Abstract
The promise of the electronic age is one of making information accessible to people without time, place or format constraints. Today's technologies and applications pale in the face of the opportunities presented by tomorrow's high speed, commercial networks. Networks are restructuring our businesses and herald the inevitable transformation of higher education. This paper focuses on issues associated with the evolution of the way business works, drawing on influences of the restructuring of businesses on universities, and it suggests how remote access to university resources may transform the institution.
Transforming Our Organizations

Networks have changed the way business works. They have blurred the distinctions among suppliers, manufacturers, retailers, and distributors and closed the gap between the consumer and the company. Changing relationships are creating virtual companies where networks are an essential management resource. Whatever the business, the focus is on the customer connection. The customer-marketer dialog and interactive advertising over the Internet replaces the current mass-market advertising model with a one-to-one marketing paradigm aimed at achieving personalized service and flexibility that support excellent customer relations. [1]

Network communications capabilities have also changed the landscape of corporate research. Research teams are formed with the best scientists from different branches of the organization and often in collaboration with researchers from other companies—once considered competitors. The strategic use of global networks for collaboration is an important priority for American companies and sets the stage for shared discovery. Getting quality products from the lab to the market place in the shortest possible time and in the most cost effective manner is a major goal of corporate research. [2]

The success of businesses in streamlining their organizations and in using technology to become more responsive to a changing market-place has not gone unnoticed by institutions of higher education. Our cost-saving strategies are patterned after those of the corporate world and our long-range plans are peppered with such terms as downsizing, reengineering, total quality management, productivity, empowerment, outsourcing, and customers. Like the business environment, higher education strives to improve quality, contain costs, and increase access among its highest priorities. Restructuring higher education means reevaluating alternative delivery systems, curricula, organizational structures, technologies, and personnel. [3]

Downsizing and Restructuring

With declining sources of revenue and escalating costs, the price of a college education has outstripped many families' ability to pay. Universities and colleges have already begun downsizing their institutions, helped by early retirement programs, department mergers,
communication technologies, and powerful software programs that shifted some of the workload from staff to faculty, thus reducing the need for certain types of secretarial services. Secretaries who could search, retrieve and catalog electronic information as well as handle managerial tasks became important assets to the department, others found their jobs eliminated.

 Improvements in student administrative support services (admission processing, registration, financial aid, and billing) represent another area where transformation of business processes has led to better student services and reduced operating expenses. For example, when overall costs of college operations grew at a higher rate than inflation and revenues remained static, Babson College embarked on a major reengineering project. Its purpose, writes President William F. Glavin, is to reduce, streamline, and simplify the administrative operations of the institutions, freeing students, parents, employers, faculty, and staff from bureaucracy and paperwork so that they may devote more of their time and resources to learning and teaching. To this end, we envision a work place which focuses upon the delivery of high quality services to our customers through the efforts of cross-functional, self-directed teams, and responsive, easy-to-use, information systems, and technologies."

While administrative services have used technology and better business practices to help reduce costs, there remains the need to find a less expensive way to deliver education. Technology, it is suggested, holds the key to this dilemma with the possibility of reaching and retaining a wider audience. However, technology represents a significant capital investment and requires a transformation of governance, assessment, and relationships with students.

**Empowering Employees**

In a networked environment, every level of the organization has access to more information than it can possibly digest. This makes the traditional hierarchical approach to information, where those at the top control the information while those at lower levels have limited access, no longer applicable. Today, people at the lower levels have access to external information that brings
the competitive pressures facing higher education right to their desktops. In the business world, this result has led to a flatter organization with more opportunities to participate in the decision-making process. This trend has yet to appear in universities to any major extent, although there is evidence that electronic communication "reduces overall miscommunication, equalizing participation levels, weakens status systems, and emphasizes informational rather than normative influences." [5]

We need to pursue strategies that promote the successful practices of the Internet such as collaborative development of resources and services, direct participation in decision-making, and innovative ideas that spring from unexpected sources. [6] Information gaps among administrators, faculty, and staffs can be bridged if the electronic internal information-sharing structure also incorporates their insights. Frequent reviews of strategic plans are also important in that they keep in the forefront of our minds the future of the institution and our place in a market-based environment. Only a well-informed university community can recognize and respond to opportunities, unmet student needs, competitive information, and achieve the goals of a shared vision and mission for the campus. The right leadership can make it happen.

More than ever, students are everyone's concern. Their needs and objectives will influence the curriculum, the design of learning materials, and the delivery of instruction. If reengineering teaching and learning is about anything, it is about providing differentiated services to a diverse student body. [7] Information technologies make it possible to offer customized services with assistance from experts from different fields and in collaboration with other institutions and organizations.

**Administrative Response to Change**

Despite the fact that higher education has emulated business goals in administrative services and become more responsive to students' needs, colleges and universities have adopted instructional innovation very slowly. For example, one would expect that innovations designed to enhance instruction in large classes would be especially attractive to institutions with a high student-faculty ratio.
This is not the case, according to Siegfried, Getz, and Anderson [8] who found no "association between that ratio and any of the innovations aimed at teaching large classes more effectively, such as video projectors and wireless microphones." They reason that some colleges and universities are insulated from the competitive pressures that would force them to stay on the cutting edge in information technologies. For some institutions, differentiation in curriculum and proximity to the student's home town creates market power. But for those prestigious colleges and universities not driven to innovate more quickly, Siegfried et al. recommend that the governing boards need to explicitly encourage their institutions to be more progressive by identifying new practices to be adopted that the board can evaluate and then reward administrators for managing change successfully.

The resurgence of interest in undergraduate education on the part of university presidents offers some ground for optimism. The reality remains that faculty have not been promoted for infusing technology into the curriculum. Thus, faculty have generally shied away from the extensive time commitment required to become adept at using and managing new information technologies. The traditional criteria for promotion are still classroom teaching, research, and service with research generally given preeminence over the other two.

Administrators must work closely with faculty to find alternatives to the current instructional model and a means of controlling institutional expense and student costs. Technology, by itself, cannot overcome bureaucratic disincentives. Success in integrating technology into the teaching process depends on early engagement of faculty in the planning process where training, support services, and recognition for their work in instructional technology are a part of the strategic plan.

With current competitive forces and the new educational alternatives available to students, universities can no longer refuse to invest in technology; they can only determine rate of implementation. A teaching infrastructure—linking computer, video and telecommunications technologies with the home, institution, and workplace—must be in place for instructional technology innovations to thrive. A flexible learning environment that focuses on the learner will depend on an infrastructure to facilitate technology-mediated learning.
Many universities have linked their classrooms, offices, and residence halls. Some have also included the local community in their network, and most would like to be able to extend their campus resources to distance learners wherever they may be. The argument is not whether one delivery system for teaching and learning should replace another. Rather, faculty should have the technological capability and be encouraged to experiment with technologies in their pursuit of the best mix for learning without compromising quality, and the institution should focus on making education available year-round—thus, reducing the time required to get a degree. These issues—an interactive infrastructure, a reward system, and a strategy for managing change—are some of the pressing issues that presidents must confront as they make choices about how scarce moneys are to be spent.

**Collaboration and Distance Learning**

New opportunities precipitated by advances in communications have brought universities and telecommunications companies together. In spring 1995, New York University offered a 16-credit graduate program entirely through an interactive network. NYU's collaborator, NYNEX, New York's main telecommunications company, linked each student's home to an NYU computer-base of instructional videos and group-communications servers through an Integrated Services Digital Network of high-speed telephone lines. Using the NYNEX ISDN service, NYU teleprogram students access video lessons on demand and participate in online computer laboratories as if they were in on-campus labs. According to Richard P. Vigilante, director of the Information Technologies Institute and founder of the Virtual College, online instruction provides busy adult students with a far richer learning experience than they would traditionally receive by just attending their evening classes. [9] Success with this delivery system will encourage promotion and expansion of other NYU courses aimed at students who want alternatives to classroom attendance and education-on-demand.

In addition to creating course materials for local use, some institutions are developing resource materials with an eye to sharing them internationally. The World Wide Web Server for Virology at the Institute for Molecular Virology, University of Wisconsin-Madison, was designed to disseminate virology-related information to scientists, students, and the general public. Included
in the resources available are computer-generated images and animations of virus structures, topographical maps of virus surfaces, digitized electron micrographs, and much more. Not only is the server an important reference resource, but it can also be used as a forum for teaching.

Virologists are invited to participate in the bionet.virology USENET newsgroup and to share their course syllabi with new instructors. Being able to customized the virology server for use by their own students offers another exciting possibility. From the research perspective, it is simple to obtain structured data from a variety of sources and view animations of interactive visualizations of these data on their own computer. Researchers are encouraged to submit additional virus visualization to the virology server, thus, increasing its value to virologists throughout the world. "Ease of access to rendered structure data is expected to catalyze speculation and collaboration among virologist." [10] The uniqueness of this collection of resources is that it can serve both instructional and research purposes.

The "Making of America" is an ambitious collaborative project between Cornell University and the University of Michigan. Together, they are building a distributed digital library in the humanities—specifically 19th century U.S. history materials. Funded by the Mellon Foundation, the first phase of the project includes converting to digital image form 5,000 volumes from the holdings of the two library systems and making them available across the two campuses. As a part of the project, there are plans to conduct evaluation studies on user acceptance of digital surrogates and on the costs associated with the development. [11]

It is intended that this digital collection of books, articles, manuscripts, drawings, architectural blueprints, business records, maps, and other materials will include approximately 100,000 volumes in the next few years and will encompass a variety of disciplines bearing on the history of America. Project collaborators assume that "providing worldwide network access to such an electronically integrated collection of 19th century American history will open new opportunities for interdisciplinary research." [12] The project represents one of several "virtual" collections in specific fields which are being created and made available electronically, increasing the ability of students and faculty to share important historical resources.
Networks are the glue that hold collaborative projects together. They facilitate the cross-fertilization among disciplines and synergistic collaboration among the public and private sectors. Many of the projects currently underway are leading to the creation of significant teaching resources and research materials which can improve teaching and enhance research capabilities.

**Approaching a Virtual Community**

There is a shift away from schools as the central site for learning towards the home, businesses, libraries, museums, and other organizations. [13] Freeing students to learn at times and places of their own choosing requires new ways of thinking about the process of teaching and learning and the uses of university space and personnel. Distance learning presents a great opportunity to restructure educational methods to facilitate new delivery modes for a diverse population. However, many instructional television programs and Internet courses remain tied to traditional classroom and correspondence course metaphors, respectively. For the technology to succeed, it must have the underpinnings of an appropriate instructional model, and the faculty must have access to a full range of multimedia tools and support people to develop and implement new learning materials. Use of new technologies may likely be a participatory team effort bringing faculty, delivery personnel, and instructional designers together. [14]

Information technologies call for a new set of faculty-student relations. Faculty will move from lecturing to mentoring, giving more guidance to individual students and becoming active participants in the learning process, using a similar model to that of the graduate scientific research faculty and their students. In this teaching-learning interaction, students will shed passive note-taking for more immediate processing of information and problem solving. Classes will extend beyond the allotted time over the Internet. E-mail access to the faculty frees learners from the time and place constraints imposed by faculty office hours and gives students an opportunity to improve the quality and amount of communication with faculty. Students say that they form a closer relationship with their instructor and with other students through electronic mail and bulletin boards, that they get more timely and constructive feedback.
There is a definite sense of community that evolves and a gradual transformation from passive learning to more self-directed learning.

**Responding to Diversity and Distance Learners**

One important contribution that information technologies can make is in addressing different cognitive styles. Some people learn best by reading, others by seeing, listening, teaching their peers, working in groups or some combination of these modes. Only a small percentage of the population are strictly auditory learners, yet this has been the predominant delivery mode. Furthermore, traditional pedagogy focuses on only two of seven human intelligences identified by Gardner: the linguistic and logical-mathematical intelligences as reflected by intelligence test and other measures of ability.[15] (The other five intelligences are spatial, bodily-kinesthetic, musical, interpersonal intelligences, and intrapersonal intelligence.) Educational experiences that promote the various multiple intelligences and interlinkages need to be considered in the design of optimum electronic learning experiences.

Another important contribution would be the provision of just-in-time learning. The military, government, and industry have been successful in providing just-in-time training for problems that may arise on the job and must be solved before work can be continued on various projects. Expert systems help tank mechanics, power plant operators, income tax personnel, and a host of other workers learn on the job. Thinking about how people learn on the job is becoming an important research area. Designers are currently interpreting how people work and how the work gets done. This knowledge will be incorporated into tomorrow's powerful work systems and tools in an effort to support a productive business environment and have ramifications for higher education (see [16]).

Some faculty have also begun to apply simulations and smart tools as teaching-learning aids in their courses. Marie-Michèle Boulet [17] has developed an intelligent advisor system (Conceptual Database Modeling Advisor, CODAMA) for use in her two distance learning courses, "System Analysis" and "Design and Information Technology." The CODAMA, an adaptive system, assists distance learners in each of the several stages involved in database design. The system provides an on-demand
learning environment which erases the boundary between learning and doing for distance learners.

The Choices We Make

Positioning Ourselves in Light of New Competition

The cost-effectiveness of communication also means that institutions of higher education can expect new competition. Britain's Open University recently delivered its first course on a CD-ROM. At universities around the world, technology is toppling the ivory towers. Approximately 4,000 corporate engineers currently "earn advanced degrees at their workplace via satellite from the National Technological University, now one of the largest engineering schools in the nation." [18]

Rochester Institute of Technology (RIT) offers graduate and undergraduate degrees including health systems administration, management, environmental management, applied computing, telecommunications, software development and management to students in 16 states. RIT recently has enrolled 150 high school students in a pilot program. Courses are designed to use a blend of four technologies: videotapes, conference calls, computers, and print material. Some courses are also supported by other technologies, including picture phones, electronic blackboards, or audio cassette tapes.

Another virtual institution with impressive enrollments is Maryland's College of the Air which specializes in part-time education for military personnel in Europe and Asia, using computer-conferences and voice-mail to allow students to communicate with instructors and with each other. The College offers 10 telecourses per semester via the Maryland Center for Public Broadcasting to approximately 10,000 students.

Competing with colleges and universities is a private company, Jones International Ltd., which operates cable television companies and Mind Extension University. Mind Extension University offers certificate and graduate degree programs in education, business, and library science. These graduate programs are delivered over the Jones Education Networks and are sponsored in cooperation with Colorado State University, the University of Arizona, and the George Washington University. In fall 1996, Jones International Ltd. is scheduled to launch two new networks: a Health Network and a Language Network—both are considered to be principal markets for distance learning.
International University College, also a creation of Jones International Ltd., is a recent newcomer to the growing list of competitors. It offers a Masters Degree in Business Communication and is billed as a low-cost alternative to traditional courses in higher education. Instructional materials for this degree program will be produced on videotape, and faculty members will use the telephone and electronic mail to correspond with students. The audience will be international and attract people not served by traditional colleges.

Internet courses are also fast breaking ground with over 30 accredited universities offering more than 650 courses over the Internet in 1995. Many of these offerings use the Internet primarily for its communications facilities. Nova Southeastern University, for example, grants M.S. and Ed.D. degrees using online technologies for communication and for discussion of the curriculum. Students have immediate access to electronic mail, bulletin boards, and formal, real-time electronic classroom sessions. Another example is Britain's Open University which plans to offer several courses and programs over the next year using the Internet as the communications medium between students, their tutors, and the university administration. Degrees offered will be the Masters in Open and Distance Education and the postgraduate computing courses which lead to an M.Sc. in Computing. In contrast, the Indiana University East and several other college programs use the Internet exclusively, registering students and providing all learning materials (tutorials, exercises, texts, and guides), assignments, and tests online.

However, it is likely that most institutions will continue to support teaching with a mix of media—some blend of networking technology combined with satellite, cable television, and CD-ROM—at least until speedier connections make transmitting multimedia over networks the norm.

**Increasing the Value of Existing Resources**

The Internet has significantly changed the way business is being conducted in the United States and abroad from marketing and selling products to the development of new products with customer participation. It has revolutionized the way business communicates by enabling them to put on-line marketing literature, product documentation, catalogs, and discussions about the performance of a specific product at other sites. In essence, the Internet is the world's largest store, the
The Internet is already changing the relationship between faculty and students and enhancing and facilitating student learning. Al Filreis, University of Pennsylvania, speaks often about some of the benefits of teaching his course on Modern American Poetry online. The silent ones in class, he says, found their voices online. Further, in reading each others statements, students became more aware of details and the consequence of their arguments and spent serious amounts of time thinking about poetry. [19]

Capitalizing on students' enthusiasm for web assignments, Daniel Anderson, an instructor in the Computer Writing and Research Laboratory at the University of Texas at Austin, created a web service for his American literature class. The American Literature Survey Site features fiction by American authors, papers, student reviews, and transcriptions of class discussions. A message board was added to allow Internet users to comment on students' essays. As the web site developed, individuals outside of the class began to respond. University students were surprised and motivated by the interest and comments of the outsiders, who one day just appeared. Other classes soon joined, allowing multiple perspectives about texts to take shape. Professor Anderson says it is a pretty amazing, new way of teaching.

One of the remarkable things, he notes, is the increased life expectancy and "membership" of the class. "The resources that the students developed are being made use of more now than even when the course was in session. Most students are still on the site listserv and receive feedback from all over the country. The site is showing the possibilities for students to interact with and impact an audience on a large and possibly long term scale." [20]

Many activities that impact on student learning are now available on the Internet. The examples given above demonstrate the value of online faculty-student interaction and intense small group discussions on specific topics. It is worth mentioning that students no longer lose touch with home town contacts and friends who are attending other schools. To this list, they continually add new people for mentoring and advise, encouragement, sharing experiences, and help with assignments. Some of these activities were once the responsibility of individual faculty to manage and are
now available globally, 24 hours a day, 12 months a year from everyday people to experts in a particular field.

Up to now, faculty have typically spent very little time involved in what the literature cites is needed to assure quality: student-centeredness, attention to the teaching and learning process and gaining the feedback to assure educational effectiveness. However, when 25% of the freshman class drop out (most of whom leave for reasons other than lack of intellectual ability) and 55% do not graduate within four years, the institution needs to examine more closely its educational practices. The availability of the Internet, with its low-cost global communications, appropriateness for collaborative work, on-line software, and unique databases, gives us reasons to rethink the role of faculty and the use of technologies in order both to enhance student learning and reduce costs. In a networked society, we can expect that faculty will spend much more time locating or creating teaching materials and in organizing them into appropriate blocks of learning for a diverse student body. How will their restructured role change learning? One view is that:

...students will spend more time learning by themselves and with their peers and much more time engaged with powerful, interactive technologies, and will spend less actual time—but more creative, intensive, and focused time—with faculty members. Faculty, in turn, will work with greater numbers of students but "teach" much less [in the classroom]. [21]

Distance learning, as a supplement to existing university life, will play an increasingly larger role in providing greater opportunities for all learners and will have a profound effect on higher education as it blurs the lines between high school and college and degree programs and shifts society toward lifelong learning. [22] The possibility of taking distance learning courses at convenient times throughout the year will create enormous competition for students among higher education institutions. Since the full cost of an education will likely become the individual's responsibility, greater numbers of students will attend universities part-time and be highly motivated to shop around for the best solutions to their educational needs, whether they be in non-degree or degree programs held on- or off-campus.
If the Internet is to totally reshape education, it will have to move from the glitz of home pages to a conveyor of instructional content. Nevertheless, technology, in one form or another, will radically change the way society learns and provide some exciting resources for teaching and learning.


10. From an e-mail communication with Professor Max L. Nibert, Institute for Molecular Virology, University of Wisconsin-Madison, October 12, 1995.

11. From an e-mail communication with Anne R. Kenney, Associate Director of the Department of Preservation and Conservation, Cornell University, October 15, 1995.


19. From an e-mail communication with Al Filreis, Professor of English and Undergraduate Chair, University of Pennsylvania, October 4, 1995.

20. From an e-mail communication with Daniel Anderson, Assistant Director of the Computing Writing and Research Lab, The University of Texas at Austin, October 19, 1995.
