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ABSTRACT

Ways that business and colleges can work together to promote continuing higher education and collaboration models are described in articles based on a forum sponsored by the National University Continuing Education Association's Continuing Higher Education Leadership Project. The perspectives of industry and higher education are covered, along with the topics of lifelong learning and early retirement. Article titles and authors are as follows: "High Tech Industries: Staying on the Technological Forefront through Reducation: Implications for Academica" (Terry L. Gildea, Hewlett Packard); "The Corporation and the Campus: Developing New Partnerships" (Robert DeSio); "Quality and Accountability: The Foundations of Collaboration" (Jack Bowsher); "New Roles for Continuing Higher Education" (Mary Walshok); "Toward a New Approach to Collaboration" (Philip Nowlen); "Demographic Challenges for Collaboration" (Allan Ostar); "Effective Education, Technology, and Teaching" (Theodore Bickart); "Knowledge Maintenance for the Professional" (Michael Danchak); "The Limits of Technology" (Leon Botstein); "Early Retirement: Implications for Higher Education" (Dale Hiestand); "The Economic Costs of Early Retirement" (George Anderson); "Retirees as Students" (Letitia Chamberlain); and "Second Careers" (Art Pumo). The following programs are described: Pennsylvania Technical Assistance Program, Colorado State University/Hewlett Packard Software Retraining Program, National Technological University, University of California-San Diego Executive Program for Scientists and Engineers, and University of Illinois-Motorola Masters Program. (SW)

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CHALLENGES

For Continuing Higher Education Leadership

CORPORATE/CAMPUS COLLABORATION

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A Note of Appreciation

This University Forum would not have been possible without the efforts of David Grossman, director of independent study at the University of Minnesota, who designed and organized the program.

Carol Gasparach, CHEL Project associate, worked tirelessly to assure the smooth functioning of the Forum and production of this publication. Jean Preer, journalist and educator, served as the reporter for the Forum. It is her work that formed the basis for this document. Wendy Sibelman and George Faux of the NUCEA staff played a major role in the preparation of this publication. Kate Lowman provided final editing assistance.

Many of the members of the CHEL Commission actively participated. Paul Miller, president emeritus of the Rochester Institute of Technology, Governor John Carlin of Kansas, and Harold Miller, dean of continuing education and extension at the University of Minnesota, chaired the three main sessions.

Finally, the Project is most grateful for the invitation of IBM s Corporate Technical Institutes from Robert DeSio, IBM s director of university relations, and the support of the IBM Corporation. The Forum was the first outside event held at CTI, and the efforts of Robert DeSio and his staff contributed to the success of the program.

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Challenges to Continuing Higher Education Corporate/Campus Collaboration

The NUCEA Continuing Higher Education Leadership Project

Social, economic, and technological change presents continuing higher education with the need for forceful and effective leadership. Recognizing that need, the National University Continuing Education Association (NUCEA) in 1984 initiated a five-year project to develop leadership both within and for continuing education, and to identify significant policy issues affecting the field. The NUCEA Continuing Higher Education Leadership Project (CHEL) is funded by the W.K Kellogg Foundation, and is directed by a national Commission including representatives from government, industry, and higher education.

The University Forum

Continuing higher education has historically been in the forefront of higher education's efforts to respond to the needs of society. The University Forum represents one of the CHEL Project's efforts to identify and explore the significant issues facing society. Through the Fora, leaders from continuing higher education, business, public affairs, and higher education come together to discuss and debate these issues. What emerges is not only a greater understanding of the issues, but also ideas for programs responding to the issues and needs identified at the Fora.

The CHEL Commission's goal is not only to explore the critical issues which it identifies, but also to develop a model of issue oriented professional leadership development.

The Thornwood Forum: Corporate/Campus Collaboration

Too often, colleges and universities approach corporations as the "vendors" of knowledge, eager for a slice of the billions of dollars spent on education and training. In turn, many corporations fail to articulate their long-term needs from higher education and are then disappointed when institutions cannot respond with new programs on short notice.

The goal of this University Forum was to go beyond the vendor-client relationship to develop a basis for mutual understanding. By examining the challenges facing both industry and higher education, by better understanding the nature of the corporate culture and of the campus culture, we begin to see where our common interests lie.

The Forum was organized to promote this understanding, with panels of continuing educators and senior academic administrators reflecting on the challenges put forth by industry leaders. To enhance the value of these discussions, the CHEL Project staff selected examples of programs offered by institutions meeting the challenge of corporate/campus collaboration.

The most valuable outcome was the sharing of concerns. It is often very difficult for individuals from the campus and the corporation to communicate effectively. There has been considerable discussion of late and much written, but what remains is a serious need for mutual understanding.

The site of the forum, IBM's newly constructed Corporate Technical Institutes, provided an appropriate setting to explore corporate/campus collaboration through high technology industries The increasingly rapid pace of technological change and increasing international competition, for example, demand improved education, training, reeducation, and retraining efforts. High tech corporations are making increasing use of their technology in their own education and training, suggesting potential uses in the college classroom, a point of not inconsiderable controversy on university campuses. Also, the "brain drain" of top scientists and engineers to the corporations has serious implications for higher education. Finally, the increasing use by the computer world of early retirement to maintain full-employment policies suggests the growth of a new group with special needs for higher education

Terry Gildea, manager of technical training at Hewlett Packard, told the Forum that "the future of your institutions and mine depend upon our being able to come up with creative and workable cooperative efforts."

James B Hirsh, Director
NUCEA Continuing Higher Education
Leadership Project

High Tech Industries: Staying on the Technological Forefront Through Employee Reeducation: Implications for Academia

Terry L. Gildea
Manager of Technical Training
Hewlett Packard Company

In the next decade, our system of higher education, one of the most vibrant and envied in the world, faces great changes Those of us in industry have already experienced a similar set of changes; perhaps our experience will offer some perspective on these challenges for academia

Industry Problems

American industry is faced with great competitive challenges. The Japanese have revolutionized the American automobile industry. They taught market researchers that there really was a huge market for small, fuel efficient, inexpensive cars They detected, before we did, the shift in our values which ended the reign of the automobile as a major determinant of status in American society

Although one can make too much of it, the Japanese have also taught us that there is more than one way to organize a manufacturing company Their concepts of labor relations, "just-in-time inventory, and total quality control have been widely studied and, in some cases, adopted by American companies

Closer to home, at least for me, is their success in the electronics industry Television sets are no longer built in this country Much of the most technically advanced and, at the same time, most inexpensive consumer electronics are manufactured in Asia These are not just copies of American products. The Japanese invented VCR equipment and created the market for them

In a slightly more esoteric field, Hewlett Packard buys most of its integrated circuit memory chips from Asian suppliers. Compared to domestic products, the performance of these chips is equal the price is lower, and the quality is higher The Japanese essentially own the 64K chip business

Even as we wonder why the Japanese are so successful, we continue to educate more lawyers than engineers. Japan educates four times as many engineers as they do lawyers We can't seem to understand why we have a liability insurance crisis in this country at the same time that we have a $50 billion annual trade deficit with Japan

We face challenges from other directions Since the Challenger accident, we have had to consider seriously whether or not the French space program has created a more reliable space vehicle launcher than our own shuttle The European space program, while not without problems, is a serious contender in the space business The most exciting work of late in high energy particle physics research is being done at the European Center for Nuclear Research near Geneva The United States is no longer the only, and perhaps not the leading, nation in this field

"Even as we wonder why the Japanese are so successful, we continue to educate more lawyers than engineers."

The problem is not just one of technology or engineering Our traditional commercial trading patterns are undergoing great change The Pacific Rim nations have become our largest trading partners, but we continue to teach French and German in our schools, and only rarely Korean or Japanese

In our own nation, we are seeing a dramatic change in the ethnic composition of our society In the San Francisco Bay area, most public notices are printed in English, Spanish, and Vietnamese

Some studies have indicated that by the year 2000, just 14 years from now, there will be more native Spanish speakers than English speakers in the state of California In spite of this, we continue to edu cate our high school students as if they will need no language other than English

Let me suggest, as one hypothesis, that we are educating people for the wrong jobs and provid ing them with the wrong skills Our colleges and universities need to change the educational programs they currently offer Our nation's future leaders must be prepared to lead in this new global environment They must be market sensitive in a multinational, multicultural, and multilingual context. The products and services that we offer must compete in an international marketplace

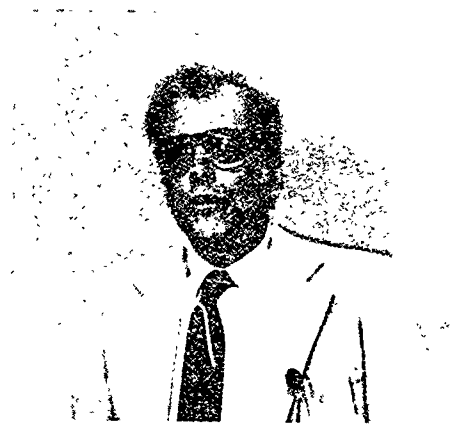
Language skills are becoming increasingly im portant Hewlett Packard has just announced a personal computer with keyboard, display, and printer suitable for Asian languages, Korean, Chinese, and Japanese For several years, we have manufactured printers capable of printing in Cyril lic or Arabic scripts Our former exclusive focus on Western Europe is no longer appropriate.

It has often been argued that either we are in, or we are about to enter, the information society, that the United States is becoming a service economy; that manufacturing is dying in this country Like so many generalizations, there is some truth in these observations, but they should not be accepted at face value For example, we still manu facture about the same fraction of our domestic needs as before We do it, however, with a smaller labor force We have also lost many of our export markets, as other countries have learned to make their own steel, automobiles, and other goods

If we are in or entering the information age, then our experiences in the high technology indus tries are relevant As creators of these technologies, we tend to use them earlier than other industries, and so are the first to experience the changes they bring about.

New knowledge is the life blood of our business. Every year, we derive about half of our revenues from products that did not exist three years earlier In the electronics industry, products are rapidly replaced with better ones which have more functionality at even lower prices. In fact, electronics is the only industry in the history of mankind in which prices have fallen 30 percent per year, every year, for more than a quarter of a century. As a result, if we at Hewlett Packard do not replace our products with newer ones using the latest technology, our competitors will

It is a constant race Every year, we have to run faster just to stay even. All of this puts a very high premium on technical excellence We spend 10 percent of sales on research and development every year, thus, the engineering workforce is crucial to our business success



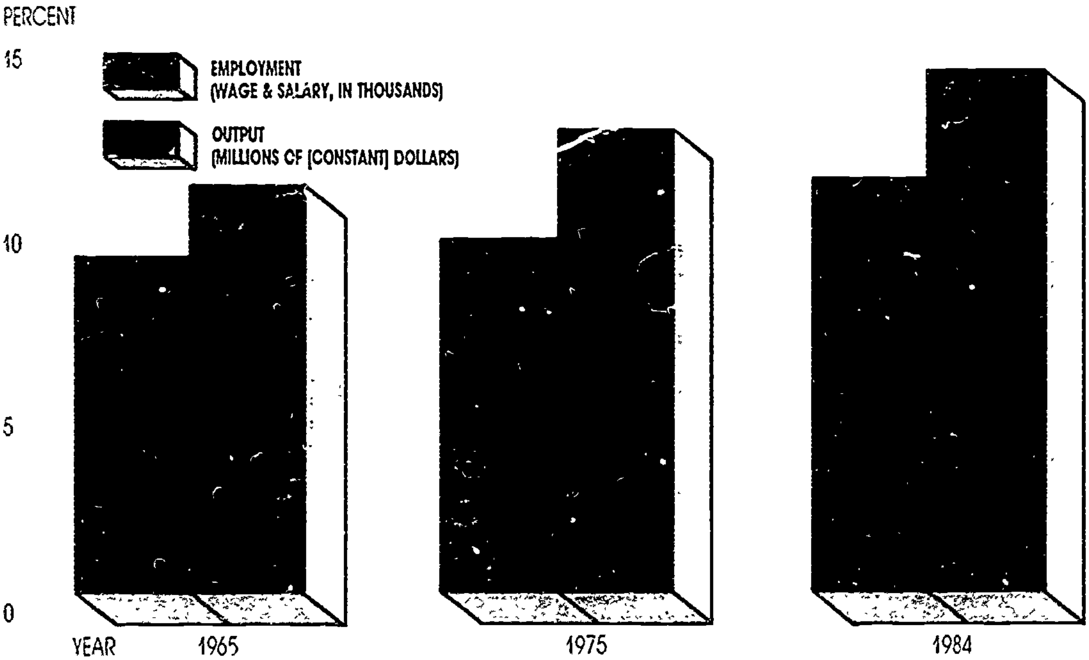
Terry Gildea

One of the problems we face today is that an electrical engineer has a half life on the order of five years In the field of computer science, the half life is only two and a half years Last year, for the first time, Hewlett Packard hired more computer science majors than electrical engineering majors The half life of this crucial segment of our workforce is getting shorter, and with every passing year, the knowledge and skills of our engineers are atrophying

University Problems

We in industry are not the only ones facing these problems Let me assure you that we are well aware of the situation on campus The same rapid

High Tech* Output and Employment
As Percentages of Total Output and Employment



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pace of technology that provides new and dynamic markets for us makes laboratory equipment obsolete for universities Most of the undergraduate laboratories in engineering colleges around the country are a disgrace. All of the estimates which I have seen place the cost of upgrading these labs at several billion dollars

Demographic projections indicate that there will be fewer students of traditional college age than we have enjoyed in recent decades Fewer students translates into smaller classes and lower tuition revenues The competition for the best students is growing tougher each year

The concern over federal budget deficits has made it harder to obtain research grants. Stipends for graduate students are few and far between, and faculty must be content with less ambitious research projects due to the lack of financial support

Higher education is faced with a situation of steady or declining revenues At the same time, the tenured faculty would like to receive annual salary raises To put it mildly, this is not a situation designed to promote happiness on campus And the situation carries the seeds of even more serious problems in the future Earning a Ph D and undertaking a lifetime of teaching and research on campus is not viewed by our brightest students as an attractive career choice

The senior faculty are left with crushing work loads They must write more research grants because the success rate is going down, they must try to compensate for any deficiencies in the teaching skills of junior faculty, they must try to work around obsolete lab equipment, restructuring their teaching and research to minimize the impact of inadequate equipment While facing these problems, their real income is falling as faculty salaries fail to keep pace with salaries in industry

Is it any wonder that technical obsolescence is overtaking our engineering faculties? The same half life phenomenon that we observe in industry is operating on campus It is not, however, always so apparent The faculty can and does specify what courses the students must take Professors need only be current in the one or two courses which are in their field of interest, and then they can require that students take them This sometimes results in students being less well prepared than those of us in industry would like

One institution has recognized this problem Massachusetts Institute of Technology has, for several years, been giving short courses during semester breaks to its own faculty Sophomore and junior undergraduate courses have been oversubscribed by senior faculty eager to learn the "newest things in the field"

Industry's Solution

We have always thought about unemployment due to structural changes in the workplace as if it were solely a blue collar phenomenon. It was always the steel workers and the auto workers who were going to be put out of a job In the electronics industry, automation has also eliminated large numbers of factory jobs. At Hewlett Packard, we have extensive employee education programs designed to convert material handlers and electronic assemblers into productive word processors, etc Retraining the workforce for new occupations is rapidly becoming a way of life Only by doing this can we avoid the social costs of whole towns whose economic raison d être has vanished Only through employee education programs can we raise the skill level of our workforce to make it competitive with foreign industries'

However, retraining needs extend beyond production workers We are actually retraining most of our engineering workforce These men and women are the cream of the crop, the intellectual elite of Hewlett Packard, and they are obsolete. Since 1980, our industry has shifted from a hardware design environment to a software design environment While 70 percent of our engineering design work today is software-related, many of our engineers were educated in the intricacies of hardware design in the days before "software" was even a word, much less a complete degree program This results in a major resource commitment to education at Hewlett Packard And Hewlett Packard is not alone in this commitment The site of this University Forum, IBM's Corporate Technical Institutes, represents IBM's commitment to continually educate its technical workforce.

The Campus Solution

The "villain" in all this is technology, more particularly, the rapid pace of technological change And yet the same technology that leads to the problem also provides us with the solution. Let me give you an industrial view of this opportunity, and then be so bold as to suggest some ideas for the campus.

I think that we should consider all of the "bad" things which I have been discussing as real opportunities for improving our respective organizations. The problem is that we all want opportunities, but none of us wants change. Change, however, is the technological imperative of our age. Since we do not have a choice, my position is that we should make the best of this situation.

At its most fundamental level, the solution boils down to getting more output from the same resources; what those of us in industry call productivity improvements. The way to free faculty time for self improvement is to find ways to teach more per hour. The way to find more money for faculty salaries is to make each faculty member more productive. This is not an argument that is easily sold to faculties. Before the advent of the intellectual workforce in industry, it would probably have been impossible to argue for increased productivity, and even now it will be difficult.

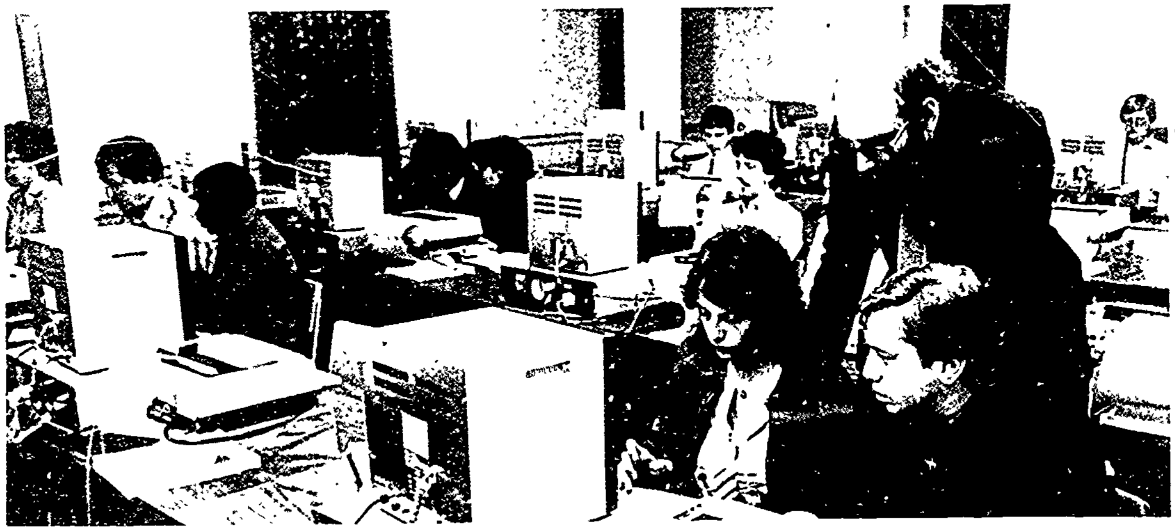


PHOTO University of Maryland University College

The use of high technology in higher education is evident in this microcomputer lab at the University of Maryland University College.

But we have found ways to make research more efficient. We are constantly developing tools which make each Hewlett Packard engineer more productive, tools which allow the average engineer to produce more intellectual work in the standard 40-hour work week.

We are also developing teaching techniques which allow students to learn faster and more thoroughly, techniques which allow the average student to learn more in a 40-hour week. In fact, we have recently finished working with two MIT professors to revise their teaching materials for a major undergraduate course to help them make the pedagogy more effective

The idea that we need to use appropriate technologies to improve teaching productivity is not limited to the engineering sciences. We need to use the same technologies in teaching the humanities. One of the problems with our current engineering curriculum is that there is not enough time to include sufficient study in the humanities. Engineering students spend all their time studying engineering and when they graduate, they don't know how to apply that knowledge to solving society's problems.

If we could improve the productivity of the learning process, we could make time for engineering students to take more liberal arts courses They could learn to be better communicators and to work more effectively with people in organizations.

We have, of course, made some progress in applying the new information technologies to academic life Many college libraries now have computerized databases for catalogs. Many students can use computer terminals to search the literature in their fields Some students are bringing their own personal computers to the campus to use mainly as word processors, and some institutions now require that each student purchase a personal computer But we have yet to reach the point where these simple tools are applied on a scale anywhere approaching their applications in industry.

It would seem to me that television could be much more widely used on campuses, and not just to record "talking head" lectures. As anyone who has watched public television knows, the television camera can bring us new experiences not economically obtainable in any other way It can allow students to see natural science in the most remote places on earth, far under the sea and in dangerous environments. Television has even transported us inside the human body.

The people at Cal Tech have produced a series called "The Mechanical Universe." It contains some marvelous dramatizations and, more importantly, some excellent experiments. Television and computers could revolutionize the laboratory sciences. Using computer simulations, we can give the student control over an experiment's parameters, allowing the exploration of a wide range of alternatives in a relatively short period of time. We also do not run the risk that a mistake would blow up the laboratory. Television can be used to provide demonstrations of dangerous or expensive experiments which are impractical for students to carry out on their own. Using television and computers, colleges and universities can avoid the necessity of purchasing seldom used, but very expensive, lab equipment.

Neither television nor computers will eliminate the need for students to participate in real "hands on" laboratory experiments, but many of the key concepts could be taught using the newer technologies.

Computer simulations are perhaps even more important than television. After all, in modern engineering practice, most designs will be created using computer simulations. We no longer build a series of models, each one incrementally better than the preceding one What traditionally has been a significant part of the engineer's job is now largely done using Computer Assisted Engineering.

If television and computers are individually important to improving teaching, how much more important is their marriage, the computer controlled video laser disc? Here we have a technology which promises to offer us the best of both worlds. Using techniques such as those used in the famous MIT tour of Aspen, Colorado, we can provide the student with real individualized exploratory learning experiences.

Now, just having these tools and realizing their potential does not give us good education. We all know that most television is terrible, or at least not very educational. Using these tools requires enormous commitments of resources, both time and money. At Hewlett Packard, we operate a network-quality television studio. It costs us $2,000 per minute to produce educational material. However, for many subjects it is still the cheapest alternative

In general, I think universities have a much too constrained view of academic specialties. At Hewlett Packard, we have an employee who is a former professor of Greek. His interest in comparative languages, along with his communication skills and desire to teach others, has made him a valuable customer support engineer for computer languages. Unfortunately, he probably would not be hired by any university computer science department because he does not have the proper academic qualifications.

Let us consider another example: For a number of years, Hewlett Packard has been using satellite television for instructional purposes. We now have what we believe is the largest industrially owned television network in the world. It's wonderful, it brings our top people to our employees, regardless of where they are located. The National Technological University* offers similar advantages to universities. It is now possible for engineering schools to offer their students special courses which attract low enrollments without having to hire a faculty member in that narrow specialty. It is a logical extension of the cross registration arrangements which are common in higher educ-tion.

As many educators will attest, these efforts at cooperation do not come easily. There are many political barriers to overcome. The human species is naturally a territorial animal, and the turf wars resulting from these efforts are legend. My message is that the coming of the new information age leaves us no choice but to solve these problems. The future of your institutions and mine depend upon our being able to come up with creative and workable cooperative efforts.

The best teaching is, or ought to be, a highly personal activity. As teachers, we should be humble enough to recognize that most learning takes place in the dormitory, not in the lecture hall. I am

"Higher education will have to become the principal provider of lifelong learning, both to its own faculty and staff and to graduates working in industry."

not advocating the replacement of student faculty interaction with cold, technological automation. I am, however, suggesting that by creatively using the available technologies, we can provide more time for personal teaching and for a more rewarding career for our faculty.

We probably need to change the reward system on campus. Teaching is undervalued in relation to research. Let me give you an example from my own company. Historically, Hewlett Packard flourished as a group of autonomous, independent divisions. Each division had its own product line charter and, taken as a whole, Hewlett Packard offered a broad line of instrumentation second to none. Somewhere in our catalog, we had an instrument for every frequency from DC to light. We prided ourselves on the breadth of our catalog offerings and the independence of each division, each an expert in its own field of activity.

The internal culture of our organization rewarded independence. At the margins, our divisions competed against each other. We felt that some internal competition was healthy. This system built one of the great industrial organizations of the modern world. It has been studied, written about, and imitated. It has been fantastically successful. A few years ago, we found that the very reward system that had been responsible for our past success stood in the way of our future progress. Today, the critical need is to build systems in which all the pieces fit together. Anyone who has tried to run Apple Macintosh software on an IBM computer, or to hook up a Hewlett Packard plotter to a Compaq computer will understand the problem. Now, the requirement for success is cooperation, not competition.

I will not insult your intelligence by drawing the analogy between our catalog and yours, between our divisions and your departments, between our need to change and yours. I have heard at least as many arguments as any of you about quality control of the final product and how it would be damaged by letting some other person or department have some influence over it.

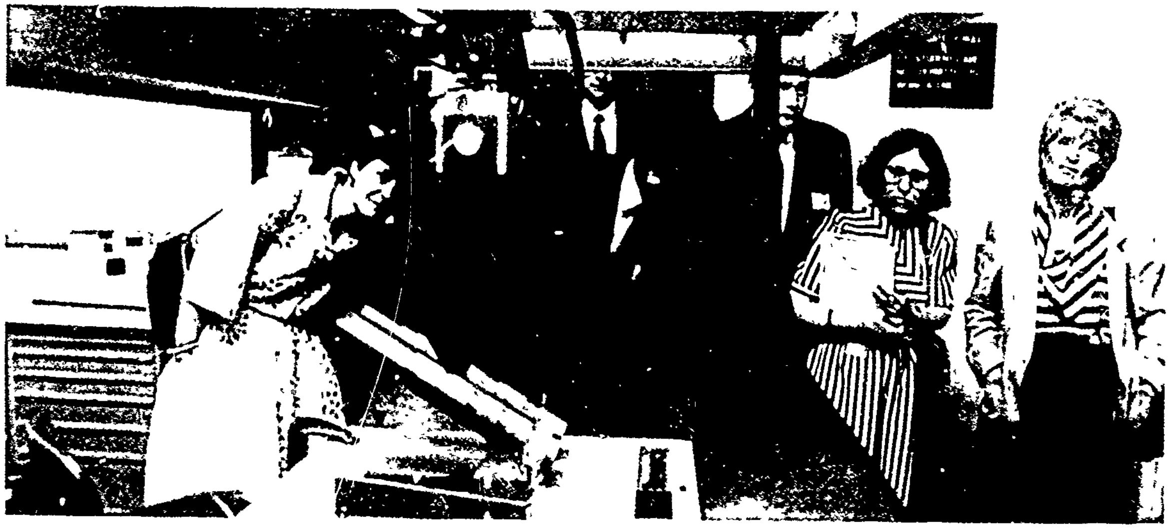
*See description of NTU page 26

A More Perfect Partnership

We must form more perfect partnerships between industry and academia if we are to accommodate the rate of change which we are experiencing. Specifically, universities and colleges will have to rethink their missions I will even suggest what that new mission should be. Higher education will have to become the principal provider of lifelong learning, both to its own faculty and staff and to graduates working in industry.

University faculty need lifelong learning for a number of reasons. First, as intellectual stimulation to enrich their own professional careers. We need to develop cooperative programs in which industry provides short-term employment opportunities for college faculty. This is what I like to call the "reality check" It is an ideal way for faculty to learn about what their students will face in the workplace after graduation. There are many skills required on the job which are not commonly taught in college Yet most college students rely on the teaching faculty to guide them in assessing their career strengths and weaknesses

Much of the development of new technology now takes place in industrial labs This is a relatively new phenomenon Historically, universities discovered new knowledge and industries developed the commercial applications of these discoveries



Representatives of higher education tour a student research laboratory at the IBM Corporate Technical Institutes in Thornwood New York

These roles are no longer fixed in concrete In many fields, the cost of research and the tremendous impact that research can have, not only in creating new businesses, but also leading to obsolescence in existing businesses, have resulted in the industrialization of research Industrial campuses rival university campuses in their amenities as well as in their laboratory facilities It is essential that industry develop better ways to communicate their discoveries to the universities so that this new knowledge can be incorporated into the curriculum.

The challenge which I suggest then, is threefold. First, think about changing the subjects taught, and about using knowledgeable experts from industry to keep abreast of the latest developments Second, think in even broader terms as you seek to expand your audience beyond the traditional 18- to 22-year-old undergraduate, including industrial employees and your own faculty Finally, change your organization and reward system to promote effective use of the best educational technology to achieve these goals.

Challenges To Corporate/Campus Collaboration

INDUSTRY'S PERSPECTIVE

Technological change is affecting all sectors of society, but it often hits industry sooner and more intensely. As a result, the traditional relationships between corporations and higher education are changing as well. At the University Forum, representatives from high tech industries described the challenges facing both sectors and suggested approaches for more fruitful partnerships.

The Corporation and the Campus: Developing New Partnerships

Robert DeSio
Director of University Relations, IBM

Rapid changes in the knowledge base challenge the ability of industrial scientists and engineers to stay current and the capability of universities to offer up-to-date courses and degree programs Factors in the marketplace, such as international competition and the rapid pace of technological change, have required corporations to act faster, adapt more quickly, and forge ahead of their scientific and technical counterparts on campus. In manufacturing, high tech engineers are actually applying new technologies to products before the underlying scientific principles are understood

Corporate/campus collaboration is crucial. Higher education provides the fundamental knowledge base, while industry provides specialized training that enables technical professionals to do the job. You provide the foundation. And we add to it. When people first come into our business and then throughout their careers, we provide them with whatever training is necessary to do their current job. Training is related to the job, and that is tactical.

But in the face of technological and market pressures, corporations are becoming increasingly involved in education as well as training. It is important for people to go back to the university or to provide them with education. Education has become a fundamental part of the total strategy However, new disciplines are now evolving in the high tech industries before moving into the universities. The creation of the Corporate Technical Institutes at IBM illustrates the way in which industry is anticipating and shaping new areas of academic interest.

In 1960, IBM established a computer science school and invited university faculty to attend its programs so that the faculty could return to their campuses to set up computer science programs

Five or six years ago, manufacturing had a low status on engineering campuses IBM recognized the need to develop programs in manufacturing and set up a program IBM developed its own courses in robotics, CAD/CAM, and facilities engineering at a time when only one university in the country offered a masters degree in manufacturing systems engineering. After establishing the Manufacturing Technology Institute, IBM ran a competition to stimulate universities to develop graduate programs in manufacturing engineering, and gave grants of $2 million each to five institutions to support the establishment of graduate programs. There are now 56 such programs in existence. We set up our schools out of desperation and then we tried to influence the academic community.

Barriers to Collaboration

In general, universities are not organized to respond quickly to the needs of high tech industry. The product cycle, for example, is contracting. Once four or five years from invention to design to production, the cycle today is far shorter. This phenomenon requires industry to move rapidly. The discovery of new technologies often does not follow traditional academic disciplines.

The world is becoming interdisciplinary and that is a problem in universities. You have rigid departments, and in an interdisciplinary world, there is difficulty in cutting across those departments and disciplines. That is why, from time to time, in trying to be responsive to what may be the shortsighted needs of industry, it is hard for you to put together programs

Corporate/Campus Collaboration

Mary Walshok

Allan Ostar

Philip Nowlen

Robert DeSio

Jack Bowsher

At the same time, corporations have not articulated their strategic needs to the academic sector. Instead, they have turned to universities for quick assistance, not understanding that it often takes universities three to five years to organize the curricula necessary for new graduate programs. Industry has to be much more crisp in identifying where it is going and letting educators know about it. That is why partnerships are important.

Partnerships

Business and industry already recognize that learning is an integral part of the job. In this country, we are evolving rapidly to a national strategy which includes continuing lifelong learning. Industry must rely on universities for help in keeping their employees current. For their part, universities must be more cognizant of how industry is applying basic scientific knowledge, and of what is going on in industrial laboratories. In order to prepare your students properly, you have to have a very tight set of interactions with the industrial and business segments.

New educational technologies have already made possible a variety of corporate/campus collaborations. Instructional television, microwave transmission, and satellite hook-ups mean that employees can take courses at their workplace. Employers are no longer limited to the offerings of the local educational institution, but now can draw on a vast array of offerings in diverse formats. The National Technological University*, currently connecting 22 engineering schools and a number of corporations through satellite delivery of graduate courses nationwide, is an example of the new partnership possibilities. Continuing educators should examine the possibilities raised by these programs.

In seeking collaborative arrangements with higher education, industry looks for high quality offerings. Educators who make effective use of the new technologies will be the most competitive in the marketplace. There are too many university campuses that are not exploiting the use of the new technologies in the learning process. You are not only supposed to be experts in the disciplines and subject areas, but also in the process of learning and education. How do you use all that technology to reinforce and help the process of learning?

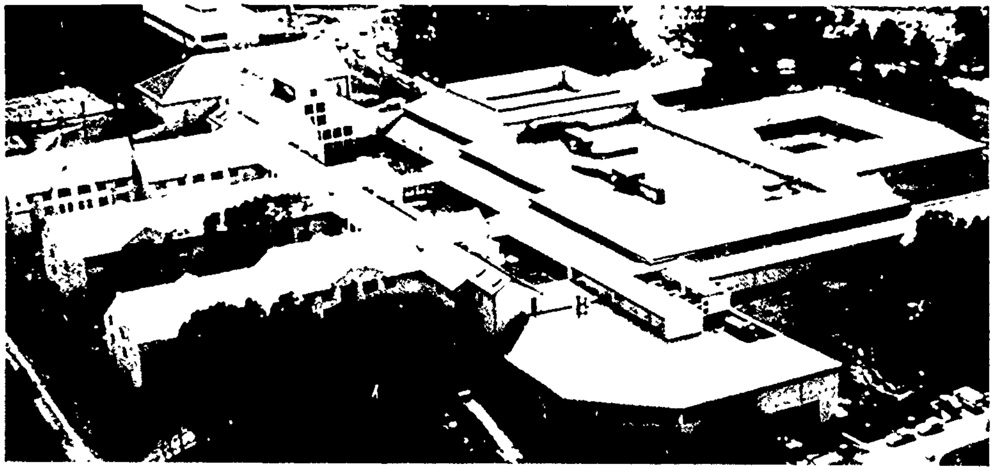
"Educators who make effective use of the new technologies will be the most competitive in the marketplace."

Sharing personnel may offer other avenues for collaboration. Industry, by offering attractive salaries and research opportunities, has drawn promising graduates away from academic careers. We in industry have an obligation and responsibility to the academic community to give some of that back. IBM and Texas Instruments, among others, have programs to encourage technical personnel to pursue second careers in college teaching, administration, and research, but sometimes such initiatives are thwarted by academic tenure and rigid personnel policies.

New technical employees now expect, as a condition of employment, that their company will support them while they complete their advanced degrees on a part-time basis. This is one reason corporations place so much emphasis on continuing education. We need it, but it is also a competitive matter.

Finally, high tech corporations would benefit from more collaborative course development. Already in the semi-conductor industry, corporations are cooperating in research areas. Industry-wide involvement in curricular concerns could similarly eliminate costly duplication of effort and also facilitate corporate/campus communication.

*See description of NTU, page 26



A bird's eye view of IBM's state-of-the-art Corporate Technical Institutes.

The IBM Corporate Technical Institutes

The first of the IBM Corporate Technical Institutes (CTI) was established in 1960 to provide IBM professionals with the graduate-level education that was unavailable in universities. CTI seeks to broaden employee capabilities and to explore new developments in systems engineering, computing, and information systems sciences.

The Thornwood facility in New York includes state-of-the-art computing, classrooms, a library, educational delivery systems and support facilities, an information systems center, individual rooms for 250 students, faculty and staff offices, an auditorium, a dining room, residential lounges, and recreational facilities. CTI also houses several laboratories used to augment instruction with practical application.

Candidates for CTI enroll in a competitive admissions process, and are evaluated on the basis of achievement and experience usually with the recommendation of their immediate supervisors. Students are encouraged to apply for college credit at schools that they select.

CTI also broadcasts live courses to other IBM locations via a satellite-based education delivery system. A tutored video instruction program, using videotaped CTI courses, helps meet the increasing demand for courses at distant IBM centers while keeping down the costs of maintaining CTI. Currently, CTI is developing programs for interactive videodisc-based learning systems, computer-based education, and computer conferencing.

Courses are taught by IBM professionals assigned full-time to CTI. Faculty have teaching loads similar to those of many faculty on college and university campuses, and are expected to conduct research in their fields.

In addition, CTI has established three formal university faculty residency programs. The University Faculty Guest Sabbatical Program allows faculty to pursue research related to key curriculum areas and to participate in the Institutes' educational programs as faculty members. The Visiting Professors Program allows faculty from universities with curricula similar to the Institutes' to examine, compare, and exchange ideas about educational activities. The University Faculty Guest Student Program is designed to assist universities in curriculum development by allowing campus faculty to participate as students in the Institutes' educational programs on a full-time basis.

Quality and Accountability: The Foundations of Collaboration

Jack Bowsher
Director of Education, IBM

At IBM, formulating goals and establishing long-range plans to meet those goals is used both to develop new products and to train employees.

A corporation s ability to move into new areas depends on the capability of its people. The recent inclusion of corporate education in IBM's annual planning and commitment process indicates the importance of training and education to the achievement of corporate goals. Education and training are the "delivery system of executives," essential to corporate growth, employee productivity, resource management, and the attainment of quality objectives. Changes, whether they involve a new product or procedure, must be preceded by training if they are to be effectively implemented. In corporations such as IBM, which historically has been committed to full employment and promotion from within, employees must be trained to continue in their current jobs. They also need education to prepare them to grow into more responsible jobs.

Cost Effectiveness

At IBM and other high tech companies, cost effectiveness and high quality are major concerns of corporate education and training staffs. The education function at IBM was centralized in 1984, in part because of the awareness of cost. Industrial education is extremely expensive. Half of the cost derives from the salary, benefits and, if necessary, travel expenses of the students. IBM spends between $800 and $900 million a year and employs 6,000 people full time for training and education The fact that it costs an average of $200 a day for each student sitting in the classroom rules out the option of a sloppy education program.

To bring the most cost effective educational delivery system into play, IBM has shifted as much as 50 percent of the teaching of factual material to computer-based training and self-study. The classroom should be where you apply the knowledge. That is where you get into the case studies, into the performance-based type programs.

> Between 1979 and 1984, an estimated 11.5 million people lost their jobs through plant closings, relocations, or technological innovations. An estimated 20 percent of those people need to improve their basic skills in reading, writing, mathematics, and communication if they are to find jobs with good chances for advancement.

Furthermore, IBM is evaluating its education and training more closely Most educators in corporations try to resist measurement In fact, most training directors cannot tell you how much it costs. They don't want to know They are afraid that if they know, somebody will cut the budget In our business, the area that has the finest training and education has the most measurements and, frankly, gets the most resources.

Finally, when IBM goes outside the corporation, it is looking for very high quality, customized, cost efficient courses. In discussing a partnership between industrial education and universities, you will find that the companies with money to spend and the desire for partnership are going to expect high quality. They are not going to be a bunch of sloppy amateurs, as some articles have suggested. The key is that we have to be very precise in stating what we need from you so that you can respond to us. Most organizations today are not that precise.

HIGHER EDUCATION'S PERSPECTIVE

Commission members Mary Walshok, Philip Nowlen, and Allan Ostar responded to the issues raised by the speakers from IBM While focusing on different aspects of possible corporate/campus collaborations, they urged that each sector identify its own role and interests, as well as those areas of shared concerns in order to make dialogue more productive

New Roles for Continuing Higher Education

Mary Walshok
Associate Vice Chancellor for Extended Studies and Public Service
University of California-San Diego

Higher education could learn some valuable lessons from industry, particularly in management planning, evaluation, and accountability. IBM's Education Division might provide a model for continuing education programs illustrating how to relate their own goals and objectives to the strategic objectives of their academic institutions.

It may be time for those in the field of continuing education to think of themselves in different professional terms. We have been very good advocates of the adult learner, the individual student We might want to see ourselves in a slightly different role and that is as the intermediary institutions between universities and the world of practice. The lifelong learning needs of society are no longer lodged in individuals but in institutions. The issue of adult and continuing education is not just a problem of the adult learner, it is an institutional issue

There are three key opportunities for collaboration between industry and academia. First, when a program is in the design phase, corporate and campus representatives need to work together to identify the skills and knowledge required and the best modes for delivery. Second, as knowledge needs change, continuing educators must become more adaptive, through planning and development, and by training their own personnel. Third, continuing education must become more accountable, developing criteria for evaluation beyond credentials, following up with users to gauge performance changes in students, and involving the corporate sector in ongoing reviews of needs and programs.

Toward a New Approach to Collaboration

Philip Nowlen
Executive Director, Office of Continuing Education
University of Chicago

The nature of the collaborative relationship between business and education must be defined. We need to get underneath it in order to discover the self interests on the part of corporations and universities that are served by real collaboration, rather than by a vendor-contract relationship. We need somehow to identify the self interests on both sides to enrich the mix sufficiently so as to free both sides from their mutual rigidities.

Corporations and campuses represent different cultures. Extended and in-depth contact, including internships, is needed to foster better communication. Both sides should seek to identify "corridors of ambivalence" through which to establish new relationships. The most promising and most politically neutral area for those of us on the university side is through the service of the social sciences to business and industry. Why not tap into the disciplines of anthropology, sociology, and international studies to aid the work of corporate advertisers, marketing representatives, and planners?

In exchange, universities can learn much from industry. Corporations could greatly assist us, if they knew us better, in terms of our own extraordinarily medieval strategic planning and management problems, and decision support systems in universities and higher education in general. This brand new level of strategic collaboration could make this country much more competitive.

Demographic Challenges for Collaboration

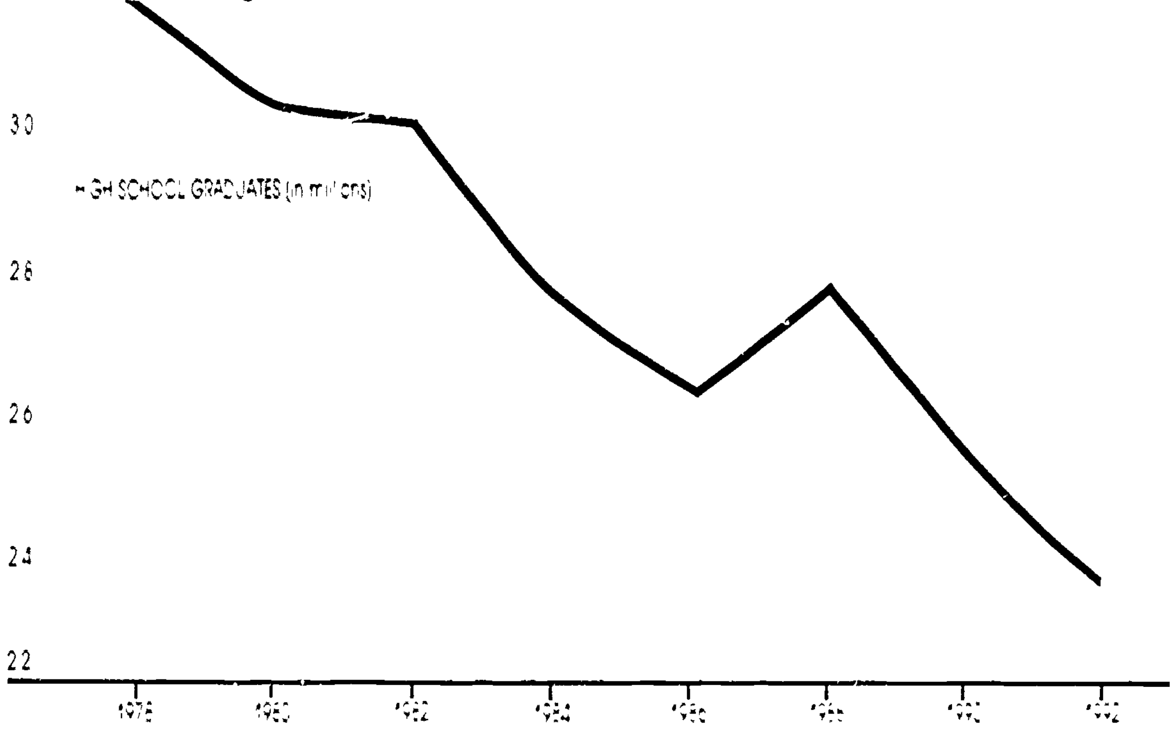
Allan Ostar
President
American Association of State Colleges and Universities

The interests of education and industry are converging. With the federal budget shifting from science education to basic research, where are we going to find the future supply of scientists, engineers, and mathematicians that we are going to need in companies such as IBM and indeed throughout our society? And, secondly, what can we do in our schools and colleges to give people who are not preparing to be scientists a greater appreciation of the role of science and technology in our society, so that they, in turn, can make intelligent public policy decisions?

The shortage of qualified teachers of science and mathematics in elementary and secondary schools is already critical. Mid-career high tech workers and retirees could be trained to teach not only in colleges and universities, but also in grades K-12.

The pool of high school graduates is shrinking, and minority youths, who are a growing proportion of new workforce entrants, have been traditionally under-represented in scientific and technical fields. Many of these youth will be attracted by the education benefits of military service. In the face of increased competition for high school graduates among higher education, industry, and the military, these sectors must actively collaborate. Our planners ought to be sitting down with your planners and with military planners to see how the entire society and the entire economy are going to be affected by these changes

High School Graduates: United States, 1977–78 to 1991–92



HIGHER EDUCATION AND LIFELONG LEARNING

Panelists Theodore Bickart, Michael Danchak, and Leon Botstein considered the implications for higher education of the increasing need for mid-career training and education of scientists and engineers from the perspective of university leaders. At issue are the difficulties technical professionals face in keeping current over the course of a career, the importance of a good baccalaureate education, the role of technology in enhancing education, and the most appropriate curricula for scientists and engineers.

Effective Education, Technology, and Teaching

Theodore Bickart
Dean of Engineering, Syracuse University

The question of cost effectiveness of educational opportunities is central to any discussion of corporate education for high tech industry professionals. The cost per class hour in a university classroom falls somewhere between the cost of premium, on-site corporate education and that of new high tech delivery systems such as those utilized by the National Technological University*. Higher education needs to decide which approaches to education and training are appropriate, to look at the cost of the various approaches, and to decide which ones the universities should and can provide. I do not believe that universities are necessarily cost ineffective. In fact, we are relatively cost effective, provided we can stay in the mainstream of technology as it is driving us forward.

Educators must creatively use a variety of technological means and teaching arrangements We have to use more technology to improve the quality of what we are teaching. If it also drives down the cost, hurray! Faculty traditionally have responded conservatively to the use of new technology in the classroom and should explore the myriad possibilities for delivering a single course, including tutored video, instructional television, live instruction, and possibly bringing in an adjunct right into the middle of a course, if somebody from industry can do a better job with a block of material. In the long run, this should drive the cost down. I like to think of this as video-enhanced instruction and I think we owe that to our students.

Colleges and universities must remain involved in the education of students beyond their years as undergraduates or graduates throughout the decades of their work experience. This process will help faculty stay relatively current. Similarly, faculty can remain up to date by actively seeking sabbaticals in the corporate world and by encouraging people from industry to come into the university.

Bickart: "Educators must creatively use a variety of technological means and teaching arrangements."

Reward systems at universities should not be changed too rapidly in response to industry's needs. High technology industries look to research universities for their premier talent. If we drastically change

*See description of NTU, page 26

the reward system, the top quality research associated with universities could move to industry and we may end up with just a teaching enterprise in our universities. Universities, however, should stop viewing faculty whose primary interest is in teaching as "second-class" members of the academy.

Regarding the "half-life" of engineering skills, the majority of the curriculum in an engineering education involves basic education that transcends the short half life of the tecnnical skills which comprise only about 30 percent of the curriculum. This concentration on the basics best prepares students to continue to learn throughout their careers.

Continuing education in the sciences is changing with more direct involvement by the faculty. The disciplines are going to have to participate more in the definition of what will go on in continuing education.

Knowledge Maintenance For the Professional

Michael Danchak
Dean of Engineering, Hartford Graduate Center

It is necessary to upgrade and refresh skills over the course of an employee's whole working life. We can't just grant the degree and send the graduate out the door. Whether we can put oak leaf clusters on masters or bachelors degrees, we need to instill the idea of coming back. Furthermore, the student pool is not limited to 18- to 20-year-olds, or six- to 22-year-olds. It goes all the way up to 70. The

Danchak: "I am advocating a 'knowledge maintenance contract' that is built on rigor, . . . it emphasizes the fundamentals."

commonly held notion that engineers begin to become obsolete by age 35 is ridiculous. Lifelong learning can prevent atrophy.

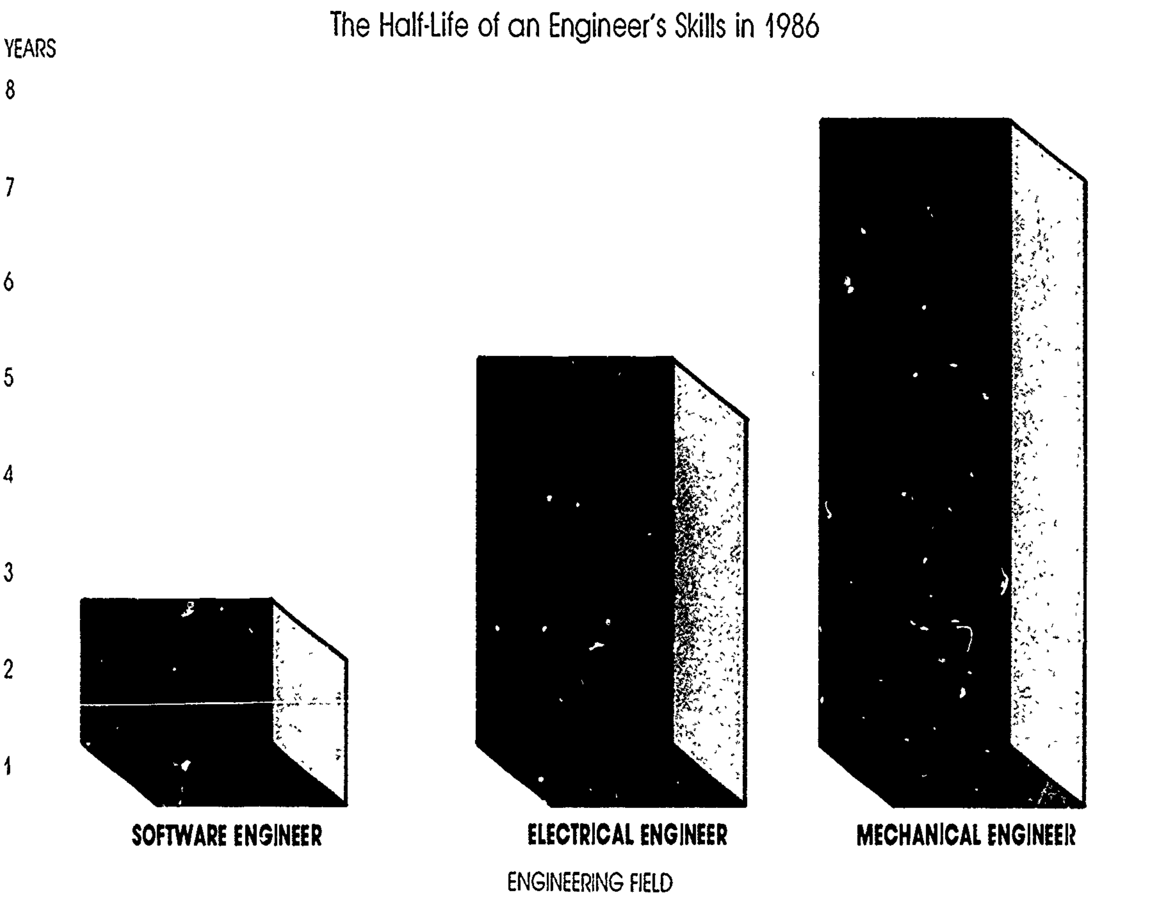
We have to be in a position to offer industry a choice which, in its terms, might be called a "knowledge maintenance contract."

This approach has three major components: 1) remedial education; 2) formal education, and 3) technical updates. Engineers and scientists need to forestall obsolescence through the study of "forgotten" knowledge as well as new technologies.

Very often, we must awaken old skills that have not been exercised recently. Older employees may need to review basic mathematics and scientific principles before attempting to understand the technical details of new technologies. They need to review, from time to time, subjects such as calculus or quantum electronics, knowledge they may not have used in some time.

Also, new graduates need to delve into narrow areas in much greater depth. This "first pass" through the cycle leads to a masters degree. However, people need periodically to return to the classroom, with all its homework and examinations, to keep an open mind regarding change.

Finally, technical updates must be integrated into the lifelong educational process. These updates may be of the survey type as well as in-depth


The Half-Life of an Engineer's Skills in 1986
YEARS
8
7
6
5
4
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1
SOFTWARE ENGINEER
ELECTRICAL ENGINEER
MECHANICAL ENGINEER
ENGINEERING FIELD

to allow the engineer to understand and contribute to the technology. This component may be the most amenable to instruction via computer or television. I am advocating a "knowledge maintenance contract" that is built on rigor; insofar as it emphasizes the fundamentals.

Corporations should re-evaluate their paths to career advancement. Too many engineers believe that the way to move up in the company is to obtain an MBA as their first graduate degree and become a manager When they are not promoted, they become disillusioned At least in the Hartford area, corporations are recognizing this and are saying that "the working degree" in engineering is the masters degree "We will consider funding an MBA after you have a subject masters "

Educators must look closely at what they teach We are in education, not in training. Fundamentals are important. We need to be responsive to industry but someone has to step back and say, "But should we be teaching 'oomlaut' manufacturing, or is there something fundamental under there that may be an application of manufacturing? Is there a more generic principle we have to dwell on?"

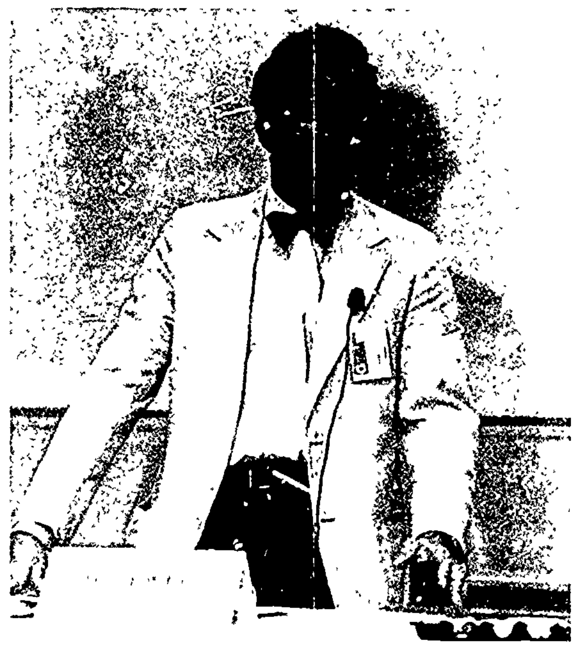
Technology must be used thoughtfully in education. The main role of faculty is to motivate students to pursue learning on their own. Use technology, but also keep in mind that just dispensing the information is not teaching, there is much more to the process than that I would like to encourage everyone to think of how we can challenge the students throughout their lifetime

The Limits of Technology

Leon Botstein
President, Bard College

It is ludicrous to assume that any technology can make education more efficient, or more productive, without fundamental human intervention. By definition, teaching is inefficient, human, and interactive Technology can supplement the teaching enterprise, but cannot fundamentally change it.

Quality undergraduate instruction provides the foundation for lifelong learning—programs should not be too plugged into jobs. If we train people in graduate programs in engineering and in undergraduate programs who are really well taught in the fundamental issues of science and mathematics, in the conceptual bases, what we call basic science, then their capacity to absorb efficient retraining in continuing education is that much greater. There is a tendency towards a surfeit of managers and certificates. We have become a society that we manage by protocols and certifications and not by evaluation of what people actually can do.



Botstein: "By definition, teaching is inefficient, human, and interactive. Technology can supplement the teaching enterprise, but cannot fundamentally change it."

EARLY RETIREMENT

Like the need for employee retraining, the trend toward early retirement presents opportunities for collaboration between industry and higher education. Some early retirements are the involuntary result of corporate realignments. In 1986 alone, corporations such as A.T. & T., Kodak, Exxon, General Motors, and CBS all used early retirement benefits as a way to reduce their work forces. In September 1986, IBM announced new early retirement benefits. The move was designed to improve the company's competitive strength by reducing costs and to allow IBM to preserve its full employment tradition.

But an increasing number of employees take early retirement voluntarily as a prelude to a second career. Retirements of all kinds reflect complex changes in our economy and society, and the patterns are sometimes contradictory. Dale Hiestand, along with George Anderson, Letitia Chamberlain, and Art Pumo, discussed these trends and the challenges they present to corporations and to educators.

University of Maryland University College

Many professionals make several career transitions over the course of their lives. College and university programs play an important role in facilitating these career transitions

Early Retirement: Implications For Higher Education

Dale Hiestand
Professor, Columbia University's
Graduate School of Business

Average retirement age has been dropping, yet recently enacted legislation seeks to make it possible for individuals to remain in the workforce longer. While it was once conventional wisdom to consider 65 retirement age, a significant proportion of men withdraw from the labor force as early as age 50. The proportion has been growing for a generation. In 1985, one in seven men aged 50 was no longer in the labor force, one in six men aged 60 was no longer employed, and the average retirement age was 63. By 1990, about 40 percent of the men may have retired by age 60, and the average age of retirement may be less than 62. With each generation, more women are in the labor force, peaking at age 50. But of women aged 60 or over, two of three are not employed.

Conflicting Pressures

This trend has been complicated by contradictory pressures at work in society. The trend in legislation has been to bar discrimination in employment because of age. In 1978, Congress made mandatory retirement before age 70 illegal. Then, in the autumn of 1986, Congress largely eliminated mandatory retirement at any age. Notwithstanding these laws, intense economic competition from abroad, along with domestic deregulation and antitrust actions, have forced many employers to cut their workforces through termination or early retirement.

Thus, retirees pursuing a second career are a heterogeneous group, and the responses to retirement are as varied as the reasons for it. For some it may be a liberating experience, while for others it can be a devastating blow to self-confidence. Middle-aged students who return to school may experience a pe... d of exploration or seek new forms of self-fulfillment. Students with serious mid-life choices may require not only career, but also psychological, counseling.

For those who enjoy the financial security afforded by generous retirement packages, a second career is not an economic necessity. Consequently, these secon... ...reerists may put a high prem...um on the quality of work, basing their decision on whether a job is interesting, personally satisfying, and whether it offers flexibility, rather than whether it is highly paid.

The Economic Costs of Early Retirement

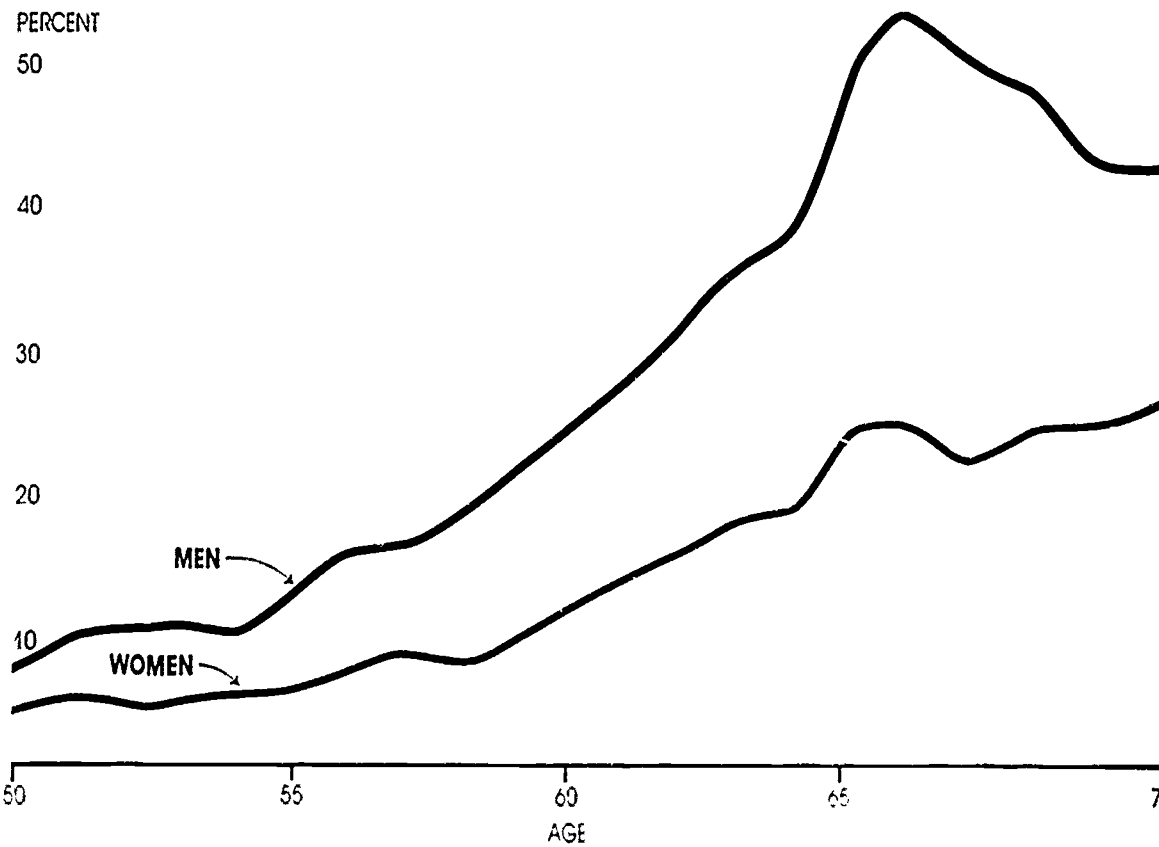
George Anderson
Manager of Corporate Education and
Retiree Relations, ALCOA

The issue is really one of longer life expectancy rather than early retirement. Along with tremendous opportunities for personal growth, longer life expectancy also involves enormous economic costs. We say our private pensions are well-funded. True. But the medical portion is not. The cost to fund the medical portion of pensions long-term is more than the cur...ent assets of all the major corporations in this country. ALCOA currently spends $100 million annually for the medical portion of retirement, and expects to spend between $300 and 400 million a year by the turn of the century. Ongoing health education is an economic necessity.

The ratio of workers to retirees is changing drastically. In 1950 49 workers supported one retiree, in 1985, the ratio was 1.7 workers for each retiree

By the year 2000, there will be 55 million Americans over the age of 65. Assuming that 5 to 6 percent of the employees take advantage of pre-retirement courses, thr... ...llion older students may seek educational oppo...unities long term if the right programs are offered.

Percent of Population with Pension Income, 1983



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Retirees as Students

Letitia Chamberlain
Director, New York University's
Center for Career and Life Planning

Our center counsels between 2,000 and 3,000 adults of all ages each year. We are just beginning to learn about the stages of adult development. When you talk about a group of 55-year-olds, you are talking about a group that is so diversified that our language has not yet caught up with us and neither has our education.

In American society, personal identity is so closely tied to work roles that retirement and loss of that identity often present a stressful transition. Psychological needs must be addressed. None of the education that we can offer will be useful to people unless anxiety is reduced and stress is handled.

Courses for older students must be tailored to the students' needs. Because they are wiser and more discriminating, they need sensitive teachers and need to be involved with their learning. Staff development is essential to providing their instructors with the requisite skills.

Active encouragement, planning, and anticipating are crucial for a successful transition from worker to retiree. I would like to see many more corporate/university collaborations. There is ample room for collaboration between the private and the university sector.

Second Careers

Art Pumo
Manager of Retirement Programs, IBM

Second careers will become the norm in society. What is new is that early retirement opportunities, the financial feasibility of it, longer life, and good health all lead to a second career. What's new is not that you can have a few more good years on the golf course. It's that everyone now foresees a future in our society where two careers, not one, will be standard for many people. We need help to prepare for that.

Corporations are already providing a variety of educational opportunities for employees planning to retire. IBM offers retirement-related education assistance from five years before to three years after retirement. In 1985, some 9,500 IBM employees and their spouses attended the corporation's Retirement Education Assistance Program. Recently, IBM offered opportunities for retirees to return to work on a temporary or part-time basis in order to ease the separation from co-workers and the workplace.

According to the United States General Accounting Office, white males and high school graduates have the highest rate of early pension receipt. Military pensions account for more than 50 percent of recipients under age 55. Approximately 50 percent of men and 38 percent of women receiving private pensions in this age group have disability-related benefits.

Pension receipt reaches a high of 51 percent for men at age 66. The zenith for women is 24 percent at age 70. The difference in pension receipt rates for men and women can be attributed to the fact that fewer women have extended involvement in the workforce. Many women restart their careers later in life, accounting for the later peak age for pension receipt.

Models of Corporate/Campus Collaboration

Pennsylvania Technical Assistance Program

The Pennsylvania Technical Assistance Program (PENNTAP) was started in 1965 by the Pennsylvania State University Office of Continuing Education and the state Department of Commerce. The program was designed to assist in the transfer of scientific and engineering information to the business community.

In 1972, PENNTAP expanded to assist with problem-solving in the public sector including local, state, and federal governments, schools and colleges, non-profit organizations, and health care groups. Today, Penn State operates 24 offices throughout the state.

Users pay no fees; the program is funded through the state's Department of Commerce and Penn State, which also provides administrative services. Other state and federal agencies co-sponsor the program on a project-by-project basis.

Inquiries are referred to one of eight technical specialists, chosen on the basis of their professional experience and ability to communicate. Specialists hold academic rank in, or are members of, Penn State. They work full time assisting in the transfer and application of technical information for PENNTAP. An advisory council recommends policies and priorities, and evaluates PENNTAP's efforts.

PENNTAP disseminates information through two avenues, a response method and an active approach method. When a private or public user requests assistance from PENNTAP, a technical specialist analyzes the problem to determine possible solutions. The specialist assists the user in applying the information and later receives an evaluation of the benefits derived from the PENNTAP connection.

In the active method, specialists disseminate new, available information by approaching potential users. Such active contact often increases business efficiency or avoids future problems by matching technical information sources with potential users.

Users report considerable benefits from their association with PENNTAP. In 1985, reported economic benefits exceeded $9.8 million. Although it is difficult to measure intangible benefits, a conservative estimate made by the organization calculates that for every direct dollar invested by the state and university in PENNTAP, an average of $17.7 was returned to the state's economy.

Penn State officials are committed to furthering the public good in the tradition of the land grant institution, but there have been other benefits from the highly publicized PENNTAP. Faculty members are used by many businesses as consultants, and the University receives donations of funds and equipment from businesses as a result of their involvement with PENNTAP.

Colorado State University/Hewlett Packard Software Retraining Program

Colorado State University (CSU) and the Hewlett Packard Company (HP) have cooperated to develop a retraining program for HP professional engineers. The HP Greeley Division broached the partnership idea with CSU in 1986 because it wanted to retrain mechanical engineers for careers as functional software engineers.

CSU's Computer Science Department, together with the CSU Division of Continuing Education, developed a highly intensive, 12-week computer science program on the CSU campus. Three four-credit courses address computer architecture, programming systems concepts, and operating systems. After successfully completing the courses, participating employees continue their computer science education by enrolling in the State University and Resources of Graduate Education (SURGE) program, an on-site videotaped program which leads to a masters degree in computer sciences.

CSU also provides several on-site undergraduate programs for Hewlett Packard employees at three separate locations. Whereas the engineer retraining program is held on the CSU campus to take advantage of the University's facilities and faculty, the undergraduate programs are all held on-site to provide maximum convenience to students. HP employees take the courses after work, thereby avoiding the problems of commuting to class. The courses are taught by regular CSU faculty who travel to the HP sites.

Both the Hewlett Packard Corporation as a whole, and individual employees have benefited from the relationship with CSU. The software retraining program is more cost effective than any the corporation could have mounted on its own. Moreover, the retraining program has enabled HP to retrain high quality employees and shift them to more promising positions within the corporaiton as the opportunities in their original fields diminish. The undergraduate program has updated the skills and knowledge of many HP employees in a setting that facilitates both academic and occupational endeavors.

Affiliation with Hewlett Packard has provided important benefits to CSU. The University has received equipment and donations from the company, and traditional CSU students have had access to HP experts, who have served as affiliate faculty members on campus. CSU faculty have increased their business associations and research opportunities in the corporate world through greater contact with Hewlett Packard personnel.

National Technological University

The National Technological University (NTU)—a non-profit corporation—was established in 1984 to meet the educational needs of engineers and technical professionals through satellite delivery of advanced education to the workplace.

During its first year of satellite curricula (1985-1986), NTU delivered more than 300 courses and 4,000 hours of credit instruction from its Fort Collins, Colorado center. While not a university, NTU does award its own masters degrees in computer engineering, computer science, electrical engineering,

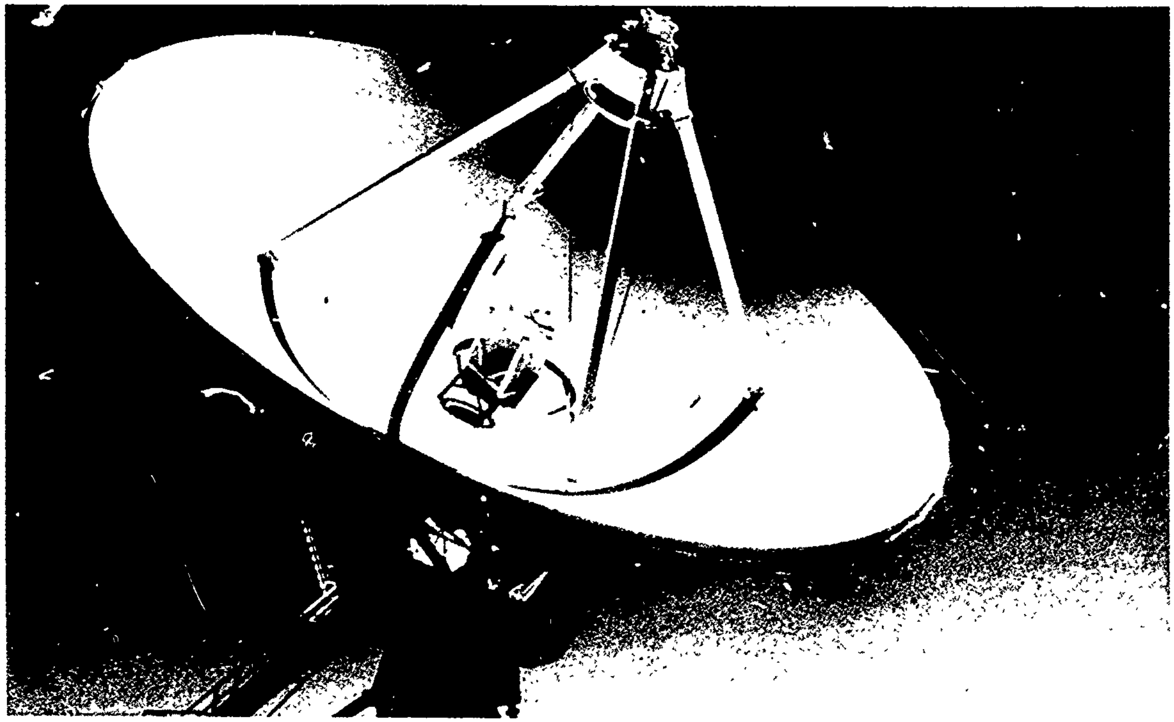

PHOTO Public Broadcasting Service

Participating universities in the National Technological University (NTU) system have satellite uplinks which facilitate the transmission of engineering courses as well as faculty conferences, student advising information, and special programming.

engineering management, and manufacturing systems engineering. Many non-degree students, however, take courses to upgrade their technical skills for specific job needs.

NTU delivers courses from 22 participating universities, all of which are members of the Association for Media-Based Continuing Education for Engineers (AMCEE). Experienced faculty from such institutions as Boston University, Michigan Technical University, and the University of South Carolina serve as instructors. Instructors are paid on a per-student formula by NTU, and universities receive tuition per semester hour for the courses they offer.

Participants must be sponsored by their employers, with the sponsoring corporation providing the on-site classroom. NTU acts as a link between the students and the universities, coordinating course schedules, tuition and fees, and student support services. The logistics of homework and grading generally are handled by the continuing education division of the university delivering the course.

Most courses are recorded at the universities and then transmitted to the students at their work sites. Live teleconferences, computer conferencing, and electronic mail facilitate instructor-student communication.

Corporations find that satellite courses are convenient and flexible, and that on-site delivery greatly reduces the costs of retraining employees for constantly changing technical positions. Although the turn-around of homework is a problem for this complex network, participating universities have reaped many benefits from their association with NTU. The satellite medium enlarges a program's audience, and greater exposure to business increases the prestige and demand of the university's courses. Because most courses are recorded, universities can maximize their course delivery at minimal cost and logistical complexity.

The UCSD Executive Program for Scientists and Engineers

The University of California-San Diego (UCSD) Executive Program for Scientists and Engineers (EPSE) addresses the special needs of senior scientists and engineers wishing to expand their managerial capabilities.

Initiated in 1983, UCSD University Extension worked closely with industry leaders from the San Diego region to develop a program that takes advantage of the strengths of both industry and education. The program builds on the strengths of the University and its on-campus resources, while incorporating advisors to focus the program on the specific needs of businesses. This has assured maximum applicability of the coursework to technical management.

EPSE is a nine-month, non-credit program, with classes held once a week for seven hours. Participants receive instruction in managing professionals in high technology companies; developing tools for organizing, planning, and control; and planning and implementing strategy. Courses are taught by UCSD and San Diego State University faculty, as well as by members of local industries selected by University Extension.

The program is designed for the professional engineer or scientist who holds, or is about to assume, a managerial position. Participants are company-nominated professionals with at least five years experience who hold baccalaureate or masters degrees in an engineering or scientific field. Some participants hold doctorates.

Positive media coverage has helped to promote UCSD University Extension in the field of executive and professional education. UCSD now offers a Professional Certificate in Engineering Management and is developing an executive program for engineering and research and development vice presidents. The expanded partnership between UCSD and area firms has given the University the experience necessary to cater to specific business needs. Since the summer of 1985, University Extension has offered eight yearly seminars through the CONNECT program. CONNECT uses the resources of the University to link high-tech entrepreneurs to the technical, managerial, and financial resources they need by taking advantage of UCSD's extensive business associations.

University of Illinois-Motorola Masters Programs

In the course of the last decade, the University of Illinois at Chicago (UI) has developed masters degree programs in mechanical engineering, electrical engineering, and computer science for Motorola Corporation professionals wishing to acquire advanced technical skills.

The Division of Continuing Education at the University of Illinois is responsible for initiating the cooperative arrangement. The programs are now overseen by full-time UI administrators. A committee of University faculty and industry representatives determines the course schedules and all classes are held at Motorola's Schaumburg, Illinois site, 40 miles from the UI campus.

Each year, approximately 100 Motorola professionals enroll in the program. Each class meets twice weekly for two hours during regular work hours to accommodate participants. Class size varies from as few as seven students to as many as 35. A student can earn a masters degree after successfully completing 12 courses, including a thesis or research project. On UI's quarterly, year-round system, a degree can be obtained in about three years, although many participants take longer to complete their course of study.

UI faculty participate in the Motorola programs on a voluntary basis. The courses are counted as part of the regular teaching load of the faculty, so no additional compensation is received other than transportation costs. Instructors are available to meet with students before and after class to answer questions or alleviate any logistical problems that may develop.

The Motorola program yields important benefits to the University as a whole. As a result of the programs, several faculty members have become technical consultants for Motorola. Such faculty are able to stay abreast of state-of-the-art technology in the workplace and pass along the experience to their traditional students on campus.

The visibility of the University of Illinois at Chicago both within Motorola and elsewhere in the high-tech Schaumburg area has been enhanced. As a consequence, the University has received new industry scholarships, equipment donations, and co-op programs.

Motorola also benefits from the relationship with UI. Professional technical skills are updated at a fraction of the cost of an in-house program. The corporation taps into UI resources more easily than before through personal contacts with faculty and administrators. In so far as technical skills tend to become obsolete very rapidly, the masters degree programs have helped Motorola recruit new professionals who are more cognizant of the need to update their education.

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