

## Part II. Planning and Implementing Integrated Information Services

### Integration and Outreach: Integrated Academic Information Management Systems (IAIMS)\* at Maryland

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The University of Maryland Campus for the Professions is now realizing the first benefits of integrated academic information management systems (IAIMS). With the support of the National Library of Medicine, the Information Resources Management Division has joined with the Health Sciences Library to plan and to implement change. Within the information utility concept, networked data communications and end-user computing function as the means to integration. Plans call for new 370-based software to extend system capabilities. Mechanisms for outreach ensure that the potential of integration is realized. These mechanisms include technology assisted learning centers, informatics program development, special programs (geriatrics, hypertension pilot), and new applications (conferencing system, voice mail, videodisc development, interinstitutional resource sharing).

#### Planning for Integration

##### *National Library of Medicine Initiative*

The IAIMS initiative mounted by the National Library of Medicine is now over five years old. Through its request for proposals issued in 1982, the NLM opened up a new realm of opportunities to the world of academic health sciences. In supporting the planning, development, and implementation

of integrated academic information management systems, the NLM might appear to be supporting computer projects, the domain of the National Science Foundation and other technically focused organizations. This appearance is an illusion of sorts; the reality is logically and firmly based in the Library's traditional role [1].

In fulfilling this traditional role, the NLM's real concern is with information [2]. The illusion results from the reflection cast by computing, which is for the IAIMS initiative the technology by which information is stored and accessed. In electronic terms, computing is the medium, information the message. The medium is the equipment that provides the connectivity, enabling the microcomputer user to access other computers, other systems. These computers link the user with colleagues, institutions, libraries. The medium provides new tools, giving to the health care professional new capabilities for multiple functions—education, research, clinical care, and management of them all.

##### *New Relationship Between the Library and Computing*

In its IAIMS pilot project, [3-4] the University of Maryland Campus for the Professions has observed this distinction between the medium and the message. What was once the computer center has been reorganized into an Information Resources Management Division (IRMD). This entity has joined forces with the Health Sciences Library (HSL). Together these two core facilities are working to create the infrastructure which will make information acces-

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sible to the experimental pilot site and eventually to the campus as a whole [5]. The role of the core facilities is to provide the means of integration to the campus [6]; outreach is the critical mechanism by which integration is to be achieved. Concurrently, the Hypertension Center is pursuing its content specific interests as the IAIMS model development site.

The interdependency between computing center and library is mirrored at a number of academic health centers [7,8], where shared reporting lines and governance bodies, with senior level policy officers at the head, are becoming increasingly common. In an elegant biomedical metaphor, the evolving relationship between library and computing center has been likened to the genetic code, the DNA, for the academic health center of the future. At Maryland's Campus for the Professions, this relationship has been recognized in—indeed mandated by—the strategic planning process initiated under the original IAIMS contract [9].

The strategic plan [10], in its three iterations, has identified alternative routes for realizing these concepts. All options dealt with two complementary aspects of infrastructure. First was organizational; second, technological. Both infrastructures were addressed so as to create an environment supportive of the campus' multiple missions. Organizational mechanisms or structures were incorporated into the core facilities, under an information utility concept.

## Information Utility Concept

Developments in information technology support integration, which is also nurtured by the National Library of Medicine's long range planning and its Integrated Academic Information Management System (IAIMS) initiative. Policy level officers on the campus have looked to future oriented professional organizations for insights, among them the International Medical Informatics Association (IMIA) and the Symposium for Computer Applications in Medical Care (SCAMC), along with CAUSE and EDUCOM.

The most viable concept for an academic health center, where resources are finite, is that of information resources management. Based on the belief that information is a resource to be managed like any other resource—such as people, space, dollars, or equipment—the resulting approach looks to optimize information through managing available technologies.

Organizationally, this requires a radical departure from the computer center of yesterday. Across the nation, academic health centers have reorganized to bring information resources under the control of top level policy officers [11–12]. The new organizational position of information resources has been accompanied by internal restructuring. This restructuring is both the result of and the response to the new capabilities provided by information technologies. As communications and computing continue to develop and to merge, new environments become possible. For the academic health center, with its multifaceted mission and functionalities, the technological environment most supportive of integration can best be described as an information utility.

Like the public utility model, the information utility provides access to a core facility which supports users dispersed by geography and distinguished by different levels of need and requirements. Those users are responsible for accomplishing their task or tasks; they develop and manage their own applications, utilizing the computing power supplied by the information utility, as if it were natural gas, electricity, or water. The power source serves as the mechanism for integration, yet its potential cannot be realized unless the applications and devices that the user attempts to run with that power source are compatible with it and with one another. If they are, the user is empowered by the full capabilities of the utility.

The utility now being implemented at the University of Maryland will have as its infrastructure a distributed and fully networked system, providing the user access to all levels of computing, from supercomputer through resident mainframe to microcomputer, and to a host of peripherals, including printers, desktop publishing, file servers, and protocol converters. Acquisition of 370 mainframe architecture is now underway. Hardware will be linked by data communications equipment, from local area networks to gateways and beyond. The microcomputer, or workstation, now on a growing number of desks will be the user's device through which computing power is transmitted.

## Networked Data Communications

To achieve integration [13], the IRMD built upon its traditional role of providing linkages between terminals and the mainframe computers, and assumed the responsibility for expanded data communications. Although the original plans called for an integrated voice and data switch to be installed; it became clear during the protracted contract negotiations that a single switch was not the optimal solution. Consequently, alternate plans were made for separate data communications, first upgrading the existing system originally installed to link campus mainframes with terminals. This upgrade is viewed as an interim measure, and will be supplemented by the installation of faster and more powerful capabilities for high volume applications, such as medical imaging and distributed data bases.

The IRMD will continue to offer technical services and support for data communications systems. Currently, additional local area networks are being installed and existing networks are being supplemented with gateways providing linkages to campus mainframes and external information services. These communications linkages make widely dispersed computing capabilities available to the user community, thus functioning as a computer/communications utility. This component of the services provided by the IRMD is the updated version of operational support, and constitutes one portion of the information utility construct.

## End User Computing

This portion of the construct is realized through other changes within the IRMD. Moving from the traditional data

processing shop, the IRMD is developing new services to support the campus in using information technology. These range from microcomputer courses to support for mainframe based applications either already on campus or planned for acquisition within the next five years. Along with other specialized services, these will enable users to realize the capabilities of this distributed network. In short, outreach will actualize integration.

In reallocating a significant portion of its resources to such services, the IRMD has supported the campus as it moves toward a computing intensive environment. Over the last four years, microcomputers have proliferated on campus. A pattern has emerged in their use. In the first phase, they are generally used as standalone workstations. Spreadsheet packages produce shadow budgets for individual departments, supplementing the campus financial system. Word Perfect and other packages replace minicomputer word processing systems. In the second phase, users look to extend their capabilities through linkages. These include links with other microcomputer users as well as with electronic mail, conferencing systems, and the Health Sciences Library's electronic access to reference services. Academic users may seek to link up with the statistical packages on the mainframe computer, or choose to use the microcomputer versions of Statistical Applications Software (SAS). Growing numbers of administrative users are taking advantage of downloading capabilities, taking information from the campus financial accounting system, moving it into microbased spreadsheets, notably Lotus 1-2-3, and manipulating the data there. The third phase, yet to occur, is dependent upon enhanced micro to mainframe links which new data base management systems and fourth generation languages will provide. This third phase will be implemented to meet user demand, which will arise as the potential of phase two is realized and found limiting.

### *Software Base*

Since the applications to which that computing power can be put are dependent upon the software available, software decisions are made using a participatory process involving key users from the campus community. As the interdependencies among the selection of applications packages, data base systems, and mainframe architecture have become apparent, the Associate Vice Chancellor for Information Resources has intensified the Division's cooperative efforts with senior level officers on this campus as well as at other campuses, the University of Maryland central administrative unit, and the Medical System. The Information Resources Management Division hopes, through the phasing and coordination of implementation plans, to realize the greatest possible benefits from computing acquisitions.

The intent is to select software to serve as decision support systems by building upon the data base management systems, fourth generation languages, and tool sets. With networking, these decision support systems will empower users to complete a spectrum of functions independently.

The use of compatible fourth generation based software applications will allow users to link microcomputer applications with minicomputers and in turn with campus or regional mainframes. Software acquisitions being considered include a purchasing/accounts payable system, a student information management system and, in the early 1990s, a new financial management system. These would allow the campus to continue to build an environment supportive of end user computing. Currently, the campus maximizes usage of its existing computing/communications base through activities such as downloading from the financial accounting system into Lotus 1-2-3 or uploading from microbased statistics into mainframe number crunching software.

Thus, the applications selected in collaboration with campus users will build upon the new data base management system and associated fourth generation language to be installed by the core facility. Tool sets will empower users to complete a spectrum of functions independently. Microcomputer applications will link with minicomputers and in turn with mainframes, through use of compatible software.

### **Mechanisms for Outreach**

To ensure that these technological capabilities do in fact support the user in the integration of tasks, the core facility must assume a new role, providing users with support services. These services include an educational component as well as the more traditional technical support and consultation services. Thus, delivery of these services is dependent upon the reorganization of the core facility into the information utility model. Obviously the implementation of a total environment takes considerable resources and, just as importantly, something which cannot be forced: time. The phasing of the major hardware and software acquisitions must accommodate not only purchasing regulations but also educational requirements for the IRMD staff and the campus as a whole. For the campus to take advantage of the integrated system now being planned, users must become comfortable with the new technologies and be convinced of their benefits.

### *Technology Assisted Learning (TAL) Centers*

The technology assisted learning (TAL) center is the central delivery system constructed to provide those outreach functions to the user community [14]. Such centers are basic to the integration concept, particularly in the academic health center environment, where finite resources must be maximized. As of this writing, two centers have been established at Maryland's Campus for the Professions and a third is approaching implementation. In their role as microcomputer laboratories and training facilities, the TAL centers provide students, faculty, and staff with access to hardware and software. Through the TAL centers, the IRMD offers basic courses (word processing, office automation, statistical packages) and makes resources available for other

courses (clinical and physiologic simulation, bibliographic searching, conferencing). The TAL centers also serve as demonstration centers for innovative new technologies.

These outreach centers complement and in some cases accommodate the public services traditionally offered by the Library. Plans for the construction of a health sciences core facility include a new library which contains a large TAL center within its allocated square footage.

Without outreach, the potential of information technology cannot benefit the user. As with the public utility, technical workers must provide hookups for users and special staff and assist them with specific installations and applications utilizing the power source. Organizationally these client service functions reside within the information utility and have been accommodated by reassigning existing staff and creating new user liaison positions. At the same time, end users are assuming greater responsibility for running their own particular applications, resulting in changed roles for those end users within their own units and vis a vis the information utility.

The TAL centers support these users in meeting their increased responsibilities by providing training, supplemented by other user services within the IRMD, such as consultation and the help desk. On the administrative side, such training is planned in collaboration with key administrative units.

### *Informatics Program Development*

Academically, outreach will be realized through the core facility's encouragement of and support for informatics programs in the professional schools [15]. Informatics, briefly defined as the discipline of applied information technology, is uniquely defined by each school, indeed, by each speciality and subspeciality. Organizationally, the informatics programs are gradually being formalized through the establishment of informatics departments in the various schools, which in time will develop specialized course/curriculum offerings.

The informatics initiative will provide yet another dimension to the campus' evolving environment and serve as a mechanism for integration [16]. The Associate Vice Chancellor has acted as change agent through the encouragement of and support for informatics, the discipline of applied information technology. As core facility, the IRMD provided startup support for the first dental informatics program in the United States and urged formation of informatics programs within the other professional schools. Through professional activities, publications, and liaison activities with the schools, the Associate Vice Chancellor has advanced the cause of informatics for the campus, most notably for the field of nursing. Plans have been laid within the IRMD to address the commonalities which exist across the allied health sciences at the level of the first professional degree. Proposals exist which, if funded, would join the IRMD with the School of Medicine in more advanced infor-

matics programs for professionals in medicine and in health care administration.

In support of the informatics initiative, the IRMD is currently planning further reorganization of the services it provides and of academic computing, involving the reassignment of existing staff and the creation of new positions for informaticians, microcomputer specialists, and consultants in educational software development. In strengthening outreach capabilities, all will interact to support the campus in its use of the new technological infrastructure now being planned. Nursing is targeted for the development of informatics with the IRMD serving as catalyst and change agent. Plans call for a master's level program in nursing informatics to be offered in Fall 1988.

### *Outreach Programs*

**Geriatrics and AIDS.** Outreach is the purpose of yet another campuswide initiative, the geriatrics program. In response to a state mandate, this program will provide information on and services for Maryland's elderly and foster education, research, and patient care models for Maryland's educational and health care institutions. The IRMD and Library will serve as core facilities in support of the project, with the IRMD providing the technical infrastructure. An information specialist will assume responsibility for database development and for information access and dissemination to health care professionals. The IRMD is additionally exploring the possibility of mounting a service, based on a voice information processing system, to provide recorded messages on special topics with touch tone activated access to additional information and/or to project staff. Now in the preliminary planning stage are projects related to the acquired immune deficiency syndrome (AIDS) which would provide similar outreach capabilities.

**Hypertension Pilot.** Also serving as a focus for integration and outreach is the IAIMS pilot project site funded by the National Library of Medicine. Established as a model development site and as a demonstration site, this pilot involved the interdisciplinary Hypertension Center and the Schools of Medicine and Pharmacy; its intent was to create a networked microcomputer environment and to develop clinical, bibliographic, and resource databases. Other project activities focused on enhancing the power of the microcomputer workstations. The Health Sciences Library and the IRMD have supplied technical support and training as required and will continue to do so through the grant period.

The pilot focused on the development of databases, requiring the acquisition of software within a relatively short time frame. To this end, the IRMD provided the pilot with technical assistance.

### *New Applications*

Along with these special projects, the IRMD has worked to extend the benefits of integrated information management

to the campus prior to the installation of major systems by offering selected applications to users and opinion setters. In some cases, these built upon systems already on campus, such as the uploading/downloading of financial data. Another utilized the IBM 4341 to mount a professional office system (PROFS), providing electronic mail on campus, access to the nationally based BITNET and adjoining networks, calendaring, and a number of other functions. This system gave academic users capabilities previously unavailable to them and effectively addressed the growing problem of multiple mail systems.

**Conferencing System.** Academic and administrative users were also given access to an electronic conferencing system (CoSy), mounted on a newly acquired super micro-computer. The IRMD worked with the Health Sciences Library on CoSy, with the IRMD responsible for technical support and the Library's Information Management Education Department responsible for training of the users, who were predominantly academic. The intent was to offer the benefits of networking across institutional, physical, and disciplinary boundaries, by establishing conferences in subject areas and among certain interest groups, such as hypertension and geriatrics. The Library targeted groups for training, anticipating that the system would require at least a year to function fully as a medium for professional discourse.

**Voice Mail.** Another new technology, first offered to the deans and senior level officers, was a voice mail system [17]. This computer based system provided voice messaging and storage capabilities, using touch tone telephones as terminals for input. The IRMD brought the system to the campus and arranged for training. Here the merging of two technologies—communications and computing—was embodied in a single application, the adaptation of a familiar technology, the telephone. Quickly installed and operational on a trial basis, the voice mail system offered demonstrable benefits, erasing the barriers of time and distance through its capabilities and an 800 telephone number. The success of this experiment resulted in the campus' purchase of a 1000 user system which is being integrated with the new digital voice switch.

**Videodisc Development.** Innovative technology will also support outreach through the development of videodisc applications. Utilizing the TAL center as demonstration center, the IRMD is making programs from the National Library of Medicine and other sources available through large screen projection systems, and developing a disk in conjunction with the Dental School and its Dental Informatics Division. With IRMD funding for equipment and a key dental school faculty member, the videodisc will include over 10,000 teaching slides and have a national audience of professional dental schools. Access to the images will require a computer based retrieval system, a microcomputer based instructional delivery system, and an authoring language.

These requirements of the videodisc project mirror the pervasive need for integration. Here a relatively new tech-

nology, videodisc, can realize its potential only when it is linked with computing hardware and with software applications. The merging of image and data is dependent upon that linkage. In like manner, the geriatric project will benefit from not only improved data communications but also the merging of voice and data technologies.

**Interinstitutional Resource Sharing.** Data communications provide the base for another new initiative. The IRMD and Library are currently involved in a consortium with two other academic health centers which are also IAIMS awardees, Johns Hopkins and Georgetown. Their intent is to create a network linking the three institutions and allowing them to share valuable—and expensive—databases, such as Current Contents, McKusick's Mendelian Database, and other valuable specialty databases. Once implemented, this will clearly maximize the campus' information resources, while minimizing costs.

## Realizing the Benefits of Integration

These newly available applications have an importance beyond their technical capabilities. Through their implementation, they have embodied the concept of integration for the campus. In so doing, they have validated the considerable expectations raised by the strategic planning process. Given the magnitude and the complexity of the changes planned, and the resources required to effect those changes, perceptions on the part of the campus community are critically important. The intent has been to provide some measurable evidence that those expectations will be met, despite the time involved to implement organizational and technological innovations of this scale.

Thus, the linking of diverse information technologies serves as the mechanism for the integration of the campus' multiple missions. Other than the developing technologies themselves, the most potent forces for integration are the evolving organizational changes supportive of their use. Acknowledged by the governance structure and apparent in shared undertakings is the growing symbiosis between what were traditionally separate entities, the library and the computing center. This relationship is complemented by intensifying interrelationships between professionals involved in the cooperative ventures described above.

Partnerships and end user driven software along with 370 computing architecture and telecommunications connectivity will transform computing. The resulting integrated environment will enable campus decision makers to transform data into information, and information into knowledge. This newly integrated and networked system will support the University of Maryland Campus for the Professions in tying together its multiple missions of administration, education, clinical care, and research.

None of these achievements would have been possible without the active support and guidance of the Chancellor of the University of Maryland Campus for the Professions. Top level support is essential to the success of IAIMS, involving

as it does tremendous demands on the core facilities as they strive to transform the campus and give it the full benefits of integrated information management.

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