

5. INFORMATION SYSTEMS (LIBRARIES) / INFORMATION TECHNOLOGY

INTRODUCTION

During the past decade, information systems and the underlying technology upon which they are based have changed dramatically. These changes have had and will continue to have a profound impact on the university and the larger society of which it is a part. Within the university we have experienced exactly the same shift from centralized to distributed computing/information systems and points of access that has occurred at both universities and corporate enterprises throughout the country. This shift in emphasis, access to an information-rich environment, and the ubiquity of distributed computing has brought with it tremendous opportunities and profound changes that are beginning to transform the institution and challenge the manner in which we provide and support our instructional, research, and public service programs. Although this change has been taking place over the past decade with the infusion of personal computing and local area networks, the pace has dramatically accelerated with the growth of the Internet, new information technology resources, and the increasing computational power of personal computers, workstations, and large-scale servers. In the information-rich electronic environment, the issues regarding content and conduit are becoming increasingly inseparable.

Strategic-planning efforts have recognized the transformational role of information technology resources on the entire higher educational enterprise. Information technology resources and a new generation of scholarly tools are rapidly becoming part of the core educational infrastructure at Rutgers University and need to be meshed with the missions, priorities and goals of the institution. The transforming impact of new information technologies has both challenged and created major stresses on our organizational structures and models for how we provide and support information technology, resources and services. New organizational structures, roles, service, and support models are needed if the growing information resource needs of higher education are to be adequately met in the information age.

Distributed network-based learning technologies are eliminating many of the traditional barriers to information access. Concomitant with this trend, the legislature in New Jersey is beginning to make strategic investments in infrastructure technologies necessary to provide state-wide access to the wealth of information resources available in its institutions of higher education in order better to serve the changing educational needs of its citizenry.

As a consequence of the information revolution that has been taking place at the university, a number of committees have been formed to address many of the issues, problems, and opportunities that have been identified. The report prepared by the Committee on Computing and Information Planning (CCIP) in 1992, *A Transformation of Computer and Information Technology at Rutgers*, provides not only important insight into the issues surrounding computing, information systems, and related fields at the university, but also a vision for the future. This document can be viewed as an initial blueprint for the transformation of the university in response to the computer and information revolution that is taking place. The vision of the future that has been proposed must be based on a partnership which "... all groups within the

university—faculty, students, and staff—and the state of New Jersey share in and actively support.... ” The transformation that has been proposed will recreate a university in which:

- All students, faculty, and administrators have access to the computing, information and media services they need, whether in the office, the laboratory, in specially equipped classrooms, or in public-access facilities;
- Communication is facilitated by a high-speed data network extending to all appropriate offices, to all dormitories, and to all libraries;
- State-wide information databases, accessible electronically in libraries, schools, and colleges across the state, will facilitate economic and intellectual development in New Jersey.

In short, Rutgers will be a state university that recognizes effectively the central and critical role of computing and information technology for the success of the university and the state.

Since the development of this report in 1992, numerous improvements have been made, as detailed below, in the university’s information systems and technology environment. Investments in both computing and the libraries provide the enabling infrastructure of content and conduit that will move the university forward into the next millennium.

CONTEXT AND CURRENT STATUS: THE LIBRARIES

ORGANIZATION AND UNIVERSITY RELATIONSHIPS

The 18 Rutgers University libraries, geographically dispersed on three campuses, are organized as a unified library system with a common mission and goals shared by all libraries that report to the university librarian. (See Appendix 1.) The law libraries in Camden and Newark report to their respective deans, and the libraries of the Center for Alcohol Studies and of the School of Management and Labor Relations are incorporated into the university library system, but report to their director/dean, and are only partially funded by the libraries.

The university librarian reports to the university vice president for academic affairs, and is a member of the university’s Administrative Council (a group including the vice presidents, provosts, and deans), the University Senate, and the Trustees Library Advisory Committee. These partnerships with the deans, provosts and vice presidents are essential for the libraries’ planning to support academic programs and priorities. Library planning and system-wide service programs and policies are coordinated through the University Librarian’s Cabinet, standing advisory committees of the library faculty, and other library committees. The libraries have used a variety of means to incorporate user input into decision making. Some librarians/directors are members of campus advisory committees for libraries and/or computing. Librarians with subject expertise are designated as liaisons for collection development and specialized services to the relevant academic departments on the three campuses to maintain a current understanding of the information needs of various disciplines and for resource planning. A student library advisory

committee, begun in New Brunswick several years ago, has been a moderately successful forum to address student library needs.

As content and conduit have become inextricably intertwined, close collaboration between the libraries and computing services has become crucial. The Joint Committee on Information Technology composed of members from the libraries and computing services was formed for this purpose and has been addressing issues of mutual concern, but it is only a first step in developing closer ties.

While these many committees and groups have been useful venues for advice and consultation on the development of library policies and priorities, there is no university-wide group that provides advice to the university librarian on such matters.

INFORMATION TECHNOLOGY STRUCTURE

In October 1993 the libraries updated their long-range plan, "The Rutgers Advantage," to address specifically the information technology component. Using the university's Committee on Computing and Information Planning report, *A Transformation of Computer and Information Technology at Rutgers*, as a guide, the libraries also produced *An Information Strategy for the Rutgers University Libraries* (Appendix 2), outlining the strategic directions that the libraries would pursue for the next several years. It is current through 1997. These strategies include pursuing an aggressive policy in the acquisition and provision of electronic information, planning for a next-generation online catalog, acquiring a library server and software for mounting and serving databases locally, completing the conversion of the card catalog to machine-readable form, completing the networking of all libraries and workstations within buildings, increasing the number of public and staff workstations, and escalating instruction programs for staff and patrons in the use of electronic information resources. Considerable progress has been made in all these areas.

Until August 1997 the libraries' information infrastructure was supported by four separate systems: RLIN, a national database used for cataloging, interlibrary loan services, and some CitaDel subject databases, the GEAC system supporting the online catalog and circulation, Innopac for acquisitions and serials control, and OVID for maintaining local bibliographic and full-text databases. The GEAC system, aside from being obsolete both physically and technologically, was not capable of providing services the university now needs. For example, newer systems can act as gateways to information sources on the Internet and elsewhere on campus, as well as to bibliographic information from the library catalog. They are used as organizers or jumping-off points to myriad information sources provided by the library. They provide access to full-text data and to images, including those now being published in electronic journals, and to multimedia materials and electronic reserves.

For these reasons, the acquisition of a new integrated information system was the top priority for the libraries for fiscal year 1996–97 as the necessary technological infrastructure to support the provision of scholarly information for the Rutgers community into the next century. Through a year-long planning process in fiscal year 1995–96 involving many librarians and staff and with assistance from computing services, the libraries identified a commercially available integrated library information system (LIS) that would combine the features of the current systems and enhance functionality for users. The new system would also permit the streamlining of work flows for staff by combining acquisitions and cataloging functions and permit the implementation of vendor-supplied cataloging, electronic invoicing, and other related services. It would also allow the libraries to implement "authority control" on all records in the

system to ensure accuracy in author, subject, and series title headings for better user access. The new LIS would also permit the implementation of many user-generated services, such as self-circulation and renewal of library materials, placing recalls and interlibrary loans online, and posting email notices and requests. These patron-initiated services have the potential of saving staff time. The new LIS would also provide the necessary management data on the use of collections to permit better informed decision making for future resource planning.

At the end of fiscal 1995–96, the libraries received special funding of more than \$1 million from the university to purchase SIRSI, as the new, integrated LIS. Working on an extremely short implementation schedule, the libraries announced the availability of the online catalog and circulation portion of the LIS to the Rutgers community in September 1997. The serials check-in system and full implementation of the acquisitions system are being phased in during the fall 1997 semester. Once the LIS is in place and all modules fully operational, the libraries will have a more effective system for collecting data on how collections are being used. With the former systems this data was not easily retrievable. We will now be able to map the use of currently acquired materials as well as older materials. We can ascertain which users—by category: faculty, graduate students, undergraduates—are using certain collections. We will also be able to gather additional granular data on the use of electronic resources. This data should help focus collection-development strategies more effectively, especially after a few years of data can be compared. For example, what percentage of newly acquired materials are being used each year or within the current five years? Which percentage of the collections circulate most heavily as a percentage of acquisitions? Which materials are being circulated most heavily among the three campuses, and for which disciplinary users? The answers to these questions and others will undoubtedly have an impact on budget allocations and on collection development strategies.

The online catalog contains records for only 70% of all library materials; these include all items acquired since 1972 plus any older materials circulating since 1986. Through a series of “recon” (REtrospective CONversion) projects the Kilmer Library and Robeson Library have completely converted their card catalogs to electronic format. The Library of Science and Medicine, the Douglass Library, and the Dana Library have conducted small projects each year; the recon of the reference collection at the Alexander Library, the Sinclair New Jersey collection, and the rare book collection of Special Collections have been completed. Few users still use the old card catalog. The card-catalog records for the remaining 30% of the library’s collection need to be entered into the new system, so that users will be able to locate and request them through the online REQuest system, which is supported by a mail delivery service operating among the Rutgers libraries. The university will then realize more fully the return on its investment in these older materials as they are more readily known and accessible.

Overall, the libraries’ technological infrastructure is relatively well advanced, compared to that of other university units, colleges and departments. All libraries, with the exception of the School of Management and Labor Relations, are now connected directly to the university network. Frequently this has been accomplished through network drops to library buildings or other key buildings in which branch libraries reside as RUCS has networked the campuses. The libraries also support 11 Novell networks and more than 550 networked computers. Internal building networking has been funded through the reallocation of internal resources, HEFT funding, high technology funds, and external fundraising. All library staff and librarians have had email accounts for several years and use them regularly. Numerous list servers have also been established to facilitate topic- and task-oriented discussions.

The libraries' systems office also purchased a SUN 3000 server for the LIS in 1995 with ELF funds to provide network access to locally mounted electronic databases. Currently 17 databases in a wide variety of disciplines are mounted locally on the server using OVID software as the search engine, in addition to the many databases accessed remotely. Numerous CD-ROMs have been available on local area networks in individual libraries for many years.

The number of computer workstations has increased dramatically in the last four years, primarily as a result of ELF, ICI, external fundraising, high technology funds, and internal reallocations. The majority of new machines are public workstations for users; the staff equipment has not increased as significantly, primarily because most equipment funds have come from sources that have targeted user services. In addition, the Robeson Library in Camden, the Dana Library in Newark, the Douglass and Kilmer libraries, and the Library of Science and Medicine in New Brunswick are satellite sites for public-access student microlabs, which RUCS has installed and is maintaining as part of the ICI project. While a substantial number of new workstations will be acquired as part of the purchase of the new information system, not all staff will have new or upgraded equipment to take advantage of the full spectrum of information technology available. Over the next several years the libraries must place a priority on the upgrade and replacement of staff equipment.

The libraries' central systems staff, formed through the internal reallocation of positions, are chiefly responsible for equipment and software standards, configuration, installation, and systems support for both public and staff infrastructures. Staff in each library are increasingly involved in providing support for public and staff workstations and are rapidly developing microcomputer-related skills. Each library has designated at least one staff member as a PC coordinator to provide first-line training and support for staff and/or public workstations in the area, to share information, and to act as liaison with the respective library's systems department. Collectively they form the PC Working Group whose role is to increase the libraries' capability to support and exploit the local technical infrastructure. Various models for future systems support are being explored in order to provide for an increasing number of computer workstations, electronic classrooms, and other computer-based operations/activities within the libraries. As with all units of the university, levels of staffing appropriate for maintaining and providing service for the technology infrastructure are critical to its successful utilization.

INFORMATION RESOURCES: CONTENT

The Rutgers University Library system holds more than 3 million volumes of monographs and bound periodicals, more than 3.9 million units of microforms, 2.5 million government documents, and collections of manuscripts, maps and audio visual materials. Approximately 23,000 titles of current serials are received, and some 80,000 volumes are added each year. The Alexander Library and the Library of Science and Medicine are federal and state depository libraries and collect broadly in international government publications. The special collections and archives contain the premier collection of materials related to New Jersey as well as other notable collections, especially in the area of United States social and cultural history. Other outstanding collections and unique resources are maintained at the Institute of Jazz Studies, the Alcohol Studies Library, and Criminal Justice Library.

The libraries have steadily increased the number of electronic information resources made available to the Rutgers community, from standalone CD-ROM products, to local area networked CD-ROMs to university-wide networked electronic databases. Twenty-six databases are now available through the university network, including full-text databases first offered in 1996 (Appendix 3). The funds for these

acquisitions have come from a reallocation in the collections budget from print to electronic resources, the replacement of print materials by the equivalent electronic product, or from extra funding, such as the ICI fees. Networked electronic resources are particularly valuable to the Rutgers community, with its large off-campus population and the university's widely dispersed geography. The libraries currently spend approximately 6.6% of the collections budget on networked information resources including CD-ROMs, and expect to spend nearly 10% of the collections budget on electronic resources in fiscal 1997–98.

The libraries' system-wide collection development is coordinated through the Office of the Associate University Librarian for Collection Development and Management. Collections acquired on each of the three major campuses (Camden, Newark, New Brunswick) serve the campus missions, and each library in the system has a distinct collections profile. Since the mid-1980s the libraries have made a concerted effort to avoid duplication of materials where possible and to rely on an extensive internally operated mail delivery service to provide delivery of materials located at any Rutgers library. Rutgers belongs to the Online Computer Library Center (OCLC) and its local division, Palinet, the Research Libraries Group (RLG), the Center for Research Libraries (CRL), the Metropolitan Research Libraries (METRO), the Northeast Research Libraries Consortium, and the New Jersey Library Network, to provide the Rutgers community with on-site access to collections/resources held elsewhere and for interlibrary loan services. In addition, special arrangements with Princeton University provide direct borrowing privileges for 50 faculty users each year.

The base budget for library collections has decreased by nearly \$.5 million over the last eight years, due primarily to severe losses in state funding to the university. As a result, the libraries have not been able to keep pace with the inflationary costs of information resources. Non-state funds, beyond the base budget, have been available as a supplement. These include gifts and endowments that can be spent at any time. The annual "parents' phonathon", the proceeds of which have been dedicated to library collections, has provided approximately \$175,000 in supplemental funding each year. The Instructional Computing Initiative has provided \$190,000 for each of the last two years for networked electronic resources of interest to students, and in fiscal 1996–97 the libraries received approximately \$30,000 from the university's multicultural funds. Other gifts and endowments are, for the most part, restricted to a specific subject and/or library. Total endowments for collections amount to \$5,849,182. Small temporary supplements are sometimes given by academic departments to a specific subject, and at times, the university's central administration has provided temporary unrestricted supplements that have been used primarily to purchase monographs. In the last four years (fiscal 1993–94 – fiscal 1996–97) the libraries received \$709,000 in one-time supplemental funding from the university to support collection development. For fiscal 1997–98, the university has allocated an additional \$500,000 for collections as part of the president's program for a "reinvestment in Rutgers," which will keep the university on its path to excellence as outlined in the strategic plan. This investment adds to the \$7 million that the university has provided to the libraries in the last four years for capital construction, renovation, equipment, collections and the new LIS.

Based on criteria established by the Association of Research Libraries (ARL), the Rutgers University Libraries have fallen from a high ranking of 16th (out of 108 institutions) in fiscal 1987–88 to a ranking of 25th in fiscal 1995–96 due in part to the lack of budget increases for collections resources (Appendix 4). Among the 30 AAU public institutional members of the ARL, Rutgers is ranked thirteenth. This ranking is based on a combination of factors including volumes in the library, volumes added, current serials, total staff, and total operating expenditures. As a result of inflationary increases and a no-growth base budget,

the libraries have engaged in yearly serials cancellation projects to reduce the fixed costs in the collections budget, severely curtailed the binding of library materials, and purchased fewer monographs.

There has been little opportunity for the libraries to move funds from other budget categories to protect collections from the impact of inflation as university funding has been reduced. In each of the last eight years of budget reductions, the libraries have not reduced the allocation to collections except for a small amount in one year, primarily because Rutgers spends approximately 29% of its budget on collections compared to the ARL mean of 36.7%. We have tried at least to maintain, if not improve, this ratio. As a result, staffing has declined by nearly 45 positions and the flexible operating budget (supplies, equipment, hourly wages, travel, etc.) has also declined. For example, Rutgers spends approximately 6.3% of its budget on operating expenses, compared with the ARL mean percentage of 13.6%. The total budget of the libraries over the same time period has increased significantly, however, because of negotiated salary increases over which the libraries have no control. Indeed, Rutgers has ranked consistently first or second among its ARL peers in average salary for librarians (a unionized faculty) for a number of years, but the total ratio of staff per user population compared to ARL peers is not high. As a result, examination of how to achieve some flexibility among the budget categories is an important management task, since approximately 64% of the libraries' budget is allocated to salaries, compared to the ARL mean of 48.5%.

Like other major university libraries in North America, Rutgers libraries are confronting a threefold challenge in building library collections: (1) the budgetary challenge of an ever-increasing volume of new publications, especially serials, at the same time that prices continue to rise at rates higher than general inflation and well in excess of small, if any, increases in the collections budget; (2) the technological challenge of a proliferation of materials in new formats and media, which often do not supersede or replace more traditional products and generally are more expensive than similar print materials; and (3) the academic challenge of many new university programs being implemented, including the increase in graduate programs on the Newark and Camden campuses.

Each of these factors, some of which are national issues, is examined below in the context of the Rutgers situation.

Programmatic Growth and Anticipated Growth

Since 1989, Rutgers has approved 33 new programs representing 36 degrees and a net total of 12 programs have been suspended, discontinued, consolidated, and merged. Of the new programs, 9 are doctoral, 13 are master's, and 11 are undergraduate. Thirteen of these programs are located in New Brunswick, twelve are located in Newark, and eight are in Camden. Only a very small portion of these new programs has received extra funding for library support as they have gone through the university's program approval process. In addition, a number of new or expanded academic directions for the university are highlighted in the recent *Strategic Plan* and subsequent *Implementation Plans*. Among these are the arts and sciences (such as human evolutionary studies), international studies (global studies and global change and governance), cognitive science and neuroscience (such as language and cognition and modeling of neuron codes), the creative arts, engineering, environmental studies (such as biodiversity), gender studies, information science (including Internet technology and bioinformatics and computational neuroscience), the life sciences and agriculture, and professional studies (such as public health and arts management). In addition, the New Brunswick campus aspires to the top quartile of public AAU institutions by the year 2010, and the Newark campus aspires to Research II university status. All these factors will require access to significant collections resources to support new or ongoing programs, and in some cases expensive resources may need to be replicated on more than one campus.

A key point made in a number of campus documents involving strategic planning and its implementation is the importance of continuing to strengthen existing programs that are central and have achieved high levels of excellence or are poised to reach such levels. New programs, though indicative of important new directions for the university, are not by themselves sufficient indicators to guide collection budget reallocations. At every level—in analyzing relative allocations among the campuses, units within a campus, disciplines, or programs—close consultation between librarians and the corresponding academic officers is essential. In this way the relative importance, centrality, and excellence of new programs can be balanced against existing ones, especially if additional resources will not be forthcoming to support new initiatives and reallocation is required. Moreover, since the particular research strengths and specialties differ among the three campuses, decision making about which resources need to be acquired or reallocated to support or strengthen a particular campus program should be made at the campus level.

Price Increases in Library Materials

Recent years have seen academic libraries throughout the nation spending more of their financial resources to buy fewer materials. The Mellon Foundation study on university libraries and scholarly communication (1992)¹ documents the rapid increases in expenditures for serial subscriptions and the way that subscriptions have consumed an increasingly larger proportion of materials budgets. The prices of scientific and technical journals have continued to increase at extraordinary rates, far above the overall price index for all goods and services. Prices in other fields, though not increasing so much as the increases in science and technology journals (with the exception of business and economics), have also increased at rates significantly higher than the general inflation. Book prices in the sciences and technology have also increased at a higher rate than other areas, though, again, books in all fields have increased at a rate greater than inflation.

For the period from 1992–96, the average price increase for the science journals required to support the various programs at Rutgers was approximately 54%, with the average subscription price for a science journal reaching \$722. Journals in the social sciences and humanities increased in price over the same period by 43%, with the average price for a journal at \$169. The average price increase for journals in business and economics was 67%. It is important to note that these are average price increases, with some journal prices increasing by more than 100%, and some journal subscriptions costing more than \$20,000.

The annual disciplinary increases between 1995 and 1996 alone ranged from a high of 20% in engineering and geology to a low of 10% or less in anthropology, history, art, and music serials. With respect to 1996 costs, the average cost for serials titles was highest in physics (\$1,354) and chemistry (\$1,239), while the lowest average costs were in literature (\$86) and music (\$62). It should also be noted that the average cost of a scientific journal is approximately \$553 more than the cost of a social science/humanities journal. Libraries also pay an average of six times the cost of a subscription more than an individual does. Apart from the print materials, the various disciplinary electronic collections (i.e., access arrangements, local networked materials, CD-ROMs, and the like), have also experienced significant increases in their prices, and this is expected to continue.

¹ Cummings, Anthony M., Witte, Marcia L., Bowen, William G., Lazarus, Laura O., and Ekman, Richard. "University Libraries and Scholarly Communication," a study prepared for the Andrew W. Mellon Foundation. Washington, DC: Association of Research Libraries, 1992.

Collection development librarians on all campuses have worked very closely with their faculty constituents to provide the most appropriate balance of materials within budgetary constraints. For those libraries supporting science and/or technology programs, such as the Library of Science and Medicine and the science branch libraries in New Brunswick and the Dana Library in Newark, the impact has been enormous, since the relative portion of funds allocated to science budgets in New Brunswick has been held steady. The result has been continuous journal cancellations, including many titles unique to the libraries, and with very little money available for the acquisition of books. In large part, book or monograph purchasing for these libraries has been based on the availability of non-state funds. In the case of the libraries supporting business programs, for example, there have been fewer book titles acquired in business on the Newark campus and elsewhere at a time when there is great demand for this type of information. Close consultation with appropriate university officers, deans, and faculty is necessary to maintain the appropriate balance among the various disciplines when costs are escalating unevenly among them. Alternative ways to support information needs are also being explored. Some of these include document supply on demand, expedited interlibrary loan, and consortial negotiations for discounted pricing. Small pilot projects, such as the UnCover/Reveal documents-on-demand experiment conducted in spring/summer 1997 with several Cook College faculty, should provide useful feedback for alternate models for information access.

The impact of severely escalating journal prices, in particular, has created stresses within and outside the libraries. While much of the stress was related to our own budget situation, the libraries have not been uniformly effective in influencing the discussion of the broader national issues with university administrative officers and the faculty. While it may be unrealistic to expect annual budget increases at the rate of 8% per year to keep pace with current inflation, collection budgets with no increases allow no possibility for maintenance and little opportunity for flexibility. Alternative strategies that combine realistic budget increases with document delivery, electronic resources, reallocation and rebalancing will be required. The spring 1997 issue of the *RUL Report*, sent to all faculty, was designed to outline the national issues in the context of the libraries' collection development strategies. A summit conference on the libraries, recommended by the New Brunswick faculty council in spring 1997, was an opportunity to begin a university-wide dialogue on the changing nature of library collections and the many choices in providing information resources. The summit conference highlighted the need to work collaboratively with the university community to develop new understandings and strategies for collection development in the current and future environment. The role that the faculty can play not only in collaborating on collection development strategies, but also in addressing the cost factors of scholarly publishing in their disciplines, needs broader campus discussion. The faculty's posture toward intellectual property, specifically as it may contribute to the cost of and access to scholarly information, also needs to be explored and articulated. Recommendations coming from the summit conference include such broad-based discussions and the need to update the libraries' long-range plan, "The Rutgers Advantage," through a planning process in collaboration with teaching faculty during fiscal 1997-98.

Balance between Electronic and Print Formats

Today's fluid information environment makes it difficult to determine a firm balance between print and electronic resources. Libraries must provide information in both print and electronic forms, but proportions will change. The strategic balance between print and electronic publications is more complex and profound than among other choices in collections decisions. Printed books and journals are still the predominant modes of formal scholarly communications, but digital information allows scholars and students quick

access to current information from any location and enables manipulation in a variety of useful ways that is not possible in the print environment.

The benefits of electronic media include speed of access, currency, and the ability to skip from screen to screen in a non-linear fashion and search and retrieve information from large databases. Information whose value increases in digitized form includes data (e.g., statistics, lists, stock market quotes, preliminary findings of ongoing research) that continually change and must be current, and bibliographies, indexes, handbooks, and reference works that do not require sustained reading. The percentage of the collections budget allocated to electronic information needs to increase as more electronic information of high quality becomes available.

Full-text and other electronic information can provide additional value to a geographically dispersed campus environment. This is particularly relevant for Rutgers, because faculty on all three campuses and on several campuses in New Brunswick need convenient access to the same information. The most obvious examples occur in the sciences where faculty in Newark, Camden, and in New Brunswick on the Busch and Cook campuses need ready access to the same expensive journals. The ability to access information from home for commuters, in dormitories for students, and in offices for faculty provides an additional service that print collections cannot. Electronic information resources will become increasingly important as Rutgers expands the number of distance-education courses that will require distributed access to information.

Purchase decisions for electronic publications are more complicated than those for print media as content, access points, ease of use, timeliness, compatibility with existing computer systems, search capabilities, display options, printing and downloading facilities, software support, and data storage requirements must all be considered. The libraries' current planning for networked electronic information resources focuses on providing initially broad disciplinary coverage of the major bibliographic and abstracting services, and then adding broadly based full-text information. Maintaining a consistent user interface to these many products has also been a priority so that users need not learn a separate searching technique for each database product. This requires that purchase decisions be predicated on the availability of resources for mounting on OVID or through RLG's CitaDel files, or OCLC's Firstsearch, which would provide exactly such a consistent user interface or limit the overall number of separate interfaces. Cost and availability of high-quality electronic information have been the major factors determining choices among the many resources recommended by a subcommittee of the libraries' Standing Advisory Committee on Collection Development. While the science faculty have been more "network-ready" than other disciplines, their electronic resources have also been the most prohibitively expensive. As a result, we have been unable to acquire some of the networked databases most desired, such as BIOSIS, INSPEC, and Chemical Abstracts.

Continued planning for electronic information will require close collaboration with faculty because the balance between print and electronic will vary from discipline to discipline and from one generation of scholar to the next. In order to make informed decisions concerning the acquisition of electronic resources, the libraries must plan to investigate the changing patterns of use—who uses what, how often, and for what purpose. It will also require an understanding and affirmation of shifting paradigms in collection development from ownership of information to access to information, as electronic resources are often only licensed for use, not for permanent ownership.

Collaboration

Situated in the metropolitan New York/New Jersey area, the Rutgers libraries are in a unique position of having major research library collections within convenient access—Columbia University, Princeton University, New York University, the Research Libraries of the New York Public Library, and the University of Pennsylvania, as well as many very specialized collections. Through memberships in RLG and METRO, Rutgers faculty and students have onsite access to these collections, which might otherwise be limited. The proximity of these research collections has, however, only modestly influenced local collection development policies. To some degree this may be attributed to the regular use of these libraries by faculty in the humanities and social sciences resulting in their low interest or expectations of Rutgers' collections in some areas.

Collaborative planning for collection development within the state and nationally will be necessary to contain costs, where possible, and still provide effective information access. Among a small subset of research libraries within METRO, Rutgers has participated for the last several years in cooperative purchasing of expensive collections that focus each year on a specific discipline or area. The purchased collection is then located at one of the libraries but available to all. The libraries have also used their Palinet membership (regional OCLC group) for collective discounts on such purchases as the Academic Press electronic journal package, *Ideal*. Rutgers will also be participating in a journal-overlap study being conducted by the Council of Directors of New Jersey College and University Libraries. The study will provide data for future collaboration, for local decision making related to serial purchases, or for selective cancellations due to multiple subscriptions held across the state. The council is also looking at cooperative purchase of electronic databases to achieve discounts. The Rutgers libraries have also entered into a consortium of university libraries in the Northeast organized by Yale University Libraries for similar cooperative purchasing, and they have enjoyed discounts of consortial pricing through Palinet.

In addition, an initiative to create a state-wide virtual library has also recently begun. Using a model such as the Galileo virtual library in Georgia (among several such state models), Rutgers libraries would be a partner in a virtual state network for access to other library collections, shared electronic resources, interlibrary lending, and the like. A proposal to establish the Virtual Academic Library Environment (VALE), under the aegis of NJIN, the New Jersey Intercampus Network, is being developed. Through the creative use of technology, collaborative planning, and leverage of funds, New Jersey academic libraries can connect their catalogs using Z39.50 interconnectivity, jointly purchase electronic databases, and scan and transmit print resources at Ariel workstations. They can link to the network for access to K-12 and public libraries. It is hoped that \$5 million from the \$55 million technology funds for higher education will jump start the initiative and demonstrate the importance of state funding in this critical area. Through shared planning and collective purchasing, each institution can achieve more cooperatively than it can on its own. This is an important strategic direction with the potential to provide expanded information access for the Rutgers community.

Assessment Measures

Most major libraries use data supplied by the Association of Research Libraries (ARL) to compare their standings with peer institutions. Collection measures, especially in an electronic information environment, are problematic on some levels. ARL realizes that in a changing information environment new and enhanced measures are required, so that electronic resources and information access as well as ownership

can be factored effectively into their rankings. Other measures in addition to quantity are needed to demonstrate library effectiveness in meeting the information needs of their clientele. These measures should include how information is accessed and used—"just-in-time" access as well as "just-in-case." The libraries now use a variety of ways to measure effectiveness. These include informal assessments made by library liaisons to the various departments whose responsibilities include the development of collections to meet programmatic needs. User surveys are conducted on an irregular basis by the libraries and on a regular basis by some campus administrations. While these surveys frequently focus on library services, some questions specifically address collections issues. Periodical-use studies are conducted regularly at the Douglass Library and the Library of Science and Medicine, which is completing its third journal-use study since 1991. Focus-group discussions with faculty have occurred on all campuses from time to time, and the new LIS will provide better data on collections growth and usage that can be integrated into resource planning.

The libraries participate in special surveys conducted by the RLG and the ARL that can be used in benchmarking. For example, the libraries participated recently in an interlibrary loan survey conducted among ARL members to compare costs of ILL transactions. The libraries have also conducted periodic surveys of ILL turnaround time, MDS turnaround time, and recalled-book turnaround time. At a time of tremendous change and severely increasing costs, it is more imperative than ever that the libraries engage the university community in discussions regarding the kinds of information resources it wishes to have available in order to support the university's aspirations to be a premier research institution among its AAU peers. In addition, assessment measures of library effectiveness need to become a more formalized process.

INFORMATION SERVICES

Rutgers libraries have a strong commitment to service. More than 3 million users frequent the libraries each year, and the success of our service mission is recognized by high user satisfaction reported in numerous student and other user surveys conducted by the libraries on an irregular basis and regularly by university offices on some campuses. Reference/information assistance, available in all libraries in person or electronically during nearly all hours that the libraries are open, responds to more than 500,000 queries per year. Library home pages and numerous subject pages provide supplemental online information assistance.

Statistics for all library services remain high despite budget reductions. There were, for instance, over 69,100 intralibrary (Materials Delivery Service) loan transactions among the campuses in fiscal year 1995–96, representing an increase of 96.4% when compared to fiscal year 1988–89. This is an indication not only of the success of this service, but of its necessity due to the reduced duplication of resources among the campuses. Other services which continue to grow include reference service, user education programs, and building use. (See *RUL Annual Report*.) Interlibrary (ILL) borrowing has fluctuated moderately, but remains high. ILL requests to Rutgers from other libraries have declined. This may be a result of serials cancellations, the lack of a complete retrospective conversion of the Rutgers holdings, the decline in the acquisitions budget, or a reliance by others on commercial document delivery or full-text electronic databases. Mediated database searching has also declined, due primarily to the number of databases now directly available to users.

The Rutgers libraries participate actively in service outreach to the state. The libraries have a contract with the State Library to provide interlibrary loans to network member libraries. The state grant-funded

Citation/Location Center serves as a resource for the verification of citations to information resources and the location of these resources for interlibrary borrowing. In addition, reciprocal onsite borrowing privileges are granted to faculty of the two- and four-year public colleges and universities. The Robeson Library has a contract with the South Jersey Regional Library Network (SJRLN) to provide mediated database searching for members.

Numerous programs with local high schools have begun in the last few years to introduce teachers to new electronic information resources or in the creation of new instructional tools. For example, Alexander and special collections librarians are working with high school teachers in Hunterdon county to create a Web site for the study of American history. Teachers and librarians are collaborating on the digitizing of primary source materials from our special collections, and librarians are instructing teachers in how to create the Web site, which the libraries are maintaining. Librarians in New Brunswick are facilitating information literacy for teachers and students at the professional development school in New Brunswick, and librarians on the Newark campus are doing similar work with Newark “magnet” high schools. The Alexander Library regularly hosts the Model UN program with regional high school students and their teachers. The Douglass Library provides instructional sessions and assistance for ninth graders who participate in the Douglass Program for Women in Science held every summer. In fiscal 1996–97 the libraries provided special programs of instruction for more than 1,100 students and teachers in the K–12 population in New Jersey.

In the context of new demands from users, primarily as a result of information technology, the Rutgers libraries face fundamental challenges in the way they conceive and deliver services to clients. Information technology has required the redesign of positions and the recruitment of staff and librarians with new skills. As specialized resources are now acquired by the libraries, librarians who can organize and manipulate electronic information, such as social science data, or who are familiar with geographical and spatial data and other media, are becoming an essential part of the library faculty. In addition, librarians who have a combination of disciplinary expertise and technology skills are being asked for advice and support in the creation of new curricular materials. They are also involved as partners in the creation of new digital resources, such as the New Jersey state-funded ecopolicy project to design an online directory of information resources, and then to create online links to the full text of the resources themselves. The libraries have also been asked to play a role in the preservation, presentation, and servicing of databases created by university units, such as the Eagleton poll, and to make them more broadly accessible.

Technology, escalating service demands, and new services have required the libraries to scrutinize organizational structures for effective service delivery. Through strategic planning and a reorganization process, the libraries have concentrated on ways in which service can be improved and existing resources maximized. As part of the current New Brunswick library reorganization, the libraries will reengineer (rather than just streamline) service functions in such a way as to effect, among other things, some fundamental changes in how services are effectively delivered on the New Brunswick campus. Among these are decentralizing interlibrary loan, creating electronic reserve rooms, investigating patron-initiated services, and creating service teams across all New Brunswick libraries to maximize flexibility among all personnel and to reduce administrative redundancies. This reorganization process is the result of a report issued by the libraries’ task force on New Brunswick libraries, charged by the university librarian in September 1995 to examine how collections and services were deployed across the New Brunswick libraries. The reorganization process, combined with the new integrated library system, should facilitate workflow efficiencies in all areas, but especially in technical service operations. This should result in the

redeployment of resources to direct user services. It will also allow all personnel on the New Brunswick campus to focus resources across the campus as emerging needs and new service programs are identified. A new organizational structure for New Brunswick libraries is now in process of implementation. Recommendations for changes to locations where services are delivered and where print collections reside will result from consultation with the university community through the long-range planning process.

USER EDUCATION/INFORMATION LITERACY

The availability of network technology and electronic information resources has made ongoing skills development in the effective use of these resources a necessity for users as well as library staff. While more material has become available directly to users through the Web, its lack of organization and the unknown quality of information found therein have made information literacy instruction more necessary than ever before. The libraries have responded to this need with a variety of instructional modalities. In 1991–92, a pilot project for the integration of information literacy into the undergraduate curriculum was conducted in several sections of the Writing 102 classes on the New Brunswick campuses. The Library of Science and Medicine librarians also developed a series of workshops on Internet resources. In 1990 they received an award for excellence from Dialog Information Services for the innovative integration of library instruction into the physical chemistry upper undergraduate curriculum. In 1992–93, librarians at Kilmer Library integrated information literacy into their instruction programs.

In 1993–94, the libraries' electronic resources committee developed a program of instructional classes (some hands-on) for using electronic resources, such as Eureka, UnCover and the CitaDel databases. These classes were offered on all campuses at a variety of times and were available to the entire Rutgers community. The committee continues to provide these courses in response to the informational needs of students, staff, and faculty. Each semester these workshops are updated to include the latest information on changes on Rutgers' INFO and the Internet. Classes are focused primarily on resources provided directly by the libraries. Special subject classes now offered focus on global scholarly resources available on the Internet. The goals of these classes are to provide members of the Rutgers community with the ability to locate, evaluate, analyze, and use an extensive medley of information from culturally diverse sources worldwide. During fiscal year 1995–96, 798 library classes and 15,000 students were taught by librarians in computer classrooms in all the libraries. As for the libraries' in-house training, 22 programs on topics related to information technology were offered to librarians and staff to increase their skills.

The libraries have also received several Dialogues grants through the Office of the Vice President for Undergraduate Education and through the campus Teaching Excellence Centers to provide online tutorials for information literacy and to develop specific programs in collaboration with teaching faculty. In addition, New Brunswick librarians have been asked by the undergraduate colleges to design and offer a credit course on research methodology for all honors students beginning fall 1997. The Dana Library will be participating in an information literacy component for the new honors college on the Newark campus. The libraries will continue to take an active role in promoting information literacy and helping users gain the important information skills required by our academic programs and for lifelong learning.

The libraries' instructional programs have been greatly enhanced in the last several years by a classroom infrastructure which now accommodates the needs of the rapidly changing technological environment. Computers and electronic display projection panels allow librarians to conduct real-time classroom demonstrations of library resources on the university network. This same equipment is used to offer training and demonstrations to other staff and librarians. The first hands-on electronic classroom was

installed in the Library of Science and Medicine as one of four sites chosen nationally for the Online Teaching Partnership Program of the Chemical Abstracts Service. Today each of the major libraries has an electronic classroom with direct network access, thus providing users with hands-on training. Of particular note is the Scholarly Communication Center (SCC), located in Alexander Library on the College Avenue Campus, which opened in May 1997. The SCC is equipped with two adjacent 25-workstation computer classrooms connected to the university network to be used for hands-on instruction in the use of electronic information resources. One of the classrooms has distance-education capabilities. A videoconferencing auditorium accommodates approximately 100 users. The instructor's podium is modeled after those in "smart classrooms" on all campuses, but the technology infrastructure offers more functionality, including distance education. The SCC's humanities and social science data center provides access to full-text humanities databases, geographical information systems, and social science data. Three seminar/conference rooms and study space can be used for multiple purposes, and a project room for five users provides an environment where electronic research and instructional projects can be developed in consultation with subject specialist librarians. Staff from the Center for Electronic Texts in the Humanities (CETH) are located within the SCC to enhance the library's capabilities to support humanities computing endeavors. The SCC is already attracting visiting librarian interns from around the world.

The recently opened Stephen and Lucy Chang Science Library on the Cook campus was designed with a robust electronic infrastructure and equipped and staffed for creative instructional initiatives. More than 50 workstations, a wired seminar room, servers, a scanner, a high-level laptop, and appropriate software are available to the librarian and computing professionals for instructional activities.

The libraries' media services have also taken on an expanded role as the campus has created "smart classrooms" for faculty to teach with technology. Media Services has historically collected audio-visual resources, such as films and video, that faculty require for classroom instruction. Media staff deliver both collections and equipment to classrooms on all campuses in New Brunswick and provide media information resources needed on other campuses. As of fiscal 1996-97, the media services section is now teaching faculty on the New Brunswick campus how to operate equipment in these "smart classrooms," delivering specialized media resources, responding to requests for assistance in the use and operation of the equipment, and maintaining and servicing the equipment. In cooperation with the university's Office of Television and Radio, Media Services produced a video demonstrating how to use the equipment in smart classrooms. The video can be used during an orientation session or borrowed by faculty who wish to review procedures in advance of teaching in one of these rooms. When the "smart classrooms" became operational, additional resources to support them were provided by the university administration, and the libraries continue to assess the level of support required as demand for these classrooms increases.

In the first year of operation, more than 200 faculty participated in orientation sessions, and a faculty survey indicated enthusiasm for these new facilities. It is clear that this usage will increase and that additional support will be required for faculty who wish to create new, technology-enriched curriculum. The libraries are prepared to collaborate with other campus organizations, such as the Teaching Excellence Centers, RUCS, the Office of Television and Radio (OTR), and the Office of the Vice President for Continuous Education and Outreach, to design new collaborations or organizational models to support faculty development in this area. Several committees have already been established on the Newark and New Brunswick campuses to focus on how such collaboration would support faculty initiatives.

FACILITIES/SPACE

Major library building expansions and renovations completed on the Camden, Newark and New Brunswick campuses during the last five years have provided much-needed additional space for collections and users, as well as improved space for technology. Expansions and renovations occurred at the Dana Library, Newark campus, the Robeson Library in Camden, and the Alexander Library and Library of Science and Medicine in New Brunswick. In addition, a new, highly electronic capable science library, the Stephen and Lucy Chang Science Library, was constructed in Foran Hall on the Cook campus in New Brunswick, and a new art library was constructed on the College Avenue campus. Much of this work was supported through \$3.1 million in HEFT funds, the 1988 “jobs, education, and competitiveness” bond issue, and external fundraising. By the end of the 1995–96 academic year, the libraries had added approximately 125,000 net assignable square feet, an increase of about 25% since fiscal 1990–91 in total library space, along with 1,300 additional user seats. With the exception of an additional staff position and limited operating funds, the new library, space enhancements, increased building usage, and additional service functions have been supported through the judicious use of existing library resources.

While there has been needed expansion in space and many technology enhancements, there is still a need to provide additional and improved space for collections, information services, and library instruction in some libraries, especially the Library of Science and Medicine (LSM) and the science branch libraries. The population served by LSM has increased more than four times since its opening day 25 years ago. Even when Phase I of the current LSM expansion and renovation project is completed, many operations will remain in inadequate space, and there is insufficient space for new services designed to support digital information. The chemistry and physics libraries have a significant portion of their regularly used collections in the libraries’ remote storage facility due to lack of space, and they, along with the mathematical sciences library, have limited infrastructure capacity and space for networked workstations. The recent purchase of compact shelving for the physics library will provide temporary relief for expanding print collections, but it will not address facilities needs for the longer term.

The third floor of the Dana library, remaining unfinished following a building expansion/ renovation project, will provide necessary space for the creation of the Center for Instructional and Information Technologies (CIIT), a collaboration between the libraries and several academic programs on the Newark campus. In addition, Dana’s second floor reading areas and group study rooms need to be networked.

The Library Annex, with rapid access and requiring a minimum staff involvement, is economical compact storage space for low-use print materials from the libraries and for special collections and archives’ growing collections. When the annex was constructed, compact shelving was only erected in two-thirds of the building due to cost constraints. The existing shelving is already full, and environmental controls needed to preserve the materials are inadequate. Provision of additional compact shelving in the remaining one-third of the annex would ease current problems of overcrowding in all the science libraries and in special collections/archives. It will also assist university archives adequately to support the university’s records-management program by providing needed space to accommodate the storage of departmental records. It will also allow flexibility for the library system to adjust during a time of rapid and comprehensive change and growth while the balance between print and electronic resources is still emerging.

Expanded and reconfigured space appropriate for music/media in the Douglass Library was recommended in the last external review. The media equipment in the Douglass Library has not been

upgraded in more than 23 years, and new technologies for music composition and listening, as well as media to support dance, theater and the visual arts, need to be introduced to provide students with the enhanced educational experience they require. A task force on a multimedia resource center for the arts will be examining the needs for space and technology and recommending a plan that can be phased in as funds become available. This center would support recommendations in the *Strategic Plan* that focus on the creative arts, especially the development of a multimedia arts distribution network.

HUMAN RESOURCES

The university and the library system reap enormous benefits from the high quality of librarians and staff. The dedication, industry, and creativity of professional librarians and support staff enable the libraries, in face of recurring budget reductions, to continue to serve even more users and retain a high level of service. While the total library budget has increased slightly due to negotiated salary increases, budget reductions over the nine years beginning fiscal 1988–89 totaled over \$3.58 million, including the loss of 44.83 permanent staff/faculty lines.

Increased demands for information and information technology assistance to users at a time of declining human resources have been met in large measure by setting priorities on services and functions, reallocating staff, retraining, and staff development initiatives. The need to emphasize the teaching role of librarians in the area of electronic information, and the need to create new positions for systems support staff, and for librarians with expertise in multi-media, social sciences data, geographical/spatial data, and bioinformatics, are illustrations of shifts in resource allocations. Additionally, information technology has required a higher level of skills for all personnel. The requirement that units fund salary increases from their own resources for staff reclassifications, the absence of specific provision for merit increases for some staff, combined with union contracts/agreements on layoffs, work loads, and job assignments, give Rutgers libraries (and the university) less flexibility than some other libraries have in adjusting the work force to meet new operating and fiscal conditions. During fiscal 1996–97 the libraries have been reviewing the overall budgetary balance among the campuses, based on both objective and “soft” factors, so that in times of fiscal constraint each campus will have the resources required to provide effective services.

To meet changing needs in an increasingly electronic environment, human resources development programs are provided regularly to enhance the skills of library staff. During last year alone, 25 formal training events, including a number focused on technology skills, as well as six lunchtime seminars, were held in the libraries with a total of 465 participants. Numerous informal training programs are regularly held in all libraries. Diversity workshops designed to give staff an opportunity to develop ways to work more effectively with each other and with library users in a multicultural environment were also offered. Many of these were organized by the libraries’ advisory committee on diversity. Consultants from the ARL have assisted library personnel in developing group process and team skills as the libraries work through the New Brunswick reorganization process. Massive training programs are being planned as part of the implementation of the new LIS. There is, however, a need for extraordinary training beyond the expertise that the libraries can provide. Our growing complement of computing professionals and librarians with advanced technological competencies requires training opportunities that maintain and enhance their special skills.

DEVELOPMENT/PUBLICATIONS

In order to supplement regular budget allocations, the libraries have been pursuing fundraising efforts aggressively and with success. External funding to the libraries in fiscal 1995–96 totaled more than \$2.5 million, including contributions from annual giving, new and continuing grants, bequests, and in-kind gifts of books and other library materials. New and continuing grants together equaled \$1.77 million. External funding to the libraries during the past three years totaled more than \$6.8 million, including a National Endowment for the Humanities Challenge Grant of \$500,000 for the completion of the scholarly communications center in the Alexander Library.

Over the last 10 years the libraries have created a development/public relations/publications office of three full-time employees, using existing staff, and have created a fundraising committee within the Friends of the Libraries organization to focus attention on external library support. As the University Foundation organizes itself under new leadership and in preparation for a capital campaign, the position of “school development officer” for the libraries will be reviewed to focus on major gifts. Other responsibilities in the office will be realigned among the staff, so that the school development officer can pursue fundraising efforts full-time.

Library publications and communications are also being reviewed. Working with University Publications, the libraries have developed an identity package that will be used on library guides, brochures, publications and Web resources. The purpose of the identity package/logo is to upgrade the quality of library communication in all formats and to create a unified presentation.

END NOTE

In addition to the Appendices, the following documentation is also available for the Accreditation Team.

List of Major Administrative Computing Systems Serving Rutgers
A Transformation of Computer and Information Technology at Rutgers, 1992
Report on Administrative Systems Planning and Assessment Studies
Report of the Future Technology Task Force
Multi-Year Plan for Administrative Systems
The Rutgers Advantage, the Libraries’ Long-Range Plan and Supplement
Programs Merged, Suspended, or Discontinued since 1989
RUL Report, Spring 1997
Invitation to Summit Conference on the Libraries
RUL Annual Report, 1995/96
Report of the Task Force on New Brunswick Libraries and Transition Team Report

CONTEXT AND CURRENT STATUS: RUTGERS UNIVERSITY COMPUTER SERVICES

ORGANIZATION AND STRUCTURE

Rutgers University Computing Services (RUCS) is the university's centralized computing and telecommunications support organization which consists of three campus-based divisions on the Newark, Camden and New Brunswick campuses, as well as two university-wide divisions supporting administrative computing and telecommunications services (Appendix 5). The 220-member computing services staff collectively provide support for voice and data networking services, centralized batch and timesharing computing platforms, administrative applications software, and instructional computing resources in support of Rutgers' threefold mission of instruction, research, and public service. The executive director of computing services reports to the vice president for institutional research and planning and is a member of the university's Administrative Council (a group including the vice presidents, provosts, and deans) and the University Senate. The vice president for institutional research and planning reports to the president and is a member of the President's Cabinet.

Campus-based computing services divisions each maintain centralized data centers which provide general-purpose academic computing systems and software support on the Camden, Newark and New Brunswick campuses as well as operating and maintaining student computing labs. The administrative computing division maintains a centralized mainframe data center that provides and supports the primary administrative applications for supporting the core business functions of the university. The telecommunication division supports university-wide voice and data networking connectivity throughout Rutgers.

The Newark and Camden provosts have longstanding advisory committee structures that work closely with respective RUCS divisions in the planning for resources and services to meet campus needs and requirements. All three campuses have computing advisory committees that work in collaboration with RUCS and the academic leadership to allocate student computing fee revenues for public access labs as well as departmental initiatives. Given recent changes in the academic structure within the New Brunswick campus community, there is currently a need to establish an effective advisory committee structure for computing that appropriately represents the academic structure within the New Brunswick community. Additionally, there is currently a need to reestablish a university-wide policy-level committee to review the status of computing and information technology issues on an ongoing basis and to formalize policy and resource recommendations to the university administration.

SERVICE AND SUPPORT MODEL

The historic mission, role and function of computing services as a university-wide support organization changed with the widespread proliferation of distributed desktop computing, as well as the rapid growth, expansion and development of the university's data network over the last decade. While significant

funding resources were allocated to expand the network infrastructure, staffing resources necessary to plan, design, install and support this priority infrastructure predominately came from reallocated resources within the computing services organization, resulting in decreasing levels of support in traditional service areas.

With the tremendous migration from centralized to distributed computing environments, the support requirements at Rutgers changed from the passive support of a handful of mainframe applications serving a few, to myriad new dynamic applications and systems distributed across desktops on local area networks throughout the entire university community. These trends placed great demands and stresses on outdated centralized organizational structures and support models. Increasing levels of dissatisfaction within departmental communities escalated. They have been particularly evident on the Newark and New Brunswick campuses, and have led many departments to reallocate existing staffing and budget resources to provide local computing support to meet the increasing departmental requirements in this area. The search for organizational alternatives led to an evaluation of support models at peer institutions also experiencing the shift from centralized to distributed modes of computing. A support model successfully implemented at other institutions to improve levels of distributed support involves developing an organizational structure which combines features of centralized and departmental computing. The essential feature of this model involves the establishment of an effective working partnership between the central computing organization and local departmental support providers. In this model, the central computing organization is responsible for providing the core group of technologies, standards, and services, and local support providers are responsible for basic levels of primary support to departmental users and for managing the interface to the services and specialists within the central computing organization.

Primary support consists of answering user questions directly to the departmental users. This contrasts with secondary or expert support in which a group of staff provides information resources, tools, deeper levels of expertise, and backup for those who provide the front-line, primary response. Historically, when users were fewer and more homogenous, centralized computing organizations provided most primary support, often employing expert consultants and programmers. As the population of users has changed in a distributed environment, this practice has become both ineffective and inefficient. It is ineffective because no single consultant can possibly know all the answers that the wide spectrum of users requires. As the number and range of questions increase, it also becomes inefficient to use highly skilled experts to provide primary consultation. A more effective model provides departmental staff on the front lines who are trained in diagnosis—more like primary-care physicians than specialists. A single pool of staff will be less effective at answering front-line questions for a heterogeneous population of thousands of users than the same number of staff divided among the users in smaller sets, with the opportunity to learn the capabilities and needs of their individual subsets of customers.²

A pilot project is currently under way on the Livingston campus to reshape distributed support services. The Rutgers “computer support model” is based on a model developed at Indiana University to improve distributed departmental support. The model calls for the hiring of departmental unit computing specialists (UCS) who will act as the first points of contact for all departmental computing needs. The departmental UCS positions are funded 100% the first year from central university resources, with a gradual transition to

² McClure, P.A., Smith, J.W., and T.D. “The Crisis in Information Technology Support: Has Our Current Model Reached Its Limit?” Boulder, CO: CAUSE, 1997.

the departments phased over a three- to four-year period. By reporting jointly to the department and RUCS, the UCS will be closely aligned with the disciplinary needs and requirements of departmental faculty, but will have ready access to levels of technical expertise within the divisions of RUCS. The support model calls for the commitment of extensive training and development of departmental UCS staff to provide them with the skills and knowledge needed to become less reliant on the central computing organization and better able to provide local support to departmental users. In this tiered, hierarchical support model, problems flow from individual users to departmental UCS. If the UCS cannot resolve a problem, it is referred to a RUCS pilot implementation team member for resolution. If a team member is unable to solve the problem, it is escalated to the third tier, the central divisions within RUCS. Based on experience with the pilot over the coming year, the model will be refined and expanded to other Rutgers campuses.

Experience with the model to date indicates that additional organizational restructuring within the central computing organization is necessary to create a model that will provide a sufficient level of decentralization while maintaining a uniform fabric upon which an integrated environment can be supported. Several approaches that are under discussion and some in stages of experimentation include: (1) establishing a specialized group within the central organization whose clients are departmental support personnel; (2) in collaboration with the libraries, creating discipline-focused, physically dispersed technology centers, such as Dartmouth recently established with its business, science and humanities centers; (3) establishing a free-standing campus department to support and coordinate departmental support personnel; (4) building expert information databases and online training and question answering systems for use by departmental support providers; (5) providing incentives for departmental support providers to participate in the educational and integrative activities made available. These might include formal certification, pay supplements, equipment, or software. These and other approaches need to be more actively explored with a sufficient level of priority and institutional dialog and support.

NETWORKING INFRASTRUCTURE

As one of the country's largest universities, Rutgers comprises some 750 buildings on more than 6,000 acres in three primary physical locations (New Brunswick/Piscataway, Newark, Camden) spanning 90 miles. The physical realities of Rutgers' enormous size and obvious geographic complexities are further compounded by the escalating communications service needs of some 48,000 students (14,000 living in university housing), 2,500 faculty, and significant numbers of administrators.

Rutgers was among the earliest pioneers in pre-Internet data networking activities through participation by the computer science department in the ARPANET in the early 1970s. In the mid-1980s Rutgers joined with Princeton, Harvard, Yale, and other organizations including the State of New Jersey Commission on Science and Technology in establishing the John von Neumann National Supercomputer Center (JvNC) in New Jersey, including the deployment of the nation's first wide-area T1-based backbone network. Concurrently, Rutgers built its first Ethernet-based intranet serving 13 buildings on the Busch campus (Buschnet). Following the initial success of Buschnet, Rutgers embarked on a long-term plan in 1990 to build a unified data communications network for all academic, administrative, and research needs based on adherence to national standards. Through a variety of funding sources, Rutgers has incrementally built the Rutgers University Network (RUNet), now valued at \$20 million.

Although incomplete, RUNet is already one of the largest higher education networks in the United States. With expansion occurring daily, major RUNet parameters include:

- 20,000 active host devices, including 650 IP-only dial-up ports
- 600 IP subnets, 434 Novell LANs, and 336 Appletalk zones
- 155 interconnected buildings across all campuses
- 40 miles of Rutgers-owned fiber optic interbuilding backbone cable
- 40,000 active network users
- 200 Cisco network routers
- 3 Cisco Lightstream 1010 ATM switches

Reflecting the complex geography and size of Rutgers, RUNet's hierarchical inter-campus fiber backbone is not yet fully contiguous, requiring that interconnections be provided through leased-line services. The bulk of the backbone consists of 10 base FL switched Ethernet with 20 leased T1's, one leased 10 Mbps SMDS line, one leased 155 Mbps OC3 line, and three 650 Mbps OC-12 ATM direct fiber links for inter-campus connectivity and redundancy. Even though the RUNet architecture is currently bandwidth-constrained, traffic has historically increased exponentially by nearly 100% each year.

While there has been steady and dramatic growth of RUNet, it remains incomplete. Only 50% of Rutgers faculty and staff and less than 31% of dormitory students have dedicated network access from their desktops today. In addition to the urgent need to complete the data network, much of the existing networking infrastructure, both wiring and electronics, needs to be upgraded since it was based on first-generation technologies now nearly obsolete.

RUNET 2000

Recognizing the need to upgrade and expand the network infrastructure, the university embarked upon a major planning effort for RUNet 2000, a comprehensive and advanced communications infrastructure designed to meet the institution's needs for voice, data, and video, and to take Rutgers students, faculty, and staff into the next century. While the goals and vision, as well as the costs, for this plan are enormous, it is essential if Rutgers is to succeed in providing an information technology infrastructure capable of meeting the institutional objectives outlined during the strategic planning process. A formal request for proposal (RFP) for the RUNet 2000 initiative was issued in December 1996, calling for formal vendor responses in August 1997. Following an extensive evaluation process involving various committee structures, recommendations to the university administration were projected to occur in November 1997.

The growing recognition of the importance of information systems and technology has led to widespread support for the RUNet 2000 program. In addition to providing high-speed access to the fiber optic backbone envisioned for completion within a three- to five-year timeframe, the network will also provide the vehicle through which information can be distributed in support of research efforts both within and outside the university. The importance of the network, its linkage to the information resources of the library system, and, ultimately, its importance in extending the reach of the institution to the citizens of the state of New Jersey should not be underestimated. The need for increased network bandwidth and information technology resources is critical to maintaining a competitive advantage in an information-age economy.

INTERNET II

In response to the current congested state and limitations of the commercial Internet, approximately 100 universities, including Rutgers, have joined together with a number of federal agencies and leading computer and telecommunication companies to accelerate the next generation of Internet technology. The project is focused on the development of a new family of advanced applications to meet emerging academic requirements in research, teaching, and learning, and will address major challenges of the next generation of university networks. Those challenges include: the creation and maintenance of a leading-edge network capability of the national research community; network developments that enable a new generation of applications that fully exploit the capabilities for broadband networks (i.e., media integration, interactivity, differentiated quality of service, and real-time collaboration); and the transfer of new network services and applications to all levels of educational use and to the broader Internet community. The network will transmit data more than 10–100 times faster than today’s Internet.

The Internet II infrastructure will be made up of extremely high-speed regional networks with high-speed points of interconnection known as “gigapops” (which stands for “gigabit capacity points of presence”). Rutgers is currently collaborating with the University of Pennsylvania, Princeton University, Lehigh and the University of Delaware on a regional gigapop named Mid-Atlantic GigaPop for Internet II (MAGPI). Rutgers has recently received a two-year grant from the National Science Foundation’s meritorious applications high-speed connections program for a connection to the vBNS backbone (very high-speed backbone network system). This national network infrastructure currently interconnects the National Supercomputing Centers, and will comprise the initial backbone, which links or ties together “gigapops” for Internet II institutional members.

RECENT PROGRESS TOWARD STRATEGIC GOALS

Despite fiscal deficits and constraints facing the institution, gradual and incremental progress has been made toward meeting many of the strategic goals of the visionary CCIP committee report. Of the recommended sources of funding, those that have contributed most to the attainment of the objectives of the report have been: the assessment of student computing fees; the use of state appropriations from the Equipment Leasing Funds (ELF) and the Higher Education Facilities Trust Fund (HEFT) programs; the substantial leveraging of available resources; and the reallocation of existing resources within RUCS, as well as provostial, decanal, and departmental resources. Over the past several years there has been a notable increase in the overall recognition of the significance and priority of computing and information technology in meeting the academic and administrative missions of the institution. There have also been substantial leveraging, partnering, and reallocations of budget and staffing resources at all levels of the institution. Collectively, in the last four years substantial progress and incremental improvements have been made university-wide to advance many of the goals and objectives outlined in the CCIP committee’s report.

ELF supported the development of many large computing and networking initiatives. These included the replacement of aging central academic mainframe computer systems (IBM 3081 and VAX clusters) serving many of the research and large-scale data analytic needs of the academic community. These central resources were replaced with newer generation technology from SUN Microsystems providing significantly improved computational performance (by an order of magnitude) and greatly expanded storage capacities to better serve the needs of the university community on all campuses. These clusters of

systems operating under the UNIX system created the Research Computing Initiative (RCI) which provides access to programming languages, statistical and simulation packages, and now maintains many faculty and staff email accounts and Web sites. ELF funding was also utilized to extend the fiber optic network backbone to the Livingston and College Avenue campuses in New Brunswick, and to complete dormitory network wiring on the Camden and Newark campuses.

SUPPORT FOR INSTRUCTIONAL APPLICATIONS

Three major initiatives in the area of instructional technology have had a significant and positive impact on teaching and learning at Rutgers: the implementation and use of funds from the Instructional Computing Initiative (ICI), expenditures on technology supported by ELF, and the development of “smart classrooms” using funds from HEFT.

In 1993, the university implemented a student computing fee to fund the development and maintenance of adequate computer facilities as part of the partnership for computing as recommended by the report of CCIP. Full-time students are assessed a fee of \$50 per term, or \$100 per academic year, and part-time students are assessed a fee proportional to the number of credit hours for which they have enrolled. This fee generates approximately \$4 million per year, which has been used to create new computing facilities for students, to provide each student with an email account that is maintained throughout their relationship with the university, and to fund departmental projects to improve the instructional computing environment.

For example, funds from the student computer fee were used to create, operate and maintain numerous student microcomputer labs on all campuses of the university. These labs or hubs contain multimedia computers for general student use, including email, word processing, graphics, spreadsheets, Web browsers and search engines, statistical and research applications, and networked classrooms in which faculty can conduct classes and staff can provide training sessions. All labs include high speed connections to the university network infrastructure. The fee provides funding for dial-up access and university-wide software site-licensing, and also supports the acquisition of electronic databases which the libraries have made available on the campus network; it has also funded discipline-specific departmental computing initiatives.

The most significant changes, campus-wide, have been the creation of email accounts for all students, faculty and staff. Faculty now have the opportunity to communicate with their students electronically, improving the efficiency of communications. Faculty now use list servers, news groups, and Web pages to communicate with their students, provide course materials, even conduct discussion groups online. Though we are far from providing networked facilities for all faculty and students, we have come a long way, and the progress we have made is affecting the way we teach, and the way Rutgers students learn.

Expenditures from the student fee have had a dramatic impact on the availability of computers for students over the last three years. In 1993, before the fee initiative was instituted, the university-wide ratio of computers to students was 1:200; in 1997 this ratio improved to 1:33. Student email accounts since the implementation of the student fee in September 1993 increased from 2,500 to 45,000 by September 1996.

COMPUTING IN THE CURRICULUM

As the quality and availability of high technology computing resources grew, an increasing number of faculty made adjustments to their courses to integrate computing and information technology and to make use of the new resource facilities. Campus computing advisory committees on the Newark, Camden, and New Brunswick campuses have formalized faculty grant award programs using student fee revenues to foster the integration of computing into the curriculum. These incentives supporting faculty development efforts have yielded productive discipline-specific initiatives in a wide variety of academic areas, including the departments of mathematics, engineering, history, music, language studies and social science research on the New Brunswick campus; the English, business, law, criminal justice, physics, chemistry, journalism and Faculty of Management programs in Newark; and the history, mathematics, nursing, biology, business and law programs on the Camden campus.

While these incentives have served to seed initial levels of integration of information technology into the curriculum, it is clear that additional progress and development are needed in this area. A priority commitment to a formal instructional support program for faculty and graduate students will be needed to address the requirements of the information age.

ELECTRONIC CLASSROOMS

HEFT afforded the opportunity to create an improved environment for instruction through a large number of construction and renovation projects. Of particular interest for instructional computing on the New Brunswick campus is the construction of the new Science and Engineering Resources Center (SERC II), which will house additional classrooms, a new 45-seat lecture hall, 18 renovated and redesigned classrooms and 10 lecture halls creating "smart classrooms." The New Brunswick HEFT Classroom Renovation Program Committee helped to plan and design the new "smart classrooms."

A fully equipped "smart classroom" has the following equipment: a fixed podium containing a touch-screen control panel for operating most of the equipment, a VCR with real-time counter, a laser disc/CD player, an audio cassette player/recorder, a high-resolution video/data projector with jacks for connection by Mac and WINTEL laptop computers, and a connection for Mac and WINTEL laptop computers into the university network. A 35-mm slide projector and an overhead projector are elsewhere in the room, and are not operated from the podium.

The large classrooms and the lecture halls also have a 16-mm film projector; the 10 "smart" lecture halls contain a document camera, or video visualizer. The construction phase of the HEFT Classroom Renovation Project was completed in one summer. The rooms were scheduled for nearly 300 separate courses during the fall of 1996. Two-thirds of the faculty teaching in the "smart classrooms" in the fall of 1996 attended an orientation to learn how to access the new equipment. By spring 1997, nearly all faculty teaching in the smart classrooms were trained in, and are using, at least some of the new equipment. These new classroom facilities have, for the first time, given the faculty access to any teaching technology they care to use. The faculty have responded by asking for assistance in learning how to use the equipment more effectively and for assistance in the development of curricular media and materials. The critical need for enhanced faculty development efforts and formalized support structures is evident on all three Rutgers campuses.

Electronic classroom projects and distance learning facilities containing multimedia projection equipment and networked computers have been introduced on the Newark and Camden campuses as well. The School of Business–Camden has constructed an electronic classroom where 33 Pentium computers are built into custom desks, and plans include adding distance learning technology to this room. In Newark, a distance learning classroom was installed in Ackerson Hall, and the Dana Library has an outstanding multimedia complex that can be used to view discs/video tapes/live TV/the Internet on a scheduled basis and will house a large video server for advanced distributed video applications.

DISTANCE EDUCATION

Many futurists suggest that workers in the information age will need to spend at least 20% of their time engaged in new learning. They have also estimated that by the year 2005, the average individual in the work force will need to accumulate every seven years the learning equivalent to 30 credits of instruction. It is anticipated that this level of learning will be needed for every member of the information age work force who wishes to remain competitive and productive.³ This could translate into the full-time enrollment of one-seventh of the workforce at any single point in time. As New Jersey's state university, Rutgers recognizes its obligation and responsibility to find a way of answering these ongoing educational needs without having its citizenry return to the walls of the institution. Planning initiatives focused on serving the changing needs of this new population of perpetual learners in the information age are needed if Rutgers is to compete successfully in this new learning marketplace.

With the newly created Office of the Vice President for Continuous Education and Outreach, the university will be moving aggressively into the area of distance education. Several facilities with the appropriate technical infrastructure have been constructed or retrofitted on all campuses, and more will be required. Equipment has been installed on the Camden, Newark, and New Brunswick campuses through a variety of funding sources. The nursing program and the Law School–Camden are already delivering courses on multiple campuses using these distance learning classrooms. The Scholarly Communication Center on the fourth floor of Alexander Library will also have the capability for distance education beginning in the spring of 1997. The school of Business–Camden is beginning a satellite program in Atlantic City and will use distance learning for some of the courses. Ongoing attention to the support and maintenance of these specialized facilities will be necessary.

A critical element in the planning for distance education courses will be the incorporation of the information resource component, so that enrolled students will have every opportunity for success in the courses. Many of the students taking these courses will reside in other states or at a significant distance away from a Rutgers library. Planning for how remote students will be provided with information content beyond the instructor's notes and information assistance, such as reference materials and interlibrary loans, will require involvement of the libraries in planning. Contemplated cooperative arrangements with other institutions for information access should also involve the libraries in planning, so that users will be provided with the necessary support and their information needs met as seamlessly as possible.

³ Norris, D.M. and Dolance, M.G. "Transforming Higher Education: A Vision for Learning in the 21st Century." Ann Arbor, MI: Society for College and University Planning, 1995.

CENTRALIZED RESEARCH COMPUTING RESOURCES

RUCS provides clusters of general-purpose timesharing/batch systems (operating under the UNIX system) on each of its major campuses as part of the research computing initiative. These systems have historically been oriented towards unfunded research needs and requirements, and generally provide support for large-data-set statistical analysis, programming language support, and moderately intensive numerical computation, as well as general purpose software applications, email and Web support for faculty and departments. Large-scale optical disk storage capacity houses machine-readable data files such as census, financial and social sciences research data (ICPSR). High-capacity disk storage is available to the research community on these centrally supported computing resources. Computing accounts with email access are available to all faculty and staff at Rutgers on these centrally supported system resources.

SUPPORT FOR HIGH-PERFORMANCE COMPUTING APPLICATIONS

To encourage the use of national high-performance computing facilities, Rutgers established and has provided annual funding since 1985 for a formal High Performance Computing Project (HPCP). The project receives advice and guidance from a committee composed of members from the departments of mechanical and aerospace engineering, physics, chemistry, neuroscience, and from RUCS. With four staff positions, the HPCP has provided supercomputing users with access to four Supercomputer Remote Access Centers (SRACs), all located on the New Brunswick campus in the College of Engineering, chemistry, physics, and RUCS. The SRACs provide full-service support, including: training courses on vectorization and parallelization of code and the use of the national supercomputer centers; liaison activities to these centers (including obtaining accounts and preparing proposals); local workstations for code development, data processing and manuscript preparation; and specialized software for data visualization, intrabuilding network installation, and systems software development. The university administration has recently provided funding from its SROA for a high-performance computing initiative on the Newark campus that will acquire an IBM SP2 parallel supercomputer to support computational biology and neuroscience. In 1995–96, Rutgers researchers obtained over 22,000 hours of supercomputing time at the national supercomputing centers. The equivalent market value of these acquired resources is \$22 million, and the cost of buying a computer capable of providing comparable computational capacity is \$10 million.

DEPARTMENTALLY MAINTAINED RESEARCH COMPUTING RESOURCES

Throughout Rutgers, a significant percentage of computing is provided and maintained at the departmental level and is customized to support both discipline-specific as well as general-purpose computing needs and requirements. Historically, the funding for these computing and staff resources has not been centrally provided, and has been maintained through internally reallocated resources and grant-funded initiatives. This trend evolved in the late 1980s as the costs for departmentally sized systems became practical, and centrally available systems were configured for general-purpose use rather than tailored to discipline-oriented departmental needs and requirements. Examples of departmental resources include clusters of SUN/SGI servers and high-performance workstations in disciplines such as mathematics, the sciences and engineering; DEC-VAX/SUN/Convex mini-supercomputers in chemistry and molecular biology and neuroscience; N-CUBE and IBM SP2 parallel computing architectures, as well as over 400 Novell servers supporting departmental Intel workstation platforms.

UNIVERSITY-WIDE SITE-LICENSED SOFTWARE

RUCS provides and maintains a variety of university-wide site licenses and reduced cost purchasing agreements for research, instructional and general-purpose use. These include licenses from Microsoft application software suites; statistical packages such as SPSS, SAS, IMSL, LISREL; Borland (all packages); MAPLE; PC-Xware; and SUN Microsystems language compilers.

SUPPORT FOR ADMINISTRATIVE APPLICATIONS

Like other institutions of Rutgers' size and complexity, many of the centralized administrative computing systems were designed and developed during the initial 20 years of the computer revolution. The technological limits of the period constrained the overall architecture and adaptability of these systems. Many of these systems, which are still in place today, are for the most part inflexible, with vertical structures and poor data integration across the range of functional application areas.

Several major assessment, evaluation, and planning efforts have occurred since 1991. To summarize broadly, these assessments have generally concluded that while Rutgers' administrative systems are extremely reliable and have served the university well, they are locked into outdated technology and have hindered the university's ability to move forward in strategic directions. These evaluations have recognized and acknowledged that the customer definition has changed significantly since the core application systems were originally designed, and that there is a critical need to provide widespread distributed access to a considerable body of university administrative data.

A Future Technology Task Force for administrative systems provided an assessment and evaluation of a variety of relational data base and client server technologies. The task force recommended the acquisition of an Oracle relational database software site license as the primary foundation for the migration of existing applications, as well as for the development of data warehousing and new application systems. They strongly noted that the lack of an adequate, university-wide supporting network infrastructure severely restricted the ability of the computing organization to implement client/server technology applications on a university-wide basis.

Another major conclusion resulting from an operational analysis of university administrative practices was that there exists significant complexity and diversity in the academic structure, as well as overly complex processes and rules which have severely limited the ability of the institution to select and implement off-the-shelf vendor administrative packages. This complexity problem is common to many of the large research public institutions. Although off-the-shelf administrative packages have been successfully implemented in many small-to-medium-size institutions, there have been difficulties representing the complexity associated with academic structures typically found in larger research public institutions.

In response to these studies and evaluations, there is currently a funded multi-year plan for Rutgers' administrative computing systems which leverages new functionality and service from existing systems through the use of Web-based and Oracle warehousing technology, while replacement plans are developed and implemented over multiple years. Through a combined leveraging and replacement strategy, Rutgers' core administrative systems will be migrated to new data and computing architectures that take advantage of current technology, streamline administrative activities, and provide the university community with improved information for planning and analysis.

The effectiveness of this general strategy has recently improved administrative efficiencies through the successful implementation of low-cost, high-value administrative system enhancements. These have dramatically reduced redundant data entry, and improved information access and systems integration. Highlights of such improvements include: (1) touchtone telephone registration and grade reporting; (2) online financial information access; (3) online working budget system; (4) integrated direct student-loan processing; (5) automated production of student refund checks and Summer Session term bills; (6) online cash registers; (7) relational database warehousing of human resource and student information; and (8) the creation of numerous Web interfaces to administrative data that have vastly improved administrative processes such as admissions, which now provides prospective students with the ability to complete admission application materials directly over the Web and provides a browser interface for interactively checking on the status of applications.

RECOMMENDATIONS

THE LIBRARIES

The university libraries provide the critical information infrastructure that supports all university initiatives for instruction and research. Rutgers' move into the top echelon of public AAU universities as targeted in the *University Strategic Plan* requires information resources that will sustain world-class faculty research, attract the best graduate students, and support undergraduate instruction through the creative use of information technology. While it is clear that the RUNet2000 and "smart classrooms" provide the enabling technical infrastructure, it is the information content itself—and the librarians and staff who select, acquire, organize, teach the use of, and provide the technical support for these resources—that will permit Rutgers to achieve the level of excellence to which it aspires. The university has invested heavily in the enabling infrastructure of the libraries over the last several years. This investment will permit flexibility in making choices between print and electronic resources, enable better user services, and provide reliable management data.

The information environment, however, is at a very volatile stage in its development. Technology has had a major impact, from the design and deployment of user services to the selection, acquisition, and provision of information resources. It is impossible to predict the future of scholarly communication, but new strategies need to be developed to ensure that the faculty and students benefit from the best use of information resources among the many choices available. These strategies must be flexible enough to change with the marketplace, and their development requires that the libraries work closely with the teaching and research faculty within the context of the *University Strategic Plan*.

Therefore we recommend that:

- The libraries begin immediately to update their long-range plan to remain current for the next three to five years. The plan should be developed in collaboration with the university community so that the changing nature of information resources can be discussed widely, and priorities for services and collections can be established.
- Longer-term strategies to fund collections resources in all formats be explored. These may include the participation in and/or development of consortia for pricing discounts, the

- dedication of a percentage of the instructional computing fees for electronic information resources, the development of endowments for collections, and reallocation from other university resources (for example, ICR from grants or from areas of lesser priority).
- While the campus-based library committees provide useful advice for local library planning, more effective means to gather regular advice on university-wide priorities for library services and information resources should be investigated, such as a system-wide advisory committee on the libraries.
 - The libraries continue to review organizational effectiveness and make changes that maximize the use of resources and provide effective user services for faculty and students, such as the ongoing reorganization of the New Brunswick libraries.
 - Because information literacy programs in the changing technology environment will continue to be important for student success and lifelong learning, the libraries continue to work with faculty to pursue more effective integration of information literacy skills in the curriculum.
 - The libraries continue to assess the need for additional and/or renovated space as technology influences space needs for user services and collection resources, and that they plan growth accordingly.

COMPUTING AND INFORMATION TECHNOLOGY

RUNet 2000

Completion of the RUNet communications infrastructure must continue to be a major institutional priority, essential to the attainment of the challenges facing Rutgers in the information age. While there is widespread institutional support and recognition of the priority nature of this critical infrastructure, the enormous costs associated with the scope of the initiative will pose significant funding challenges, given competing institutional needs, priorities and strategic objectives. The implementation of this underlying infrastructure is prerequisite and critical to the attainment of many of the strategic objectives of the university.

The scope of the RUNet 2000 initiative is focused on communications infrastructure including backbone fiber optic cabling, intrabuilding wiring topologies, as well as data and video electronics. In order effectively to meet the information systems needs of the university as outlined in the strategic planning process, new information systems technologies, servers, and large-scale storage warehouses will be needed to support the requirements of an information-rich research and academic environment. Thus, it is recommended that:

- Additional planning processes and task-force initiatives be established to assess information systems and technology resource needs and to provide institutional recommendations for acquisition.
- A university-wide advisory structure be established to provide ongoing advice concerning institutional policy planning related to strategic technology directions.

Distributed Support Structures

The exponential growth of distributed computing has created a support crisis at Rutgers as well as at other institutions. A decade ago, fewer than 20% of Rutgers' faculty, staff and students were active customers of technology services and support. Today, almost all of them are and they require effective support mechanisms. Creating such a synergistic working partnership between the central computing organization and departmentally based support providers is a critical feature of a support model currently under examination. It is therefore recommended that:

- Continued institutional support and a priority organizational commitment to this project be effected as essential for its deployment, refinement, and expansion to other campuses at Rutgers.

Space Needs

The enormous growth in support of technology initiatives university-wide has created the need for significant expansion in space for additional staff offices, network control and monitoring locations, additional training facilities and special purpose laboratories. It is recommended that:

- Priority attention be given to the provision of adequate space on each campus to accommodate the growth and expansion that has recently occurred as well as to accommodate additional growth likely to occur as a result of new technology initiatives.

Departmentally Maintained Research Computing Resources

Although a significant percentage of computing is provided and maintained at the departmental level, funding of equipment has predominately been provided through external grants, with little funding provided through direct allocation by the central administration. In recognition of the importance of departmental computing to the unique requirements of the disciplines, we recommend that:

- The university provide, on a competitive basis, some portion of the funding required to sustain and support departmental computing efforts and initiatives.

Administrative Computing

While the multiyear plan for administrative computing outlines near-term plans for leveraging systems and technologies, plans must be developed and funding identified for implementing replacement systems. These will support the administrative infrastructure including academic, research, and public service requirements for administrative data and processing. Simultaneously with such planning, the drivers of administrative complexity such as historical business processes, unique specialized treatments, and inconsistent or nonexistent policies need to be identified, reviewed and weighed in light of efficiency and university need. It is therefore recommended that:

- University-wide and interdepartmental strategies be developed for streamlining and reducing complexity in administrative processes.

- Attention be given to developing a university-wide data architecture for distributing and providing access to university information. This should be done in collaboration with the university community and administrative data custodians.
- Replacement plans for administrative computing should continue to be refined. The technology market is changing rapidly and the viability of off-the-shelf integrated vendor packages is growing.

DISTANCE EDUCATION

As the university expands its distance-education capabilities, effective means to provide support services for information access must be provided. Therefore we recommend that:

- The libraries, the Office of the Vice President for Continuous Education and Outreach, and RUCS collaborate on the development of plans for information services support for students enrolled in distance education courses.
- Intellectual property and copyright policies be articulated for the development and use of materials in the delivery of an electronic curriculum.

COLLABORATION

Given the changing role of information technology resources in supporting the academic enterprise, there is clearly the need for increased collaboration between technologists and librarians in the attempt to maximize resources, provide effective support mechanisms, and contribute to the creation of the digital library. Changes in traditional support roles and structures are already under way and increasing levels of cooperation and collaboration on joint initiatives need to be fostered and encouraged. We recommend that:

- Opportunities for collaboration be explored, including the following: joint staff appointments; internships; collaboration on the development of joint-user service-information center(s) and educational programs; increased collaboration in support of scholarly communications center(s), as well as support of digital library applications sponsored under the Internet II initiative.
- As various units of the university create/complie electronic data resources and wish to share them beyond their immediate unit, but do not have the resources required to do so (the Eagleton poll, for example) that the libraries and RUCS collaborate to archive, preserve, and provide access to these electronic resources created by the Rutgers community, thereby providing a valuable service to the broader scholarly community and contributing to the creation of the digital library.

INSTRUCTIONAL TECHNOLOGY SUPPORT

As the information technology infrastructure of the university continues to improve, the need for support to faculty and graduate students to incorporate technology into the curriculum is critical. A number of organizations within the university community have service missions and appropriate expertise to contribute to this type of support. These include the Teaching Excellence Centers, the libraries, the Center for Electronic Texts in the Humanities, Rutgers Computing Services, the Office of Television and Radio, and the Office of the Vice President for Continuous Education and Outreach. The role of each of these units on any campus or across the university vis-a-vis instructional-technology development support should be clarified, so that appropriate and effective support mechanisms can be developed. Therefore we recommend that:

- An instructional-technology support initiative be implemented for faculty and graduate students in the use of information/instructional technology drawing upon the expertise of existing service units; and that additional staffing resources required be identified, so that an effective infrastructure for support can be provided.

STAFFING

State higher education budget shortfalls over the last eight years have had an impact on staffing in both the libraries and computing services and directly affect services to users. While both units have made adjustments to these reductions to minimize the impact, information technology has placed escalating demands on both organizations. As these functions are critical to the current and future operations of the university we recommend that:

- There be an increase in staffing levels in both the libraries and computing services that address Rutgers' ability to maintain necessary infrastructure support services.
- Appropriate staffing resources be made available to support the massive network expansion that will be associated with the RUNet 2000 initiative.

APPENDIX 1
ORGANIZATION CHART
UNIVERSITY LIBRARIES

APPENDIX 2
AN INFORMATION STRATEGY
FOR RUTGERS UNIVERSITY LIBRARIES

APPENDIX 3
NETWORKED DATABASES AT
RUTGERS UNIVERSITY LIBRARIES

APPENDIX 4

**THE CURRENT STATE OF
LIBRARY COLLECTIONS AT RUTGERS
AND
FUTURE STRATEGIES AND OPTIONS**

APPENDIX 5
ORGANIZATION CHART
RUTGERS UNIVERSITY COMPUTING SERVICES