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Advantageous Liaisons

Connections between academia and industry, both foreign and domestic, are crucial to the health of U.S. research, education, and competitiveness.

Last June, I gave congressional testimony on the subject of technology transfer, paying special attention—as requested—to possible conflicts of interest in collaborations between research universities and companies.

In the questions that followed my summary statement, many of the representatives present—members of the Subcommittee on Human Resources and Intergovernmental Relations of the House Committee on Government Operations—focused specifically on MIT's Industrial Liaison Program, a fee-for-service activity whose purpose is to encourage the development of mutually beneficial ties between MIT and the industrial community. In particular, they were concerned that our policy of admitting foreign firms into the program threatens to undercut our nation's ability to compete.

Such concern is understandable, stemming as it does from the disappointing performance of U.S. products and services in today's global markets. But to question the open exchange of people and information at our research universities, or to consider barring foreigners from certain activities on our campuses, shows that the link between universities and industry, and, more importantly, between academic research and industrial competitiveness, is greatly misunderstood.

A two-way street

The concept of a formal program to link campuses with the corporate world emerged in the late 1940s when Dr. Eger V.Murphree, research director of Esso Development Corporation (Standard Oil of New Jersey) suggested to James R. Killian, Jr., then president of MIT, the idea of offering companies some kind of service—activities to help them stay abreast of what was happening in specific areas of research—in return for contributed funds.

The program began in August 1948 with seven founding members: Standard Oil of New Jersey, Humble Oil, Standard Oil of Indiana, Socony-Vacuum, Stone and Webster, A.O.Smith Corporation, and

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the Texas Company. By the end of one year, membership had grown to include Phelps Dodge, Union Carbide, Cities Service, Alcoa, Goodyear, and IBM. Within five years, there were over 60 members. Today, MIT's Industrial Liaison Program (ILP) has more than 250 members from 19 countries.

Such services have by no means been limited to MIT. Early liaison programs were started at several other research universities, including the California Institute of Technology (1949), Stanford University (1950), the University of Wisconsin (1958), and the University of Michigan (1959). Today, according to a recent study conducted by the National Science Board (NSB), liaison programs are well established at some 40 universities in the United States. Total membership comprises 2,848 U.S. organizations (85 percent) and 496 foreign companies (15 percent).

But despite the value of such programs, to industry and academia alike, corporate support of university research was not dominant in the United States during the post-war period. It was eclipsed by increased funding from a variety of federal agencies, including the Department of Defense, the National Science Foundation, the National Insitutes of Health, the Atomic Energy Commission, and, later on, the Department of Energy. The scale and character of academic research was transformed completely as federal funding soared from just a few million dollars a year before the war to well over $2 billion annually by 1980.

Meanwhile, however, industry showed a growing interest in research and development. In 1965, for example, industry sponsored just 35 percent of all R&D in the nation, and the federal government sponsored 65 percent. By 1980, industry's share had passed 50 percent. Thus it was altogether natural that in the 1980s, when federal funding declined in some key areas of research, universities turned to industry for support, and liaison programs spread quickly. The NSB study observed that 70 percent of them had been founded since 1980, and most had grown rapidly.

Although the details of these programs differ from campus to campus, their services are similar. In general, they are designed to give members a "window" on emerging technologies—a convenient way to get in touch with faculty experts and to keep up with current research programs. The services of MIT's Industrial Liaison Program are fairly typical. They include the following:

Meetings with faculty and staff. The program helps arrange meetings, between representatives of a member company and appropriate members of MIT's faculty or research staff, to discuss an emerging area of science or technology, to answer specific questions about research trends in a particular field, or to obtain the view of an independent expert on a particular technical problem a member firm has encountered.

Faculty visits to member companies. As prominent members of the international research community, faculty and research staff travel extensively. When an MIT researcher travels near a facility of a member company, and that person and firm have mutual interests, the ILP can arrange a visit. On such an occasion, the visitor may give an overview of MIT research in his or her field, or meet with company staff to discuss work in progress there.

Symposia. The program produces a yearly series of over 30 seminars and symposia that are offered to members. These focused meetings feature presentations by faculty and staff, as well as by industry experts, on a broad range of emerging issues in science, technology, and management that are of interest to the business community.

Publications. Members receive a monthly newsletter that highlights important research advances, identifies promising new areas of investigation, describes patent licensing opportunities, and keeps readers up to date on events and activities on campus. In addition, it lists the latest research reports and papers by faculty and staff. Each year, the program also publishes a comprehensive listing of the research projects under way at MIT.

Links to other resources. The ILP also works to help its members take advantage of the rich variety of resources and activities at MIT—such as libraries. continuing education programs, seminars and lectures arranged by other groups on campus, recruiting services, and industrially supported research consortia—that may be of interest to them.

In exchange for such services, a university either charges a fee or requests a contribution. Although such funds are intended to support liaison program activities, most programs barely break even, and some need to be augmented by university operating budgets. It's money well spent, however; for both the university and industry, the value of these activities goes far

beyond the simple quid pro quo of the basic services. Liaison program services can lead to longer-term and more in-depth relationships between universities and industry, which are the most rewarding out-come for all involved.

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For faculty, meetings with representatives of member companies—both on and off campus—help them to keep up with the latest trends and developments in industry. This input is of value in inform ing and shaping educational initiatives as well as research programs. Contacts made in these meetings can also lead to industrial support and participation in faculty-guided research.

For example, companies may decide to sponsor research that complements or augments their in-house efforts. Basic or exploratory research is much more risky than applied research, and few firms can afford to invest in the necessary staff and facilities. Instead, they often fund promising research at a university, either as a sole sponsor or as a member of a consortium, with the understanding that results will not be proprietary.

Close ties to university programs are also a good way for companies to build relationships with prospective employees among the students. The principal product of a university, after all, is its graduates. And it is the graduates who are the most effective means of transferring technology from universities to industry.

It is important to note that access to the faculty, the research programs, and the knowledge generated at a university is by no means exclusively channeled through liaison programs. As members of the international academic community and as recognized leaders in their fields, faculty are free to publish their ideas wherever they want and to talk to whomever they please.

To encourage the development of relationships that augment professors' abilities as educators and researchers, most research universities allow their faculty members to devote up to 20 percent of their time to outside professional activities. And in fact, it is not unusual for contacts with industry to occur apart from the liaison programs. At last count, 282 companies were funding contract research at MIT. Of these, 175, or 62 percent, were not members of the Industrial Liaison Program.

Ties to the international community

The research universities of the United States are the envy of the world. No other nation can match them either in number or in quality. But although the system is uniquely American, its strength arises in large part from its participation in the international cooperative network of organizations that conducts the world's basic research. Applied research, most often performed by government labs and industry, is directed toward more immediate commercial or national goals and can therefore be proprietary or classified. This is not the case with university research, which is principally motivated by intellectual challenge instead of specific or shorter-term needs.

Data and other results from the international research community are shared among investigators the world over in journals, professional meetings, informal gatherings, and casual conversations. Even the smallest incremental scientific advances are published as quickly as possible, not only to help establish professional reputations but also to allow colleagues to review, test, and build on the information.

This pool of fundamental knowledge is inherently accessible to researchers everywhere. The companies of foreign nations, in joining liaison programs and building ties to American research universities, are therefore not taking away any results that "belong" to the United States. They are taking advantage of an international resource that draws on the contributions of the best minds, wherever they may be.

Moreover, interaction between universities and industry is a two-way street. One of academia's chief motivations in striking up relationships with foreign firms is to learn from them, as we do from U.S. companies. For example, a 1986 survey of MIT faculty members found that they are extraordinarily active in learning about Japanese research results. Among the 31 percent who responded, 90 percent said that

Japanese developments in their field were very important, and over a third said that exposure to Japanese research had greatly contributed to their work.

Contacts with foreign firms also reinforce one of our key educational missions: to educate the nation's professional work force. In a few short years, students must absorb both the intellectual underpinnings and the specific skills that will allow them to contribute productively and creatively to our society. The research conducted at many of our universities is undertaken as an integral part of that educational process. In fact, most of the work in university laboratories is actual ly carried out by graduate students, under the supervision of faculty. This close and deliberate coupling of education and research is a unique strength of American research universities.

Because the overwhelming majority of these students end up working in industry, universities require a broadly based understanding of current industrial practice in order to prepare them properly for their careers. Contacts with industry that are afforded by liaison programs and other university-industry activities are important vehicles for nurturing and developing that understanding. Moreover, in fields such as semiconductors, where industry is at the leading edge of basic research, it is especially critical for university educators and researchers to maintain their relationships with the corporate world.

In other words, it is the obligation of educational institutions—to our students in particular and to American society in general—to stay in close touch with the international industrial community. But all too often these days, what constitutes best business or research practice is found in European or Japanese companies, not in U.S. firms. In today's complex and global economy, we must teach our students what it takes to be a success, even if some of the examples we use are not American.

A call to U.S. industry

Any kind of alliance with an academic institution is an investment in the future. Research universities in the United States have long played a central role in coming up with many of the basic new concepts that have shaped our society, but turning these concepts into processes or products has usually been a long and expensive procedure, requiring years of further analysis and development. The principles of molecular biology, for example, surfaced in the 1940s. It was not until the 1970s, after decades of research, that the first techniques of genetic engineering were developed. And only now, after an infusion of billions of dollars of venture capital, are the first bioengineered products appearing in the marketplace.

Because of the fundamental nature of research conducted at universities, and because of the way its results are shared with the international research community, its principal value to industry is in the long-term perspective it affords. It serves as an indicator of potential avenues to monitor or investigate.

But knowledge alone is not what builds a business; it's what you do with it. And these days it's often not the innovation but the *implementation* that brings success in the marketplace. In addition to considerable vision, it takes years of applied research, much money, and a great deal of patience to develop a VCR for the consumer market, to produce a more powerful memory chip, or to build a better automobile.

These realities have not been lost on our competitors. The Japanese in particular have proven themselves adept at scouring the world's pool of new knowledge, objectively exploring and evaluating the potential of novel ideas, and boldly investing in the ones with the most promise. As part of this process, they have sought to establish ties to many American research universities. They join liaison programs, they sponsor on-campus research, they send visiting scientists to university laboratories, and they even provide funding for university endowments, helping to maintain the long-term health and productivity of the resource.

In contrast, many U.S. firms have been much more reluctant to invest in the longer-term potential of emerging technologies. And they are much less willing to seek out and pursue ideas that come from outside their own laboratories, even from U.S. universities. Many faculty members are complaining these days that whereas U.S. firms have resisted their pleas to support novel research programs on campus, Japanese firms are often standing in line.

The Japanese aren't stealing ideas from us; they are just more willing to pay the up-front costs of studying, developing, and implementing them. We cannot fault the Japanese for taking advantage of the broadly accessible resources of the international research community. Nor can we attempt to build walls around our

universities. Not only would it be extremely difficult to keep the fruits of university research at home, but cutting ourselves off from the creative ideas and insights of the people of other nations would be like poisoning the town well so that our neighbors couldn't drink.

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American industry must adjust to the fact that many of the best new ideas and approaches are coming from other quarters. Like its Japanese counterparts, it must pursue the concepts that look the most promising—wherever they come from—and adopt the practices that work best. But ironically, one of the strongest sources of ideas is right under our domestic industry's nose; the United States may have lost its competitive edge in some markets, but its university system is still unequaled. Not only must we preserve the creativity of this resource, we must also come up with innovative ways to encourage our industries to take full advantage of it.

We can get there from here

Of course, the United States is not Japan. The operation of our country's financial markets makes long-term investments in R&D more difficult. And it would be difficult for the U.S. government, in pursuit of broad economic objectives, to support large-scale industrial collaborations in the way that the Japanese government can. But although we shouldn't expect to radically transform the way we conduct business, there are nevertheless a number of practical approaches for helping our industries to take a longer-term view:

Train managers in technology. About 70 percent of the top manager in European and Japanese industry have technical training. In U.S. industry, the corresponding figure is only 30 percent. In a world where technology plays a central role in virtually every industry, it is crucial that executives have a broad appreciation of the goals, techniques, and ultimate rewards of scientific and engineering research.

The responsibility for dealing with this problem lies with universities as well as with industry, and at MIT we are experimenting with one promising approach. In 1988, we formed the Leaders for Manufacturing Program—an alliance of our School of Engineering, the Sloan School of Management, and 11 U.S. manufacturing firms—for the purpose of training leaders armed with both the management and the technical expertise needed to put innovations to work.

But even the best of intentions must be backed by commitment. A crucial facet of the Leaders program is that the participating companies have agreed not only to support its training efforts and to participate actively in its intellectual development, but also to provide attractive career paths for the program's graduates.

Learn to learn from others. One of the toughest roadblocks to overcome on America's path to restored competitiveness is industry's "not invented here" syndrome. There have been countless stories of U.S. firms failing to pursue novel ideas coming out of American universities, only to find them incorporated in Japanese products or processes a short time later.

Developing closer alliances with research universities—for example, by sending key researchers to campuses under mutually agreeable circumstances for a reasonable period of time—is only part of the solution. We must train ourselves to look even farther than our own backyard, building bridges to the idea-generating institutions of other nations in order to keep abreast of the latest advances the world over.

Industry must show its commitment to this perspective by providing rewards and incentives for employees with international experience and knowledge of foreign languages, cultures, and ideas. But again, as the breeding ground for tomorrow's leaders, universities can play a key role, and they can do far more than reinstate language requirements.

Just last November, for example, Stanford opened up a new campus in Kyoto, Japan, with two programs aimed at helping students from a variety of fields gain a better understanding of the Japanese culture. Another, longer-established effort (since 1981) is the MIT-Japan Program, which first provides engineering

and science students with Japanese language skills and cultural education, and then places them in Japanese industry, government, and university research facilities to acquire first-hand experience in that country's methods of research, technology development, and manufacturing.

Foster creative collaborations. U.S. industry, universities, and government all maintain superb research operations, yet rarely do they combine forces in a sustained and effective way. We must encourage the various members of this extended research community to cooperate for the long-term good of the nation without compromising their own special goals.

An excellent model for such collaboration is the National Science Foundation's innovative Engineering Research Center program. Initiated in 1985, it has been instrumental in stimulating ties between American industry, universities, and other organizations by requiring active industrial participation and support. These centers—to date, there are 17 of them at campuses across the nation—embrace a wide range of strategically important fields. For example, a center focusing on Hazardous Substance Control was established in 1987 at UCLA. The center brings together university researchers with a team of companies, each pledged to provide up to $30,000 a year in financial support in addition to participating in personnel exchanges. Four state agencies also provide test sites, facilities, and personnel in support of the program.

Other centers, just to cite a few, include Compound Semiconductor Microelectronics at the University of Illinois, Biotechnology Process Engineering at MIT, and a joint venture on advanced combustion at Brigham Young University and the University of Utah.

Expand continuing-education programs. In many critical fields, such as electrical engineering, new developments are coming along at such a rapid rate that even recent am slipping the state of the art. Stanford University's Televised Video Instruction program, which allows faculty to teach classes at remote industrial sites without leaving the campus, is an excellent example of a novel approach to this problem. MIT's Center for Advanced Engineering Study, which offers an on-campus Advanced Study Program for experienced scientists and engineers as well as a series of self-study videotapes on a wide range of subjects, is another example. Such efforts must be expanded, both in scope and in number, so that industry and the university community may work together to keep our nation's scientists and engineers productive throughout their careers.

Support basic research and upgrade facilities at universities. We must ensure that our nation's universities remain the best—not only to maintain U.S. leadership in science and engineering but also to continue providing a window on the latest advances in basic research and entering technologies worldwide. This role of the university system requires the continued support of a wide range of basic research by the various agencies of the federal government. It follows that funds must also be made available so that our university laboratories are housed in modern facilities and have access to the latest equipment.

Make R&D tax credits permanent. Few doubt the value of research and development in the generation of new business opportunities in today's high-tech world. Yet according to a recent survey by the National Science Foundation, industry's R&D spending in 1989 fell in real terms for the first time since 1975, largely as a result of mounting cost pleasures. Though financial incentives such as federal tax credits can encourage American industry to expand its commitment to the continuing creativity of our nation's laboratories—both on campuses and in-house—Congress has unfortunately failed to make the tax credit permanent since it was first passed in 1981. The resulting uncertainty in the tax climate has made it more difficult for companies to make plans for long-term investments in R&D.

Develop long-term links between the campus and the corporate world. Because of the nature of basic research, it is dangerous to count on either immediate or specific rewards. Our experience at MIT has shown that the most fruitful research relationships between universities and industry develop continuously over a long period of time. For nearly seven years, for example, Du Pont sponsored basic research in our chemistry department on a new class of radioactive isotopes that were ultimately determined to be extremely useful as agents for detecting heart disease. This relationship has been just one of several between

MIT and Du Pont. The lesson here is for American industry to be curious, to be patient, to keep its eyes open to the possibilities that may emerge, and to pursue objectively and aggressively any opportunities that do arise.

Many of the examples cited in the above suggestions show that we are not short on ideas or innovations. A number of programs obviously exist already, and they are helping us to strengthen the ties between academia and industry—both foreign and domestic. In the battle to boost our nation's productivity and to sharpen our competitive edge, the connections between our nation's universities and the academic and industrial communities of other nations are not part of the problem; they are part of the solution.

The real issue for the United States is not whether or not we should bar foreign nations from our research universities. The challenge is to ourselves. We must come up with creative ways to overcome the barriers that perpetuate our short-sightedness, thereby encouraging our industry to take full advantage of its own great resources. It is my hope that the recent congressional inquiry will serve to highlight this critical national problem and spur us all into concerted and constructive action.

Recommended reading

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