. Technology will provide opportunities to be innovative and to create distributed environments that enhance every facet of the educational process in academics, research and administration. Caution will assure that these distributed environments are focused on a common goal of fulfilling the institution's mission.

A Movement to Distributed Activities

Distributed or decentralized actions were a popular trend in the 1980s in many areas. Business and industrial arenas offer many examples of distributed activities, many of which can be attributed to the highly autonomous structure of business. Individual business units were given responsibility for their own field operations and each developed its own information systems strategies, standards, plans, and controls.[2]

An example from higher education is Stanford University. It underwent a major reorganization in 1987 when application support programmers were moved into the line organizations. The University of Wisconsin/Stevens Point went one step farther when it eliminated the central computer center and distributed the hardware and all facets of the computing operation to administrative departments.

Perhaps Virginia Tech was ahead of its time when the decision was made 20 years ago to distribute certain responsibilities for administrative systems. Operational and maintenance functions were assigned to administrative offices, and each office was also responsible for securing personnel to staff the support function. This distribution allowed the central development staff to focus on new development and major enhancements for administrative systems. At first the idea was not well received, but certain advantages made the transition attractive to administrative offices and central resources.

> Systems personnel located in administrative offices would create a sense of ownership, pride, and responsibility in the offices.
>
> Departmental control (to a certain degree) over operational and maintenance issues would result in quick resolutions.
>
> The systems personnel would provide a needed level of expertise to business functions in the administrative areas.
>
> Management and staff in the administrative areas would have the opportunity to learn more about technical issues associated with administrative systems.

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[2]Ralph Carlyle, "Martin Marietta Flies in Formation," Datamation, August 15, 1990, pp. 85-87.

Distributing activities in these various environments was, in many cases, a natural progression because distribution would provide a degree of freedom that enabled the organization to function independently and to satisfy specific needs.

An Evaluation for the Future

Business and industry, as well as higher education, are operating in an era of constant change, and these changes are challenging organizations to evaluate all phases of their operations. Management is being directed to provide more efficient and effective operations and to discover ways to do more with less. A focus on the organization (or institution) as a whole is being emphasized in all units, from planning to operations.

Coordination was lacking for the distributed activities at Virginia Tech, as is true for many of the other movements in this direction. The premise was that areas would take care of themselves and an informal network would keep people in contact. This concept may have worked in some environments, but uncontrollable growth and changes in procedures have resulted in unacceptable distributed activities in most cases.

Many of those organizations that took the plunge in the 1980s now have major concerns. As was so amply described by one world-wide company: "...after a decade of allowing independent business units to call their own information systems shots, many companies are realizing that they are stuck with a variety of inconsistent technologies and no way to forge enterprisewide applications. While Humpty Dumpty is in pieces, managers can't get a unified view of their business, an essential requirement for a market-driven company and a global competitor."[3] Isn't this also characteristic of many of the distributed systems find in higher education institutions today?

Uncertainly still exists about the reorganization at Stanford. Prior to the reassignment of programmers to line offices, a stable organization worked together to assure consistency and integration. Even though these individuals have now been distributed, they cooperate to avoid creating isolated environments. Fortunately, Stanford has had only one significant personnel change during the past three years. Another advantage in the Stanford situation is that certain support services have remained within a central group that serves all administrative systems. Excellent personal communication among the individuals involved with administrative systems and central support services has eliminated any significant problems at this point. One concern at Stanford has been that the movement of programmers in the administrative

[3]Ralph Carlyle, "The Tomorrow Organization," Datamation, February 1, 1990, pp.22-29.

offices may be restrictive, that is, programmers do not have the opportunity to work in different areas and their career paths may be hindered.[4]

The University of Wisconsin/Stevens Point used a committee to coordinate its initial efforts in distributing responsibility to administrative offices. Stevens Point felt this was cost-effective since the campus-wide network offered the opportunity to locate each application in its operating environment. Moving the hardware out on the network was the easy part. Concerns that have initiated a review of this structure are a lack of consistency, difficulty in integrating administrative applications, and costs (because of the duplication of some services).

In addition to these examples, a number of unfavorable observations can be made about the distributed environment for administrative systems at Virginia Tech. Even though a central systems development staff is still located within the Information Systems organization, its role is to provide development and implementation support to administrative offices and to initiate strategic projects to benefit the institution as a whole. Individual administrative offices continue to have primary responsibility for administrative systems, but, in recent years, individual staffs have grown beyond the initially envisioned operational and maintenance roles.

A thorough analysis of current administrative systems at Virginia Tech and the supporting organizations uncovered the following points:

> A lack of central coordination for distributed activities results in poor planning, duplication of efforts, a lack of integrated systems, and inconsistency.
>
> Certain areas operate in a vacuum and give limited consideration to issues of a global perspective. A limited sense of synergy exists for the administrative systems environment.
>
> Certain administrative areas are unwilling or unable to provide a support staff and rely solely on central resources.
>
> The definition of roles for specific personnel is unclear in administrative offices that accept responsibility for administrative systems, and in the central resources.

How administrative systems and the distributed activities are perceived vary from one group to another. Individual administrative offices may be content that most systems are meeting their needs. However, users outside that administrative office have a different opinion. The global view reveals that the lack of coordination for these distributed activities has created an environment that is fragmented, undependable, and nonresponsive.

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[4]Personal communication, Ced Bennett, Director, Application Support Center, Stanford University, November 9, 1990.

Coordination for Success

This discussion is not intended to discourage distributed activities nor to imply that all distributed efforts are failures. On the contrary, successful distributed operations indicate that distributed functions are a permanent organizational structure. Some form of distributed activity may be prominent in almost any organization in the next decade. Many organizations, such as Virginia Tech, must react to the situation and correct problems they have encountered. This will provide those facing this inevitable change to their environment the information needed for planning and moving forward with an infrastructure that assures success.

The difference between failure and success for many distributed activities is coordination. A recent article on the issue of downsizing indicated that one way to avoid failure is to have a controlling framework or infrastructure. The author further states that "the more dispensed the technology and the people are, the more important coordination, coherence and consistency become -- especially as power users and similar constituencies start deploying sophisticated departmental systems of their own."[5] This applies to distributed activities, as well as mirrors the environments of many organizations.

Many challenges are facing those responsible for making a decision on distributed activities. If an organization is to have successful distributed activities that support a global mission, there must eventually be a point of central coordination. The type of organization and what is expected from distributed activities will help determine how the coordination function fits into the structure. Management support is essential, and all personnel involved with distributed activities must understand their roles, responsibilities, and how they interact with the central coordinating function.

Responding to the Need

Business and industry are reacting to the problems of distributed, incompatible, inconsistent, and often out-of-control information systems by increasing the control and coordination of their activities. Although distributed activities will continue to increase, more emphasis must be placed on standards and the integration of systems. If the information in an organization is not shared and used in a uniform manner, it loses value. To assure that a highly integrated environment is present and that information needs of the future can be met, business and industry are turning to chief information officers, integrated project teams, and corporate information planning functions.

Stanford University is making few changes in its environment because the people involved with the systems are communicating and there is a certain amount of "informal" coordination. Regular meetings keep people informed,

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[5]Theodore P. Klein, "How to Avoid the Five Biggest Downsizing Errors," Computerworld, June 11, 1990, pp. 91-93.

and the central organizations arrange seminars to explain new initiatives and future projects and plans.

The hardware and applications are still distributed at Stevens Point, but other changes have been made to better serve administrative systems. Programmers have been moved into a central organization that coordinates and supports activities for administrative systems. An increase in the integration of distributed administrative applications has also prompted Stevens Point to recently establish a new campus-wide data administrator position.[6] This individual is responsible for university data across all systems.

Virginia Tech has been pondering its situation for the last few years. The interest has been in creating an environment where distributed activities are not necessarily discouraged, but solutions created for specific areas do not, at the same time, diminish support of institutional needs. The Information Systems organization has insisted that administrative offices be responsible for administrative systems. Although objections to this philosophy are not intense, problems do exist in the current structure.

Administrative Systems Planning

Administrative offices at Virginia Tech have continually accepted increasing responsibility for planning, developing, and operating administrative systems in their areas. Subjective strategies in individual offices have often resulted in systems that were designed for solving problems in an isolated environment. This situation has resulted in fragmented systems and increased the possibility of risks in terms of costs and inadequate systems. Such an environment can be attributed to the lack of any centralized direction and coordination for these distributed activities. Users at several levels feel Virginia Tech is lacking a formal planning activity, a uniform process for implementing systems, specific standards to enhance integration, and strategic directions for administrative computing.[7] Not only is there a lack of teamwork by the various "players," there is also no manager for the team.

Administrators at Virginia Tech have been somewhat cautious about this situation, but took an initial step in early 1990 when they established an administrative systems planning function. The initial announcement for this new function indicated it would be charged with developing and maintaining a comprehensive and coordinated plan for administrative systems throughout the University. Part of the charge was to provide the administration with recommendations to ensure successful administrative systems - distributed or otherwise. After only a few weeks, a number of issues had surfaced that needed to be addressed by this "independent" function. A mission statement,

[6]Personal communication, Clark Pallen, Campus-wide Data Administrator, Wisconsin/Stevens Point, November 8, 1990.

[7]"Administrative Systems Review Committee - Final Report," Administrative Systems Review Committee, Virginia Tech, June 7, 1989.

as well as supporting statements, were presented and approved by the administration. The mission statement reflects an initiative to ensure that information technology is supporting the administrative functions at Virginia Tech:

> Ensure that automated administrative systems adequately support the fulfillment of the University's mission and the attainment of its goals and objectives, and that strategic initiatives in administrative areas are within defined guidelines and directions.

Strange as it may seem, this new administrative systems planning function is part of a management services operation within the department of Internal Auditing. Several "political" reasons placed it within this organizational structure, but it was primarily due to the fact that no one wanted to accept responsibility for coordinating distributed activities. The arrangement has worked out reasonably well, but any such planning or coordinating function should eventually be more strategically placed within the organization.

Efforts and Actions

Virginia Tech is fortunate to have a history of successful administrative systems. Many of the systems installed today incorporate advanced technologies in their operations and are regarded as more than adequate systems. However, the system and its usefulness may be seen in a different perspective outside the operational office. Deficiencies in administrative systems and the knowledge of distributed activities provided sufficient information to begin defining initial tasks for the administrative systems planning function. A strategic plan for administrative systems would be needed to provide a framework for future endeavors. More immediate tasks essential to developing a planning process and unified vision for administrative systems included the following: assessing current administrative systems and preparing a report, defining an acceptable operating environment for administrative systems, evaluating the need for standards, defining a comprehensive methodology for structuring operations in administrative systems (including cost justification), monitoring and assessing technological changes as they might apply to administrative functions, meeting with people throughout the university to promote the planning effort, and finally, serving as a focal point for issues relating to present and future administrative systems.

The assessment report was important and served as a working document for defining future initiatives, but the interesting outcome of these initial efforts was meeting with the people and learning what they thought about their responsibilities and future directions for administrative systems. Unfortunately, most people think in a vacuum! Planning has been in a reactive mode, which contributes to ineffectiveness and exposures to risk. These administrative offices and support staffs do little to promote the sharing of ideas, data, initiatives, or resources. Each group decides its priorities and proceeds with development and implementation. Projects are often directed at the immediate needs of individual offices and the institutional impacts are not fully assessed. Consequently, much effort is presently going into promoting a sense of cooperation and teamwork with these areas and individuals, and emphasizing the need for considering change. Dr. Richard Nolan emphasized at the CAUSE 1989 national conference that it is important to view change as a transformation, that is, a destruction of the old and the simultaneous rebuilding of the new.[8] Educating people about change can greatly enhance the opportunities available through technology.

Interest groups, rather than formal committees, have been organized for some of the other initial efforts. An interest group on a comprehensive methodology now meets regularly to discuss needs and define content. In addition, some contact has been made with other institutions in the state in an effort to determine if cooperative projects may be feasible. At the present time, two planning phases have been defined for the methodology at Virginia Tech and both are being used in test situations. Some activity is also beginning with Information Resource Management and Institutional Research concerning standards for administrative data.

A draft of the strategic plan for administrative systems is being reviewed for a projected completion date of January, 1991. The plan will recognize and communicate the future directions for administrative systems at Virginia Tech. It can be used as a framework to develop other strategic, tactical, and operational plans.

Recommendations for Change

Initial efforts by Administrative Systems Planning recently culminated in a report to the Executive Vice President and Chief Business Officer. An extensive list of active and potential projects was defined; strategic initiatives that relate to and would improve administrative systems were identified; and recommendations were presented for changes in organization, as well as policies and procedures.[9] Organizational change and evaluation of policies and procedures relate most directly to improving the environment of distributed activities and are described below.

The report states that a distributed environment without central coordination is not the most efficient or effective organization for administrative systems. Such a structure creates "isolated" areas that often function in a vacuum and contributes to duplication of systems, data, processes, and so on. The specific steps to improve the organizational support for administrative systems at Virginia Tech include the following.

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[8]Richard L. Nolan, "Transformation of Information Technology in the Modern Higher Education Institution," general session address at CAUSE89, San Diego, California, November, 1989.

[9]"Administrative Systems Project and Organization Report," Administrative Systems Planning, Virginia Tech, September 24, 1990.

Identify an office that will be responsible for overall administrative systems and establish a matrix type organization for the distributed support staffs.

Emphasize the responsibilities for distributed support staffs, evaluate personnel assignments, and create a central resource pool.

Utilize the central Systems Development staff for new and enhanced administrative projects.

Implement a University Data Base concept with Institutional Research.[10]

These recommendations are currently being reviewed by the senior administrative staff. All these recommendations can be accomplished with existing resources and in a reasonable time frame.

The report also recommends that certain supporting policies and procedures should be in place as improvements are made in the organizational support for administrative systems. Some recommendations are the following.

Approve the pending policy for developing and implementing administrative systems[11] and clearly state that the policy will be followed.

Recognize an Administrative Systems Advisory Committee that will review items of importance for administrative systems, provide advice and recommendations, and approve certain actions.

Approve an efficient and effective procedure for assigning resources to projects based on acceptable criteria.

Stress the importance of standards and support efforts to define and implement guidelines.

Recommend the review of existing policies and procedures that might hinder automated administrative systems from responding effectively to management and user needs.

The current unstable organization of administrative systems and budgetary constraints at Virginia Tech are necessitating change. Implementation of these

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[10] "An Information Infrastructure For The Future," a report by Data Administration, Virginia Tech, April 14, 1988, p. 10.

[11] This pending policy states that all new and enhanced projects will be reviewed by a central office, and if approved, assigned a priority for the allocation of resources.

recommendations will coordinate distributed activities, provide a significantly more efficient operation, and better utilize existing resources.

Conclusion

The distributed technologies that will prevail in the 1990s will certainly provide challenges and opportunities. The experiences and recommendations presented in this discussion should help prepare some institutions for imminent changes. Coordination of distributed activities will be more vital than ever before, however, coordination should also become an easier task. Advances in technology will decrease the concern about hardware categories; universal standards will enhance the connectivity of diverse systems; and administrative applications will actually gravitate to the system that best supports them. The major concern may then be in providing an integrated, seamless, open and, yet secure, environment. Integration, rather than innovation, might be the theme for the 1990s.

Contiguous Information Systems at the University of Hartford

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ABSTRACT

The main objectives of this strategy were to leverage the investment in the University's administrative information systems and data bases by creating an environment in which the central and departmental resources can together accomplish end user informational objectives while maintaining informational hygiene. Users in departments utilize the central capabilities and data to create and maintain functional and service extensions - "contiguous systems".

An evolutionary approach was selected to monitor progress and expand the capabilities and access as success warranted. Important influences for this approach were the University environment, small information system staff, expanding campus network, proliferation of computer technology on campus, and demand for application development.

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Background on the University of Hartford
The University of Hartford is an independent, comprehensive university, which provides educational programs in the liberal arts and professional disciplines for undergraduate and graduate majors. There are 105 undergraduate majors and 50 graduate degree programs offered by the University. Most of the more than 4,300 full-time undergraduate students come from the northeastern part of the United States. In addition to the full-time undergraduate students, there are over 7,000 others who enroll at the University during the year.

The University is located on a 265 acre campus in the greater Hartford area and has practically all of its facilities - colleges, dormitories and administrative buildings - located here.

Administrative Systems - Background
For over six years, the University of Hartford has invested in a portfolio of advanced, integrated administrative information systems. This strategic project was accomplished with one software vendor - Systems and Computer Technology (SCT). The original systems are student accounts receivable (ARIS - integrated with ISIS), human resource and payroll system (HRIS), financial information system (IFIS), and student information system (ISIS), which is by far the largest of all the systems. In 1989, a fifth system was placed in production - the alumni development and donor system (ADDS), which is also from SCT. The present portfolio of administrative information systems along with a brief description of each system is given in Table 1.

It is important to note that these five application systems are not stagnant. Major enhancements and, in some cases, total application system upgrades have expanded the functionality and capabilities of the systems. In fact, protecting the investment by keeping these systems updated has been a driving force in the application systems strategy. Not only are the latest enhancements from the vendor installed but in many cases the University has worked together with the software vendor, SCT, to be the user testing site for system enhancements before their general release. Furthermore, there have been a number of important subsystems that were developed in-house, because the University considered them strategic and time critical.

The growth of the systems can be indicated by a few quantifiable measures shown in Table 2. This Table displays the dramatic increase in all categories except one - namely, the number of the central applications staff. The increase for application support requirements and a continuing demand by end users gave impetus to end user computing and the class of programs that I have termed "contiguous information systems."

Another important factor has been the expansion of the infrastructure at the University to include a campus network that now includes all administrative systems users. The number of end users with privilege to access the production on-line administrative systems has more than doubled to 400 over the past few years. As should be expected, the original base of operational, supervisory, and managerial users has expanded to include more occasional users. The increased level of access and use of the administrative systems and data has been a factor in the demand for administrative information, enhanced system functionality, and enhanced system output.

Contiguous Information Systems - Definition & Objectives
End user computing, client/server architecture, distributed computing, and many other descriptions and definitions have entered into common usage. While each of these describe interesting and advance concepts, the particular thrust of the phase "contiguous information systems" that I wish to discuss in this presentation describes a class of programs and systems that are, in some manner, obvious or reasonable extensions of the central administrative systems. The extensions can be functional and/or service extensions. Systems such as a specialized theater and sports ticketing systems, ad hoc activities, and isolated PC applications are not within this definition. While where the data is processed or who actually has operational responsibilities is not a criteria for inclusion or exclusion, it will be noted that the trend has been to process more and more in the user environment. Another criteria for contiguous information systems is that the user has developed a major part of the program or procedure and exercises significant control on a production aspect of the contiguous system.

The contiguous information systems could have been entirely developed and controlled by the central information systems group. Indeed, some of the functionally contiguous systems had been requested by various departments for development; however, the institutional priority for these requests had been placed in a lower position in the queue than the department thought appropriate. In some cases, some of the functionality of a contiguous program will be absorbed into an expanded central information system in the future.

From the perspective of the institution as a whole, the responsibility of enhancing and ensuring the smooth operation of the administrative information systems is a prime consideration for the information systems group. This creates the usual conflict of demand for a limited development resource. In this case, it means that the demand for application systems development exceeds the limited resource of the application staff. This common situation, as well as the benefits of leveraging the institutional investment in the advanced administrative systems, was recognized as an opportunity to expand end user involvement in meeting some of their informational needs.

There are many objectives for contiguous information systems and some of these have been mentioned before. The main objectives are the following.

Contiguous Information Systems - Main Objectives

* Leverage the investment in the administrative information systems.
* Maintain the security, integrity, and availability of the administrative information systems and their data bases, while allowing end users to satisfy some of their informational needs.
* Decrease the application backlog.
* Provide consulting by application staff for start-up efforts of departments, while providing decreased continuing support as end users became proficient.
* Take advantage of the new infrastructure in networks and user orientated mainframe products.

In summary, the above objectives can be thought of as maintaining central "informational hygiene," while giving end users tools, support, and opportunities to satisfy some of their simpler informational needs.

Informational Hygiene

The term "informational hygiene" can be thought of as the conditions and/or practices conductive to the well-being of information systems and data. These are the myriad of conditions and practices that are well-known to professional information systems personnel but are, in many cases, less appreciated by typical end users. Analogous to the term "hygiene" in the medical field, informational hygiene is a collection of conditions and practices that are not exciting but very are important. Informational hygiene is time consuming and requires constant attention and discipline to achieve its results in the information field. Some of the more well-known results are data bases that are of high quality, have high integrity, and are secure; high quality applications that have been thoroughly tested, documented, and created to be accurate, reliable, recoverable, and easily maintained; and highly reliable computer operations with up-to-date back-up and recovery procedures.

For the information systems group, informational hygiene denotes policies, procedures, and standards for all aspects of information systems activities - system development and maintenance, computer system operations, quality control, and operating systems - as well as separation of duties and audit trails for standard procedures. Informational hygiene is particularly important for systems that are or will become operationally embedded in the institution's activities.

To maintain informational hygiene of the central administrative information systems, only authorized end users may have read-only access to the administrative data base using exclusively the mainframe software supplied and maintained by the information systems department. All changes to the administrative data from any contiguous information system must go through the same editing programs that would be appropriate for similar changes done the usual way. In other words, while informational hygiene at the users level may be as good as with the information systems group, this can not be assumed; therefore, strict controls are enforced to protect the integrity of the institutional systems and data base.

Although the end user may achieve the same level of information hygiene, they are not encouraged to attempt the more complex, higher risk operational applications appropriate for the information systems department. While importance to the institution is a factor for deciding upon who should be responsible for the development of a particular system, other technical factors are also important considerations. Typically, the higher risk projects are the larger, more technologically advanced applications for which the inherent structure is low. In a similar train of thought, applications that are to become integral to the operational aspects of an organization need careful review as to which group should be responsible for the long term. For example, it can be noted that although decision support and executive information systems are important, they do not present the level of criticality that complex operationally embedded systems do.

With this understanding, it is clear that such contiguous systems should not compromise the standard practices and procedures of the information systems group or impact the production on-line and batch administrative information systems. To fully appreciate the implications and impact of contiguous information programs and systems for the established administrative systems, an evolutionary strategy was selected and is discussed next.

Evolutionary Approach
An evolutionary approach was adopted as the best way to achieve our objectives without compromising informational hygiene. Contiguous systems applications were to expand as experience with less ambitious projects proved successful. Past experience has shown that this has demonstrated to be a effective approach. Not only was there a conscious policy of evolution, but there were also other factors that have paced the development of contiguous systems. The most important factors have been the absorption of information technology and the expansion of the campus network.

When some of the administrative systems were first installed in the early 1980s at the University of Hartford, personal computers and networks were still relatively new for many institutions. As the technology has diffused across the entire organization, opportunities for end users to satisfy part of their own institutional needs blossomed. Today the institutional network has expanded around campus and provides a capability for more advanced contiguous information systems.

End User Support
Early in the evolutionary process, it became apparent that technical ands consulting support of end users was a critical factor. Beyond providing the tools, infrastructure, and training, there were two important areas - the use of tools and infrastructure and the understanding of the meaning of the data in the administrative data bases. In the first area, many end users become proficient, while others who are not technically inclined continue to require support. The latter area of administrative data bases brings into focus the difficulty of presenting a complex data base structure that is not only designed for efficient operation but also much larger than the experience of even the most technical end user.

It is a well-known difficulty of presenting the data in a form and manner that is easily understood and accessible by less technical personnel. There are many ways to help resolve this issue; such as sophisticated data dictionaries and mainframe decision support software with its own form of the administrative data base (a static copy updated periodically). At this time, there is no consensus that the substantial institutional resources for such an effort should be allocated for that purpose. Most of the end users eventually identify the data elements that they need. However, enhancements and modifications to the administrative systems and the shifting environment of the end user have continued the demand for information systems support in this area.

Evolutionary Contiguous Information Systems - Examples
As discussed above, contiguous information systems have been evolving since major components of the administrative information systems were installed. The following examples are arranged in a roughly chronological order, which is also an order of increasing complexity. To help illustrate some of the relationships, a simplified network layout is presented in Figure 1.

<u>Downloads of Extracted Data and PC Processing</u>
The first examples were systems where data extraction and download programs were developed and put into production for the mainframe administrative systems. The extracted data was put

on movable media for sending by "sneaker net" to the end user's personal computer. Further analysis, summarization, sorting, and reports were done by the end user with standard personal computer software, e.g., spread sheets, data base, graphics program, statistical analysis, and word processing. In these cases, the end user could vary the data that was extracted within specified parameters and could initiate the process. Examples include decision support systems and financial analysis reports.

Mainframe Software and Files

Later, mainframe facilities (e.g., SPECTRA from CINCOM Systems and Easytrieve) for end user computing were installed for the administration information system. Although these facilities were designed primarily for ad hoc reports, they also are used to extract and store data on the mainframe data files. Mainframe reports can then be generated from these user created data files or the administrative data base or both. One of the key capabilities is the on-line feature that has appeal to departments that need a fast response to meet their daily operational needs.

The Bursars Department has developed over 100 SPECTRA programs ("processes"). About 70% of these would fall into the contiguous information category, since they are used for verification and reconciliation of departmental operations. Some of the programs are run daily to extract data from the administrative systems data base and subsequently store this data in the users' personal mainframe data files for later processing.

Network Usage and File Server

With the advent of the network (DECnet) in a number of end user departments, the previously mentioned mainframe software was utilized to access the administrative data base to create mainframe files that users directed to be moved to any node on the network and then converted for use by their personal computer standard software. End users have the option of moving the data files to the network file server or to their own data disks on their personal computer. The "virtual disk" feature of the network allows the personal computers of users to access data on the file server as if it were an attached disk dive (e.g., disk drive H:). The end user can grant access to these virtual disks for the sharing of data files.

Our Financial Affairs Department has effectively utilized these features for data concerning budget preparation, program ledger, general ledger, subsidiary ledger, and vendors. The personal computer software includes spread sheet and data base management programs. In addition to analysis reports, the data is also employed to aid in their department's management of the data on the administrative financial system. They have used word processing programs to produce letters with administrative data on their personal computer printers; these letters are created when the secondary merge data (e.g., vendor addresses) on a virtual drive is merged with a "shell" or primary document on their personal computer.

It should be recalled that my definition of a contiguous information system also incudes services performed by the end users to satisfy their own needs. An example of this occurrence is the situation where there was a user requirement for correspondence-quality printed envelopes, which was a service not (and is not now) provided by computer operations. These envelopes are for the correspondence-quality, personalized letters having "digitized" signatures on departmental stationary, which is the output of a production job executed by computer services operations. As in the previous example for Financial Affairs, an extracted file of addresses is moved to a virtual disk and the end users themselves produce the addressed envelopes with a word processor and correspondence printer. Due to the high volume of letters, it was necessary to have a production job developed by the information systems group to produce the letters and the address file in order to synchronize the order for later envelope stuffing. Total volume from a number of such jobs now exceeds 200,000 letters per year. A number of departments (e.g., Admissions and Alumni Development) have found this method to be an effective way to achieve their important objective of presenting the best quality of communication to their target audiences of prospective students and donors.

The Alumni Department has other systems of interest that fall into the contiguous category. One example is a production job extract that periodically moves financial information to the file server, where periodic reports and analyses are created by the end user employing data base programs, spreadsheet programs, and word processors. It is also interesting to note another benefit that end users now enjoy. End users can now "dress up" reports and presentations to important audiences with their personal computer software and advanced laser printers.

Mainframe and Personal Computer Processing

The examples above have emphasized the extraction of data from the administrative data base and the end user manipulating the data to produce periodic reports, analyses, or operational reports or providing services not available at computer operations. While the previous examples have some "feed back" of data changes (some of which are very important) to the administrative systems, there was little application logic that initiates a high volume of production changes to the data base. The next application provides an example of this type.

Our residential student housing department had the pressing need for enhancements to the administrative system. This need was in part due to the large number of new residences being completed and to satisfy student life style preferences in the process of assigning rooms, while at the same time meeting the institutional fee structures and policies. Although there was an enhancement under development for the housing module in the administrative system, the increased burden and time constraints had to be addressed. Room assignment information was the basis for assessing certain fees in the student administrative system and this assessment process had a time window that must be met for the billing cycle.

To meet these objectives and requirements, this contiguous system was developed to first extract certain student biographic and academic information from the student administrative system. Next, this data was moved to the residential housing department for creating and updating records on their data base on their personal computer local area network. The room assignment/fee process was accomplished by a program, which the residential life developed utilizing a standard personal computer software product. Then, they extracted and prepared the housing records for processing by the administrative system.

The step of entering the records into the editing program can be accomplished in two ways. The first way is updating on-line with a personal computer product entering the data into the screen as if were being keyed by a person. From the administrative system view point, this method creates an on-line transaction that is not discernable from any other on-line transaction. The other way is to send a special file of these records, which is run by an administrative batch program that processes the records as if they were on-line transactions but in a batch mode. In either method, informational hygiene of the administrative data base is maintained since these housing records are processed by the same editing routines that are regularly used for verification and updating the data base.

Evaluation of Current Status

There have been a number of departmental successes. Some of the more significant success factors for departments has been found to be an existing expertise in computers and software (PC and/or mainframe) and a high motivation to satisfy an informational need. While continuity in the department effort was (and is) a major concern, this has not been a problem to date.

The policies and procedures have been successful in maintaining the informational hygiene of the administrative information systems and their data base, but this has slowed the progress in the spread of contiguous information systems and use of the various end user tools. However, this slower progress has been accepted as unfortunate but necessary to achieve the objectives listed earlier.

Support of the end users has been more extensive and continues longer than was expected. Nevertheless, there has been a significant net gain in the decrease of the application backlog and increase in the satisfaction of end user needs.

Concluding Remarks

This presentation has focused on a subset of end user computing that has grown over the past few years as information technology has advanced and has been absorbed in the end user organizations. The goal of informational hygiene will continue to have an information systems organization (centralized or decentralized) attempt to expand their systems to important operational and multi-departmental systems, while end users will continue to satisfy some of their own current and future informational needs. While the goals may conflict, the information systems group will be expected to be responsible for the higher risk projects either from the beginning or at a later time.

Since information technology will continue to advance for the foreseeable future, the feasibility for more contiguous systems will also expand. It should also be noted that the ability of end users to respond more quickly to changes and new demands in their own informational environment is a growing phenomenon that also provides an impetus to expanding the domain of end user computing in general and contiguous systems in particular. As the increased ability to accomplish informational tasks has become known, there has also been an increased expectation of performance that reinforces the impetus for end user computing.

As changes happen with the administrative systems, the impact of these changes will spread out to the end user, who will have to maintain the compatibility of their systems. It will be a challenge to continue to coordinate the contiguous information systems as changes occur in the administrative systems. For the future, there will be continuing expansion and shifting boundaries between the domains of the end user and the information systems group; it is this process and its tensions that needs to be understood and carefully managed to ensure institutional standards and objectives.

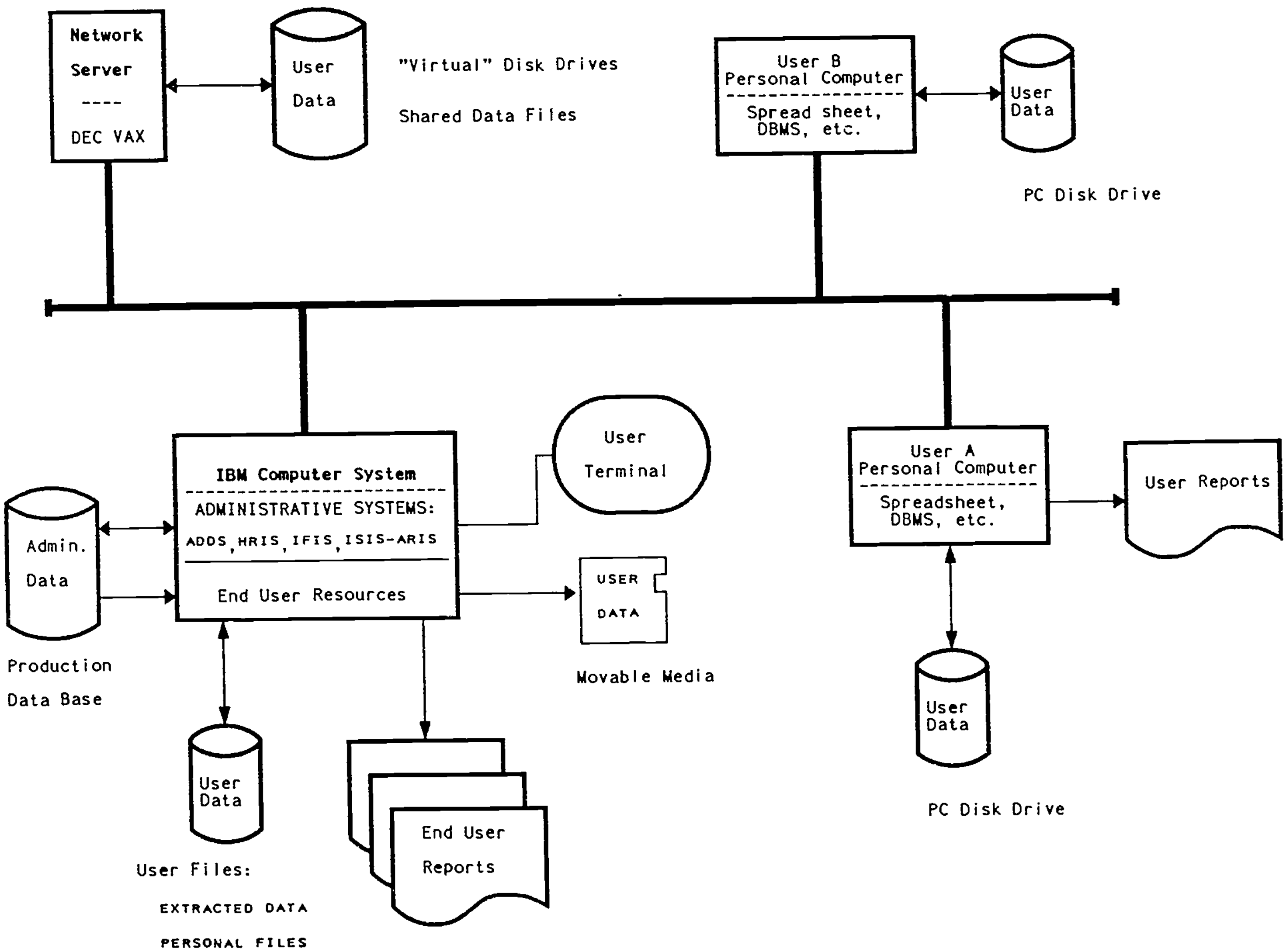
Table # 1 - Administrative Information Systems Portfolio			
System Name		Installed / Major Upgrade	Summary Description
ADDS	Alumni Donor and Development System	3/1989	Constituent and Solicitor Organization Modules, Pledges, Campaigns, Gift & Pledge Payments, Matching Gifts, Designations, Clubs & Associations, Alumni Support
ARIS	Accounts Receivable Information System	2/1984	Accounts receivable for student system (ISIS)
HRIS	Human Resource Information System	3/1987	Payroll, Personnel, & Position Control; Applicant Tracking, Payroll, Pay History, Benefits Administration, Human Resources Information, Government Regulatory Requirements
IFIS	Integrated Financial Information System	12/1990*	Fund Accounting, Grant Accounting*, Budget Preparation, Purchasing & Procurement*, Miscellaneous Account Receivable, Cost Accounting, Fixed Assets
ISIS	Integrated Student Information System	2/1984	Prospective Student Information, Admissions, Advising, Financial Aid, Registration, Housing/Room Scheduling*, Course Catalog, Class Schedule, Assessment, Grading, Faculty Load*, Academic History/Transcript

Table # 2 - Growth in Administrative Information Systems		
Number of:	1986	1990 Est.*
Source Code Modules	1,200	2,500
On-line Screens	182	368
Batch Jobs	N/A	760
Data Base Records	5 million	11.7 million
Application Staff	8	9

NOTE: (*) In process of implementation or upgrade.

University of Hartford - Figure # 1

Simplified Network Diagram



Campus-wide RDBMS: A Search for Partnerships

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Abstract

The University of Pennsylvania recently signed a five-year, campus-wide partnership agreement with Ingres Corporation (now the Ingres Division of ASK Computer Systems) for relational database management system (RDBMS) software, support, training, and consulting. In this panel, we report on our experiences in choosing a relational database partner and negotiating a fruitful campus-wide license and support agreement. We outline the disparate needs that led us into and through the process, and we report on the initial database projects in three areas. Finally, we observe that the internal partnerships that emerged in the process will serve the University at least as well as the partnership with Ingres.

Introduction

Virtually every university seeks to improve school and departmental management, reporting, and data analysis capabilities. Limitations of mainframe-based information systems lead sub-units to explore minicomputer-, workstation-, and pc-based solutions. Independent applications development carries risks, however, such as software incompatibility and loss of data integrity.

In recent years relational database management systems (RDBMS) have been hailed as the best platform for building flexible applications supporting ad hoc query and data sharing, even if they do not yet deliver the most cost-effective transaction processing. Moreover some leading RDBMS software vendors claim to be able to integrate applications across multiple host and desktop platforms, even (in some cases) if applications were built with a competitor's RDBMS. Thus institution-wide use of RDBMS technology holds great promise for solving sub-unit information systems problems.

A key question is whether compatibility with the emerging industry-standard Structured Query Language (SQL) is sufficient to assure integration across multiple software platforms. If so, schools and administrative units could be allowed to make their own best deals with RDBMS vendors (and applications software vendors using RDBMS) in the context of their own hardware strategies.

At the University of Pennsylvania, we adopted the opposite strategy: seeking the best possible partnership with one RDBMS vendor for mid-range and desktop platforms. (Our mainframe database strategy is still under study). Our reasons were threefold: (1) we judged that SQL is not yet a sufficiently robust standard, since most leading vendors vigorously advertise proprietary enhancements; (2) we learned from other universities about the formidable effort required to support even one RDBMS; and (3) we observed how costly the "best deal" would be for one or two sub-units negotiating alone.

In May 1990 we sent a Request for Partnership (RFP) to four leading vendors of RDBMS software and support services. A campus-wide committee evaluated the proposals and judged that Ingres Corporation had the most responsive combination of state-of-the-art software for VAX, UNIX, and desktop hardware; support, training, and consulting programs; and commitment to a partnership that would make the University of Pennsylvania a showcase for RDBMS technology in administration, research, and instruction. After a month of negotiation with Ingres representatives, we signed a five-year partnership agreement on June 29, 1990.

Two units, Development Information Systems and the Wharton School, played major roles in the RDBMS evaluation and negotiation processes, which were led by the central Office of Information Systems and Computing (ISC). A third unit, the School of Arts and Sciences, had priorities and pre-existing RDBMS software that provided important context. These three perspectives are described below, followed by the ISC viewpoint and some conclusions.

Development and University Relations Perspective

The department of Development and University Relations is the University's primary "interface" to the external world. It provides the principal means of contact for Penn's alumni; it manages the University's public image and its relations with outside organizations; and it solicits voluntary contributions from alumni and other private sources in support of the University's academic and research programs. The department's 200 fundraising staff are distributed among the University's twelve schools, six resource centers, and eight central offices, all supported by a central services organization.

Since information is a fundamental resource for institutional advancement, the success of an advancement program depends critically on the quality and accessibility of information. Our traditional information environment has been primarily IBM mainframe-based, comprising three separate, non-integrated systems developed to perform gift accounting, prospect tracking and management, and prospect bio-demographic inquiry and maintenance.

In October 1989, the University officially kicked off a five-year capital fundraising campaign. Our goal is to raise one billion dollars to ensure Penn's place in the front rank of the nation's universities. Over 550 million dollars has been raised so far, including a record-setting 140 million in the past year.

The Campaign for Penn became, in many ways, a "critical incident" for the University. In planning for this extraordinary fundraising effort we became increasingly aware of the crucial role that information would play. At the same time we began to recognize the inadequacies of existing information resources.

Development Information Systems faced three major problems. Our ability to produce reports (6,500 last year with growth projected at 15-20 per cent) from the three databases was too limited. Even as the biggest user of the central IBM 3090, Development was subject to the resource constraints that sharing a central computer entails—our needs far exceeded our capacity. In addition, the existing fundraising applications were primarily transaction-oriented; their design caused complex queries to be processed inefficiently. And, our minimally-skilled programmers needed to understand file design and access strategy tradeoffs to reduce report turnaround times.

Second, we needed to develop a departmental capability to design and implement new fundraising applications. Fundraising, a dynamic enterprise, puts extraordinary demands on its information resource base. Further, the existing constellation of applications required signing on to all three systems in the course of investigating a single prospect's record.

Third, we found ourselves, in the central Development office, under increasing pressure from schools to decentralize information resources and to move toward more school-based control of data. Failure to address this issue might result in sub-optimal decision-making by school offices, which would compromise overall data integrity.

Our solution was to integrate the three major fundraising applications into one, thus providing a single-system image. Screens would be re-designed for better access, creating a pc-like interface, with pull-down menus and customizable user views. Development Information Systems staff would design this system on a separate department-based minicomputer to improve our ad hoc reporting environment by separating query processing on the mini from transaction processing, which would stay on the mainframe. We would also create an easy-to-use report generator, so our front-line fundraisers themselves could get answers according to their schedules, not ours.

A relational database management software product was determined to be ideal for our needs. We also understood that with the needs of the capital campaign behind our arguments, we were in good position to win University approval of our proposal.

Over several months we investigated Ingres, Oracle, and Sybase as candidate RDBMS. Our technical selection criteria were stringent. We needed:

• A robust set of application development tools to enable easy application generation by our departmental technical staff

• Query optimization within the database software, so our programmers need not understand and select optimal file access paths

• The capability to implement "business rules" in the database server, so that they would be accessible by any applications we might develop

• Industry-standard SQL, for data access and manipulation

• The capacity to develop distributed applications over time, so that more technically advanced schools could assume greater responsibility for maintaining their own information.

Ingres was our first choice, based on an evaluation of technical specifications. We then arranged to perform an on-site evaluation of the Ingres software along with the UNIX-based minicomputer we were planning to obtain from Sequent Computer Corporation. The joint evaluation (with both vendors participating fully) was completed in ninety days last spring.

At the time we began to negotiate with Ingres, the Wharton School was beginning its own negotiations with RDBMS vendors. Development and Wharton decided to combine efforts in order to provide a unified bargaining position. Our activity generated interest at Penn in a University-wide site license.

The resulting Penn-Ingres partnership has provided several benefits to the Development department. We acquired the Ingres software at only one-third our projected cost. We now have the promise of central campus support of Ingres. The central IS office on campus is vigorously marketing Ingres internally to other departments, thus enlarging the user base. And, the cooperative links forged during the Ingres partnership negotiations are serving us well in other areas of information resource management at the University.

The Wharton School Perspective

The Wharton School of the University of Pennsylvania has over 5,000 students. In addition to 1,500 MBA and 300 Ph.D. candidates, Wharton enrolls 3,000 students in undergraduate day and evening programs plus 200 in an Executive MBA program.

Information technology has become integral to the mission and operation of the School at all levels. Wharton Computing historically has been charged with academic computing, and the School developed its own internal academic computing center during the early seventies. Over the past five years the responsibilities of the computer center changed in response to pressures from administrative units to develop support for their users' needs. In the highly decentralized environment of the University of Pennsylvania, central university information systems were not able to support much more than the lowest common denominator, so the additional needs of professional schools, such as Wharton, were addressed only minimally.

The personal computer revolution has allowed Wharton departments to develop specialized applications to fill gaps in University systems. Over time these pc applications have proliferated to the point of becoming unmanageable. Often departments have used part-time student workers to develop their applications. When a new crew of students arrives, systems often have to be revamped, because of lack of documentation. Thus a School-wide database strategy has become an essential component of our response to the escalation of user demands.

Wharton's strategic planning process is the central force driving our RDBMS partnership. Strategic planning has been an annual School-wide process for more than five years, emphasizing planning for management of technological change. For example, one of our strategic goals is to provide information systems that respond directly to the needs and goals of the Wharton School without redundancy with central University systems. The solution is the selection of an information architecture for development of academic and administrative applications, a tactical approach linked directly to departmental goals across the School. Our underlying methodology is evolutionary, rather than revolutionary.

Wharton Computing had initiated an unsuccessful RDBMS selection process two years earlier. What is different today? The tactical solutions in progress today are in response to user demands tied directly to major business goals of the Wharton School. In retrospect, our earlier efforts anticipated user demand by about one year; thus, the School was not ready to respond with an institutional commitment of direction and additional funding. Today, our tactical solutions are compatible with the internal and external culture of the institution. Internally, there is an awareness of the mission-critical information needs across the senior management level of the School and in our top-level advisory committees. Externally, we have received support from the University's central office of Information Systems and Computing toward collective solutions that support our distributed computing environment.

Wharton needed an RDBMS platform primarily to support applications development for two mission-critical projects, Graduate Admissions and External Affairs' Alumni Development Information Systems. These two ends of the student life cycle were in need of immediate solutions; between them other student information needs were waiting impatiently.

The RDBMS becomes the integrator for new development combined with available packaged solutions. Departments throughout the School are in need of an infrastructure to integrate central administrative data, School-wide data, and department-specific data; to manage their data; and to support ad hoc queries and routine reporting requirements. Departmental pc solutions are showing signs of collapsing under their own weight and are in need of computer professional expertise and an information architecture to continue growing. These support structures are being implemented, our staff has been deployed in many departments, including the Graduate Admissions and External Affairs offices, and our RDBMS strategy is key to the technology support structure being built.

Our RDBMS selection was based on the following primary criteria for an information architecture to support long-term information systems development and integration:

• The RDBMS should be highly portable. Wharton required support for multiple platforms, primarily VAX VMS and ULTRIX, Berkeley and System V UNIX.

•The RDBMS should support access to data residing at many levels of the organization. We required both distributed databases and distributed processing.

• The RDBMS should improve development productivity and computing support. We required efficient end-user tools, including a low-end report generator and SQL, and efficient programmer tools.

• The RDBMS should be affordable. Wharton required a cost-effective solution for our central VAX and for various departmental systems, from microVAXes to Intel 80386-based systems.

Our RDBMS efforts have furthered the goals of the School. Moreover, internal partnerships have been developed and strengthened. Development and Wharton recognized the commonality of our directions and established an alliance to improve our position with the vendors. That we were able to find a partnership with the central University administration was an exceptional opportunity to build bridges connecting our frequently autonomous worlds.

Fostering and promoting the partnerships developed through this selection process is key to successful and extensive exploitation of RDBMS technology. Through the Ingres partnership we have developed associations that can help us exploit the software to gain a competitive edge with this technology. When Ron Weissman, of NeXT, Inc., spoke at Penn recently, he characterized some universities' pursuing vendor donations to support computing as a "belief in Santa Claus." Indeed, many of us have seen the dismal result of gifts and grants with no supporting budget from our institutions, but we cannot afford not to believe in Santa Claus. We must plan around the opportunities that our vendor relationships create for our institutions.

Wharton gained from the central University partnership a more powerful representation at the negotiating table with Ingres; and furthermore, the significant, farsighted vision is that this is the beginning of campus-wide directions, perhaps even standards, for distributed information systems development at Penn. Our other Penn partnerships initially strengthened our bargaining position. Furthermore, the Penn partnerships open the door for a concerted effort to build on each other's successes and provide the structure to plan for contiguous systems.

Our current direction is to implement pilot projects that will foster an understanding of the total impact of this technology on our organization. The purpose of these pilot projects is not simply to see if the proposed solution works, but to address how well this technology will work within our environment. What are the costs, time, and effort required to install, migrate to, develop, and maintain systems using this RDBMS technology? How successful are these tools in achieving our strategic objectives? Our initial pilot is a project in Graduate Admissions that is moving us toward a School-wide student information database.

How well did this decision process work for us? Given the number of leading RDBMS vendors supporting VMS, there were many good solutions—only a non-decision could have been a bad decision. Other alternatives would have equipped Wharton with a technology to develop good applications, but our decision framework required us to balance cost, performance and technical quality, and time. We believe that the Ingres decision maximizes the benefits across these three factors. Furthermore, Ingres was the clear choice to optimize the strengths of the University working in partnerships, and we are now the proving ground for how well these partnerships can benefit each of the partners.

The School of Arts and Sciences Perspective

The University of Pennsylvania is a decentralized institution, with the autonomy of the twelve schools enhanced by responsibility center budgeting. Many University functions are split, with basic services provided centrally and specialized services provided by the schools.

For example, the School of Arts and Sciences is responsible for its own strategic planning and institutional research. Within the Arts and Sciences Dean's Office, a staff of six share responsibility for School-wide institutional research, planning, and administrative information systems. Ever since serious strategic planning began in Arts and Sciences in the early 1980's, the demand for information in support of long-range planning as well as day-to-day decision-making has grown rapidly. Planning and strategic management have become the responsibility of virtually every senior and mid-level manager in the School. Thus, associate deans, department chairs, and directors all request much more information.

In Arts and Sciences the crucial need for information to support planning drove the search for a relational database management system and for the formation of university partnerships to develop the comprehensive information query system we all needed. One recent event that made that system even more immediately necessary was the installation of a new University Student Records System (SRS). While that system has greatly improved the actual registration process and provides better information on-line about individual students and courses, it is optimized for individual transactions, not for ad hoc query. In addition, there was an enormous backlog of programs to be rewritten, and the programming languages analysts had used before (SAS and FOCUS) were not suitable for SRS' complex data structures. Finally, it was impossible to create the links between systems required for sophisticated institutional research.

During fall 1989 we began to realize that the only real solution to our difficulties would be the creation of a comprehensive, integrated, institutional research database. Our plan was to extract data from the various transactional systems and put it into a relational database with appropriate security, user access tools, support documentation, and personal consulting. Arts and Sciences technical staff analyzed our own resources, examined other possible options, and concluded that our only cost-effective option was to make use of existing School platforms: an IBM 3090/200, an IBM 4341, and SQL/DS, IBM's relational database management system for the VM/CMS operating system. Since the University at that time had no available platform or standard for relational databases, we decided to make use of the best systems available to us at the lowest cost.

Once we examined our platform options, we realized that we were considering design and development of a complex information database that could easily serve the entire University's needs as well as those of our School. Arts and Sciences thus made a proposal for joint School/University development of the Institutional Research Query Database (IRQDB). We made the proposal in January 1990, before the University had seriously considered entering into a institution-wide licensing agreement for RDBMS technology.

Proposing a University-wide rather than a School-specific project did, however, slow down the process for us. For example we had numerous discussions of possible hardware and software platforms. After lengthy negotiations, we ultimately resolved some of our difficulties. First, we realized that the platform decision could be postponed for at least six months without damaging the project. Second, as a campus-wide RDBMS strategy became increasingly viable, we agreed to remain flexible on the platform for IRQDB, if we could be involved in any University discussion of RDBMS.

In September 1990, our proposal was approved, and we are now in the planning phase of IRQDB. The RDBMS platform for the project must still be determined. One complication is that Ingres does not run on the IBM VM platforms owned by Arts and Sciences, although Ingres does provide a gateway to SQL/DS.

Has the School/University partnership regarding RDBMS and IRQDB been useful and rewarding? The process has been so slow that it is still too early for a final judgment. Is this an equal partnership? Not totally. From our perspective, when the central offices are in control to some degree, they feel comfortable and function fairly well. For example the driving forces for the purchase of RDBMS software were external to ISC, but ISC then took over and successfully managed the process in partnership with the separate schools and offices.

With IRQDB, the project manager is external to ISC. Some central staff apparently think they are not sufficiently controlling the process and and often act much less comfortable. We hope to modify those attitudes over time through cooperative behavior leading to successful projects.

Information Systems and Computing Perspective

The University of Pennsylvania, a private research university with a major teaching hospital and a $1.1 billion annual budget, is well-known for its "responsibility center" management style, whereby schools and centers are held accountable for meeting revenue and expense targets. In this milieu, central initiatives that increase indirect costs or reduce local autonomy are, predictably, resisted. Fortunately, there appear to be a growing number of decision makers at the University who understand the importance of an integrated information architecture, even if they are unclear what costs and tradeoffs will be required. Any new initiative, such as a campus-wide RDBMS partnership, must be understood in this context.

More specifically, the Ingres partnership can be seen as a direct result of the strategic planning process that ISC had carried out the previous year. Of the twelve objectives spelled out in the February 1990 "Strategic Directions" document, three are germane:

• Provide administrators with the information and systems needed to do their jobs. Design new systems and their underlying data structures from a University-wide perspective to promote integrated management of University resources.

• Facilitate, coordinate, and support the computing activities of schools, centers, libraries, and administrative offices.

• Establish an integrated, campus-wide architecture of selected hardware and software to enable cost-effective system development and data sharing among microcomputers, minicomputers, and mainframes.

A key strategy outlined in that document is partnerships, both internal and external. The proposal review committee was impressed by the partnership vision in the Ingres proposal, and we (ISC as well as the Schools) have been impressed with the first six months of Ingres' "service after the sale." A concern, however, is the fate of the Ingres technology, personnel, and higher education partnership commitment since the takeover by ASK Computer Systems last fall. We intend to visit ASK corporate headquarters soon to pursue these issues.

Internally, the partnerships established during the RFP and negotiation processes continue to serve the University well. For example, both Development and Wharton have donated host resources for campus-wide training seminars, Development has provided resources on its Sequent for development by the central MIS group of its first Ingres application, and all three units are working with ISC on data modeling and CASE projects. Moreover, many observers report increased openness and trust between ISC and its client groups. Although we have by no means solved the problem of providing robust campus-wide support as Ingres usage proliferates, we are encouraged that a partnership solution can be found.

Conclusion

Creating a campus-wide strategy for RDBMS selection, application, and support is a formidable challenge, given the distributed responsibility for management and computing characteristic of research universities. Turbulence in the RDBMS marketplace exacerbates the problem. At the University of Pennsylvania, an internal partnership of schools, administrative units, and Information Systems and Computing has been created to address this challenge.

Despite the differing needs and priorities of the partners, we have found that motivation, leadership, and good will can lead to timely, joint decision making. In addition we have become convinced also that the commitment of vendors to long-term partnerships are as important as the power and cost of their products.

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