

# FOR COMMENT

## Addenda

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The December 5, 1989, *Almanac* featured the final reports of the ten working groups charged with helping develop new priorities for the University. Among these was the report of the Working Group on the Academic Information Environment, which focused on Penn's capacity to provide access to academic information. As a part of its consideration, the Working Group examined PennNet, support services both for computing and data administration and for the University library system, and the information needs of faculty and students.

Concurrent with the efforts of the Working Group, Paul Mosher, Vice Provost and Director of the Libraries, and Ron Arenson, Acting Vice Provost for Computing, began working with faculty and administrative colleagues to develop vision statements for the library and for information systems and computing. Their efforts formed the basis of many of the discussions and considerations of the Working Group and were in turn formed by them.

In the years to come, the vitality of Penn's research and learning environment will depend on the University's ability to meet the increasing technology and information demands of its community. The two documents that follow outline goals and strategies that build on our current strengths in libraries and computing and can result in a scholarly information environment of singular excellence.

*Michael Aiken, Provost*

# University of Pennsylvania Libraries

## Information at Penn in the Year 2000: A Conceptual Planning Document

by Paul H. Mosher, Vice Provost and Director of Libraries

In this era of rapidly changing technology, Penn has undertaken a systematic reconsideration of its capacity to provide access to academic information. Building on our current strengths in Libraries and Computing, the University must create a scholarly information environment of singular excellence. The scholarly information environment will link the Library and Computing in a common mission; to join knowledge and information resources of great depth, both local and distant, to the academic community through sophisticated electronic technology that will provide rapid and consistent effortless access and delivery. The University Library, the centerpiece of Penn's information environment, must be one focus.

During the years ahead, the Library must perform several significant tasks: maintain and improve the print collection of books and journals to match present and future academic programs; take advantage of electronic information resources needed by faculty and students as they become available; work in close partnership with information systems and technology to increase access to and delivery of information on campus in an increasingly distributed environment; achieve optimum cost-benefit in Departmental Libraries; use available space to maximum efficiency; develop systems for optimal information storage and retrieval; and strengthen links to other major research libraries and centers which will improve local access to materials held elsewhere.

### What is the "Library" for the Year 2000?

The information environment of any research university is a complex organism. The purpose of a university is to discover, create and disseminate knowledge and information. The Library must therefore provide faculty and student scholars with access to the largest possible range of knowledge and information resources available, both locally and distantly, in the whole range and variety of formats in which it is made available.

The term "information environment" is both indicative and misleading, for there is a real difference between "information" and "knowledge," as Daniel Boorstin, Emeritus Librarian of Congress, pointed out in his informative essay, "Gresham's Law." The process of scholarly communication—the creation and dissemination of the results of research through publication, presentation, and teaching—involves not only the raw material of social science and science, that is, the data, observations and symbols that represent "information," but also constructions or assemblies of information in the form of books or other formats, such as films, video tapes, or electronic discs. We must be sure that our scholars have access to both information and knowledge. There is a difference, for example, between the *Sadler Spectra* and Dante's *Divine Comedy*.

This raises a further element important to the University, and that is the act of creation, whether literary or artistic rather than scientific. The results of creation, whether textual, visual, or aural, constitute as important a component of the information store of the University as do data sets or bases. The important element is for the University Library to achieve an equilibrium between knowledge, information resources, data and creative works that parallels the equilibrium of research, teaching and study carried out by the academic programs of the University.

The mission of the University Library is thus to acquire, in contract with the faculty, that segment of the year's output of new knowledge and information appropriate to the University's academic programs, guided by policy outlining Penn's priorities for the acquisition of its information base. This must be done within the restrictions set by the University's budget.

In doing this, the Library acts as the University's chief academic information office and is responsible for acquiring knowledge and information in whatever formats are required for scholarly work by the academic programs of the University. In addition, the Library seeks to identify and provide access mechanisms to the enormous amount of information available from other major information repositories, both domestic and international, in both traditional and newer formats. Access to the information database of the Research Libraries Group, and access to the hundreds of databases available through online commercial services like DIALOG or BRS, are examples of these distant information resources.

Finally, the Library is responsible both for making available to campus users information about information, that is, "bibliographic access" (what information is available and how it can be obtained), and for obtaining delivery on campus of the information itself (physical access or delivery).

The Library must be a partner with the computing enterprise on campus in order to develop an appropriate equilibrium between information, information systems (including networking), and technology, and to help guide the University, in ways that will be cost-beneficial, along the path from traditional information resources available in repositories (the library of the past), toward a distant future in which more information will be provided in electronic format. Distributed Networking technology that permits distributed access to information will radically transform the information seeking and communication behavior of campus scholars, by bringing increasing amounts of information to them without requiring them to go physically to the information.

In this collaboration between the Library and Computing, it will be important for both to remember that new information and new technology do not replace old information or old technology. Studies of electronic information have demonstrated that it is supplemental to hard-copy information rather than displacing, as was previously assumed. Thus the emphasis is likely to shift gradually over time rather than through some media revolution.

### Traditional Information and Knowledge

Each year the University Library acquires about 63,000 titles from 600,000 new titles published around the world. In 1988, domestic production of new titles in the traditional book format was nearly 59,000 new titles. We currently subscribe to some 28,000 current serial titles (compared to some 90,000 current serial titles acquired by the University of California at Berkeley, for example), as well as acquire through gift, exchange and purchase several thousand other pieces of knowledge and information from the hundreds of thousands made available every year around the globe (e.g. documents, manuscripts, microfilm, sound recordings, data tapes, slides).

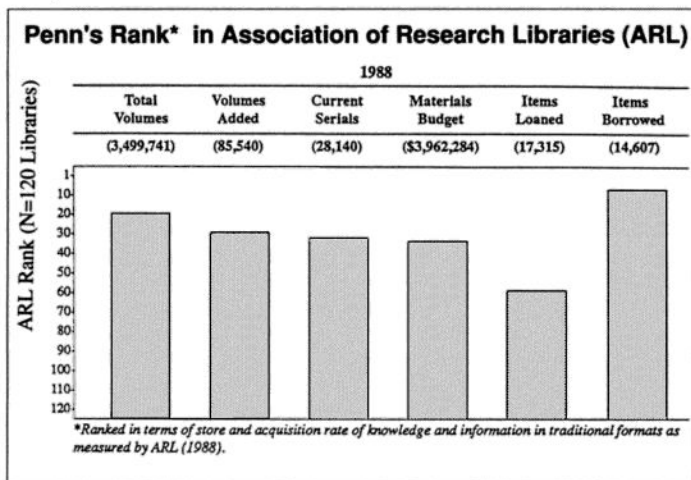
Penn's present store and acquisition rate of knowledge and information in traditional formats can be gauged by the following figures from the 1987-88 Association of Research Libraries statistics.

This data underscores evidence from faculty that the University's level of acquisition of traditional information has fallen too low: Penn needs to devote effort to improving the relative position of the Library in order to attract and support faculty and student scholars of the first rank. In the last resort, scholars will go where the information is, because they can work more effectively and more efficiently there.

The process of re-establishing the University's competitive edge with respect to its knowledge and information store will require additional infusions of funding in order to obtain a measure of real growth



in the five years ahead. It will also require at least a few new staff positions to provide the capacity to make these improvements. The first position, a Curatorship for Social Science Collections was created this year. Endowment for three others is included as a major element in our capital campaign. It will be important for the University to balance the need for improvement in locally available information with needs for computing, and develop the infrastructure necessary to support the electronic information component and added computing capacity. Both must move forward in the years ahead and, for the foreseeable future, we can expect the output of traditional paper resources to continue to increase at the exponential rate they have increased since the 18th century, except in the area of reference materials.



## Electronic Information: Acquisition and Use

According to the 1988 edition of the *Directory of Online Databases* there are 3,893 sets or databases available at the present time, from 1,723 producers. Most of this material is information about information, data, abstracts or indexes. A very small proportion is full text. The U.S. accounts for 45% of the producers, the U.K. 7%, Canada and France each 5%, the Federal Republic of Germany 4%, and Australia and Japan each 2%. Very little is available from Eastern Europe, Africa, Latin America, and East Asia outside Japan. This represents a minute percentage of world publishing. In 1984 world book production came to around 574,000 titles and database production to around 2,000, many of which were proprietary or restricted.

The number of publicly available databases is said to increase at the rate of 20-30% per year according to one author. However this form of publishing suffers from considerable volatility. In 1986, 3,169 data files were produced. Of these 108 were dropped and 1,000 were altered significantly. Others were proprietary or restricted, leaving 567 bases actually available in stable form.

Penn has access to approximately 485 databases in the Libraries or through PennLIN. In addition, patrons have access to BRS and several other composite or specialized databases at reduced cost, through time-sharing arrangements.

Last year, there were about 26,000 hours of use of locally loaded databases, such as MEDLINE and ABI-INFORM, in campus Libraries. The Libraries urgently need to load other local databases of high potential use, such as *Current Contents*, which contains the tables of contents of current journals in most academic fields, the ERIC database, *Psychological Abstracts* and others. The Library's information resources budget will need to be increased in a way that can handle subscriptions and purchases of electronic information resources which are incremental to, not supplantive of, the more traditional information needed primarily by scholars in the humanities and social sciences.

Available data show that electronic information is rapidly coming to dominate the world of information about information. Reference sources, abstracts, indexes, tables of contents, and other similar publications are fairly rapidly coming to be available in electronic form. In addition, significant bases of data and information for the sciences and the quantified social sciences enable information to be rapidly accessed and disseminated in an environment where time is essential to successful scholarly productivity. While the traditional information store needs to be improved for the humanities and some social science fields, electronic information and rapid information delivery systems are becoming

increasingly vital for experimental, applied, and grant-related research.

The Library participates with Computing in requiring infrastructural improvements within the electronic information environment at Penn that will provide consistent interfaces, as transparent as possible for the user. The structure of microcomputers currently being established for purposes of word processing and text creation can then be used to provide distributed access to information resources, as well as computing communication capacity. The networking of these small, increasingly powerful microcomputers transforms them into workstations so that information can flow, with relative ease throughout the University, must be one of Penn's highest priorities during the five years ahead. The 7,000 faculty and students who use the Library system each day require access both to the word processing facilities and to the network information manipulation and transmission features of this electronic infrastructure. Much development both in hardware acquisition and installation and in networking will be required to complete the process of "wiring" the campus, including the libraries in order to support adequately the functionality required to optimize campus-wide support of the new modalities of research, study and teaching.

## Creating an Information Equilibrium

How is the University to improve its traditional information and knowledge resources, add sorely needed new electronic information bases and files, and develop the electronic hardware and network resources required to support scholarly work as it will take shape over the next five years?

An equilibrium is needed that will allow construction of an information environment that will satisfy the needs of numerous academic programs at Penn, ranging from allied sciences to the "hard core humanities." What is required is a pluralistic information environment that can match the pluralism of methodologies, subjects and disciplines of Penn's wide-ranging programs of teaching and research.

Table I represents the range of needs required by the different sets of disciplines of the sciences, the humanities, and the social sciences. The sciences and humanities may be seen as poles representing different extremes on the knowledge-information plane, with the social and behavioral sciences being scattered in between.

Penn requires both a strong store of traditional resources for its programs in the humanities and history, and an information center or broker structure for the sciences and technology that more closely resembles the information center of a business or industrial research model than the traditional library. The former will continue over the years ahead to look and work like a traditional library, but with a new electronic component for information access, electronic information delivery, text processing, and communication.

The sciences will require a very different form of "library" from the one that has traditionally existed at Penn. Widespread local access to information (in labs, libraries, offices, etc.) and rapid delivery, using an electronic infrastructure, must be created in order to provide for the new and interdisciplinary information needs of research and graduate education in the sciences and quantified social sciences.

In all cases, in order to optimize the cost-benefit, resources should be focused on peaks of excellence for the University, its schools and its departments, rather than distributed equally across all potential fields. Core needs of groups of faculty representing significant or major initiatives should be emphasized, perhaps at the expense of cost and labor intensive unique or exotic initiatives of single faculty members. In the latter case, particular effort should be made to gain external sources of funding to sustain more isolated or adventuresome efforts.

In addition, the resources of the University's development structure and current capital campaign should be focused in a way that can help supplement existing resources allocated to support both traditional information needs. The information needs created by new technology in the area of electronic information create supplemental needs that require supplemental resources.

## The Library in the Period of Information Transition

The nature of the Library is changing. Change must be attuned to the availability of electronic information and the need of academic programs for it. The term "Library" must be understood to mean both the store of traditional paper documents and related services, and also the principal electronic information broker on campus.

Real financial growth is needed to cover the information needs of a first-rate University during the five years ahead. For example, if the

overall cost of a steady volume of new information (including cost-rise, inflation, and dollar revaluation, etc.) is measured at 10% in one year, and the resources allocated by the University are 5%, there is a decline in the University's buying power of 5%, not an increase of 5%. To achieve a real 5% increase, the University will have to allocate 15% against a 10% cost rise in order to achieve an actual 5% improvement in buying power. There should be an effort to measure the actual cost increase of information acquired by the University, and a concomitant effort by the University administration and the Schools to provide for supplemental, gradual growth increments over each of the next five years.

As has been demonstrated above, electronic information is expanding less rapidly than has been projected over the last twenty years. We project roughly the same growth rate over the next five years. However, the cost of a single database is often much greater than the cost of a single traditional book or most journals. There are also associated requirements for networking, hardware, infrastructural development, computing and data processing. Stepping up the available budget for electronic information at the present time will enable the University to position itself well and soundly in this area, and eliminate enormous, inflated step costs that will arise later on when the field begins to expand more rapidly.

### **Lack of Empirical Study of Information Use**

To date, both the Library and Computing on campus have tended in planning to be guided by assumptions and claims made by faculty about their needs for information and knowledge. There has been little empirical study or data presented other than Library circulation figures or volumes of mainframe computer use. A few years ago, a major study of information use and need was conducted for U.S. Council on Higher Education by the Office of Scholarly Communication of the American Council of Learned Societies. The data gathered was presented as a composite study in *The Chronicle of Higher Education*. The study was subsequently revised and applied locally at Stanford University, both to ascertain the difference between Stanford and the national norm, and to provide an empirical basis for the development of information resources on the Stanford campus.

The Vice Provosts for Libraries and Computing plan to conduct a joint study of information and computing use on the Penn campus during FY 1990 in order to develop an empirical basis for planning and budgeting over the next five years. Results of the study will be widely publicized, and broadly discussed by appropriate campus groups.

### **A Conceptual Plan for the Support of Electronic Scholarship at Penn**

Computer technology is gradually affecting many aspects of teaching and research at Penn. It is similarly influencing and shaping the pattern of Library services which support these vital University functions in a way that can be synergistic and mutually supportive of the efforts of the office of the Vice Provost for Computing and computing units of the various schools of the University. Just as the work of technical processing and interlibrary services has been revolutionized by automation, so too have public services taken advantage of the computer revolution to provide patrons with an increasingly wide variety of information resources in various electronic formats.

The collection development and management program of the Library is "format blind," and is based on the need of Penn's academic program for knowledge and information. It is not the form but the content that drives our acquisitions policy. For some years the Library reference operations have been integrating into routine operations both locally held electronic information and that available through subscription or unit-payment off campus.

However, not all faculty and students at Penn have convenient or transparent connections to all of the information that is beginning to be available. Further, less than 1% of information produced around the world each year is available in electronic form. Nevertheless, the Library is working to identify new resources designated by faculty as especially useful and, when it appears to be financially possible, is acquiring these material for use—a process shared in a mutually supportive way by the computing units of Arts and Sciences, Medicine, Wharton, and other schools.

Within the sphere of electronic information at Penn, the Library's primary function is liaison with faculty to identify appropriate re-

sources. The Library also selects and acquires formal information that is "published" or "juried" made available for scholarly use through traditional publishing and distribution sources, including electronic scholarly information for local distribution knowledge and information sources for Penn's programs that appear to be cost-beneficial for local acquisition and mounting. The Library's acquisition budget is used for purchase of these materials and will be augmented over the years ahead to make possible aggressive pursuit of appropriate new information sources. At the same time the Library provides access to "brokers," a wide range of information resources or bases off campus, made available through the campus network.

The Library also has the responsibility of creating "catalog" records for all "formal" informational materials, including information in electronic formats, available for faculty and student use on campus, and shares with computing organizations responsibility for providing information about access and use. The Library also has responsibility for ensuring that information about how to gain access to electronic resources is readily available through the catalog or other means. The Library shares with Computing and with appropriate faculty units responsibility for informing people about operational access to and use of materials in electronic formats wherever they may reside on campus, and regularly teaches about how to find, gain access to, and use information which has been acquired on campus in electronic formats. To this end there will need to be facilities designed for instruction in the use of electronic materials throughout the library system. Most librarians in public service units provide basic consulting service for databases available on or through PennLIN and PennNET, but will count on their colleagues in computer centers for training and consulting at more advanced levels concerning use of software, hardware or the application of systems.

Library patrons are gradually becoming more sophisticated in their knowledge of available resources and in ways of manipulating electronic information. As scholarly use of computing, text creation, and video technology develop, Library services need to keep pace. The question is how to provide necessary technology, instruction, and support to facilitate the growing integration of electronic media with more traditional materials and with the methodologies of scholarship, teaching, and study. In addition to distributed technology we must provide easy local access and the linkage of all Library workstations to PennNET. The Library strongly supports all efforts to create consistent, transparent and effortless connectivity for members of the campus community to all informational and knowledge resources available on campus.

What follows is an attempt at a conceptual framework and outline within which the Library will collaborate with the Vice Provost for Computing and campus computer centers in the design and implementation of electronic services for Penn patrons.

### **Support of "Electronic Scholarship"**

In planning for the future, an all-important and all-pervasive dimension of the University will be electronic scholarship (use by faculty, students, and staff for computing, electronic information access, and electronic communication capabilities in their daily work). To support this pervasive activity, computing capacity, information retrieval, storage of information and knowledge in electronic formats, and communication capabilities will be needed. These functions should be available at scholarly workstations (or personal computers functioning as workstations or terminals) which will be located wherever scholarly work is done: libraries, labs, offices, studies, dissertation rooms, and electronic classrooms, placed at various locations throughout the University.

Automated systems should be designed to accommodate both existing and emerging technologies. Maximum flexibility, adaptability, and capacity for change are called for because the rate of change of technology is rapid and is unlikely to decline in the foreseeable future.

Automated systems for the Libraries at Penn, as well as for offices, studies, laboratories, classrooms and dormitories, must be designed from the perspectives and needs of the faculty, other researchers, and students, rather than being abstractly conceived and externally imposed. Knowledge and information appropriate to the level of program need should be provided in all appropriate formats in support of scholarly work.

The Library has responsibility for obtaining and providing access to "formal" information, while Computing Services has primary responsibility for providing support for other information resources, that is,



scholarly work in progress, the creation of experimental or one-time information bases, computer-based technology for classroom use, the distribution of information through campus networks, administrative computing, and support services. The Library will continue to depend on campus automation professionals and organizations for these latter services. Computing and Libraries should share in the functions of instruction and consulting as appropriate to their functions. A schematic portrayal of the Library's role within the campus network is attached (Table II).

Scholars want what they want when and where they want it, whether or not they fully know what it is that they want. For this reason, fragmentation of access to the variety of automated data bases and services now becoming available is inimical to scholarly creation and to the purposes of the University. A simple, universally accessible, consistent, transparent, useful electronic infrastructure is needed at Penn to assure simple and relatively inexpensive access by all campus users to all available information sources on a university-wide basis. Campus users will require a common set of language and protocols and a minimum amount of logging off, logging on, complex key strokes, language variations, or idiosyncratic protocols. A consistent, shared interface is needed for use by all.

## Conclusions and Recommendations

1. Penn's scholarly needs require the design and implementation of an electronic work environment which will accommodate a wide range of work styles, from the isolated to the group, from the simple to the complex, and which will be scattered in a variety of work places, from dormitories to libraries. Work-stations and networked personal computers should also be available in various configurations to conform to work styles of users, from pods or clusters to single workstations and work carrels.

2. Most studies show user self-sufficiency to be a high priority of campus scholars. Therefore, self-service capacity should be central to automation design. While technical consulting, search design and other mediated services will still be required, the emphasis should be on self-service. For example, a student should be able to retrieve data and assignments from workstations through a file server without assistance. We recognize that, despite our emphasis on self-sufficiency, expert and well-trained technical consultants and library subject specialists will continue to be as important in 10 years as they are now.

3. Users in many areas will still need access to hard copy or traditional material over the period that we are developing the technological infrastructure and superstructure. Therefore, faculty, students, and staff will need to be able to use both electronic and traditional forms (e.g. books, journals) of knowledge and information, such as books, and journals, in conjunction with each other. For example, we may wish to locate terminals in library stacks, or in dorm rooms, or see students using video for cross-referencing a written script.

4. The Library will continue to acquire machine-readable data files bases and sets, catalog them, and negotiate appropriate computer homes for them, including the Library computer, for storage and mounting. Libraries will provide subject experts and an agreed level of consulting to guide faculty and students in their use, while Computing staff will provide more advanced technical expertise and consulting.

5. Printers must be widely available, but conveniently centralized by location in ways which will provide appropriate security, oversight and maintenance, quiet areas for study, and where their noise can be isolated from the processes of study and research.

6. Consistent screens and access mechanisms should be developed where needed to help bridge idiosyncracies, variant languages or protocols required for access to different databases or system components. Most users will need a consistent environment for their work across the schools. An example of an expert system would be a computer program which could lead a student through the process of performing information searches in a variety of bases via terminal or pc.

7. Functional capacities for each library will need to be projected on the particular focus of its patrons, who may require access to the bases of the International Consortium for Political and Social Research (ICPSR), census data, MEDLINE, LEXIS, or certain specifically designed sets of software or information prepared by an instructor for use here by students.

8. While personal computers or workstations will need to be distributed through library facilities, offices, laboratories and dormitories, more powerful or specialized computers should be located in specially designed rooms, pods, or centers such as computer labs.

9. Planning for the use of new technologies, such as advanced computer networking and communication, optical text scanning, facsimile transmission, advanced rapid delivery capabilities, and optical-videodisc capabilities should be introduced as they become cost-beneficial and increasingly in demand over the next 5 to 10 years.

10. We recommend that the Library's budget be incremented by at least inflation plus 4% over the next five years in order to provide real growth in information resources, including focused and intensive development of electronic information and data bases and sets.

11. Depreciation funds should be established to provide for periodic replacement and upgrading of hardware and software. These funds should be based on the traditional three-to five-year replacement or upgrading cycle which has become practice, except where longer use patterns are appropriate.

## Appendix

### The Library Electronic Information Environment for 2001

How does one happily munch in an intellectual meadow? In an age when most students and faculty did their creative work with pens and typewriters, the answer was to create places called libraries that would house large collections of information in the form of books and manuscripts, and provide access to them in the form of dictionary catalogs with millions of cards. Information in these libraries had to be found by going and working in them.

The working environment of the scholar has been transformed by the advent of personal computers, which have become the most common medium for scholarly creation and communication. These personal computers are not only capable of word processing and editing in forms that vastly improve scholarly creation; they are also devices which, through network inter-connection, can be transmitters of information, ideas, and knowledge. Personal computers, serving as workstations, networked with each other, with mainframe computers, and information located elsewhere, are beginning to provide a whole new working environment for scholarship in which scholarly work can be infinitely more flexible, faster, and more interconnected than in the world which preceded it.

The key to this transformation is the empowerment of the user: placing in the hands—or the computer—of the user, the capacity to access a world of information that previously could be discovered only by physical journey to the library.

Penn's vision for the information environment of the mid 1990's—leading to that of the 21st Century—focuses upon access to the library's collections and services through a structure of multi-tasking personal computers networked together as workstations. In order to achieve this vision, Penn's Libraries must be ready to take full advantage of automated and new electronic information resources to support the academic information environment of our future.

Phase I of PennLIN (the Pennsylvania Library Information Network) currently provides an invaluable academic information resource for students, faculty and researchers. This work was made possible by a generous initial grant in 1984 from the Pew Memorial Trust and through additional grants from IBM. Central to PennLIN is the online catalog, now containing over one million titles from the Library's collections. Circulation information and serials data are also available in the present form of PennLIN. In addition, two major databases, MEDLINE and ABI/INFORM, are available for searching online through PennLIN from any networked campus pc. Other popular databases such as PsychLit and ERIC are provided in CD-ROM format. Users may gain access to PennLIN from pcs in many locations throughout the campus.

The Penn Libraries are now poised to begin the second phase of PennLIN implementation and to make the vision of the electronic library real. To do this we need support to achieve breakthroughs in three major projects:

1. To develop a gateway and accompanying network technology and software to provide easy, consistent access to both local and national information resources. At present such access is laborious, difficult and requires too complex a set of instructional and protocol mechanisms.

2. To enhance the scholarly work environment through fully functional personal computers acting as multi-tasking, computerized workstations.

3. To expand available databases in the humanities and social sciences, in order to provide a larger range of information in electronic form to those academic communities of the campus which require it.

continued next page

We plan to bring together diverse information resources to form an academic information environment that is seamless and easy for our users to browse, to learn and to use.

Since 1967, when Penn became the first academic research library to

develop a computerized circulation control system, automating the Libraries has been a high priority. Progress has been made, yet more must be done if the Library is to meet the demands of electronic scholarship envisioned—and already underway—at Penn.

Table 1

### Differences In Information-Need Characteristics By Academic Program

#### Science/Engineering-Like

Use-Intensive  
5-15 Year Collections  
Serials-Intensive  
Use/Citation Review Sensitive  
80% Current  
Data/Information-Intensive  
Rapid Delivery Vital  
Specific Information-Intensive  
Lab Research Driven  
c.10% Retrospective  
Basic graduate & undergraduate curricular materials—mostly textbooks

#### Social Sciences

##### Quantified\*

Psychology  
Linguistics  
Most Economics  
Some Political Science  
Some Education  
Some Communications  
c.15% retrospective

Sociology\*

\*Sociology uses more books than journals (Baughman)

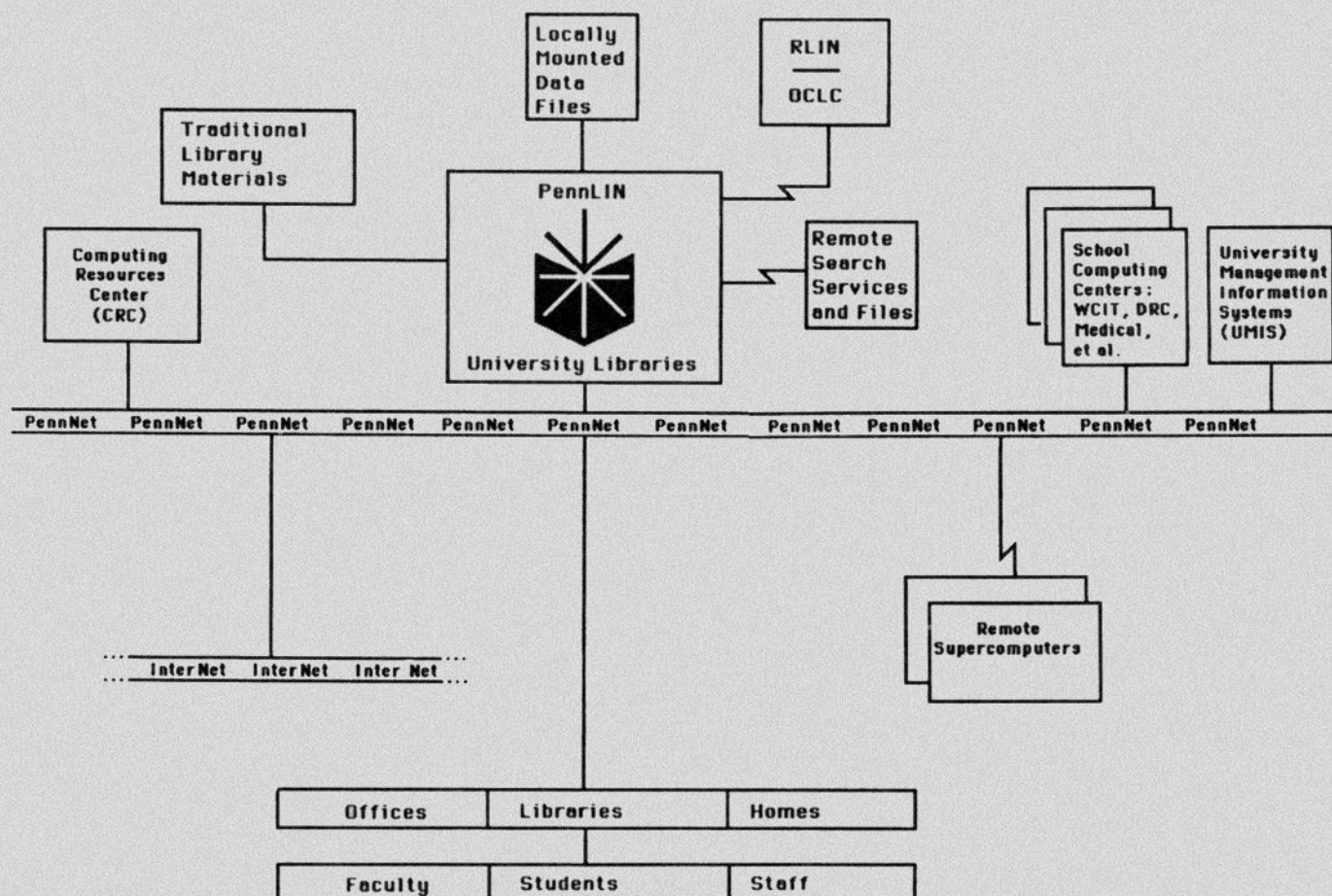
##### Humanities-Like

Anthropology  
Economic History  
International Studies  
Political Theory  
Some Political Sciences  
Some Education  
Some Communications  
c.25% Retrospective

#### Humanities/History-Like

Need-Intensive  
Older Materials Retain Value  
Monographs. Monographic Series-Intensive  
Full-Text-Intensive  
Primary Text/Source Intensive  
In-Library Use Heavy  
c.50% Retrospective  
More use of a wide range of materials for undergraduate curriculum

### ACADEMIC INFORMATION ENVIRONMENT





# Strategic Directions for Information Systems and Computing at the University of Pennsylvania

*Office of the Vice Provost for Information Systems and Computing*

Information...is central to the function of a large research-oriented university such as the University of Pennsylvania. The changes in technology affecting the methods and economics of collecting, storing, retrieving, communicating, and displaying information will inevitably bring about large changes in the ways we teach, carry on research, and manage the institution. For Pennsylvania to maintain its position of excellence in instruction and research, the University must take advantage of the revolutionary changes occurring in computing.

—*A Strategic Plan for Academic Computing at the University of Pennsylvania, November 1983*

Our institutions are being challenged to find creative ways to deliver better quality goods and services in an ever more complex and competitive environment. In such an environment, management of information itself—its planning, acquisition, storage, dissemination, utilization and disposal—emerges as critical to achieving the ends of any university.

—*Strategic Information Resource Management Plan of the University of Pennsylvania, November 1987*

I skate to where I think the puck will be.

—*Wayne Gretzky*

## Executive Summary

The University of Pennsylvania must plan and manage information resources—just as it must plan and manage buildings, people, and money. “Strategic Directions for Information Systems and Computing at the University of Pennsylvania” presents a vision and a set of objectives and strategies for information and computing in the 1990’s. Whether these objectives are achieved in five years or in ten depends on leadership, effective management, and availability of resources.

“Strategic Directions” is a statement of vision, not a detailed plan. The Office of the Vice Provost for Information Systems and Computing will develop a concrete plan in concert with the new University-wide Information Resource Management Committee.

### Vision of the Future

“Strategic Directions” is shaped by a vision of Penn in the 1990’s that anticipates:

**Enhanced personal productivity**, with appropriate information resources and computing tools, on campus and elsewhere, that are easy to use and readily available to faculty, students, researchers, and administrators.

**Increased collaboration**, within and across disciplines, between students and faculty, and in administrative areas, for example as PennNet is enhanced by new information services, extended to dormitories, and interconnected to a more robust, world-wide academic network.

**A cohesive University**, as an increasingly diverse population of undergraduates and graduate students, dormitory and off-campus residents, faculty, researchers, clinicians, staff, and alumni come to value Penn as more than the sum of its world-class parts. Campus-wide access to new information services and to an integrated administrative data encyclopedia will contribute in important ways to this cohesion.

**Invigorated teaching and learning**, with support for development and use

of state-of-the-art presentations, demonstrations, simulations, tutorials, and access to semantically-organized knowledge bases.

**Excellence** in research, scholarship, student services, patient care, and public service, as Penn’s ability to attract the best faculty, students, and staff is supported by our reputation for an outstanding yet cost-effective information infrastructure.

### Role of the Vice Provost

Computing is extraordinarily decentralized at Penn, with the schools, centers, and libraries providing a major share of the facilities and services. In this environment, information resource management decisions made by one unit can have serious implications for the University as a whole. Information Systems and Computing provides leadership, central services, and facilitation and coordination of local initiatives. Strong central leadership and standards are most appropriate in networking and administrative data processing, whereas the facilitation role dominates in academic computing.

### Primary Objectives

Information Systems and Computing has set twelve objectives for the next five years. The five primary objectives are:

- Enhance access to scholarly information in partnership with University libraries. Provide consistent, easy, fast access from the desktop computer to Penn and other universities’ library catalogs and databases.
- Ensure computing capacity for the research community—from resource sharing within the University to participation in regional and national supercomputing centers.
- Support school initiatives in instructional uses of computing.
- Provide students with information, network services, and computing tools. Enable students to become partners in the information environment, using the same tools available to faculty and researchers.
- Provide administrators with the information and systems they need to do their jobs. Design new systems and their underlying data structures from a University-wide perspective to promote the integrated management of University resources.

### Organizational Objectives

The next two objectives involve organizational initiatives:

- Facilitate, coordinate, and support the computing activities of schools, centers, libraries, and administrative offices.
- Make planning and management of that portion of Penn’s information environment under the purview of ISC more widely representative and more responsive to Penn’s computing community.

### Infrastructure Objectives

The remaining five objectives involve creation of the infrastructure necessary to accomplish the primary objectives:

- Enhance network services and expand the University network, PennNet, to connect more faculty, staff, and students to the world-wide network of colleagues, libraries, academic and administrative information databases, remote supercomputers, and experimental instruments.

- 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.
- Provide a consistent, intuitive user interface to the selected hardware and software, to encourage easy access and use.
- Make University data accessible, accurate, secure, and widely understood, within the framework of a University data encyclopedia.
- Enhance user support services, including education, technical assistance, consulting, and problem identification and resolution.

## Strategies

Information Systems and Computing has identified ten strategies to achieve these objectives:

**Close Follower.** Stay close behind the leading (some say “bleeding”) edge of information technology in higher education networking and administrative systems, to be positioned to integrate proven components and build upon Penn’s strengths as an interdisciplinary institution. In the academic arena, Penn will continue to develop and use state-of-the-art technology where appropriate in research and instruction.

**Funding.** Seek increased funding from government, vendors, foundations, and corporations, as well as from the University itself.

**Partnerships.** Form partnerships—internally with schools, libraries, centers, and administrative offices and externally with other universities, industry, and government.

**Planning.** Establish a broad-based planning process that coordinates the information planning of ISC, the schools, centers, and libraries—and that serves as input to the budgeting process.

**Representation.** Create a broadly-representative, campus-wide committee structure for information management.

**Program Management.** For development projects, create a Program Management process characterized by user authority and responsibility.

**Organization.** Reorganize Information Systems and Computing to ensure leadership and advocacy for the major initiatives required.

**Quality.** Based on the needs of users, establish quality standards and a process for evaluating and improving services.

**Staff Development.** Improve each stage of ISC human resource management: recruitment, job assignment, compensation, training, performance evaluation, and career-path planning and development.

**National Recognition.** Encourage faculty, students, and staff—within and outside ISC—to seek national recognition for excellence in the use and management of information systems and technology. This recognition enhances Penn’s opportunities for outside funding and partnerships.

## Feedback

This version of “Strategic Directions” reflects feedback from many Penn constituencies. Additional reactions and comments are welcome.

# Introduction

## Purpose

The University of Pennsylvania must plan and manage information resources—just as it must plan and manage buildings, people, and money. Information is strategic for a research university, so sound planning and management of information technology are essential to achieve Penn’s goals of education, research, and service.

“Strategic Directions for Information Systems and Computing at the University of Pennsylvania” presents a vision and a set of objectives and strategies for information and computing at Penn in the 1990’s. Whether these objectives are achieved in five years or in ten depends on leadership, effective management, and availability of resources. “Strategic Directions” is a statement of vision, not a detailed plan. The Office of the Vice Provost for Information Systems and Computing will develop a concrete plan in concert with the new University-wide Information Resource Management Committee.

As befits the mission of the Office of the Vice Provost for Information Systems and Computing (ISC), the focus here is on centrally-managed systems and services—but those systems and services must be directed to support decentralized activities and to coordinate efforts among the schools, libraries, and centers.

## Reactions

This version of “Strategic Directions” reflects feedback from many constituencies, including:

- Academic Computing Policy Committee
- Academic Information Environment Committee
- Academic Planning and Budget Committee
- Communications Committee
- Council of Deans
- Network Policy Committee
- Provost’s Planning Group
- Roundtable Luncheon
- Wharton Computing and Instructional Technology Committee
- Individual policymakers.

Additional reactions are welcome.

# Vision of the Future

Our planning for information systems and services is intended to assure that Penn in the 1990’s will be widely recognized as one of the top research universities in the world. To achieve this goal, the University must harness current and emerging information technology. Here is our vision.

## Personal Productivity

Personal productivity will be enhanced. Computer workstations in faculty and administrative offices, laboratories, libraries, and residences will have substantially more processing speed, memory, disk storage, graphics display resolution, network bandwidth—and ease of use—than current models. These workstations will support text processing, data entry, searching and retrieval from Penn and other universities’ libraries and databases, quantitative analysis, policy evaluation, communication, and connection to more powerful or specialized computers, as needed. We will also begin to see practical applications of artificial intelligence.

## Collaboration

Collaboration will increase, within and across disciplines, between students and faculty, and on administrative project teams as PennNet is extended to more faculty offices and dormitories, enhanced by new information services, and interconnected to a more robust, world-wide academic network. The academic Internet, now reaching over 800 universities and research institutes in 35 countries, will be extended to many more locations and will be enhanced by more sophisticated user directories and information services.

Everyone in the Penn community will have access through PennNet to electronic bulletin boards ranging from local interest topics to world-wide scholarly, technical, and avocational subjects. Electronic mail and simple document transfer, now familiar to many at Penn, will be followed soon by widespread electronic exchange of administrative data as well as documents containing graphics and sound. New technology, including hypermedia and collaborative authoring and brainstorming software, will buttress Penn’s long-standing strength in interdisciplinary programs.

## Cohesive University

Penn will be a more cohesive university, as an increasingly diverse population of undergraduates and graduates, dormitory and off-campus residents, faculty, researchers, clinicians, staff, and alumni come to value Penn as more than the sum of its world-class parts. Information technology will serve as a pervasive integrating infrastructure for the entire community.

Campus-wide access to new information services and to an integrated administrative data encyclopedia will contribute in important ways to this cohesion. An online service, PennInfo, will provide events listings, job and housing postings, procedures manuals, and train schedules, all accessible from workstations and public kiosks. Similarly, the next generation of administrative systems will be developed with emphasis on data interchange and ease of use, not only by administrators but also by faculty and students.



## Invigorated Teaching and Learning

Teaching and learning will be invigorated by multi-media presentations, demonstrations, simulations, tutorials, intelligent interactive imaging, and access to semantically organized knowledge bases. "Computers at the University will have their most pronounced effect as learning tools," predicted the Academic Computing Committee in 1983. Some exciting instructional applications have been developed at Penn and elsewhere in the intervening years, yet much remains to be done to capitalize on the increasing power and sophistication of workstations and networks. By leveraging school initiatives and vendor partnerships, Penn will become a leader in classroom innovation, routinely represented among winners of awards such as the annual EDUCOM-NCRIP-TAL Higher Education Software Awards.

## Excellence

Penn's ability to attract the best faculty, students, and staff will be supported by our reputation for an outstanding yet cost-effective information infrastructure. Prospective students and faculty already inquire about the availability and quality of computer resources, and this trend will surely accelerate as information technology plays a larger role in both the economy and the academy.

# Role of Information Systems and Computing

## Mission

The mission of Information Systems and Computing is:

To support faculty, staff, and students in achieving their missions in education, research, service, and administration by planning and managing the University's computing and information systems environment.

## Computing Is Distributed at Penn

Computing at Penn is extraordinarily distributed, reflecting recent technology trends as well as Penn's decentralized management of resources. Schools, departments, libraries, and centers provide all instructional and research computing on campus, as well as substantial administrative computing and office automation. The library catalog, PennLIN, resides on a computer managed by the School of Arts and Sciences. Components of the central administration—Development and Business Services, for example—manage their own computing facilities.

Central facilities operated by ISC include PennNet, the fiber optic data network and associated minicomputers that connects over 100 campus buildings; the central administrative mainframe; and the Computing Resource Center, which provides campus-wide user services.

Decentralization has both advantages and costs for Penn. By decentralizing computing policy and resource allocation decisions, Penn fosters a creative atmosphere that accommodates the diverse needs of the University and locates information services close to users. Moreover, Penn's decentralized management and computing services are compatible with the emerging, preferred distributed computing architecture. Decentralization has meant, however, that some schools do not benefit from exciting advances in computing and that isolated islands of data, software, training material, documentation, and expertise have formed.

## Role of ISC

In Penn's distributed computing environment, Information Systems and Computing provides leadership, central services, and facilitation and coordination of local initiatives. Strong central leadership and standards are most appropriate in networking and administrative data processing, whereas the facilitation role dominates in academic computing.

More specifically, the role of Information Systems and Computing is to:

- Build infrastructure and a core of central services.
- Facilitate creation of a shared language of standards for administrative computing, office automation, and networking.
- Plan, enable, and monitor effective distributed administrative computing.

- Coordinate and facilitate instructional and research computing.
- Represent Penn externally and serve as an advocate for computing within the University.

Each of these roles is discussed below:

**Infrastructure and Central Services.** Information infrastructure is like highways and utility lines—a basic framework of facilities that, once in place, allows an institution to flourish. The ISC contribution to an information infrastructure for Penn must extend beyond the current PennNet to include an enhanced network, an integrated architecture of selected hardware and software, a consistent user interface, and a widely understood base of University data.

Central services currently provided by Information Systems and Computing transcend the needs of individual schools and centers—user support by the Computing Resource Center (CRC), development and support of administrative systems by University Management Information Services (UMIS), PennNet management and enhancement by Data Communications and Computing Services (DCCS), and University-wide planning and management of technology and data by Data Administration and Information Resource Planning (DAIRP).

**Shared Language.** Standards are the shared language that allows the Penn community to distribute computing and still be able to work together. The role of Information Systems and Computing is to facilitate creation of standards for an essential core of networking, hardware, software, and administrative data. Penn can be expected to follow these standards if the many University constituencies are part of the definition and control processes.

**Distributed Administrative Computing.** There is widespread agreement that one central mainframe cannot provide all the administrative data processing for the University and that computing should be distributed as close as possible to users. There is growing understanding, however, that distributed information systems, designed and built (or purchased) by many different units in the absence of University-wide standards, are likely to become a "Tower of Babel." Thus a key role for ISC is to provide guidance to administrative units in system planning and development, selection of software and hardware, and management and support of their information systems.

**Academic Computing.** In instruction and research, the role of Information Systems and Computing is facilitation and coordination. The Vice Provost will lead where appropriate—for example, managing access to networking, establishing vendor relationships, and supporting newsletters and online bulletin boards—and coordinate where benefit can be gained from drawing on the computing expertise, experience, and experimentation found at all levels of the University. A central unit such as ISC cannot become expert in all of Penn's academic disciplines, but it can serve effectively as a clearinghouse for innovation, both among departments and research projects on campus and between Penn and other institutions. ISC also can play an important, but temporary, support function for schools that need technological assistance.

**Representation and Advocacy.** Charged with looking after the interests of the entire Penn computing community, the Vice Provost for Information Systems and Computing represents Penn to information technology vendors and external organizations (such as PREPNet, the Pennsylvania state-wide research network; CAUSE; and EDUCOM), and serves as an advocate for Penn computing within internal councils.

## Primary Objectives

Information Systems and Computing has set twelve objectives for the next five years. The first five objectives directly support Penn's faculty, clinicians, researchers, administrators, and students. The two objectives listed in the next section are organizational, and the final five objectives involve the infrastructure necessary to accomplish the primary objectives.

## Access to Scholarly Information

*Objective:* Enhance access to scholarly information in partnership with University libraries.

The world's information is growing at an exponential rate. One of the great challenges facing Penn is providing fast and cost-effective access to this information, which is increasingly in electronic form. Meeting this challenge requires strong partnerships with University libraries.

The University Library, as a member of the Research Libraries

Group, is engaged in cooperative projects to expand and integrate national, online bibliographic resources. Current users of PennNet can access not only PennLIN but also several dozen other universities' library catalogs, as well as commercial and public databases. Unfortunately the data structures and user interfaces vary widely, so only the most intrepid scholars can navigate successfully. Moreover interfaces to scholarly information are often different from other commonly-used systems such as word processors. ISC and the Library will work together to establish consistent, easy access from desktop computers to local and remote resources.

### Research Computing

*Objective:* Ensure computing capacity for the research community.

Much of Penn's investment in computing is driven by—and financed by—research projects. The role of ISC is to bring researchers and facilities together, no matter where they are located. Under current conditions, it is not surprising for a project to purchase a new computer while a system with similar capabilities on campus or on the national network is underused.

Within the University, ISC will promote resource sharing among the schools, for example by providing resource directories and a system for matching available resources with researcher needs. Although there are a growing number of mini-supercomputers on campus in addition to the IBM 3090-200E mainframe operated by the School of Arts and Sciences, some University research will continue to require the larger machines at national and regional supercomputer centers, available to Penn via the academic Internet. ISC will maintain PennNet's compatibility with the Internet, and actively participate in consortia and other organizations that promote and operate state-of-the-art computing facilities.

### Instructional Computing

*Objective:* Support instructional uses of computing.

Information Systems and Computing will encourage and facilitate efforts by the schools to obtain or develop technology-based instructional materials and integrate them into the curriculum. Outstanding examples of recent developments are computer and video-enhanced classroom presentation systems, such as "PODIUM" developed at the University of Delaware; simulations ranging from chemistry laboratory experiments (University of Illinois) to life in seventeenth-century France (Stanford); and tutorials such as the multi-media system for pathology instruction developed at the Penn Medical School. ISC support for software development will take the form of hardware, software tools, technical assistance, training, and funds for release time and other incentives.

Many developments in instructional computing are the work of consortia. ISC is the logical focal point for Penn's participation in these groups. For example, a group of universities and vendors, under the auspices of the EDUCOM Software Initiative, is addressing such formidable obstacles as resource directories, evaluation standards, incentives, and intellectual property rights.

### Student Access and Services

*Objective:* Provide students with information, network services, and computing tools.

Students will become partners in Penn's electronic information environment with ready access to workstations, PennNet connections, and software for learning and research. Students can also benefit from access to administrative systems, as demonstrated by widespread use of the telephone registration option within Penn's new Student Records Systems (SRS) and by Boston College's public kiosks for querying financial and registration records. ISC will support student access through extension of PennNet to residences and public facilities, development of new systems for student use, inclusion of students in the new committee structure, and facilitation of student computer purchases.

### Information and Systems for Administrators

*Objective:* Provide administrators with the information and systems they need to do their jobs.

Administrators need more responsive, flexible, and easy-to-use systems that provide access to data resident on mainframes, minicomputers, and local network file servers. Accordingly, new hardware and

software systems and their underlying data structures will be designed from a University-wide perspective, with a common user interface, a widely-understood data encyclopedia, and professional training and support.

## Organizational Objectives

The two objectives listed here involve organizational initiatives.

### Facilitation of Distributed Computing

*Objective:* Facilitate, coordinate, and support school, center, and library computing activities.

ISC will encourage the development of computing resources and leadership in schools, centers, and libraries in a manner consistent with the responsibility center approach adopted by the University for the management of other resources. The ISC also will bring the schools, libraries, and centers together to set standards for administrative systems, networking, and office automation. More direct ISC support can take the form of obtaining grants from outside agencies, negotiating discounts and service agreements with hardware and software vendors, maintaining directories and documentation, offering "train the trainer" workshops, and providing technical advice on networking, systems acquisition, software development, and data administration.

### Planning and Management

*Objective:* Make planning and management of that portion of Penn's information environment under the purview of the Vice Provost for Information Systems and Computing more widely representative and responsive.

To harness rapidly changing information technology to the varied needs of the University, members of the community must participate actively and effectively in resource allocation and priority setting. It is our judgement that both the committee structure for information resource management and the organization of Information Systems and Computing must be restructured to accomplish this. Details of the proposed restructuring are provided in the section on strategies.

## Infrastructure Objectives

The aim of the five objectives below is to enhance the University's technical and service infrastructure—a necessary foundation for accomplishing the primary objectives.

### Enhanced Network

*Objective:* Enhance services and expand the University network, PennNet.

PennNet, currently used primarily for access to host computers and file transfer, will be enhanced with services such as widespread printing facilities, online resource and personal directories, software distribution, and collaborative conferencing media, such as Michigan's CONFERR. PennInfo, the University's online general information service now in the pilot stage, will be expanded in subject matter and breadth of participation. As graphics, sound, and video transmission become more important, PennNet will be upgraded. ISC also will participate in national and international networking initiatives to ensure that the University is compatible with, and an early beneficiary of, such efforts.

More faculty, staff, and students will be connected via PennNet to the growing world-wide network of colleagues, libraries, academic and administrative databases, supercomputers, and experimental instruments. PennNet will be easily accessible on campus, at home, or where faculty, staff, or students travel on University business; at present many faculty offices and nearly all student residences lack PennNet connections.

### Integrated Hardware and Software

*Objective:* Establish an integrated, campus-wide architecture of selected hardware and software.

An integrated architecture is required for cost-effective system development and data sharing among microcomputers, minicomputers, and mainframes. Schools, centers, offices, and individuals will be encouraged to adopt compatible systems by the desirability of access to



information and support services. All research universities are committed to maintaining a multi-vendor computing environment; nevertheless, proliferation of incompatible systems imposes costs on the University as a whole.

### **Intuitive User Interface**

*Objective:* Provide a consistent, intuitive user interface to the selected hardware and software, to encourage easy access and use.

Not only are there currently too many incompatible systems, but also most systems are too difficult to learn and to use. Most experts agree that a "point to an icon on the screen and click the mouse," interface (familiar to users of the Apple Macintosh) is preferable to typing in commands. Many vendors now offer such interfaces, but not all are compatible. Moreover there is the formidable problem of extending the interface when the personal computer is used to access a mainframe database or remote library catalog.

ISC will develop standards, select proven technology from vendors and other universities, integrate where appropriate, and support the selected user interface.

### **Accessible, Accurate, Secure, Widely-Understood University Data**

*Objective:* Make University data accessible, accurate, secure, and widely-understood, within the framework of a University data encyclopedia.

Some, but not all, administrative systems at Penn have online dictionaries defining origins, meanings, and uses of input and output data. Planning and management requiring data from multiple systems—which differ in both user interface and data definitions—are currently dependent on a small group of "super users," who have learned the various systems, interfaces, and idiosyncrasies. An essential precondition for effective, widespread use of information systems at Penn is assembly and maintenance of an accessible, accurate, widely-understood base of University data, structured by a University-wide data model and described in a comprehensive online data encyclopedia. ISC also will ensure that policies and procedures are in place to secure data from loss, modification, or disclosure.

### **Enhanced User Support**

*Objective:* Enhance user support services.

The array of new and enhanced systems and services, no matter how intuitive, integrated, and "user friendly," will nevertheless require more and better user support, including education, technical assistance, problem identification and resolution. As in other areas, successful support will require close cooperation among Information Systems and Computing, libraries, schools, and centers.

## **Strategies**

Information Systems and Computing will concentrate on ten strategies to achieve these objectives. These strategies focus on coordination and collaboration with schools, libraries, and centers.

### **Close Follower**

Penn's "close follower" strategy—staying close behind the leading (some say "bleeding") edge of information technology in higher education networking and administrative systems—is a cost-effective path to excellence. Several institutions (Brown, Carnegie Mellon, MIT, and Michigan are prominent examples) have made leadership in computing infrastructure a strategic objective of the institution, with concomitant investments. Much Penn research and instructional computing will continue to develop and use state-of-the-art technology, but Penn's infrastructure strategy is to integrate proven components, building upon our unique strengths as an interdisciplinary institution. This strategy still requires substantial leadership and resource commitments.

### **Funding**

Building and maintaining an effective information environment is costly. Creative funding strategies will be needed, at the school level as

well as in the Vice Provost's office. Avenues to be explored include grants and contracts from corporations, foundations, and government; vendor discounts and multi-user licenses; facilitation of private computer purchases; development efforts in conjunction with the billion-dollar Campaign for Penn; as well as appropriate internal funding and effective charge-back mechanisms.

### **Partnerships**

The third strategy is to establish internal and external partnerships for planning, application development, support, and fund-raising. External partners will include other universities, government agencies, and commercial enterprises including vendors of information technology. Internal partnerships will be formed with schools, centers, libraries, and administrative offices, to better leverage resources in those organizations.

### **Planning**

The fourth strategy is to establish a broad-based planning process that coordinates the information planning of Information Systems and Computing, the schools, centers, and libraries. Five-year plans, updated annually, will serve as input to budget decisions. Data Administration and Information Resource Planning will facilitate and coordinate the planning process.

Schools will be encouraged to follow the lead of the School of Arts and Sciences, which has since March 1989 been planning for computing with support from Data Administration and Information Resource Planning. Out of planning efforts such as these will come proposed initiatives to be evaluated by management and by the Information Resource Management Committee described below.

### **Representation**

The fifth strategy is to implement a broadly-representative, campus-wide committee structure for information management. The Information Resource Management Committee is appointed by the Vice Provost to participate in planning, development, and management of information systems and services at Penn and to serve as a forum for review of technology-related policy from the perspective of the University as a whole.

Subcommittees on research, education, administration, and infrastructure will provide guidance on objectives and priorities in their areas. Ad hoc subcommittees will be formed as needed when issues such as office automation and information security cross functional boundaries.

The IRMC and its subcommittees will receive proposals for new information technology investments and initiatives, help shape the objectives of these proposed initiatives to take the University perspective into account, and prioritize new "programs" or development projects. Once a program is initiated, an IRMC subcommittee will monitor its progress.

The IRMC is chaired by the Assistant Vice Provost for Data Administration and Information Resource Planning. The subcommittees of the IRMC are co-chaired by members of the Penn community and by senior staff of ISC. Members include faculty, students, and administrators.

The committees replace the current Academic Computing Policy Committee and the Network Policy Committee.

### **Program Management**

The sixth strategy is to establish a Program Management structure to manage individual development projects or "programs." Program team roles and responsibilities are spelled out, along with the steps needed to produce systems on time, on budget, and as users intended. The Program Management process is characterized by end-user authority and responsibility as well as strict documentation of management and design decisions. Each program team is headed by a "Program Manager" who is usually from the user area.

The Program Management process applies to all major projects approved by the Information Resource Management Committee and is strongly recommended for other projects throughout the University.

Information Systems and Computing is responsible for training in the Program Management approach. A manual, *Program Management at Penn: a Manual for Participants*, is available from the Vice Provost's office.

## Organization

The seventh strategy is to reorganize Information Systems and Computing to ensure leadership and advocacy for the major initiatives required:

**Academic Information Services** addresses educational and research computing needs. This new division will lead the academic initiatives required by ISC's first four primary objectives and first organizational objective.

**University Information Services** builds and manages administrative systems and supports a base of University data.

**Data Communications Services** provides shared system components such as PennNet that undergird academic and administrative computing.

**Computing Resource Center** helps end-users—via consulting, training, advocacy, a hotline, and a help desk. This division will be the first contact for user questions now directed to other Information Systems and Computing units. The division will work closely with user support organizations in the schools and centers.

**Planning and Data Administration** coordinates Penn's information planning and program management processes, and assures data security and integrity. The office also oversees a "data encyclopedia" that defines and describes University data and a "data model" that provides a University-wide, pictorial representation of data relationships.

The first of these divisions will be new, the next three require reorganization of the existing CRC, DCCS, and UMIS, and the last division was established in 1988 as Data Administration and Information Resource Planning.

## Quality

The eighth strategy is to establish a quality assurance function. Delivering high quality services demands extraordinary commitment by every member of Information Systems and Computing to understanding the needs of end-users and to delivering superior services. Quality standards must be defined and a quality assurance function formalized to ensure that performance is monitored and that services are continually evaluated and improved.

## Staff Development

A talented, dedicated staff with enough depth and breadth of knowledge, skills, and experience is fundamental to the delivery of quality services. This ninth strategy requires that attention be paid to each stage of the human resource management life-cycle: recruitment, job assignment, compensation, training, performance evaluation and counseling, and career-path planning and development. ISC will facilitate, for example, movement of staff among Penn's computing organizations, which is professionally advantageous for individuals, healthy for computing support overall, and will prevent loss of talented people to Penn.

## National Recognition

The final strategy is to encourage faculty, students, and staff—within and outside ISC—to seek national recognition for excellence in use and management of information systems and technology. Publications, conference presentations, workshops, awards, and leadership in national organizations will focus attention on Penn. This recognition will enhance Penn's opportunities for outside funding and partnerships.

# Status of the Planning Process

## Community Review

The senior staff of Information Systems and Computing, along with school and central administration representatives, have been engaged in a year-long planning effort, soliciting feedback from Penn policymakers, vendors, and others during the process.

A September 1989 version of "Strategic Directions for Information Systems and Computing" was distributed widely for comment. This version reflects that feedback.

## Vendor Feedback

Information Systems and Computing will now seek feedback from the major information technology companies in order to get their technical perspective and in preparation for negotiating partnerships.

## From Vision Statement to Plan of Action

Information Systems and Computing must turn this vision statement into a concrete plan of action—in concert with the new University-wide Information Resource Management Committee. ISC has been developing preliminary, transition, and five-year budget plans, for review by the Information Resource Management Committee and subcommittees.

## IRMC Start-up

The Information Resource Management Committee will begin to meet in the early spring. Key issues for this committee will be priorities for information and computing over the next five years and appropriate levels of resource commitment.

## Leadership, Cooperation, and Resources

Turning this vision into reality requires leadership, cooperation, effective management within ISC and in academic and administrative units, and substantial resources. The staff of Information Systems and Computing looks forward to working with the Penn community to meet this challenge.

### Planning Team:

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The Planning Team acknowledges with thanks the thoughtful feedback from many members of the Penn community to prior versions of this document, the five-year planning by the individual staffs of the Vice Provost for Information Systems and Computing, and the editorial and research work of Linda May and Frank Topper of Data Administration and Information Resource Planning.



## Appendix I: Penn Computing in the 80's

The 1980's have seen a proliferation of computers and computing services on the Penn campus. Many of these developments were recommended by the Academic Computing Committee appointed by Provost Thomas Ehrlich in 1982. The committee's "Strategic Plan for Academic Computing," published in *Almanac* in November 1983, called for:

- Establishment of a Computing Resource Center to provide central support services and coordinate decentralized services.
- Creation of an Educational Development Fund to support instructional software development and integration into the curriculum.
- Provision of ready access to workstations throughout the campus.
- Installation and operation of a data communications network.
- Enhancement of multi-user computer facilities.
- Recruitment of a Vice Provost for Computing.
- Creation of a Governing Council for Computing.

Significant accomplishments are evident in all areas except the Governing Council, a reformulation of which is a primary focus of the current plan. These developments are listed below.

- The Computing Resource Center (CRC), located on Locust Walk, provides workshops, hotline service, walk-in assistance, and a widely-distributed monthly newsletter, *Penn Printout*.
- Support for instructional software development has come not only from central funds but also from major partnership programs with IBM and Apple Computer, as well as from several school initiatives. Although this has not been a strategic priority at Penn (compared to Carnegie Mellon and Drexel, for example), exemplary software developed at the University has been featured at national conferences.
- Thousands of IBM PC's, PC-compatibles, and Apple Macintoshes have been installed in faculty and staff offices as well as in school and residence hall computer laboratories. In addition, discounts negotiated with Apple, IBM, and Zenith have made personal ownership attractive for many faculty, staff, and students. Nevertheless most observers would agree that Penn does not provide enough public workstations for students.
- PennNet now links most academic and administrative buildings with a high-speed fiber-optic backbone. Over 100 host computers, including PennLIN, the University's online library catalog, are served by PennNet, and approximately 3,000 user computers and terminals are directly wired, with others connecting via telephone modems from offices, dorms, and off-campus. PennNet supports electronic mail and document exchange, in addition to time-shared computing. Through gateways to regional, national, and international academic networks, PennNet provides access to a vast array of bulletin boards, databases, library catalogs, and supercomputers. The 1983 goal of extending the network to "virtually all campus locations," was not achieved, however, as dormitory wiring was found to be too costly.
- The number of multi-user computers on campus exceeds 100, including two large IBM mainframes, one dedicated to administration and operated by University Management Information Services (UMIS) and the other, augmented by vector processors for high speed calculations, operated by the School of Arts and Sciences for research and instruction; several mini-supercomputers used in research projects; the IBM system supporting PennLIN; and numerous VAX-class minicomputers supporting instruction, research, administrative data processing, and office automation. In addition Penn researchers use national supercomputer centers in Champaign-Urbana, Ithaca, Pittsburgh, and Princeton via PennNet's connections to the regional networks, JVNCFNET and PREPNET, both part of the national NSFNET.
- The first Vice Provost for Computing, David Stonehill, recruited in 1984, served until December, 1988. Professor of Radiology Ronald L. Arenson is serving as interim Vice Provost pending the result of a nationwide search for Stonehill's successor. Reporting to the Vice Provost are the Computing Resource Center (CRC); Data Communications and Computing Services (DCCS), which operates PennNet; Data Administration and Information Resource Planning (DAIRP); and UMIS. Since UMIS was added to the VPC portfolio, several substantial applications have been installed, including the new Student Records System (SRS).

A second plan, published in 1987, also contributed in important ways to Penn's emerging vision of information systems and computing. The Strategic Information Resource Management Plan, created by a representative senior management team appointed by the President and led by the Executive Director of Resource Planning and Budget, identified the information systems critical to the mission of the University, suggested strategic priorities, and proposed governance structures and development processes for their creation. One direct outcome of this plan was creation of the Office of Data Administration and Information Resource Planning to provide services that ensure the accuracy, integrity, timeliness, and accessibility of University information.

Computing at Penn today is distributed and diverse. Although there are many computing resources on the campus, the environment is difficult for novices, for the non-technical, and for most students. Despite the substantial progress in recent years, much remains to be done as we move into the 1990's.

## Appendix II: Environmental Forces

In developing goals and strategies, Information Systems and Computing must take into account both internal University and external forces.

### Internal Forces

The key internal environmental forces are:

**Relationship with University libraries.** Information Systems and Computing has an important cooperative relationship with the Library, whose structure remains centralized and amenable to establishment of mutually advantageous links in technology development. As custodians of the most important knowledge bases on campus, the Library (along with the autonomous Law Library) must be primary partners in providing access techniques and policies for the University community.

**Decentralized environment.** The decentralized nature of the University creates an environment with wide latitude in approaching issues. Decentralization has also contributed to the development of significant technological skills within the schools as well as increased user sophistication. In addition, the presence of excellent faculty and students is a powerful force for change.

The same culture, driven by a responsibility center approach to budgeting and keen competition for increasingly limited resources, can—in the absence of integrated planning—foster a divisive atmosphere. Such divisiveness can create tensions among schools, between academic and administrative functions, and between central and decentralized administrative entities. The special challenge of the Vice Provost for Information Systems and Computing is to lead and facilitate the integrative planning for information systems and infrastructure that the University needs.

**Demand for services.** There is a large backlog of requests for information systems and technology services. These pressures are exacerbated by the lack of a formal, rigorous process that integrates plans of Information Systems and Computing with those of the rest of the University. This can lead to a reactive approach to technology development, driven by short-term operational pressures, rather than a carefully-considered and widely-communicated plan. Similarly, there is no established University process for needs analysis or justification of information technology expenses against expected benefits.

**Senior management support.** Penn's senior management is not only open to change, but is demanding it.

**Perceptions of this Office.** The legitimacy of the Vice Provost is well recognized although past problems in delivering products on time and under budget have created perceptions of inadequacy that must be overcome. These problems are exacerbated by lack of campus data standards.

**Staff training needs.** While the University boasts a dedicated and talented staff with a reasonably comprehensive breadth of skills, increased education and training are needed to help them adapt to and exploit new technologies. Additional systems and services, in the absence of a common user interface and University data standards, will add to the current complexity facing Penn's staff.

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## External Forces

The following external forces most clearly affect the current efforts of Information Systems and Computing:

**The rate of technology development.** Within less than a decade, enormous desktop computing power has become available at affordable prices. The mainframe-dominated environment has changed dramatically, as has telecommunications technology. The diversity of available hardware and software, however, confounds efforts towards integration or support. In addition, to compete effectively, research institutions now depend heavily on sophisticated computer-based technology.

**Governmental policy, particularly regarding funding of basic research.** Just as investment in expensive technological infrastructure has become increasingly critical to universities, the pool of federal research dollars has diminished. This is particularly critical at Penn, where endowments are smaller than in peer institutions. Moreover, federal compliance rules and regulations add to overhead and restrict flexibility.

**Activities of peer institutions.** Competition for shrinking resources—including faculty, staff, students, and grants—is heightened by economic and demographic factors, in particular, an aging faculty population and a more competitive labor market for professional technical staff.

**Overall proliferation of computers and related services in society.** This proliferation—in elementary and secondary schools, peer universities, businesses, and homes—has raised expectations of all constituencies, internal and external, regarding the quantity and quality of information and computing services the University should be delivering.

**Vendor relationships.** The University has been successful in obtaining significant support from industrial and commercial organizations to help build our base of information technology. Because of the enormous costs and complexities associated with these technologies, we must continue to take full advantage of such relationships, without losing sight of University priorities.

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