

**The International Relationships of MIT in a  
Technologically Competitive World**

**Faculty Study Group, Appointed by the MIT Provost, on the  
International Relations of MIT**

**Eugene Skolnikoff, chair  
Rudiger Dornbusch  
Arnoldo Hax  
Nancy Hopkins  
Eric Johnson  
Arthur Kerman  
Philip Khoury  
Richard Lester  
Nicholas Negroponte  
Jack Ruina  
Richard Samuels  
Kenneth Smith  
David Hart, staff**

**May 1, 1991**

**The International Relationships of MIT in a  
Technologically Competitive World**

**Table of Contents**

|  |    |
|--|----|
| I. Introduction  | 1  |
| II. The historic relationships and principles of MIT   | 2  |
| III. What has changed?                                 | 5  |
| IV. General principles                                 | 8  |
| V. Specific international relationships                |    |
| A. International students, alumni and faculty          | 11 |
| 1. Undergraduate students                              | 12 |
| 2. Graduate students                                   | 13 |
| 3. Alumni  | 15 |
| 4. Faculty   | 18 |
| B. Access to research at MIT                           | 19 |
| 1. Visiting faculty, post-docs and research scientists | 21 |
| 2. Support of research                                 | 24 |
| 3. Faculty consulting and off-campus visits            | 27 |
| 4. Commercialization of results of research            | 29 |
| 5. Gifts   | 29 |
| 6. Licensing of M.I.T. patents, start-up companies     | 31 |
| 7. The Industrial Liaison Program                      | 32 |
| C. Cooperation with institutions in other countries    | 36 |
| D. Public service and other programs                   | 37 |
| VI. Process  | 40 |

**The International Relationships of MIT in a  
Technologically Competitive World**

**Faculty Study Group, Appointed by the MIT Provost, on the  
International Relations of MIT**

**May 1, 1991**

**I. Introduction**

The research universities of America provide education and scholarship of a quality that is the envy of the rest of the world. They have educated generations of students to contribute to industry, government, and to the universities themselves with advanced knowledge and skills; and they have contributed to the leadership of the U.S. in scientific and technological endeavors that have served the nation's economic, security and social purposes.

Today, there are new pressures and opportunities facing research universities. The social, economic and political setting in which they are embedded has changed dramatically, perhaps most strikingly in international affairs, as the scale of interactions among national economies and societies, the change in the security situation, and the worldwide growth of competence in science and technology have altered many traditional relationships. No country, no industry, no institution in society can ignore the effects of those transformations, nor the problems they pose for the wise conduct of affairs. Universities, with the responsibility for education for the future, must be responsive not only to what has already been experienced, but equally to the implications for tomorrow that will significantly affect all aspects of national and international affairs.

In this altered setting, universities must confront compelling new challenges. They must decide how best to prepare students for a world that is very different from that their teachers faced as students, and how to organize scholarship and education, particularly in science and engineering, in a world of intense economic competition among nations that is increasingly driven by the growing strength of science and technology abroad. As the relationship between university research and education and the nation's economic vitality seems to grow ever closer, the research

universities of the U.S. face increased scrutiny from a concerned public and may have to shoulder new and unfamiliar responsibilities. The national and international roles of these universities, in the past seen as mutually supportive, at times have the appearance of being in competition, with questions raised about the appropriate relationships that universities should have with foreign students, scholars, universities, business enterprises, and governments.

At MIT, these questions are particularly important, not only because of this institution's place among research universities, but also because of MIT's long-standing commitment to effective transfer of knowledge to the society at large, its large international student enrollment, and its extensive international ties and activities.

Accordingly, a Faculty Study Group was established in 1990 by the Provost, John Deutch, to examine the issues that are raised by this new situation, to advise the Institute Administration and Faculty on the general principles that should guide MIT's international activities and relationships, and to suggest any revisions in policies and activities that should be considered. We have interpreted our charge to focus primarily on the issues raised by the economic implications of research and education, but recognize that there are other intellectual aspects of the subject deserving attention. In particular, we consider curricular issues, especially with regard to the international dimensions of the undergraduate program, to deserve intensive consideration by the Faculty and Administration.

## II. The historic relationships and principles of MIT

To establish the context for consideration of guidelines for the future, it is necessary to start from the past, to identify the important relationships and principles that have guided MIT until now.

From its establishment in 1861, MIT had a broad set of goals that emphasized both education and service to the community. Its focus was to be not only on the preeminent goal of providing the highest quality of training, but also on ensuring that technology be geared to the practical needs of society and made available for use. This stance was expressed in the original vision of MIT's founder, William Barton Rogers, and in its charter as a land-grant institution, which carried certain specific

obligations. Other public and private land-grant institutions (and other colleges as well, particularly those that grew from a religious base) share that explicit commitment to serving social needs.

The Institute recognized from its earliest days the importance of quality in its faculty and research as the key to its success in teaching and in the development of technology. It was this principle that led the Institute to be the originator of several new fields of technology, to be able to develop first-class scientific competence in the 1930s, and to be able to carry out successfully (in response to Government request) the enormous expansion of educational plant and research during the Second World War. The commitment to quality as a governing idea is deeply embedded, and it is expressed in a variety of general procedures designed to ensure the highest possible level for both faculty and students. It contributes as well to the integration of research and teaching, not only at the graduate level, but as part of undergraduate education as well.

In the conviction that open communication of the results of research is central to excellence in education, the functioning of science, and the effective transfer of knowledge, the Institute is committed to publication of all research, and to open access to the work of its laboratories and centers. Proprietary research was occasionally allowed under special circumstances at MIT before World War II, but has long since been prohibited. Classified research on the campus, which was introduced in the large wartime laboratories at the Institute, was accepted in the atmosphere of the Cold War until the 1960s. No classified research has been accepted on the campus since that time.

MIT's interest in practical applications meant that from the start the Institute had close ties to industry, and saw the transfer of knowledge from the laboratory to the world of commerce as an important operational goal. This has led to a variety of policies and activities, such as encouragement of faculty consulting for up to one day a week, faculty and student initiatives in the startup of new companies, industrial support for research, student internship programs with companies, an aggressive patent/licensing activity, the establishment of the Industrial Liaison Program in 1948,

and initiation of other industry-oriented activities.<sup>1</sup> MIT has incubated many institutional experiments and collaborations over the years, and its ability to respond to new problems that cross disciplinary borders often sets it apart from other universities.

The Institute has always strived for an atmosphere of non-discrimination that rejected distinctions other than those based on intellectual grounds. As an American-based institution, MIT naturally had more contacts with American industry and students than with those from other countries. However, until the Second World War, open communications with science and technology abroad, and welcoming of foreign students at MIT, proceeded without any bar. Wartime and postwar conditions altered that situation for a period of time, but recent decades have witnessed an enormous expansion of the international involvements of MIT.<sup>2</sup>

After the war, Federal funding became an important part of the financing of research at the Institute, as it did at all research universities. This funding was seen not only as a way of sustaining the research base that had been created during the war, but also as a response to the requirements of the Federal Government for research and development on subjects that the Government determined to be in the national interest. Federal support of research in the last two decades has been as high as 86% of the Institute's research budget; it has been gradually decreasing as a proportion of the total, standing at 75% in FY 1990.<sup>3</sup> Industrial support of research is rising as a proportion of the whole, reaching about 15% in FY 1990, up from 5% in FY 1974. There is no realistic expectation, however, that industrial support can ever replace more than a portion of Federal support.

---

<sup>1</sup> A 1989 Bank of Boston study, "MIT: Growing Businesses for the Future," (Economics Department, Bank of Boston), for instance, showed that the 636 Massachusetts businesses founded by MIT-related individuals generated about \$40 billion in annual sales and employed approximately 200,000 people in the state.

<sup>2</sup> However, even in the wartime and postwar periods, the faculty was internationalized by an influx of European educators and researchers.

<sup>3</sup> The total Institute on-campus budget has two major components: research and academic. The academic portion is provided mainly from non-government sources, including tuition, fees, endowment income, and gifts; it was \$338 million in FY 1990. The campus research budget was \$306.4 million that year.

As the postwar Federal relationship grew, MIT's traditional commitment to public service became an even more important element in the Institute's activities. Although the core of that commitment continues to be carried out through the performance of education and research at as high a level of quality as possible, there have been many examples of direct service over the years: programs to revise high school science curricula, to assist universities in developing countries, to give special attention to problems of American industrial productivity, and a wide variety of others. The largest single response to a request from the Government after the war was the agreement to found and manage the Lincoln Laboratory.<sup>4</sup>

### III. What has changed?

The environment in which MIT has been functioning has changed in significant ways in recent years, leading to new programs and practices, and in some cases, challenging traditional principles. The most important of these changes can be briefly summarized.

First, the new level of international integration of societies and economies has been accompanied by the globalization of industry, easier and more extensive communication across borders, increased dependence within any country on developments and decisions in others, and growth of issues and technologies with worldwide dimensions. With this higher level of interdependence have come difficult international problems in economic, environmental and security areas, and a wholly new level of interaction in science- and technology-related issues across national borders.

At the same time, the level of competence in science and technology has risen markedly in most industrialized and many developing countries, so that the postwar dominance of the U.S. has significantly eroded. As a result, it is now essential for the health of science and technology in the U.S., as it was not so clearly in the

---

<sup>4</sup> MIT continues to operate the Lincoln Laboratory, established in 1951, largely for the Department of Defense. Lincoln is part of MIT, but is outside the academic structure and the campus research budget, and classified research is conducted there. It is located in Lexington, about ten miles from the main campus. Its budget in FY1990 was \$420.1 million.

immediate postwar years, that American researchers have access to and keep abreast of research throughout the world.<sup>5</sup> It also means that students must be educated to be able to engage in international exchange of knowledge, just as the faculty must have new skills for international interactions. And, it means that other nations are now much better positioned to benefit from research and development done in the U.S.

The presumption of a closer relationship than in the past between the laboratory and the commercial marketplace is another substantial shift. In the U.S., support for science has been predicated in part on the likelihood of economic benefit sometime in the future. Now, shorter product cycles, increased science-dependence of some technologies, and entrepreneurial activity of faculty and students in several fields suggest a closer, more immediate tie. The actual relationship is complex and varies among fields and technologies. Though the promise of quicker economic returns has been a spur to the support of science in the universities, it also has raised the level of concern about who has access to the research and when.

In this global, competitive, technologically-dynamic economy, American industry has not fared as well, with many exceptions, as might once have been expected, and finds itself under severe challenge from foreign industry.<sup>6</sup> The reasons are complex and disputed, relating to management competence, time horizons on measurement of corporate performance, industrial structure, availability and cost of capital, training of the work force, government policy, and a host of other matters, including in particular the adeptness at translating the ideas of the laboratory into commercial

---

<sup>5</sup> In some ways, international scientific and technological parity represents a return to the situation of the earlier decades of this century, when it was necessary to keep up with European developments in order to stay at the forefront of a field.

<sup>6</sup> The casual use of "American" and "foreign" industry masks the blurring of the distinction between these terms. It is a source of dispute what meaning they have; the definitions may depend on where the primary research and development centers are located, where the maximum value-added takes place, the nationality of ownership, or where the headquarters is located. Notwithstanding the uncertainty, by and large there is still significance in where a firm's top management is located; we will continue to use that definition, recognizing it is an imperfect one. [For discussion, see Robert B. Reich, "Who is Us?," *Harvard Business Review* (January/February, 1990) and Laura D. Tyson, "They Are Not Us," *The American Prospect* (Winter, 1991).]



products.<sup>7</sup>

Added to the overall picture is the changing demographic situation in the U.S. that is both reducing the pool of eligible students born in the U.S. who might become engineers and scientists, and increasing the proportion of college-age Americans that come from disadvantaged educational backgrounds. The weakness of K-12 education in many parts of the U.S. has had a significant impact on higher education in science, engineering, and management. These patterns have made American research universities and industry increasingly dependent on students and trained workers from abroad who elect to remain in the country, especially those with graduate degrees. Fortunately, from this perspective, the quality of higher education in the U.S. remains attractive to students from foreign countries who, by remaining here, enhance the intellectual climate and research base.

Finally, the changing financial situation of American universities is significant. The uncertain availability of adequate public resources for research at a time of increasing educational, research, and facilities costs has led universities to mount aggressive fund-raising activities. The decline in Federal support for research equipment and facilities in recent years has increased the need to find resources to supplement, and support, those coming from public sources. For private universities in particular, the availability of resources is a matter of considerable anxiety, with little prospect that the situation will improve in the near future. The result is a continuing search for new and previously untapped sources.

In response to these developments, MIT has itself markedly evolved over recent decades, with greatly expanded international contacts and cooperation, development of research and teaching about foreign countries and international issues, attention to emerging problems of global dimensions, new educational and research programs targeted at problems in the American economy and in the transfer of knowledge, special programs to learn more from the U.S.'s primary competitors, increased efforts in domestic and international fund-raising, and innovative educational programs to prepare students for the altered international environment into which they will

---

<sup>7</sup> A major report on this set of issues, Made in America (MIT Press), was published by the MIT Commission on Industrial Productivity (chaired by Professor Michael Dertouzos) in 1989.

graduate.

But, new questions have emerged that have not had to be posed before, or at least for which the answers previously seemed self-evident. They touch on many central, and sensitive, aspects of university life: openness of research, discrimination in access, selection of students, relationships to professional colleagues abroad, responsibility to the surrounding community, and others. All can be subsumed in the question of how, in this changed and changing environment, MIT should respond to any conflicts that may exist between its responsibilities to the nation and its role as a major participant in a worldwide scientific and technological system.

After extensive meetings, discussions and collection of data, we have formed strong views on the various aspects of this question. We have found that the principles that we believe should guide MIT's behavior are reasonably clear and deserve to be vigorously asserted. We have also found, not surprisingly, that general principles often do not give precise guidance in specific situations, or may be in conflict with each other; particular cases present awkward shades of gray, rather than black and white contrasts.

We will present first those general principles that we believe should be the primary guidelines for the international commitments and interactions of MIT. Following that, and constituting the bulk of the report, we look at more detailed aspects of MIT's international relationships, presenting our views of the policies that should govern those relationships. Finally, we offer some recommendations for the policy process at MIT that we believe to be necessary for effective implementation of our other recommendations.

#### IV. General principles

MIT is a research university committed to fostering education and advancing knowledge for the betterment of the human condition. It is, at the same time, a national institution rooted in American culture and traditions and an integral part of the nation's education and research system. MIT's responsibility to the nation in which it was founded and nurtured is served first and foremost by maintenance of its position as a premier institution in education and research in science and technology.

The commitment to maintain preeminence mandates that quality be a primary criterion for selection of faculty and research staff and admission of students. Compromise in that criterion in personnel decisions on grounds of nationality, source of support or other dimensions, will inescapably lead to decreased intellectual capacity and performance.

To remain a premier institution requires that MIT be thoroughly engaged in international activities in science and technology; the practice of high-quality scientific and technological research implies the ability to interact fully and openly with research wherever it is carried out. Thus, in order to fulfill its basic responsibility to the nation, it is essential that MIT maintain openness of research and education, that the Institute be an active participant in international scientific and technological communities, that faculty and research staff be able to interact freely with colleagues abroad and have ready access to research in other countries.

MIT's commitment to openness and full participation in international activities is also an expression of its responsibility to the international intellectual community that is dedicated to the free and open exchange of ideas.

Yet, many intellectually challenging and socially important problems are national, regional, or local in scope. Among the most significant is the health of the U.S. economy, which, though heavily influenced by developments in the world economy, depends ultimately on actions taken at home. MIT's intellectual focus on science and technology, its traditional commitment to effective transfer of knowledge to industry, its responsibility to the nation, and its own self-interest all dictate a vital concern with the performance of the American economy. At a time when domestic productivity growth is lagging and international economic competition is intensifying, the effective transfer of knowledge to American industry must remain an important aspect of the Institute's mission.<sup>8</sup> We believe that MIT should intensify its emphasis

---

<sup>8</sup> In recent years the Institute has undertaken a number of initiatives with the aim of improving American industrial performance. Some of the more prominent of these are the MIT Commission on Industrial Productivity, the Leaders for Manufacturing program, the MIT-Japan program, the Microsystems Technology Laboratory, the new activities of the Technology Licensing Office, the Biotechnology

on ways to contribute to the health of American industry and the U.S. economy.

Occasionally, there may be major conflicts between national and international roles. In the resolution of such conflicts, we believe the Administration, with the advice of the Faculty, should give primary weight to the general responsibility to the nation.

In carrying out its various missions, MIT must also recognize the principle that the Institute's education and research activities, whether national or international, should be solidly based in faculty interest. As with all universities of quality, it is the scholarly and entrepreneurial enthusiasm that wells up from the faculty that leads to successful programs, not those designed from above or outside. The MIT Administration can create a climate that encourages programs that serve broader societal objectives, but cannot lead the faculty where it has no intellectual interests.

To be able to carry out its missions it is essential that the Institute maintain an adequate resource and funding base, but the conditions under which those resources are raised must be consistent with these principles.

We believe, therefore, that the general principles that should guide MIT's international activities are:

- 1. MIT is a research university committed to fostering education and advancing knowledge for the betterment of the human condition. It is, at the same time, a national institution rooted in American culture and traditions and an integral part of the nation's education and research system.**
- 2. MIT's responsibility to the nation in which it was founded and nurtured is served first and foremost by maintenance of its position as a premier institution in education and research in science and technology.**

---

Process Engineering Center, and the Laboratory for Manufacturing and Productivity. A new Institute-wide program on productivity and industrial performance will continue the work of the Productivity Commission. For details on many of these initiatives, see section V.D below.

a. To remain a premier institution requires that MIT be thoroughly engaged in international activities in science and technology; it must be a full participant in the world trade in ideas.

b. The commitment to excellence requires that quality be a leading criterion in the selection of faculty and research staff and admission of students, and that solid faculty interest be a prime requirement for the establishment of new programs.

c. Openness of research and publication at MIT must be maintained to enable the most effective conduct of scientific and technological research and education, to permit the faculty to interact fully with colleagues abroad, and to fulfill MIT's responsibility to the international intellectual community that derives from the dedication of that community to the free and open exchange of ideas.

3. In the resolution of major conflicts between MIT's national and international roles, the Administration, with the advice of the Faculty, should give primary weight to the general responsibility to the nation.

4. The traditional commitment of MIT to the transfer of knowledge to the community at large should be intensified, with expanded emphasis on the ways the Institute can contribute to the health of American industry and the U.S. economy.

5. The Institute depends on adequate resources to carry out its activities and execute its programs, but conditions under which those resources are obtained must be consistent with these principles.

## V. Specific international relationships

### A. International students, alumni, and faculty

We have chosen to address questions raised by the presence of substantial numbers of international students and faculty at MIT (and of alumni abroad) first since education is central to MIT's mission. This is not, however, the area in which the deepest conflicts of principle are likely to arise.

## 1. Undergraduate students

The primary goal of the undergraduate program is education, although undergraduates also take an active part in research at MIT. International students provide a degree of diversity which we believe is today an essential aspect of the educational experience of MIT undergraduates.

As of December, 1990, international students comprised 8.7% of the undergraduate population.<sup>9</sup> This proportion is up from 5.2% ten years ago. The undergraduate admissions process establishes a separate category for international applicants. A restricted number of places is allowed for this group of applicants, with a target of about 8% of the incoming class. The competition for admission within this pool is fierce, with less than 5% of these applicants being accepted last year. The target for acceptances is set by the Faculty Committee on Undergraduate Admissions and Financial Aid and has not been revised in recent years. The growth in the proportion of international undergraduates has been within the limits set in the past, but is now pressing these limits.

The debate about the appropriate proportion of international students to admit to the undergraduate population at MIT has a long history. If the number of international students were too small, the undergraduate educational experience would be insufficiently rich to prepare students well for effective participation in an increasingly interdependent world. In addition, too few opportunities might be offered to those with outstanding potential from outside the U.S. who would benefit from an MIT education. On the other hand, if the number of international students were too large, MIT would not be serving the nation as well as it should through the education of American citizens to meet the needs for trained scientists, engineers, managers, and other personnel. "Too few" and "too large" cannot be quantified in any precise fashion, but we believe the proportion of international undergraduates is about right.

---

<sup>9</sup> The figure of 8.7% includes Canadian and Mexican citizens, but not permanent foreign residents of the U.S., following the procedures of the MIT International Students Office. However, Canadian and Mexican citizens are included in the domestic pool for undergraduate admissions. There are currently 45 Canadian and 20 Mexican undergraduates.

Undergraduate tuition covers only about one-third of the total cost of education, the remainder being made up from endowment income, fees, and other sources, including some Federal support. We therefore considered the possibility of raising the tuition of those international students who are able to pay, so that they would pay a larger fraction of the true cost of education and not receive an indirect MIT subsidy. Such a policy, however, would have only minor financial effects and would send a strong message abroad that would be likely to deter applications from less well-to-do foreign students. As a result, MIT would lose an important source of the diversity it seeks in recruiting abroad, and the policy of differential tuition would be counterproductive. We therefore rejected this proposal.

At present, financial need is assessed after admission, with all admitted applicants treated identically even though financial need of international students is harder to determine. Aid policies are uniform, except for those Federal assistance programs that are limited to American citizens. We believe that such Federal incentives for Americans to study science and engineering are appropriate, but also that nationality-blind provision of financial aid should be maintained.

Our conclusions are:

- 1. International students provide an essential element of diversity in the undergraduate student body; the present proportion of international undergraduates appears to be about right.**
- 2. Federal assistance programs that are limited to American citizens for undergraduate study are appropriate, but MIT's nationality-blind tuition structure and provision of financial aid should be maintained.**

## **2. Graduate students**

At the graduate level in science and engineering, research and education become essentially indistinguishable. Academic quality, based on preparation and likelihood of contributing to research, should continue to be the overriding criterion for admission.

International students constituted about 33% of MIT's graduate student population at the end of 1990, among the highest in the nation. This proportion compares with about 26% a decade ago. In many areas of study, however, MIT's international population is not unusually large. About 40% of the MIT doctorates awarded in engineering, for instance, are received by students who are not citizens, a figure that is somewhat less than the national average. The distribution of international students across the graduate fields of the Institute is quite uneven. In the sciences, for example, international students make up about 34% of the graduate student population in physics, 55% in math, but only 14% in biology. In engineering, international students comprise 25% of the graduate student population in electrical engineering and computer science (EECS), 50% in nuclear engineering, and 56% in civil engineering.

Unlike undergraduates, graduate students are admitted by a process administered by MIT's academic departments. Procedures for admission of international students vary widely. In some departments (such as biology and EECS), the number of high-quality applicants from both the U.S. and abroad is far greater than the number of places. The graduate admissions process in these cases resembles that for the undergraduate student body, in that limits (formal or informal) on admission of foreign applicants have been in place for a number of years. The proportion of international graduate students in these departments tends to be lower than the Institute average. We believe this is an acceptable means to ensure adequate opportunities for Americans, without violating the criterion of quality.

Financial aid is usually allocated by departments at the time of admission. As with undergraduate financial aid, some graduate financial aid processes tend to favor American students, in part because Federally-funded programs such as NSF fellowships and NIH traineeships are restricted to American citizens. This seems an appropriate partiality in view of the importance of encouraging greater interest among American students in graduate fields of science and technology.

Some of the recent MIT curricular initiatives designed to address American needs, often in collaboration with American industry (such as Leaders for Manufacturing, conducted jointly by the Schools of Engineering and Management), naturally target American students and raise the question of whether students from countries other than the U.S. should be admitted to these programs. We would expect



American students to be predominant among those admitted to such programs, but there should not be a prohibition on participation by international students.

Occasionally, admission of international students to specific fields of study or from particular countries may raise questions extraneous to the academic enterprise, in fields relevant to nuclear proliferation, for example. There should be a clear process in the MIT structure to which these questions can be referred for resolution. International students, as all others, once admitted should not be excluded from research and education activities on the grounds of nationality.

With regard to graduate students, our conclusions and recommendations are:

1. Limiting the proportion of international students in those fields in which the pool of qualified American and foreign applicants is very large is an acceptable policy to ensure adequate opportunities for Americans without violating the criterion of quality.
2. Financial aid policies that favor American citizens, usually mandated in Federal programs, are appropriate as a means to encourage more interest among Americans in graduate programs in science and technology.
3. Some curricular initiatives designed to address American needs, such as Leaders for Manufacturing, naturally target American students. We would expect American students to be predominant among those admitted to these programs, but there should not be a prohibition on participation by international students.
4. Occasional questions of admission of international students to specific fields or from particular countries may emerge because of issues extraneous to the academic enterprise, such as concern about nuclear proliferation. There should be a clear process in the MIT structure to which these questions can be referred for resolution.

### 3. Alumni

The employment of students upon graduation is a major channel for transfer of knowledge from academia to industry. Thus, MIT alumni, whether U.S. citizens or not, who join industrial firms abroad may become factors in increasing foreign

competition for American firms. Similarly, U.S. firms hire both American and international alumni, who then contribute to American competitiveness. The flow is not balanced, though; a large fraction of international students, especially those from developing countries, elect to stay in the U.S., resulting in a net inflow that is of great importance to American industry and universities and, correspondingly, often of concern to their home countries. A survey of R & D directors of high-technology firms by the National Academy of Engineering, for example, revealed that they believe their industries are dependent upon foreign talent and that this dependency is increasing. Some 60% of foreign doctoral students intend to stay in the U.S. after graduation.<sup>10</sup>

Those international students that do return home after graduation from MIT and go into industry tend to rise in their companies, with a substantial proportion becoming high officials or CEOs of their firms. Of the MIT alumni living abroad for whom records are available, some 700 out of 9000 have titles of senior officials of corporations. These individuals typically remain very loyal to MIT and retain a fondness for American life, though they obviously are applying their acquired skills for the fortunes of their firms and the welfare of their nations.

The fact that future scientific, engineering, industrial and governmental leaders of other nations have spent their formative years in this country can provide a variety of benefits to the U.S. in the general advance of science, research collaboration, business relationships, and political interests. Those benefits can be important, but they will not be uniformly realized, and in any case cannot be assured

---

<sup>10</sup> National Academy of Engineering, Foreign and Foreign-Born Engineers in the U.S. (Washington: NAS, 1988), p. 3. National Research Council, Summary Report 1989: Doctorate Recipients from U.S. Universities (Washington: NAS, 1990), p. 46. The data on the rate at which international students stay in (and American depart from) the U.S. are not very complete, but the available data suggest that there has been no change in the rate over the past decade. There is anecdotal evidence that a few countries, notably Taiwan and Korea, have become better able to attract their former nationals back in recent years by providing a more congenial and productive climate for their work, but this effect may have been counteracted by an increased likelihood that students from other countries (such as China) will stay. See Michael Finn and Sheldon Clark, "Estimating Emigration of Foreign-Born Scientists and Engineers in the U.S.," unpub., Labor and Policy Studies Program, Oak Ridge Associated Universities, January, 1988, and Stephen K. Yoder, "Reverse Brain Drain Helps Asia But Robs US of Scarce Talents," Wall Street Journal, April 18, 1989, p. 1.

or measured in advance.

On balance, we believe the net flow of benefits from the training of students from abroad is strongly in favor of the U.S., particularly reflecting the importance to the American economy of international students who remain in the U.S.

The tendency of foreign students to stay in the U.S. has led to a resurgence of concern about a "brain drain" from developing countries. MIT makes little provision for tailoring its engineering and science education to the needs of those countries, which adds to the likelihood that students from those countries will be dissatisfied if they return home. In effect, MIT's education provides an incentive for them to stay in the U.S.

We do not believe that MIT should change the core of its curriculum to respond to the brain drain. The unique quality of the MIT curriculum depends on its close interaction with the cutting edge of research, which cannot be altered by fiat. In fields in which issues of particular concern to developing countries form important parts of the research agenda, such as urban studies, political science, and civil engineering, MIT does have a focus on those countries and offers relevant courses and research opportunities. But, in the majority of the fields at MIT, the domestic needs of developing countries are not directly addressed. We believe this is an appropriate policy in the light of MIT's primary missions, even though it is one that can have significant effects on developing countries. The brain drain issue is not one that can be dealt with at the level of the university, but requires attention by the U.S. Government and by the countries concerned. This is not intended to rule out special programs at MIT for developing countries as an aspect of MIT's educational and public service roles.

Our conclusions and recommendations with regard to alumni are:

1. Graduates constitute an important channel for transfer of knowledge from the university to the institutions they join, domestic or foreign. A large fraction of international students elect to stay in the U.S., and have become an essential resource for American industry and universities. Even those who return home provide long-term benefits to the U.S., as well as to their home country. On balance, the net flow

of benefits from the training of students from abroad is strongly in favor of the U.S.

2. The concern that students coming from developing countries may not return home after graduation is an important one, but we do not believe MIT should modify its curriculum in response. The brain drain is a problem primarily for the students and countries concerned, and for U.S. foreign policy.

#### 4. Faculty

American universities have come to depend on foreign-born staff, especially in science and engineering, proportionally even more than American industry. A national survey of department heads in 1986 found that about 10% of all faculty in science and engineering were non-citizens, and many more were naturalized citizens. In 1985, 47% of junior faculty positions (under 35 years of age) on engineering faculties across the country were held by non-citizens.<sup>11</sup> At MIT, some 17% of assistant professors are not citizens or permanent residents; about 30% of all faculty members were born abroad.<sup>12</sup>

MIT hires faculty and senior research staff without discrimination on the basis of nationality, a policy we believe to be essential to fulfill MIT's commitment to preeminence in research. Immigration rules permit MIT to seek permanent resident status for people given faculty and senior research appointments; this status provides a strong incentive for these individuals to remain in the U.S. throughout their careers.<sup>13</sup>

Our conclusion with regard to faculty is succinct:

1. MIT must continue to offer faculty and research positions at the Institute on the

---

<sup>11</sup> National Science Board, Report of the NSB Committee on Foreign Involvement in U.S. Universities, [NSB 89-80] (Washington: National Science Foundation, 1989), p. 10. NAE, op. cit., p. 76.

<sup>12</sup> Indeed, 6 of the 12 members of this study group were born outside the U.S.

<sup>13</sup> Regulations implementing the new immigration bill may make the employment of non-citizen junior researchers, such as postdoctoral fellows and associates, more difficult. We hope that such limitations are avoided.

**basis of quality, without reference to country of origin.**

### **B. Access to research at MIT**

Research is a central mission of MIT. The majority of research underway at American universities is funded by the Federal government, and Federal funds have contributed to a considerable portion of the physical plant and research facilities. MIT is no exception. In 1990, for example, Federal funds accounted for 75% of the MIT campus research budget. Should there be, as a consequence, any conditions placed on access to this research on the part of individuals or corporations from abroad who have not contributed to the development of the research base? Some have made that argument, advocating either restrictions on access or special payments to compensate for "cream-skimming."<sup>14</sup> The argument deserves serious consideration.

The investment of Federal funds in American research universities has been of great value to the strength and vitality of the nation. The development of a productive academic education and research system, producing graduates of quality and highly-valued research, is an American success story, which other nations have tried to emulate with mixed success. There can be no doubt that much of the past investment has already paid off handsomely. The challenge is to see that it continues to pay off in the future.

A crucial element of the vitality of the research enterprise at a university is open communication. With the spread of high-quality science and technology around the globe, open communication with foreign colleagues has become even more important. For the investment of the Federal government in university research to continue to be fully productive - and from our perspective for MIT to remain a preeminent research and education institution - openness must be maintained in the U.S. and should characterize relationships with colleagues abroad.

---

<sup>14</sup> Some of the leading figures in U.S. science and technology policy have used the argument. See, for example, the speech of Frank Press, president of the National Academy of Sciences, entitled "Do the Right Thing," to the annual meeting of the Academy, April 24, 1990, and former NSF Director Erich Bloch's letter to Issues in Science and Technology (Summer, 1990), p. 12.

Along with inputs of knowledge, adequate funding is needed for the past investment in research to continue to be fruitful. MIT finds itself in a demanding financial situation, with research and educational costs increasing and much tighter sources of support, particularly from the Federal government. Compared to other leading universities, MIT is in an especially difficult bind, because its endowment is relatively small in proportion to its scale of activities, and because its emphasis on science and technology means that fields with high and rapidly rising costs are a large percentage of the budget. In this climate, MIT is making an intensive effort to raise additional income.

Other nations have undoubtedly benefited and still benefit economically from the American investment in science and technology. Indeed, their ability to do so was an explicit objective of U.S. foreign policy for many years after World War II. (The U.S., we note, benefited in a similar way from the science and technology investments of European nations made before the war.) As beneficiaries of past investments, we think it appropriate - and indeed necessary - that foreign firms and nations help to ensure that the research base is maintained by adding money as well as knowledge to it.

This is not to mean suggest that most of the economic benefits of MIT research flow abroad. Preliminary results of a recent survey of the faculty and research staff suggest that the preponderance of their formal and informal contacts with industry is with U.S.-based corporations. About three times as many personal contacts were reported with U.S. firms than with either Western European or Japanese firms, for instance.<sup>15</sup> Proximity and cultural factors also help to make the transfer of knowledge in these much more numerous contacts easier and more effective with American firms than with foreign firms, other factors being equal.

Nonetheless, we have no doubt that MIT's international relationships that provide access to research are growing. The implications of those relationships can best be assessed, understood, and responded to by considering the specific characteristics of

---

<sup>15</sup> This survey was conducted under the auspices of the study group by Professors Richard Samuels and Eleanor Westney with a grant from the Sloan Foundation. Final results will be published in the near future.

each.

### **1. Visiting faculty, post-docs, and research scientists**

A particularly important route for learning about research at MIT is through visits to faculty and laboratories. Visitors not only can gain access to research results in preliminary and prepublished form, they also can learn about the direction of research and about more intangible aspects of processes and techniques.

The most effective transfer of knowledge usually occurs in the course of long-term visits (a semester or more) where the understanding of the subject is equivalent and the MIT and outside researcher are working toward similar goals. Faculty routinely invite long-term visitors to the Institute on the basis of their knowledge and expertise, both to contribute to research projects and to learn from their stay. In some fields, in fact, post-doctoral experience is considered to be an essential qualification for research and academic positions.

Openness in the exchange of knowledge should be a condition for all long-term visits to MIT, and should be especially observed when university research is close to industrial practice. This is not a condition that can be defined with precision, or be fully assured in advance of a visit. Essentially, it means that the host should have a realistic expectation that visitors will participate appropriately in the research underway, be willing to share their own skills and knowledge, offer seminars or other opportunities for presenting work being carried on elsewhere, and in general be full scientific colleagues without constraint.<sup>16</sup>

If genuine openness exists, foreign visitors, including those from industry, are a valuable resource both as contributors to research and as sources of knowledge about work outside the U.S. Preliminary results of the faculty survey cited above show that about 25% of the respondents believed that their research benefited from interactions

---

<sup>16</sup> It is worth noting that American parochialism is a factor that inhibits learning about the work of others outside the U.S. The NIH (not-invented-here) syndrome can still bedevil the acquisition of knowledge from willing visitors, in the outdated belief that research in other countries couldn't be equivalent to that in the U.S.

with companies based in Western Europe; an equal number responded similarly with regard to Japanese corporations. Restrictions on visitor access from abroad would impair this increasingly important source of ideas and skills.

The responsibility for ensuring that the condition of openness is met can only be carried out by individual faculty or laboratories in their selection of visitors, and in the conduct of relationships once they are here. With understanding of this responsibility, which we believe should be reinforced by a statement of policy from the Administration, we do not believe any areas of research at MIT should be prohibited from hosting visitors from abroad if the faculty wish. Acceptance of visitors should always be at the Institute's discretion.

Short-term visits in which the visitor is not deeply versed in the area of interest will not result in a significant transfer of knowledge beyond what is generally available through publications and conferences. Such visits would not be expected to be fully equivalent in the flow of information between the participants. On the other hand, even short visits to a laboratory can elicit considerable detailed technical information of potential commercial value if a visitor is well-qualified and prepared, and interested in specific MIT material; in those cases, faculty should be conscious that it is their prerogative to insist on more than a one-sided conversation.

MIT has many visitors, both short and long-term. Because the Institute is highly decentralized, a complete count of these visitors is not available. The Institute does track those with appointments and those foreign visitors for whom contact with the State Department is necessary. There are 84 visiting professors, for example, of whom 28 (33%) are foreign. Of the roughly 1250 foreign scholars on-campus in the current academic year (including professors, visiting scientists and engineers, post-docs, research affiliates, and others), only 91 were paid fully or partially by foreign industrial firms.

While this indicates that most of the visitors from abroad are not from foreign industry, but from universities, governments, and other organizations, there are



probably more long-term visitors at MIT from foreign than from domestic industry.<sup>17</sup> This is apparently because of a different, and lesser, valuation placed by American industry on the knowledge and skills that can be gained from such extended visits. In our meetings, we heard of a distressing number of unsuccessful efforts by MIT faculty to induce American companies to send staff for extended visits to promising technical programs. Many of these programs then elicited considerable interest from foreign firms. We recommend that the faculty continue to seek American industrial involvement in their laboratories, and we encourage the Administration to explore additional efforts to encourage long-term visitors from American industry.

Industrial sponsors of long-term visitors are often charged a special fee by host laboratories at the Institute; the decision to levy such a charge and determination of its scale are left to the individual laboratories. A standard policy of charging a higher fee to visitors from foreign firms and governments seems to us to be appropriate, except in special circumstances, on the grounds that they are benefiting from current and prior investments made by American sources. In those cases in which it has been difficult to attract visitors from American corporations, there should be a willingness to waive an American company's fee if that would serve to encourage greater response.

At times there may be some research areas, for example those raising concerns over proliferation of weapons, in which the participation of non-American visitors might raise questions that are not strictly related to academic pursuits. These situations are likely to be quite rare, but when they arise should be dealt with through an established Institute procedure.

Our conclusions and recommendations with regard to visitors to MIT are as follows:

1. Long-term visitors are normally invited to the Institute to participate in research programs on the basis of their knowledge and expertise relevant to the research objectives of faculty and laboratories. Openness in the exchange of knowledge should

---

<sup>17</sup> There is no central apparatus at MIT that tracks the home institution of visitors who are U.S. citizens.

be a condition for all long-term visits, and should be especially observed when university research is close to industrial practice. Acceptance of visitors should always be at the Institute's discretion.

2. The responsibility for ensuring that visitors meet the condition of openness can only be carried out by individual faculty or laboratories in their selection of visitors, and in the conduct of relationships once they are here. With understanding of this responsibility, which should be reinforced by a statement of policy from the Administration, we do not believe any areas of research at MIT should be prohibited from hosting visitors from abroad if the faculty wish.

3. Short-term visits are generally of lesser concern with regard to the transfer of knowledge, but when a visitor is in a good position to gain valuable technical information, the faculty or research staff member has the prerogative to insist on more than a one-sided conversation.

4. A standard policy of charging a higher fee to visitors from foreign firms and governments seems to us to be appropriate, except in special circumstances. The distressing difficulty of stimulating long-term visitors from American corporations may dictate a willingness to waive fees for them. The Administration should consider additional means for encouraging more long-term visitors from American corporations.

5. As with international graduate students, occasional issues extraneous to academic pursuits may arise in specific fields or with regard to visitors from particular countries. There should be a clear process in the MIT structure to which these questions can be referred for resolution.

## 2. Support of research

MIT undertakes sponsored research that advances the education and research missions of MIT, fulfills the intellectual interests of the faculty, provides an enriching experience for students, and can be freely and openly reported. One of the key elements in the strength of American research universities, by comparison with those in other countries, has been their commitment to the integration of research and education.

In recent years, MIT has attracted research support from a number of foreign-based companies. In 1990, approximately 3% of the campus research budget came from these sponsors.<sup>18</sup> This constitutes about 20% of all industrial funding.

Although industrial support of research is only 15% of research support at MIT, and foreign support of research is only a fraction of that, concern has been raised as to whether foreign support diverts the direction of research to problems defined by foreign, rather than American, industry. There is no doubt that there are complex interactions between the availability of funding and the setting of research objectives. But, as long as (1) the faculty has autonomy in deciding what research has scientific and technological merit, (2) the work has similar conditions of access as other research at the Institute and will be freely and openly reported, and (3) there are no atypical benefits of the results accruing to the sponsor, foreign research support is fully acceptable. In fact, such support provides mutual benefit to all parties for it helps to keep U.S. academic research abreast of the research frontiers of interest to foreign enterprises, provides information in the process about the state of knowledge abroad, and helps to maintain research and education in the U.S.<sup>19</sup>

In our view, therefore, foreign sources of support for research are as appropriate as domestic, as long as they satisfy the standards for all research sponsorship; indeed, such support adds to the U.S. research effort. While they may have early access to the results (at the same time as a faculty member's normal communications with colleagues in the same field), sponsors cannot restrict dissemination of research results beyond a brief delay for consideration of protection of intellectual property. Early access to research results may provide a small commercial advantage, but it is rarely decisive, as many cases discussed in Made in America demonstrate. Provision for licensing of any resulting MIT patents are subject to negotiation at the time of the establishment of the research contract. Any such licenses would be subject to

---

<sup>18</sup> These figures refer only to projects with single sponsors. We estimate that inclusion of multiple-sponsor projects would add 1-2% to the foreign share of all on-campus research sponsorship at MIT.

<sup>19</sup> Many faculty have observed that funding from foreign sources often comes with fewer strings and reporting requirements than does support from U.S. sources.

the "substantial U.S. manufacture provision," as are all MIT licenses (see below).

In all cases, bona fide students at the Institute should be eligible for participation in research, whatever their country of origin, with the research sponsor having no say in their selection. To our knowledge, no foreign sponsors have requested such authority. Long-term visitors to the Institute arranged as part of research support should meet the same conditions as all such visitors.

In the context of MIT's broader responsibilities to the nation, the Administration and Faculty should be particularly sensitive to identifying research opportunities that are responsive to the needs of American industry, and be willing to offer American companies an early chance to invest in particularly promising research ideas. Occasionally, in developing projects intended to contribute to American industrial objectives, consortia of companies are formed to provide research funding that exclude participation of foreign companies. Such programs provide important ways to fulfill MIT's national responsibilities and raise no issues of principle as long as:

- a. other faculty outside the program remain free to pursue their research with any sponsor, even if the subject is similar to, or in competition with, that of the program;
- b. all the resulting research has similar conditions of access as other research at the Institute and will be freely and openly reported; and
- c. there are no restrictions other than academic placed on students who take a part in the research.

Our conclusions and recommendations on the international issues that arise with regard to the support of research are as follows:

1. MIT undertakes sponsored research that advances the central missions of the Institute, fulfills the intellectual interests of the faculty, enriches student experience, and for which results can be freely and openly reported. Foreign sponsorship of research is entirely appropriate and provides mutual benefits, as long as it contributes to MIT's education and research missions and satisfies all other relevant criteria, such

as standard conditions of access to research in progress and open reporting of research results.

2. All bona fide students should be eligible to participate in any MIT research, without reference to country of origin, and with no say in their selection by research sponsors. Long-term visitors to the Institute arranged as part of research support should meet the same conditions as all such visitors.

3. The Administration and Faculty should seek opportunities, consistent with MIT research interests, to engage in research that is responsive to the needs of American industry, and be willing to give American firms an early chance to invest in promising new research ideas. That may at times involve exclusion of foreign firms from research consortia; such programs of limited sponsorship provide important ways to fulfill MIT's national responsibilities and raise no issues of principle, as long as they do not constrain the research interests of other faculty or their freedom to work with other sponsors, and satisfy all other criteria relevant to any research sponsorship.

### 3. Faculty consulting and off-campus visits

In addition to meeting and working with industrial visitors on-campus, faculty members often visit industrial sites. Their purposes are diverse. Some are consultants, in accordance with the MIT "day-a-week" rule, serving their individual professional goals. Some have been invited because a corporation is supporting a research project, or has donated the chair held by the faculty member. Others are meeting with scientific colleagues to exchange information. Still others may be conducting research.

These visits are a natural aspect of an MIT appointment and serve to stimulate professional development, provide a channel for knowledge transfer to and from industry, and give faculty members new insights into industrial problems. Preliminary survey results indicate that the vast majority (77%) of the consulting contacts of MIT faculty with industry are with American industry. The dominance of domestic firms in these consulting contacts strongly implies that the transfer of knowledge through these visits continues to be mainly to American industry.

Visits to foreign corporations, however, can be valuable to the education and research missions of MIT. For example, a 1987 survey of the faculty found that the most important correlate of faculty interest in Japanese scientific and technical literature - an increasingly important source of information - was a personal visit to Japan.<sup>20</sup> Such visits, when conducted as part of a university (rather than private) relationship, should be subject to the same conditions with regard to openness in the exchange of knowledge that apply to meetings with foreign visitors on campus.

In fact, the importance of gaining information about scientific and technological developments in other countries, particularly in industry, leads us to recommend that, whenever possible, reciprocal visits be built into agreements to receive visitors at MIT. This can assist in gaining access to laboratories, such as in Japan, that have often been inaccessible in the past.

Our conclusions and recommendations with regard to visits to industrial laboratories are:

- 1. Visits by MIT faculty and research staff to corporations in the U.S. and abroad are a frequent occurrence, based on a variety of university and private relationships. The dominance of contacts with American firms strongly implies that the transfer of knowledge through these visits is mainly to American industry. Those visits that are a result of university activity should be subject to the same conditions of open exchange of knowledge that apply to meetings with visitors at MIT.**
- 2. Visits to foreign industrial laboratories and other facilities by MIT faculty and research staff can serve to increase the flow of information from abroad, which is of increasing importance to research objectives; whenever possible, such reciprocal visits should be made part of agreements to accept foreign industrial visitors at MIT.**

---

<sup>20</sup> Samuels, Richard, and Westney, Eleanor, "Japanese Scientific and Technical Information at MIT," Center for International Studies, MIT Japan Science and Technology Program #87-01 (1987).

#### 4. Commercialization of results of research

Access to the results of research at the university is just one, and perhaps not the most difficult, step in the commercialization of new processes or products. Of greater importance is the ability of industry to convert new ideas and information into high-quality commercial products rapidly and efficiently. Made in America provided graphic evidence suggesting that American firms in a broad range of industries have been lagging behind their competitors in other countries in this key dimension of performance. The causes are varied and are not confined to industry; universities also share some of the responsibility. MIT, in cooperation with industry, has responded by developing several programs designed to address various facets of the problem. We recommend that the President of MIT consult with industrial leaders to establish a continuing dialogue and mechanism for additional action on this issue.

It is important, however, that weakness in the translation of research to the commercial market, the causes of which in significant part lie outside the university, not be used as a reason to limit openness of university research. Openness is essential to the productivity of the research system. Restrictions on access would ultimately erode the quality of research without producing substantive benefit.

Our recommendations are:

- 1. The relative weakness of the U.S. in the ability to translate research to the commercial marketplace is of great importance; the President of MIT should consult with industrial leaders to establish a continuing dialogue and mechanism for additional action on this issue.**
- 2. This weakness, the causes of which in significant part lie outside the university, must not be used as a reason to limit openness of university research; that would ultimately erode the quality of that research.**

#### 5. Gifts

The most appropriate way for foreign beneficiaries of American science and technology to contribute to the continued productivity of the research base is through

unrestricted gifts that support the infrastructure of education and research. Gifts reflect a shared vision of MIT as an independent research university and of academic freedom and integrity as major aspects of MIT's ethos. Gifts influence the direction of research in only the most general way, by strengthening a major area of research; donors do not set the problems or goals for MIT research. The Institute expects to develop a relationship, even a close relationship, with its major donors, but not one involving an explicit or implied provision of services as a quid pro quo. Chairholders may make occasional visits to corporations that donate chairs to report on research, but when doing so as a courtesy are not providing information not available to others.

In some cases, MIT has granted ILP membership for a limited period to corporations donating chairs in the hope of developing substantive relationships between faculty and corporations that are technically stimulating and might lead to sponsored research or other additional support. As long as the membership granted on this basis is limited in time, these arrangements seem to us to raise no special concerns.

In a few cases, agreements at the time of receiving major gifts have included a provision for the donor to send a visitor to a laboratory. Such visitors should be required to meet the usual criteria for visitors (as discussed above); in all cases, the acceptance of a proposed visitor should be at the discretion of MIT, and not the donor.

Approximately 30 of the 215 endowed chairs at the Institute have been funded by foreign-based corporations. We believe the emphasis on increasing endowment through the funding of faculty chairs is much to be commended, and see no reason to be concerned about the proportion of chairs funded from abroad as long as the caveats described here apply.

With regard to seeking gifts from foreign sources, therefore:

1. **Unrestricted gifts from foreign sources for endowment, chairs, and other purposes are an effective means for foreign beneficiaries of American science and technology to contribute to the continued productivity of the research base from which they have benefited. The relationships that naturally develop with any substantial donor to the**



Institute are equally appropriate with foreign donors.

2. Occasional arrangements for sending visitors, foreign or domestic, to the Institute in connection with a major gift raise no grounds for concern as long as the visitors meet the standards for all other visitors.

#### 6. Licensing of MIT patents, start-up companies

As part of its commitment to the transfer of technology to the larger community, MIT has a long tradition of patenting inventions made by its faculty and students and licensing them to entrepreneurs and established industry. This tradition has been reinforced in recent years by changes in Federal policy that clarify ownership of patents for inventions made under Federal research grants. As a result, MIT has given greater attention to protecting and licensing its intellectual property.

Licensing policies can have an influence on the success of commercialization of inventions and on where the benefits are realized. Federal guidelines mandate that licenses for inventions developed with Federal support require "substantial" manufacturing of the licensed product in the United States, if the product is to be sold in the U.S. MIT goes beyond rigorous adherence to these guidelines by requiring that licensees of all MIT inventions, not just those that result from Federal support, be subject to the "substantial" domestic manufacturing provision. The policy is a practical one that increases the prospect of successful commercialization because proximity to the inventor is so important in the process. As a bonus, the policy frees MIT from the administrative headache of having to determine whether or not a given invention was supported by Federal funds in any way. In FY90, 84% of MIT licenses were with U.S. firms, 16% with foreign firms that have U.S. facilities.

Beyond licensing, MIT's Technology Licensing Office also endeavors to help in the establishment of new ventures based on MIT inventions, following the pattern of entrepreneurial activity that has long characterized the ethos of the Institute. Over the years, new companies started by graduates and professors from MIT have contributed substantially to the U.S. economy, especially in high-technology fields. Recent studies of Massachusetts and Silicon Valley attributed some 450,000 jobs

directly to such companies as Raytheon, Digital Equipment, and Hewlett-Packard. The youngest firms tend to be in the most rapidly growing, high-technology fields; for example, individuals related to MIT have started 57 software and 20 biotechnology firms in Massachusetts since 1980.<sup>21</sup> This program is an important contribution to the American economy that deserves continued emphasis.

Accordingly, we recommend that:

1. **The Institute should maintain its attention to protecting and licensing intellectual property. The policy to require substantial production in the U.S. of products to be sold in the U.S. is an excellent one and should remain unchanged.**
2. **The program to assist in launching new ventures based on MIT inventions is an important contribution to the American economy that deserves continued emphasis.**

#### **7. The Industrial Liaison Program**

The Industrial Liaison Program (ILP) was established by MIT in 1948 with the objectives of raising additional resources for research and education while encouraging the transfer of knowledge to industry. The Program has been responsible for developing many productive relationships between the faculty and industry, and currently contributes some \$3 million to the Institute's budget each year (out of a total income to the Program of approximately \$8 million). Member companies are charged a fee, in return for which they are provided with assistance in keeping abreast of work at the Institute.

This assistance is provided in a number of ways: special symposia, help in organizing visits to faculty and laboratories of interest, distribution of summaries of research under way, occasional visits of faculty to company sites, and distribution of publications. The program is operated by a dedicated office, with about twenty professional Industrial Liaison Officers who are each responsible for maintaining

---

<sup>21</sup> Bank of Boston, *op. cit.* Chase Manhattan Corporation, "MIT Entrepreneurship in Silicon Valley" (April, 1990).

effective relationships with a number of companies. As of March, 1991, there were 245 corporate members of the ILP, of which 121 were foreign, including 57 from Japan, 56 from Europe, and 8 from other countries outside the U.S. The ILP has an office in Tokyo, which was established in 1976 primarily to expand the Japanese membership in the program and now services that membership; it has also begun to provide some support to other MIT activities in Japan.

Through its activities the ILP facilitates access to MIT on the part of member companies. It does not provide privileged access; all the information available through the ILP is equally available to non-members on their own initiative. Clearly, however, there is an advantage for a company that uses the ILP to learn about research of interest and to obtain information and contact with the faculty more efficiently. It is that efficiency of access to information that is intended to be the primary motive for companies to join the program.

The faculty at the Institute generally find the ILP a useful vehicle for obtaining information from industry. They also use it to increase funds for research materials and professional travel through the program's incentive system. It cannot be said that there is always, or even usually, reciprocal exchange of knowledge during ILP-mediated visits - that is not the purpose of the program - but in fact it is often considered by the faculty to be a valuable vehicle for staying abreast of advanced industrial research. However, some ILP-mediated visits involve carefully prepared and directed industry representatives. During such visits, the faculty should recognize the importance of insisting on a genuine exchange of knowledge, as discussed earlier. ILP contacts that do involve serious, substantive transfers of knowledge will frequently evolve into another form of relationship, such as sponsored research or consulting.

Industrial contacts arranged through the ILP constitute only a small portion of all relationships between the MIT faculty and industry. In particular, the relationships with American companies are considerably more numerous through direct contacts than through the ILP. The preliminary survey data show that the faculty have five times as many contacts with U.S. firms outside the ILP as through the ILP. This explains in part why foreign companies tend to have a higher level of activity in the ILP than their American counterparts, for those companies have greater difficulty (for cultural, linguistic and geographical reasons) than American firms in developing

their own direct relationships with the faculty. American firms are more likely simply to telephone faculty members, even if they have not previously been in contact.

We considered whether the ILP may now have outlived its usefulness in the transfer of knowledge to industry and as a means of raising resources, and thus whether MIT should reevaluate the justification for the Program in today's circumstances. Its prominence in MIT's relationships with foreign corporations, which has attracted attention and criticism, is also of concern. However, the value of the ILP to the faculty as a vehicle for staying abreast of industrial research, the Program's usefulness in raising resources, and the fact that the outside criticisms of the Program do not accurately reflect the actual extent of the overall relations between MIT and American industry, argue strongly in favor of the Program and give no grounds for recommending reevaluation. In fact, we strongly encourage the development of additional participation by U.S. firms in the ILP as a way of providing additional opportunities for interaction between MIT research and American industry.

On similar grounds, we see no basis for establishing a limit on the proportion of foreign-based companies in the ILP, nor for restricting the provision of services to member companies based on nationality. Restrictions of services to a subset of companies would in many cases be impractical and undesirable to administer; a two-tier system would pose difficult client management problems at the least.

Differential fees for foreign companies are a more appropriate means of reflecting the benefits of access to the results of past U.S. investments. The fees for membership currently average \$33,000 per year for American companies, and \$46,000 per year for foreign companies. We recommend that the Administration continue to differentiate between U.S. and foreign firms in negotiating ILP fees, although we recognize that the elasticity of demand for membership is not at all clear.

We have considered the role of MIT's Tokyo office. It was created to redress the difficulties that distance and cultural differences pose for management of MIT's relationships in Japan, although some have seen it as causing MIT to favor Japanese companies in the ILP. We believe its existence offers an opportunity to increase diffusion of knowledge about the Japanese scientific and technological community. We recommend, therefore, that consideration be given to expanding the role of the MIT

Tokyo office to assist members of the MIT community and non-Japanese members of the ILP to become more familiar with science and technology in Japan and to contribute to the Institute's research and education interests. A comparable office might also be established in Europe to serve similar purposes.

Such efforts would be intended in part as a public service as well as a contribution to central MIT missions; they must be periodically reevaluated to assure their value is commensurate with the resources they require.

Our conclusions and recommendations with regard to the ILP are, therefore:

1. MIT seeks mutually-beneficial relationships through its Industrial Liaison Program (ILP). The ILP serves to raise additional resources while contributing to productive transfer of knowledge.
2. The Program is valuable to MIT and its faculty and represents only a small portion of the Institute's overall industrial relationships, which are predominantly with American industry. Accordingly, we see no reason for recommending a review of the Program, nor for restricting foreign membership or services provided to foreign members. We strongly encourage attempts to increase membership of American firms.
3. When visits organized through ILP involve carefully prepared and directed industry representatives, the faculty should recognize the importance of insisting on a genuine exchange of knowledge as discussed earlier.
4. Higher fees for foreign members of the ILP should be continued.
5. The Administration should consider expanding the role of the MIT Tokyo office to assist the MIT community and non-Japanese ILP members to become more familiar with the Japanese scientific and technological community and to contribute to the Institute's research and education interests. A comparable office might also be established in Europe to serve similar purposes. Such offices should be periodically reevaluated.

### **C. Cooperation with institutions in other countries**

From time to time MIT has established programs of cooperation with universities and other institutions in other countries for research, education, or public service purposes. Often, these are promulgated at the department or laboratory level; sometimes they involve a broader institutional commitment. Those programs established for research and education purposes reflect the increasing necessity to work with foreign researchers as the quality of research competence grows and becomes more widely distributed throughout the world; they are to be welcomed as long as they contribute to research and education objectives, the faculty is fully engaged, and the quality of the cooperating institution is appropriate.

Problems may arise when the objective is to serve a public purpose, such as assisting a university in a developing country or contributing to the economic development of a country in the third world or in Eastern Europe. In such cases, it is essential that there should be strong faculty or research staff interest in working in the program and that adequate administrative and financial resources are available.

A potentially more serious issue arises if the program is primarily designed to serve a community abroad or to raise financial resources, for example, an executive training program in another country, and provides little return of a research or educational nature to the Institute. Such programs may be justified if they do not detract from the basic missions of the Institute while contributing resources for those missions. But it is critical that the faculty that would be involved are supportive of the program, and willing to participate in it. Such programs should be carefully scrutinized by the Administration before approval.

Our proposed guidelines with regard to cooperation with universities in other countries are:

- 1. The growth of cooperative relationships with institutions in other countries is in part a product of the spread of research competence and activity throughout the world. These arrangements are welcome if they advance the research and education objectives of MIT, reflect faculty interest, and involve institutions of appropriate quality.**

**2. Cooperative relationships with universities or other institutions abroad can also be appropriate if there is a broader public policy purpose to be served, or if they add to the resource base of the Institute, without, in either case, detracting from the basic education and research missions. Faculty interest in the programs, and their willingness to participate in them, are essential in all cases, as is adequate provision of financial and administrative resources. Such programs should be carefully scrutinized by the Administration before approval.**

#### **D. Public service and other programs**

Direct service to the nation and to the world at large, beyond contributions to education and knowledge, is, and should continue to be, an important aspect of MIT's culture. There are many possibilities for future international activities to serve national and international purposes that go beyond traditional education and research roles. MIT might, for example, make an institutional commitment to assist in the regeneration of Eastern European economies, to advise a third-world country on energy-efficient technologies, or to assist in the negotiation of environmental conventions. Similar initiatives in the past have included, among many others, an African Fellows program to train senior African officials, programs to help create and staff technical universities in India, and the creation of the Center for International Studies in 1951 in response to a request from the U.S. Government.

More pertinently for this report, MIT's institutional capacity and long-standing commitment to the transfer of knowledge for the benefit of society suggest a strong effort to continue to develop programs that are intended to contribute to American industrial strength in technology. A number of large institutional commitments to support American industrial competitiveness, mentioned earlier, have emerged from Faculty and Administration initiatives in recent years. The best of these serve academic as well as public service goals. One example is the MIT Commission on Industrial Productivity, which conducted in-depth studies of eight major industries and offered a set of recommendations aimed at overcoming the slowdown in manufacturing productivity growth.<sup>22</sup> Another is the Leaders for Manufacturing program, conducted

---

<sup>22</sup> Dertouzos, *et al.*, *op. cit.*

jointly by the Schools of Engineering and Management, which is intended to train a new generation of managers that understands production, a vital topic that has been slighted by higher education in the U.S. A third is the Microsystems Technology Laboratory, a \$24 million facility for chip fabrication research supported by a consortium of American firms.

A new Institute-wide research program will continue the study of productivity and industrial performance begun by the Productivity Commission. The new program will involve MIT faculty and students in a wide-ranging set of activities designed to bring the problems of American industry into the Institute's classrooms and laboratories and will introduce ideas and discoveries generated here into arenas of decision in industry and government.

An initiative of particular public policy importance - and of importance to the quality of MIT education as well - is the MIT/Japan Program, the largest program of applied Japanese studies in the U.S. It is designed to give MIT students language and cultural skills and the experience of extended work in Japan, with the intention of modifying the imbalance in the flow of scientists and engineers and scientific and technological information between Japan and the U.S. Some 250 students have completed the Program since its inception in 1981. All students participating learn the Japanese language, with additional courses preparing them for life in Japan; then, they spend a year in a Japanese laboratory as a working engineer or scientist or in a Japanese office as part of a management team. There are 46 MIT students in residence in Japan in the 1990-91 academic year, 26 in industrial laboratories, 4 in government facilities, and 16 in universities. These students will be in a position throughout their careers to provide American institutions with relatively easy access to the scientific and technological community of Japan. Since the Japanese have such access to American science and technology already, MIT/Japan students will be part of the essential communication link necessary for truly reciprocal interaction between the two countries.

This is a small start given the size of the national need, but appreciable for a single university. We hope that this program will continue to grow, and note that it has been adapted by other universities and formed the basis for a national initiative approved by Congress in 1990. MIT is considering building similar programs related to



other nations and regions.

We also recommend attention by the Administration and Faculty to two other critical needs related to the international scene, one internal and one external:

1) the international dimension of the undergraduate curriculum at MIT, which we have not discussed because of our focus on the economic/industrial aspects of MIT's international relationships, deserves sustained attention; international experience and understanding should be a more significant aspect of education not only as an essential preparation for the world that graduates in any field will face in the future, but also to enhance the contribution they can make to the economic well-being of a country deeply embedded in a global marketplace; and

2) the improvement of science education at primary and secondary school levels is so important to the nation's international position that efforts in support of that goal would be very much in the nation's, and MIT's, interest.

We believe both of these subjects deserve to be high on the Institute's agenda.

Many public service efforts are deserving of MIT's support. However, in all cases, the true costs to the Institute, in faculty and staff time as well as dollars, should be realistically assessed in advance. Programs that are predominantly to provide a public service, rather than a contribution to the Institute's central missions of education and research, must be undertaken with caution; they carry the risk of detracting from those central missions which are the Institute's most important contributions to public welfare.

Accordingly:

1. Direct service to the nation should continue to be a significant aspect of MIT's culture. It is important and appropriate for MIT actively to seek ways to contribute to national objectives, especially with respect to American industry. Several such initiatives have been undertaken in recent years, and more are planned.
2. The imbalance in the flow of scientific and technological information between the

**U.S. and Japan is a major national problem. The MIT/Japan program is a significant model of an effective way to redress this problem, as would be other programs to educate more Americans with technical backgrounds to be able to recognize the value of foreign science and technology.**

**3. We also recommend attention by the Administration and Faculty to two other critical needs related to the international scene, one internal and one external: 1) strengthening the international dimension of the undergraduate curriculum to more effectively prepare graduates for the world they will face in the future; and 2) considering how MIT can contribute to improving science education in the primary and secondary schools.**

**4. When considering a public service initiative, the full costs to the primary missions of the Institute should be realistically assessed, since those missions are the Institute's most important contributions to public welfare.**

## **VI. Process**

The responsibility for the issues discussed in this report, and for implementation of the recommendations, lies with the senior MIT Administration and with the Faculty and research staff of the Institute as a whole. We recommend designated staff responsibility for the matters discussed in this report in the Office of the Provost, with Faculty input on subjects involving education and research policy. Whether in the Provost's Office or elsewhere, a staff capability to advise MIT community members about international relationships would also be of great value.

Difficult and controversial issues will frequently arise with regard to proposed international programs, activities, and relationships. The Faculty has in place a Committee on International Institutional Commitments to represent Faculty views on these matters. The Committee cannot perform the management role of reviewing every proposal that requires Administration approval, but it is essential that the views of the Committee be sought on all those that raise significant questions. The Committee may need a revised charter and should be composed of members with substantial MIT and international experience in order to play this role effectively.

In addition, we believe it is important that a program be undertaken to provide greater understanding of MIT's views of these issues in the Executive Branch and Congress of the U.S. Government, among U.S. industrial leaders, and by the American public. Opportunities for discussions of these matters with other universities, and with the professional scientific and technological community more generally, should be welcomed and encouraged.

Finally, we believe senior Institute officials, and particularly the President, should take a visible public role in discussions of these issues, and should be prominent spokesmen for American universities and for American science and technology in relationships with government, industry and universities in other countries.

Our recommendations in this area of governance are therefore:

1. The responsibility for the issues discussed in this report, and for implementation of the recommendations, lies with the senior MIT Administration and with the Faculty and research staff of the Institute as a whole.
2. The Administration should seek the views of the Faculty Committee on International Institutional Commitments regarding all proposed international programs, activities or relationships that raise significant questions.
3. A deliberate program should be undertaken to work with the Executive Branch, the Congress, industry, and the public to provide greater understanding of MIT's perspective on the issues involved in university interactions with foreign industry and institutions.
4. Senior officials of MIT should take a leading role on these issues as prominent public spokespersons for American universities and for American science and technology.