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ABSTRACT

Recent technological advances have imposed dramatic changes in all areas of the U.S. labor market. In particular, the continually increasing demands for technical training and retraining have created an increased demand for continuing education for engineers throughout their working lives. The National Technological University (NTU) represents one innovative method of meeting the lifelong learning needs of workers in a technical field such as engineering. Representing a merger of corporate and academic concerns, NTU broadcasts instruction nationwide via satellite. NTU was created in January 1984 to award accredited masters degrees in selected fields. The NTU academic programs feature approved courses of instruction offered by the 21 universities that have joined together to form the Association for Media-based Continuing Education for Engineers (AMCEE). NTU also provides research seminars in each discipline taught; operates a modern telecommunications delivery system for convenient, flexible on-site service; offers AMCEE noncredit short courses, seminars, and workshops to introduce newly advanced technology concepts to a broad range of technical professionals; and has established a sophisticated satellite network infrastructure between industry and the university communities. NTU has participated in a study to address the accreditation and state licensing issues raised by a nationwide instructional network such as AMCEE and has undertaken an intensive 3-year test of using computer communications to enhance student-teacher interaction. (MN)

High Technology and the Future of Education

Lionel Baldwin

Occasional Paper No. 122

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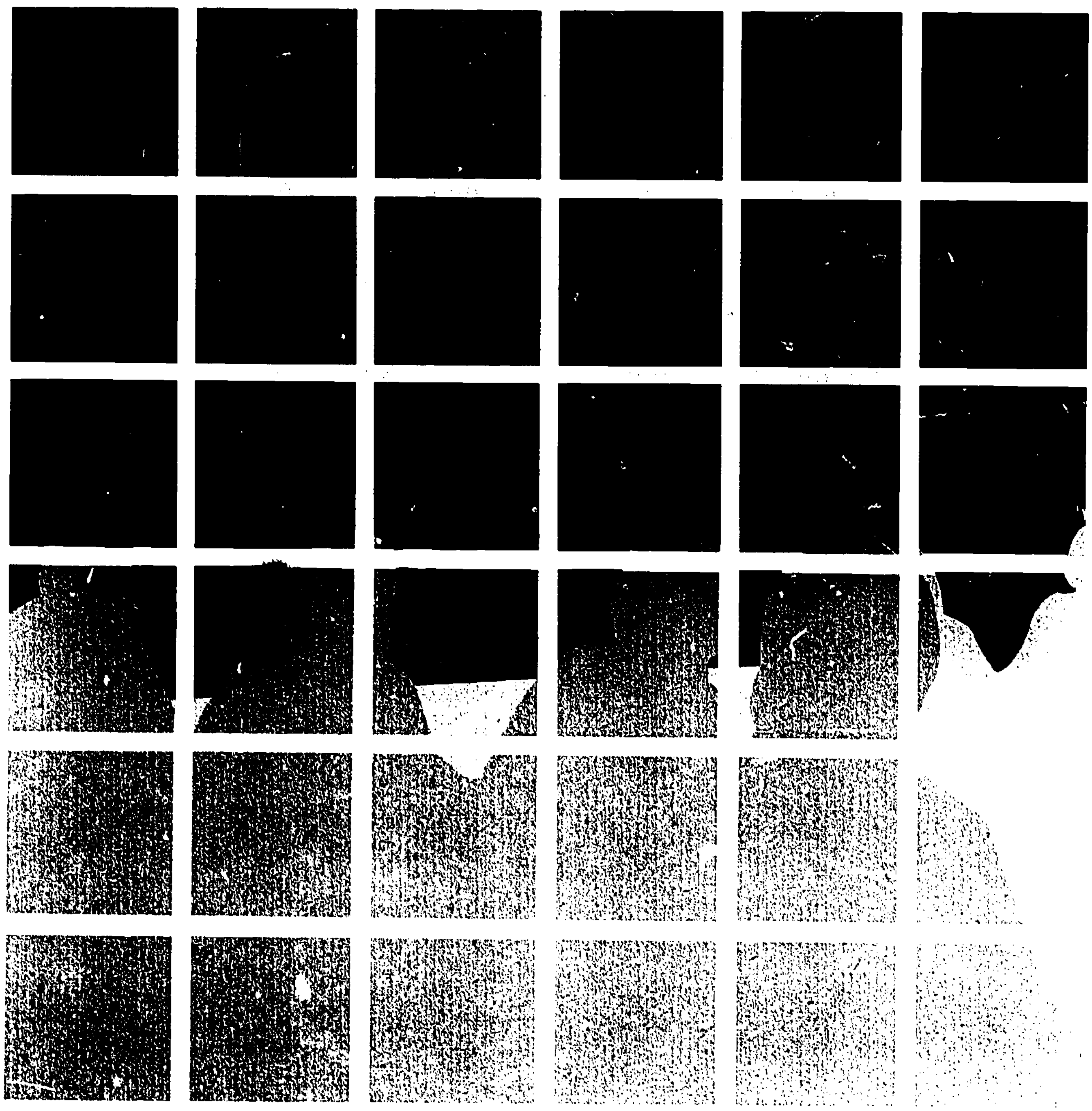

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HIGH TECHNOLOGY AND THE FUTURE OF EDUCATION

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1986

FOREWORD

From John Naisbitt, author of *Megatrends* to Nell Eurich, author of the Carnegie Foundation report *The Corporate Classroom*, and from public television to our daily newspapers, the arrival of the "Information Society" is well documented. The changing role of education in this new climate is a frequent topic, too. Information is becoming available with fewer constraints of time and place, in multiple forms, and at less expense. Tomorrow's schools and universities will be involved in various networks and communications systems; will be less tied to buildings and campuses; have fewer traditional, full-time students; and will increasingly depend on what we now still call high tech.

Dr. Lionel Baldwin is president of National Technological University, a school designed with a blueprint of the future. Before assuming the presidency of NTU in 1984, he was dean of the College of Engineering at Colorado State University (CSU) in Fort Collins for 18 years, previously taught at CSU, and worked for N.A.S.A. in Cleveland for 6 years.

Dr. Baldwin received his bachelor of science degree from Notre Dame, a master of science from Massachusetts Institute of Technology (MIT), and a Ph.D. from Case Institute of Technology, all in Chemical Engineering. He has published over 50 techical papers in his field, is affiliated with many professional societies in educational technology, and served as a board member or officer in such organizations as the Association for Media-based Continuing Education for Engineers, the General Motors Institute Visiting Committee, and the Engineering Dean's Council.

On behalf of The Ohio State University and the National Center for Research in Vocational Education, I am pleased to present this seminar paper by Dr. Lionel Baldwin.

Chester K. Hansen
Acting Executive Director

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Most of this paper is taken from a report commissioned in January 1986 by the Work of America Institute, Scarsdale, New York. I appreciate their permission to use major excerpts in this manuscript.

Lionel V. Baldwin

HIGH TECHNOLOGY AND THE FUTURE OF EDUCATION

Introduction

Recent advances in telecommunications and other technologies are contributing to change in the content and delivery of education. Representing a merger of corporate and academic concerns, The National Technological University broadcasts instruction nationwide by satellite. This presentation provides an imaginative vision of a widespread option in the near future.

Life-long Learning

The United States' work force is being affected by rapid technological change. In fact, technology seems to leave little untouched. Biblical scholars use computers, professors teach on television, sales people use the automated telephone, and robots weld and paint our cars. Each of us has experienced the personal impact of technological change. My father was a stereotyper at a newspaper until this trade disappeared 10 years ago. I now work at a university that relies wholly on modern telecommunications; this was not the case in 1961 when I first joined an engineering faculty.

Charles H. House (1985) observes that the revolution now underway in communications systems is without parallel in history. He argues that the impact on society is accelerating broadly and presents us with great opportunities. Communication systems for a society have been compared to an animal's central nervous system. The animal becomes more complex and capable as the data gathering, data massage, and data distribution functions become more advanced. Viewed in this way, the United States is the best "animal" to be associated with at the beginning of this major evolutionary change.

Innovation, vitality, and effective training of the work force are keys to America's becoming an effective competitor internationally. According to Nell Eurich (1985) both corporate education and university-business ties also need to be strengthened. Erich Bloch, former vice-president for technical personnel development at IBM and now director of the National Science Foundation, is an urgent advocate of this view. He says, "The United States can only remain competitive by addressing two major problem areas: education and research. On neither count is the nation keeping up with its competitors . . . It is incumbent on industry, together with the academic community, to take the necessary countermeasures" (Botkin 1932, p. 183).

Education and research reside in people and knowledge. The authors of *Global Stakes* emphasize that *knowledge* is now a strategic resource, as vital as natural resources and physical investments. They argue that we must change the way national priorities and strategies are set, concluding that the most important thing among these propositions concerns education, and the strategic, long-term need to resupport and reorient the American system of education. Another concerns training, and the need to revamp our approach to retraining workers who are displaced by technological change" (ibid., p. 7-8).

Progress, however, is slow. Corporate efforts to train employees to use new technologies effectively lag far behind. According to a recent report by the Work in America Institute (WAI) (Training for New Technology 1985) the rapidly accelerating pace of technological change in large organizations calls for a "new, more dynamic corporate training strategy—one that anticipates new technologies far in advance—and helps employees develop skills, not only for today's technology, but for tomorrow's and the day after's" (p. 6).

According to Jerome M. Rosow, president of the WAI, "If training programs grow directly out of the business plan, then training becomes as vital as R&D, or equipment maintenance, or capital investment in new technology—which, in fact, it is. The question ceases to be, How much is the right amount to spend on training? and becomes, How much will it cost to acquire the necessary skills?" (ibid., p. 11).

The Conference Board published a survey of industrial education and taining practices in 1977 and again in 1985. In the recent report, Lusterman (1985) indicated that a larger proportion of employees in all major job categories are now involved each year in formal training than were 5 years ago. Many employees reported that management is committed to containing training costs even as they seek more productivity from that function. This desire provides a catalyst for non-traditional approaches to training and education.

According to Lusterman, new technologies—video, computer-aided instruction, interactive video, and satellite broadcasting—are having important effects on the training function. They are providing such benefits as increased instructional effectiveness, training paced to individual needs, and the ability to train individuals, as needed, rather than in groups. They offer greater opportunity for centralized program development and, therefore, control of content.

One of the ways that engineering educators are providing new services to working technical professionals is through communications technology. Media-based graduate and continuing education programs delivered directly to corporate offices and government laboratories are the most effective and affordable approaches in meeting the need for continuing education. Media-based instruction is an alternative that does not conflict with full-time employment.

Nell P. Eurich (1985) writing for the Carnegie Foundation for the Advancement of Teaching observed that—

> Engineering schools also have had their direct pipeline to industry; that was their mission and they have fulfilled it well—perhaps too well in view of the fact that industry's almost insatiable demand for engineers and ability to pay high salaries have robbed them of much needed faculty. Because of recent attention and current emphasis on the United States' precarious position in competitive world markets, this imbalance is recognized and corrective action is underway. (p. 17)
>
> Many new and stronger links are being forged, especially with technological corporations, and initiative is coming from both sides . . . Fifteen prestigious universities from the Association for Media-Based Continuing Education for Engineers—together with 12 leading corporations—have started the new National Technological University, operating via satellite to reach engineers in corporate classrooms for advanced professional work leading to NTU's master of science degree . . . A bold and potentially very large venture, NTU's delivery system takes high quality instruction from major universities to the work-place. (p. 17).

Perhaps, engineers are, as Eurich says, "light years ahead of other professions in using media for education and training." But is our teaching art threatened? Or do we agree with Arthur Melmed (1986) that "science and technology, which have had such powerful effect in improving output in other sectors, like agriculture and medicine, have only slightly been used in education to date. However, new knowledge from cognitive science and artificial intelligence, and dramatic improvement in the capability of modern information technology create the opportunity for a much expanded role for science and technology in education."

Engineering Instructional Television (ITV) Serves Working Engineers

American universities are ideally suited to deliver engineering continuing education. The neutrality of these institutions allows them to gain electronic entrance to many corporations and to precipitate an information flow that otherwise might not exist among competitors. In 1963, engineering faculty at several colleges started a simple but effective way to *teach* adult students at a distance via television. "Candid classroom" remains a mainstay of instructional television today.

ITV instruction originates in regularly scheduled, on-campus courses that are attended by full-time students. Classes are held in specially equipped studio classrooms so that the lectures and students' questions and discussions are transmitted to off-campus students at their jobs sites.

The first major system was established in 1964 at the University of Florida. A two-way point-to-point microwave satellite system was leased from the telephone company to link the main campus to several extension centers in central Florida. In 1969, Stanford University began transmitting classes to corporate classrooms in the San Francisco Bay Area with a four-channel instructional television fixed service (ITFS) system that featured FM-talkback capability. ITFS has a broadcast radius of about 35 miles.

In 1967, Colorado State University was the first to employ courrier-carried videotape as a delivery system; tapes are returned, erased, and reused on a schedule. Today, most microwave and ITFS systems receiving sites are equipped with video tape recorders to store the class temporarily either for a review or for making up missed sessions. Faculty using videotape in regional systems have overcome the disadvantage of noninteraction by scheduling occasional visits and regular office hours for telephone consultations. A major advantage of videotape is the convenience of decoupling campus and part-time student schedules. Newer systems tend to employ combinations of delivery methods to fit the needs of specific geographic areas.

Acceptance by both faculty and students has caused the number of regional ITV systems in engineering to grow from 4 in 1967 to over 40 systems operating today. Two dozen major universities have, over the past two decades, awarded over 3,500 master of science degrees to engineers who have completed all degree requirements as part-time ITV students.

The performance of adult students taking ITV instruction is usually equal to that of on-campus students who are taught in the traditional classroom when comparable admission criteria are applied. Studies by individual graduate faculties comparing the evaluated performance of off-campus (ITV) students to traditional campus students attest to the effectiveness of ITV instruction (Baldwin and Down 1981).

- Hallmarks of good practice in ITV have emerged over the past two decades. Small groups of engineers meeting on a regular schedule is desirable, particularly if one assumes the role of discussion leader.

- On-site tutors are also beneficial although they may meet only occasionally with the group. The active involvement of each participant in brief discussions, perhaps at 10-20 minute intervals throughout a 50-minute lecture, is strongly encouraged.

- Individual commitment to outside study and completion of problem assignments is important where mastery is the goal.

- Interaction with the instructor need not be face-to-face, but telephoned questions should be answered in one of the next few class sessions while the issue is under active discussion on campus. Early tests using electronic mail and computer conferencing for interaction are encouraging because these technologies offer the same flexibility and convenience advantages as ITV itself.

- A supportive administrative and physical environment also provided by the employer are appreciated—textbooks arrive on time, equipment is maintained, and conference rooms are set aside as needed.

Employer sponsorship of all direct costs is almost universal. Employers differ, however, on how much study time is integrated into working hours. Some firms provide time for classes as part of the work schedule and pay all costs of work study directly to the university. Study and assignments in these cases are not usually done on company time. Other firms expect engineers to make up class time or to view classes after work hours. The engineer is reimbursed for tuition and books at the successful conclusion of the course as part of a tuition refund fringe benefit of the firm.

The very diverse, rapidly changing interests of engineers seeking advanced education has caused widely scattered, small clusters of students to be available at anytime for instruction. These constraints have forced engineering educators to pioneer "candid classroom" ITV. ITV classrooms enroll four engineers per credit course at a given site. An average enrollment of about four engineers at a gien site is common in the ITV systems operated by engineering colleges for practicing engineers in their region. The average age of credit enrollees is 28 years old. Instructors commonly have students at 4-8 sites.

Because the class material is constantly updated to provide the most current information, class materials are rarely reused. Few advanced topics could support the production costs of interactive videodisc or modern computer-assisted instruction alternatives.

Cooperating Schools Deliver Continuing Education

Credit courses appeal generally to engineers in their late twenties. The average age of engineers in the workplace, however, is 39. These experienced engineers prefer short courses in engineering applications taught by leading authorities. Theoretical instruction is not requested, generally. Continuing education requirements of course work variety pose special problems for universities.

No one university can meet the demand for the course work variety required by engineers. At the same time, creating these desired courses is not simple. Because students on campus are not paying for curriculum development, short courses on videotape are much more expensive to produce than those done in the candid classroom setting. An efficient national distribution system was needed to provide incentives to authors of video curricula.

In August 1974, representatives from two dozen colleges operating video-based programs, along with a sample of customers, attended a workshop to discuss ways in which collaboration might improve continuing education service. A subgroup performed follow-up planning that in April 1976 led to the formation of a nonprofit consortium, the Association for Media-based Continuing Education for Engineers (AMCEE). Initially, 12 schools set the goal "to increase the national effectiveness of continuing education for engineers." Today, the consortium boasts 33 member schools (see table 1).

AMCEE received start-up support from the National Science and Sloan Foundations. Members share information on customer needs and encourage publishing short video courses aimed at practicing engineers. AMCEE serves as marketing cooperative to help reduce the costs of materials distribution.

The first AMCEE catalog in 1978 contained 172 courses from 10 universities. The current catalog lists over 450 courses from 33 schools plus the consortium itself.

Thousands of engineering and technical professionals use AMCEE courseware each year. Participating continuing education programs are AT&T, General Motors, Hewlett-Packard, Honeywell, Digital Equipment Corporation, Allied Corporation, IBM, McDonnell Douglas, NCR, RCA, Rockwell, and Texas Instruments, Inc. Numerous government laboratories and agencies, including the Department of Defense, are also among AMCEE's clients (Fitch 1982).

By the early 1980s, AMCEE filled many previously unfulfilled needs in graduate engineering education. The consortium's success indicated that a need for a national university utilizing the latest telecommunications technologies existed. As satellite communications became increasingly affordable, AMCEE's board of directors saw the possibility of extending the range of ITV systems to a national audience. Since less than half the engineering work force was served by existing regional systems, there clearly was an audience for satellite-based education.

AMCEE members believed that the cooperative approach is the best way to meet the demand for quality graduate instruction with satellites. In February 1982, the AMCEE bord of directors agreed to study the feasibility of creating a national engineering college that would deliver its programs through the most advanced telecommunications technologies. The board pledged $100,000 of consortium funds to the study. Fourteen industrial and government sources added $370,000 to the planning effort. These sponsors provided technical advice and met regularly over a 2-year period.

The National Technological University

The National Technological Univesity (NTU) was established in Colorado as a separate nonprofit private educational corporation in January 1984. Created to award accredited masters degrees in selected fields, NTU academic programs feature approved courses of instruction offered by its 21 AMCEE-member universities (see exhibit 1).

Each participating university evaluates and records grades for students completing its courses. The student records are transferred by the participating university to the NTU registrar at the end of each term.

Advanced educational and telecommunications technology are used to deliver instructional programs to graduate technical professionals at their employment locations. There is no need for students to leave the workplace to participate in the instructional programs.

Each NTU site is operated by a sponsoring organization (the company employing the student) following guidelines provided by NTU. The courses are rigorous but provide a convenient and flexible alternative to campus study. NTU uses the resources of over 2,600 full-time engineering and computer science faculty members from participating universities to assure high-quality instructional programs. NTU also conducts research in areas of educational technology related to teaching and learning to ensure continued responsiveness to the needs of the students (Baldwin 1984).

EXHIBIT 1

Member Universities of AMCEE

Arizona State University
Auburn University
Boston University
Colorado State University*
GMI Engineering and Management Institute*
Georgia Institute of Technology*
Illinois Institute of Technology
Iowa State University*
Massachusetts Institute of Technology
Michigan Technological University
North Carolina State University*
Northeastern University*
Oklahoma State University*
Polytechnic Institute of New York
Purdue University*
Southern Methodist University*
Stanford University
University of Alaska*
Univeristy of Arizona*
University of Florida*
University of Idaho*
University of Illinois at Urbana-Champaign
University of Kentucky*
University of Maryland*
University of Massachusetts*
University of Michigan
University of Minnesota*
University of Missouri-Rolla*
University of Notre Dame*
University of South Carolina*
University of Southern California
University of Washington
University of Wisconsin-Madison

*Participants in NTU

NTU's functions are as follow:

- Award accredited master's degrees to qualified individuals in selected disciplines.
- Provide research seminars in each discipline.

- Operate a modern telecommunications delivery system for convenient, flexible on-site service.

- Offer AMCEE noncredit short courses, seminars, and workshops to introduce newly advanced techology concepts to a broad range of technical professionals.

- Establish a sophisticated satellite network infrastructure between industry and the university communities.

NTU began offering courses to more than 150 engineers in the fall of 1984. Programs were distributed by videocassette. This first group of students was employed at 14 sponsoring sites of Eastman Kodak, H-P, IBM, GE, and NCR. Six universities taught 15 courses of the Computer Engineering grduate program. In winter and spring terms, 7 universities delivered 21 courses to over 250 enrollees from corporations including new sites sponsored by Digital Equipment Corporation and Motorola. NTU ceased shipping cassettes in May 1985.

On August 28, 1985, NTU began broadcsting two channels of full-motion, color ITV via transponder 5H on GSTAR-I, a new Ku-band satellite. The dual channel service places NTU at the forefront of satellite transmission technology. Satellite delivery boosted participation dramatically. Employer-sponsored receiving sites more than doubled and enrollments in credit courses quadrupled. Over 50 receiving sites were active in the spring 1986 term. Figure 1 shows the enrollment data for credit courses.

The NTU network is configured so that eventually each instructor can teach both on- and off-campus students simultaneously. ITV classrooms, each equipped with several remotely controlled color cameras and audio microphones, are the origination point of each broadcast. The ITV signal can be beamed instantly from that campus to the satellite. Figure 2 shows a schematic of the satellite ITV system. Part-time students at their jobs sites view the class live and, by telephone, ask questions during the class session.

Demonstrations of this interaction in a teleconferencing mode via satellite have been successful. Since the NTU classes are planned to serve an average of about 55 off-campus students, classroom interaction between the teacher and off-campus students can be easily accommodated. For classes that are delayed a few hours before being broadcast because of schedule conflicts, NTU provides occasional teleconferencing time for recitation sessions. Videotape machines offer students who must miss a session the opportunity to view it at a later time. Indeed, videotape is an essential part of all live ITV today, because it adds a time buffer when needed as well as an opportunity for review.

Figure 3 is a diagram of the winter and spring semester broadcast schedule. Open times are available for occasional recititation periods for the courses delivered during the evening. The letter suffix on the course number indicates the originating school. Currently, seven universities are equipped as earth stations and are capable of real-time broadcasts. These universities and their letter designations are the University of Massachusetts (A), the University of Maryland (B), the University of Minnesota (C), the University of South Carolina (D), the University of Arizona (E), Colorado State University (H), and Georgia Institute of Technology (J). Another set of uplinks are planned for the 1986 fall term with regular additions to uplinking facilities scheduled over the next 3 years. Universities that are not earth stations have provided a master videotape to one of the schools with an uplink. Sessions at nonuplink schools are broadcast on a slightly delayed schedule.

The NTU ITV system employs the methodology that has envolved over the past two decades at the particpating institutions. The 3-hour time zone difference between the east and west coasts, along with both schools and customers in each of the four time zones, means that NTU must increase the communications opportunities for teachers and students outside of classroom periods. Experiments are now underway with AT&T mail serving as the electronic mail service to supplement telephone interaction. Additional intensive efforts to enhance computer conferencing between instructors and NTU enrollees are planned over the next few years.

The sponsoring organization equips each receiving or downlink site with a TV receive-only station (TVRO). Each receiving site then pays an access fee to join the NTU/AMCEE network. Some corporations choose to pay a corporatewide fee that allows all their U.S. locations to participate. Current and proposed 1987 access fees are in table 1.

After the receiving site pays the access fee, each enrollee is charged tuition and fees whether they register for academic credit or audit. Each particpating university sets the tuition for the instruction it provides in the NTU program. This tuition may vary from school to school. Tuition fees for audit and credit courses for most NTU universities are shown in table 2. In every instance, the employer either pays this bill directly or reimburses the employee when the course is completed.

Tuition and fees for Southern Methodist University courses total $445 per credit for students enrolled for credit and $255 per credit for students enrolled for audit.

NTU currently offers progams of study leading to the master of science degree in five disciplines. Students can choose from 246 courses in computer engineering, computer science, engineering management, and electrical engineering. Thirty-eight additional courses are availble in manufacturing systems engineering. The credit courses availble have doubled since last year; 20 participating universities, up from 14 at this time last year, now provide instruction. Curricula are regularly reviewed; new classes will be added each year and some courses will be revised or dropped.

To conduct it's academic functions, NTU relies upon a participating faculty consisting of consultants selected from the instructors of each participating institution. These faculty consultants are oranized in discipline groups to form Graduate Faculties, typically with one representative in each discipline from each participating institution. The Graduate Faculties in each discipline are supported by four standing committtees: Curriculum Committee; Admission and Academic Standards Committee, which also oversees academic advising; Staffing Committee; and, finally, the Academic Executive Committee. A senior administrator coordinator at NTU administrative offices is assigned to each Graduate Faculty to support and coordinate functions and activities.

The Curriculum Committee in each discipline develops study programs and reviews all courses submitted by the participating universities. This Committee gives recommendations for course revisions and additions to the Graduate Faculty at its semiannual meetings in order to keep the program in the forefront of the discipline. The Curriculum Committee also oversees the graduate research seminar series.

The Admissions and Academic Standards Committee for each Graduate Faculty sets the policies governing admission and criteria for students to continue as active degree candidates in the study programs. The NTU director of admissions implements the progams established by each Curriculum Committee. The Admissions and Academic Standards Committees monitor the application of these programs and supervise the work of academic advisors who are faculty consultants

TABLE 1

ACCESS FEES TO NTU/AMCEE NETWORK

Now in effect. Proposed to remain *applicable to December 31, 1986*. Two normal options for payment of subscriptions are in use.

I. Two Annual Cash Payments per RVTO Installation

Employees On Site	First Year	Second Year
over 2,000	$9,000	$9,000
1,501 - 2,000	7,500	7,500
1,001 - 1,500	6,000	6,000
500 - 1,000	4,500	4,500
under 500	3,000	3,000

II. Corporate-wide Subscription

Total Domestic Employees	Payment
less than 20,000	$ 50,000
20,000 - 60,000	100,000
60,000 - 100,000	160,000
greater than 100,000	200,000

Proposed fees effective *January 1, 1987*

I. Two Annual Cash Payments per TVRO Installation

Employees On Site	First Year	Second Year
over 2,000	$12,000	$12,000
1,501 - 2,000	10,500	10,500
1,001 - 1,500	8,000	8,000
500 - 1,000	6,500	6,500
under 500	4,000	4,000

II. Corporate-Wide Subscription

Total Domestic Employees	Payment
less than 20,000	$ 65,000
20,000 - 60,000	130,000
60,000 - 100,000	210,000
greater than 100,000	260,000

TABLE 2

1985/86 NTU TUITION RATES

Tuition and Fees for Credit

Tuition for Instruction	$200 per credit
Fees	130 per credit
TOTAL	$330 per credit

Tuition and Fees for Audit

Tuition for Instruction	$100 per credit
Fees	130 per credit
TOTAL	$230 per credit

from the participating institutions. Each matriculated student in an approved degree program is assigned an academic advisor who has access to the student records through the interactive, computer-based record system maintained at NTU.

The Staffing Committee in each discipline monitors the activities of all faculty consultants to ensure that their academic functions are performed. This commitee is responsible for recommending the replacement or termination of faculty consultants, as well as recommending faculty nominated by participating schools to serve as vacancies occur.

Elected representatives from each of the disciplinary Graduate Faculties serve on the Academic Executive Committee. This Academic Executive Committee considers and makes recommendations on academic affairs to the president and the bord of trustees of NTU. Figure 4 shows the current organizational chart. Each NTU Graduate Faculty conducts its affairs through two annual faculty meetings, correspondence, and teleconferences. Although the university does not grant tenure to faculty members, the academic organization clearly follows the traditional model providing both the freedom and the responsibility to the instructional faculty to develop and maintain outstanding programs of study in advanced technical subjects.

In May 1984, NTU submitted general data for institutional accreditation to the Commission on Institutes of Higher Education of the North Cental Association of Colleges and Schools (NCA) in regard to an eligibility review. This preliminary review was completed in the fall of 1984. The NTU staff then prepared a detailed self-study report that was the basis for the next review process. An evaluation "visiting team" of four distinguished educators toured NTU April 10-12, 1985, in Fort Collins, as well as sponsoring sites at Digital Equipment Corporation and Hewlett-Packard Company in Colorado Springs, Colorado. A few weeks later, the evaluation team members also visited the IBM Corporation, Owego, New York, and Eastman Kodak Company, Rochester, New York.

The NCA evaluation team's June 1985 report, together with NTU comments, were later reviewed by a committee of nine peers in Chicago on July 18. This group discussed NTU operations with the chairman of the evaluation team and NTU's President Lionel Baldwin. The final and most important step in the process occurred on August 22, 1985, when the Commission voted NTU to candidate status. To complete the accreditation process, NTU must graduate its first group of M.S. degree candidates. Current plans call for another NCA evaluation team to review operations and recommend final action on the NTU accreditation request in spring of 1987, soon after the first degrees are awarded.

Project ALLTEL

Telecommunications presents new challenges to both accreditation and state licensing traditions in education. These special issues were the focus of a recent study. NTU participated as one of four universities by submitting institutional data in a pilot program developed to assess long distance learning via telecommunications. Known as Project ALLTEL, this study was a joint effort of the Council on Postsecondary Accreditation (COPA) and the State Higher Education Executive Officers Association (SHEEO) under a grant by the Fund for the Improvement of Postsecondary Education (FIPSE).

The major objective of Project ALLTEL was to develop within the regional and specialized accrediting and state authorizing agencies the capacity to deal effectively and equitably with this expanding form of instructional delivery. The project sought to develoop a set of common general standards and policies by which accrediting and state authorizing agencies assess educational programs delivered through electronic media. Emphasis was placed on eliminating unnecessary interstate and regional barriers while preserving the critical elements of consumer protection and quality assurance (Chaloux 1985).

Shared Nationwide ITV Network

The satellite gives AMCEE unprecedented flexibility. Clients for whom the mode of videotape delivery works best can continue as they have in the past. But program participants with a Ku-band "downlink" can tune in each weekday to 6 hours of live educational programs and videotaped courses. In fact, for 6 hours a day or 30 hours each week, 50 weeks a year, NTU/AMCEE network sites can choose from a very wide range of noncredit, continuing education short courses and workshops. In addition, AMCEE serves annually as the vehicle for bringing the 20 hours of IEEE technical seminars to engineers via satellite.

There is a growing movement for public Ku-band downlink sites. For small companies who cannot afford to purchase a downlink, a number of university campuses provide access to AMCEE programs. At the AMCEE headquartes at Georgia Tech, both the television studio and a nearby viewing room permit course participants in the Atlanta area to take courses on the Georgia Tech campus. Other AMCEE members plan to provide open sites for student viewing on their campuses.

Response to the new satellite network has been favorable. In the first 3-months of operation, approximately 900 participants enrolled in AMCEE satellite telecourses. In part, the enthusiasm for satellite delivery is due to its cost-effectiveness. At present, many AMCEE clients have two to three students for a given course. There is a flat fee for using AMCEE courses on videotape, regardless of the number of people involved.

However, clients tuning into the satellite network pay only a per-student fee that ranges from $15 to $25 per instructional hour, as well as a network access fee.

So far, AMCEE is relying on an honor system for fee payment for satellite network courses. However, if eavesdropping becomes a problem, encryption of the type done by HBO and other cable networks may be necessary to protect the integrity of the system.

What Next

During the next 3 years, NTU will carry out an intensive test of computer communications to enhance student-teacher interaction. A major computer firm will provide equipment and funds for this purpose. NTU expects to add simple graphics capability to asynchronous electric networking near the end of the test period and will also experiment with side channel data transmission from the uplinks to provide the students who use personal computers with selective instructional support programs.

NTU has initiated a study group involving some industrial sponsors and several leading businesss college administrators. This group is examining the possibility of using the NTU/AMCEE network on Friday afternoons and evenings, as well as Saturdays, to deliver courses as part of an Executive MBA program nationwide. By fall of 1988, the NTU/AMCEE network will double its current channel output by operating four channels of ITV by satellite.

By coupling the close cooperation of leading engineering faculties with a state-of-the-art telecommunications sytem, NTU has begun what promises to be a revolution in providing high-quality, economical education for U.S. industry. Furthermore, the board of trustees that governs NTU has pledged their support to use the satellite facilities to establish a sophisticated infrastructure between industry and the university community. Once industry sites have video-sending sites installed in the next few years, an opportunity will exist for the most talented industry scientists to contribute course materials. The result could be a quality of instruction that surpasses what either academe or industry could do alone! In areas like manufacturing systems engineering, computer-aided design, and software systems engineering where industry generally is ahead of universities, industrial leaders could share research results on advanced projects with on-campus graduate students and faculty.

Other Possibilities

A vivid reminder of how the United States has evolved an eduational system with complex governance roles that includes local and private, state, and federal authorities recently came in the Paris announcement of May 22, 1985:

> President Francois Mitterand has endorsed the creation of an "open university" that would use a variety of advanced communications techniques, including direct broadcast satellites, to provide France with a nationwide system of continuing education.
>
> He has asked Jean-Pierre Chevement, minister of National Education, to draw up plans for such a system by the end of the summer. (Dickson 1985, p. 35)

The President of the United States will never make such an announcement, nor is there a corresponding U.S. Cabinet Officer with authority to create and implement such a plan. Direct federal funding of a federally chartered university is clearly at odds with U.S. traditions. Therefore, great care must be exercised to encourage the introduction of important new technologies and innovations in a manner that can effectively work in the complex U.S. system of education and training. Both freedom and diversity must be maintained.

Furthermore, rather than create new faculties—physical plants and major new investments in instructional resources—in the way that the British did with their Open University and the French apparently plan to do, the NTU/AMCEE system draws on the existing strengths of the United States' traditional research universities. Twenty-three different states are represented by participating public and private institutions. The NTU model of a new interface, service organization and the consortium model of AMCEE both have proven successful in meeting national goals and introducing new technologies while operating within the accepted governance authorizations of this nation.

NTU/ACMEE is as *de facto* operating role model of an "electronic university," American style. The NTU/AMCEE network is the first full-scale operation to apply satellite communications in a direct broadcast mode in ways designed to extend programs of universities beyond their immediate geographic location to meet the education and training needs of people wherever they are. Furthermore, NTU is pioneering several important issues that are critical to the wider adoption of the technology in higher education. Some of the "firsts" include the following:

- State licensure of a "national" university operating by communications satellite is needed. This is a very complex issue of considerable concern in the educational community (Goldstein 1983).
- Accreditation in the U.S. is done by peer groups on a regional basis. There are eight regional associations in the United States. National satellite delivery is a new challenge that NTU is well along in providing a precedent (Chaloux 1985).
- Network operations involving up to 20 earth stations are time sharing a split transponder. This has not before been attempted. Issues of reliability, affordability, and control of the NTU network will provide meaningful data for implementing new satellite-based systems.
- Quality and effectiveness of the *total* instructional system must be proven, e.g., for example on-line computer registration done remotely; student records for advisors via remote computer access; interaction between teacher and student by computer conferencing and electronic mail asynchronously; the difficult problem of affordable, fast graphics and facsimile for homework, exams, and interaction outside of the classroom.
- Faculty span of control must be tested. What limits to productivity exist with various support arrangements? How does this vary with subject matter, age of learners, and other primary variables?

Progress by NTU to date is encouraging on all fronts. The experience can surely be transferred to a broader segment of the U.S. work force, because ITV has been shown to be effective in many subject areas (Schramm 1972). Perhaps the most difficult task would be managerial, not technological. The NTU/AMCEE network clearly benefits from 20 years of regional experimentation, as well as the 8 years of cooperation in a working consortium. This provides an excellent foundation for a national program for technical professionals. Perhaps there are similar alliances between community colleges, employers, and unions that can provide a basis for enlarging the application of ITV in the workplace. We next may need to address who might provide the leadership for a feasibility study.

QUESTIONS AND ANSWERS

Lionel V. Baldwin

Question: At one point, you alluded to electronic mail. Would you describe the kinds of interaction that you have with learners through electronic mail and other techniques?

If you visit companies, you find that they are using electronic mail a great deal. They have internal systems and their projects are typically scattered. There is communication site-to-site and within a site. You can't go 20 feet in these companies without seeing the equipment. So what's the problem? Why do educational applications lag?

The truth is that even if you pick a very simple public system like AT&T Mail, only about 25 percent of our 40 instructors use it. Everyone has an account and at the beginning of every lecture we identify the account number and encourage students to use it. Only about 10 percent of the faculty use it frequently. We have decided after a few months of frustration, that training is needed to get faculty to use electronic mail—even though they are engineering and computer science faculty. Our surveys show that most faculty have the equipment in their office. Therefore, I do not think it is an equipment problem. I think it is a training problem and a matter of habit. I hope with funds from one of our sponsoring organizations, NTU spend some time and energy to solve this problem. It should be a popular idea because it would free faculty from having telephone office hours at set times.

Question: What are your delivery costs and what do they cover? Are there effective cross subsidies from the universities that participate with you? Do you get charged for faculty time that is spent in communiction? Tell me how the whole thing is financed.

Let's talk about what the charges are and then we'll talk about what the costs are. In universities, charges have rarely correlated with costs. The charges are in fact middle-of-the-road for private universities. If you look at the regional television credit hour charges for private universities, then NTU charges are quite comparable. The reason for that is preordained; that is, it was decided by the consortium that we would average up to private school costs since this country does not have any way of subsidizing a national tuition. Furthermore, it did not seem plausible to ask the president at the University of Minnesota to plead with the legislature for money because he had this great idea: "to export education to Florida and California." So to be beyond reproach, we wanted to make it clear to politicians that the instruction had been paid for.

That tuition will carry the network when we have about 100-120 receiving sites. You need enough sites to get enrollment to yield revenue to pay for satellites and to maintain uplinks and print catalogs, etc.—the fixed costs. Out of the $330 a semester credit hour that NTU collects for 1 student ($990 for a normal 3 credit hour course) almost 60 percent goes to the instructional institution. The universities, when we reach our projected enrollment, will average about 50 students taking any given class. When we get 40-50 students taking an individual class, the universities will clearly make their costs. They should release time and have teaching assistants for the teachers in this network. In addition, NTU pays the instructors from the remaining $130 per credit hour. NTU pays the instructor $25 per credit, or $75 a student in a normal course. This is in addition to the usual salaries paid by their school for teaching. What NTU pays for is advice related to excellent students and poor students and how to deal with those students. Of the remainder, about $50 goes to GTE for the for the satellite transponder, and the rest gets split roughly 50-50 to faculty consultants who work with NTU as advisors and curricula developers and the other half goes to the overhead cost for a small staff of 12 in Ft. Collins.

Question: Does the employer where the course is being taken pay for the equipment? Are they effectively subsidizing the education? Do they pay tuition?

Without exception, the employer either pays for the tuition or the students pays for it and is reimbursed by the company upon completion of the course. Actually, a minority of companies do the latter and they tend to make it a loan, so that there is never an out-of-pocket expense to the student, but the loan is due if he or she doesn't finish the course, except for interference of business. Without exception companies are paying the costs either up front or at the end. Most of them pay book costs also. All of them provide the local equipment and personnel to run the program.

Question: The cost structure suggests that you do not have a low-priced system that could undercut regular universities and that you are not going to displace regular universities. Basically, what you are doing is expanding the market to people who wouldn't come to universities otherwise. There is a lot of talk about educational technology resulting in displacement of faculty—entirely new technologies used to deliver instruction. What do you think of all that talk?

I hope people don't perceive it that way. At the dean's meeting recently, someone said that I had the old John D. Rockefeller thing in mind. As soon as I captured enough market share, NTU would cut the prices and bring them to their knees. If you wanted to make NTU a business enterprise rather than an educational institution, that might be a way of doing it. It is certainly not our plan.

Our network was set up with the idea that we should serve classes that would be small enough so these outstanding teachers would have no reason in the world not to know the individual students, and how well they were doing.

We developed the economics on the basis that NTU would be able to offer many courses to small groups of students economically and at private school tuitions that would benefit the teaching schools and the teachers. There might be other strategies that would work in other cases, but we discussed this one with our corporate sponsors during the 2-year feasibility studies. The deans discussed it from their point of view, and I visited and talked to the faculty at 14 universities.

The question was whether we were competing with the local schools. That was a sensitive issue with the people at Eastman Kodak, one of by best customers, because they essentially built one of the private schools in town and the chairman of the board continues on the board of trustees. I spent a lot of time talking to the administrators of two private schools in Rochester, New York. We carefully looked at the data of the part-time students who commute to those schools. The truth is, even though I picked up about 400 course enrollments in the first year at Eastman Kodak in Rochester, the enrollment in the two private school nighttime programs was less than 10 percent. The people who were already commuting and found the courses in the local schools in the evening that they wanted continued to do so; the students that NTU served were new students.

I think all engineering educators agree that by this network we are serving students who would not be reached any other way. These are not students who said, "I'm not going to stay on campus, I'm going to get a job and get a degree by television." It doesn't work that way. They said, "I'm not going to stay on campus, I'm not going to forgo $30,000 a year on that nice new job; I am going to go get a job now because it looks good." And then when they find themselves at work and they decide they should have studied for an advanced degree. Without exception, NTU serves new students. The resident programs on campus are not being hurt.

Question: Almost all the evidence indicates that the lecture method is one of the most inefficient ways of instruction. It seems that you are using advanced technology to spread the inefficient method on a much wider scale. Why do you think it is necessary? What function does this lecture method serve to bring students to the learnng task that other more efficient methods lack?

I think it is absolutely marvelous to be in Cambridge, Ohio, or someplace else, and to walk across the hall and take a course from Georgia Tech or from the University of Minnesota and know that the teacher is one of the best in that institution. The regional TV systems also typically feature only the best teachers at that school. The ones who cannot stand in front of a camera are not invited. NTU can carefully select its instructors at each school. If I select a "turkey," there is absolutely no reason for it other than poor planning on my part. If you walk into a room and look at 2 minutes of a course being taught, it is going to look very dull and very plain. But I guarantee you if that if you took the entire course you would discover that the instructor is a master teacher.

Why the lecture method? I can tell you why. From the teacher's point of view, what is wrong with the newest technologies such as interactive videodiscs is the amount of time and effort that the teacher must spend in preparing materials. The first edition is always amateurish and nobody has the courage or resources to do a second edition. The problem has to do with the massive investment of talent that must go into the preparation material for alternate methods.

Question: Are there articulation problems with credit, for example, with transferring credits to other programs?

If you took a course over the NTU network for credit, NTU would enroll you in the school that offered the course and did the instruction. You would have a record and a grade just as if you had been on that campus. There is no indication that the course was taken by television. The resident teacher, resident examination, and the resident standards for admission are met. Despite the fact that it was taken at a distance, the record reflects resident credit and you have a grade at the school that offered the course. We transfer those credits into a study program that is approved by a faculty advisor. The only awarding of credentials by NTU is the M.S. degrees.

Question: Do your teachers have to take a screen test?

No. In fact, that's the wrong impression. We are not running candidates for president. We are not telling one-liners. It's not that kind of business. That's what television does to politicians but that is not what television is going to do to teaching. I guarantee that if I showed you 20 samples of 1-minute duration, you would not pick the best teacher. You wouldn't come close. Being a good teacher is a lot of things. Being handsome and having wit are not the major ones. You would have to take the course to evaluate the teacher.

Question: Is industry responding at the rate at which you had anticipated in terms of agreeing to be site receivers?

No. If you make a brief presentation to a top corporate executive, they are very responsive. They immediately support the idea and they know that if NTU is not perfect today they can make it valuable. They buy the concept in a minute. There is no problem selling the people who have a large view of the situation. But if you go into the trenches where they are fighting to lower their overhead and the engineers are working overtime, education looks like "a long-term investment, I've got a problem with this quarter getting stuff on the dock." The real world of engineering is a very competitive place. Local managers get paid for that quarterly report. It's a classic American problem. It is not a media problem; it is a management and reward problem.

Question: I take it most of your customers, in terms of site receivers, are the larger industries rather than the smaller industries. Are you seeking any other kinds of alternatives, either in terms of co-op receiver sites or ways to provide this kind of education to the employees of smaller organizations?

You are exactly right. In principle, NTU is available to anyone, but in fact to date, you had better be an employee of a major company. We've done surveys through trade associations, it is clear that the smaller companies do not invest in their people, do not have mechanisms, do not have policies, and many may not even have tuition refunds. An open site, a common place in the community, is something we are studying.

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