The MIT Faculty Newsletter

Vol. VI No. 1 **October 1993**

Sustaining Leadership

Jay W. Forrester

At the request of the *Newsletter* Editorial Board and the managing editor, this article, the second half of which will appear next month, has been revised and updated from my "Growth, Equilibrium, and Self-Renewal" that appeared in *Creative Renewal in a Time of Crisis: Report of the Commission on MIT Education*, November 1970.

In the May 1993 *MIT Faculty Newsletter*, the editorial "GM, IBM, MIT: Our Turn Now?" raised again issues that have been discussed intermittently for more than twenty years. What happens to a preeminent organization that is so successful that it becomes arrogant and complacent? Is it possible to keep a leadership position from eventually being copied and overwhelmed by competition? Can MIT avoid pressures that suppress activities leading to future leadership?

MIT is coming under pressure as a consequence of losing its former preeminent position. The change does not arise from MIT doing less well, but because other institutions are rapidly catching up and even moving ahead. The former MIT position of leadership has gradually changed to one of competition between equals. Pressures from shortage of space and money lead to compromises that favor existing activities over embryonic new ideas that could become future areas of leadership. Opportunities for innovation are pushed aside by forces from overcommitment of money, space, and people.

The process chosen for allocating resources contributes to determining the evolution of an organization. MIT can select from different resource-allocation policies. The decision-making process will do much to determine the eventual

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Committee Report

Indirect Costs and Graduate Student Tuition

Robert A. Weinberg

The Problem

The substantial growth of the Institute's graduate student body over the past decade has been sustained in no small part through an unusual accounting practice. We have been able to support graduate student tuition with funds deriving from the Institute's Employee Benefit (EB) pool. This use of EB funds was spelled out in an agreement made between the Institute and the Office of Naval Research and implemented in 1984. The rationale for this practice was simple and straightforward: it resulted in considerable savings to the federal government in the cost of carrying out sponsored research at the Institute.

In fact, the Institute's federally sponsored research programs were carried out both on campus in Cambridge and at the Lincoln Laboratory, MIT's major off-campus laboratory. These two geographically separated enterprises were run under a common administrative apparatus. Accordingly, contributions into a single, common EB pool were made from both on-campus and off-campus research programs.

The practice of using EB funds to support the tuitions of graduate students has now been disallowed by the Office of Management and Budget. After a grace period ending with the first budget period after September 30, 1997, the Institute will be required to support the costs of its Research Assistant (RA) graduate students through direct charges levied

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Editorial

The Graduate Student Support Crisis: Is There A Solution?

Our last editorial ("GM, IBM, MIT: Our Turn Now?" [Vol. V, No. 5]) argued that MIT has for a long time been taking a pragmatic, evolutionary path in responding to sharply increasing external pressures; that we acted time and again to relieve pressing immediate problems without the guidance of a larger vision; that, as a result of accumulated short-range responses, we have arrived at positions that are not well matched to our external support structure, positions that are increasingly hard to justify on an *a priori* basis. Our Editorial Committee argued that the time had come to "...develop a strategy that will ensure not just the survival, but the vigorous health of MIT. That strategy possibly will call for a major change in the way the institute is structured....We call upon the administration to appoint a commission charged with developing a long range plan."

The administration has not responded to what we (of course) thought was a well reasoned and utterly convincing argument. MIT continues to drift, too taken up with short-term concerns to address the larger issues that can render all our efforts moot. This issue's front page article by Jay Forrester addresses the root of such behavior. As for the Editorial Committee, we are sure only that the situation is continuing to deteriorate and that our ability to respond will not grow stronger with time.

Bob Weinberg's article on tuition for graduate students (page one) is an example of the problems that arise when external forces and internal structures drift too far out of synchronization. There is no question that there will have to be an expedient short-term response to such a pressing problem, but we must also begin to build the groundwork for a more satisfactory long range solution. Such a solution will entail a major change in the way the country views (and funds) its highest quality technical education. This will call for major political changes in funding mechanisms, including the explicit identification of graduate education as a national mission with explicit funding.

Major political changes, especially those that seem self-serving, can only be made if a respected, highly qualified protagonist makes a very convincing, well justified case for such changes. MIT can play such a role. In fact, it is playing just such a role in the arena of student aid. The principled stand taken by President Vest in this affair has won widespread applause outside the Institute and appears to have a good chance of winning an actual as well as a moral victory. The battle to change the way our nation views its research and educational infrastructure can only benefit from our demonstrated willingness to stand firm in the face of what we believed to be ill-considered actions by the Justice Department.

Now we must respond to a far more serious problem, one that threatens the health of our research in the short-term and the quality of our teaching in the intermediate-term; the long-term calls into question our survival as a world class private institution. Unless we can solve the problem of funding both research and teaching in the nation's private universities, the strengths of the Institute will be very severely eroded, along with our ability to contribute to the national benefit.

The real problem is that the U.S. has no explicit national program for training Ph.Ds in science and engineering. It is not enough to acknowledge, as our national representatives are more than willing to do, that education is essential to modern society. It must also be acknowledged that the current *ad hoc* system has begun to come apart and that a comprehensive national higher education policy must be developed and implemented. Just as the health care crisis can only be solved by a national program with the explicit goal of providing health care to all, so too the graduate education crisis can only be solved by identifying graduate education as a national mission and funding it explicitly.

In our discussion below, we first illustrate the magnitude of our short term problem, a problem that arose when the rickety structure that we constructed to meet immediate needs could not stand up under detailed scrutiny. We, as academics, can't help the feeling that a review of history must improve our understanding of the present and so we indulge that predilection. Finally, we return to our main theme, the need to convince others of the need for a comprehensive national policy.

The Problem of Graduate Student Support

Graduate education at MIT is largely funded through a patchwork of research programs which fund education as a cost of research. The precise value of the research-to-education transfer is hard to derive from published information, but its magnitude can be estimated. It is easy to show that if the present system of indirect subsidy is terminated, MIT must find a substitute funding mechanism or make a profound change in its programs and structure.

Approximately 5,000 graduate students are currently enrolled at MIT. A graduate student's annual tuition, including summer session, is approximately $25,000. This is charged every year, regardless of declining use of pedagogic resources as the emphasis shifts from the classroom to research. The aggregate tuition is thus $125,000,000. A fraction of this is returned in the form of teaching assistant stipends, but the direct research-to-education transfer of the 2200 research assistants on research grants is approximately $55,000,000.

Any significant decline in these funds would be a serious crisis for the Institute's budget. Several concurrent events threaten just such a decline. Our current funding arrangement, spreading the transfer cost over a wider base (specifically including Lincoln Laboratories) is no longer acceptable, as pointed out by Professor Weinberg. The NIH is capping reimbursable tuition costs at 70% of the tuition charged, which also limits our ability to transfer funds from research to education. This is not the only problem. MIT's tuition is much higher than that of state-subsidized

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The Graduate Student Support Crisis

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universities. There is growing pressure in this period of fiscal constraint to take the cost of research student support into account when awarding research grants. In fact, the true cost of research assistants to research budgets is on the order of $40,000/year including stipend and benefits. Our ability to attract research funds is being severely eroded.

If research will no longer support graduate student tuition costs and, as is the case, most students are unable or unwilling to pay them directly, the only conclusion is that the number of graduate students at MIT will drop precipitously. The Institute could, of course, continue its research with post-doctoral research support, perhaps even at lower cost, but the teaching-by-doing aspect of education in which we take such pride would be lost, along with one of our main contributions to the strength of the nation's research infrastructure.

The problem is easy to state and, as in many other easily stated problems, difficult to solve. If the present arrangements are terminated and nothing is put in their place, the Institute, our students, and the national interest will all be adversely affected. It seems to us that the only long-range solution for the private research institutions is the development of a national policy that has the explicit goal of supporting graduate research education.

Lessons from History

The major expansion of graduate programs in the United States took place after World War II. The "Serviceman's Readjustment Act," the G.I. Bill, channeled some 2.25 million veterans into colleges and universities. These institutions were rescued from the fiscal crises of the pre-war depression, and were able to undergo a major expansion with the tuition funds provided by the Bill. An additional group of veterans went to college with federal funds after the Korean War.

A second innovation of this period was the establishing of the grant system by the NIH and NSF, to channel public research funds into private universities following the model developed by the Office of Scientific Research and Development in WWII. Once a vigorous research effort had been initiated, it became rapidly clear that the mechanisms for financing graduate education were unable to provide the level of highly-trained personnel needed for expansion of the work force. One possible response would have been the explicit development of a national higher education policy to expand access to universities. In fact, this did not develop until decades later. Instead the National Institutes of Health developed the Training Grant Mechanism to provide stipends and tuition to graduate students, and to encourage the employment of graduate students through charging them to research grants as research assistants. In the 1950's when it was not possible for aspiring but low income premedical students to get fellowships to medical school, thousands of graduate students were receiving tuition and stipends from training grants. The combination of these inputs with research grants financed the expansion of the university system and of the medical schools. As a case in point, the largest current pool for external support of graduate students in biology and chemistry in the U.S. are NIH training grants.

In 1957, the shock of the Soviet-launched Sputnik stimulated a new period of extraordinary growth, particularly in the education of scientists and engineers. The National Defense Education Act was followed by a plethora of federal programs of aid to secondary and college science and education. Almost every committee of Congress and every federal agency became involved with colleges and universities. NSF and the Office of Education became big players. To address the shortage of college teachers, NDEA Title IV created substantial three-year fellowship programs designed to help college graduates become college teachers and to expand doctoral programs. NASA also established graduate fellowship and research programs. These events marked a sharp change in social values, with a college education becoming a social standard in what parents wanted for children.

A National Policy for Higher Education

The level of graduate education in the sciences and engineering in the U.S. depends primarily on the channeling of federal research funds into tuition and stipends. However few of the programs are explicitly labeled graduate education, so that in general the public is not aware of the fact that graduate students in the sciences and engineering are financed by tax dollars. Graduate students financed through research grants appear in Congressional budgets disguised as research staff. We train and educate Ph.Ds not just to produce the next generation of researchers, but to ensure that a broad sector of the U.S. population is literate in the sciences. This population needs to be sharply expanded. We need a National Education Act that guarantees higher education for all Americans that seek it and are qualified. We must also educate a sufficient number of Ph.Ds to maintain the educational infrastructure.

An alternate but acceptable course would be to build on the NIH Training Grant model, but expand this so that all agencies of government devote resources to training grants (NASA, EPA, DofT, State Department, DOE, etc.) . This would provide a mechanism for supporting at least those areas of graduate education currently recognized as areas of national interest.

Editorial Committee

Next Issue +

The second part of Prof. Forrester's discussion of sustaining leadership at MIT (including suggested solutions) will appear in the next issue of the *Faculty Newsletter*, as will continued commentary on graduate student tuition and related budgetary concerns.

We encourage submissions on these or any topic of interest to the MIT community. Information on reaching us can be found on Page 2.

We'd also like to thank Pacific Microelectronics, Inc. (Mountain View, CA) for donating the file transfer program *Mac-In-Dos*. It has proven very helpful.✣

From The Faculty Chair

Faculty Retirement and Intellectual Renewal

Robert L. Jaffe

The Editorial Board has extended to me the opportunity to contribute to the *Faculty Newsletter*, and I hope to do so on a regular basis. The *Newsletter* can be a very effective means of unifying our "peripheralized" faculty (to borrow a phrase from Jay Keyser's recent *Newsletter* piece), and I hope you will read it, write for it, and support it.

I would especially like to welcome new faculty and invite you to participate in the process of faculty governance by coming to faculty meetings, regularly held on the third Wednesday of every month, and by serving on faculty and other Institute committees. These are challenging times for our faculty: many issues which affect our day-to-day life will be addressed by faculty committees and will be brought forward for action at the monthly faculty meetings. In quieter times faculty members have not always crowded to faculty meetings, but I expect that some of the topics looming for this year's agenda may excite considerable interest. I urge you to watch for the monthly announcements of the meetings and to attend.

A regular column will give me the opportunity to communicate with you about significant issues confronting us as MIT faculty. As Kim Vandiver outlined in his departing column last May, there are several important issues in the pipeline: budget reductions, faculty retirement and tenure policies, and community tensions headed his list. To these I would add graduate student support, faculty "quality of life," Institute policy on grievances and harassment, and our undergraduate Core requirements and other freshman year issues. As you can see, there is no shortage of topics to discuss. Other subjects will undoubtedly come up in "crisis mode" during the year. This column deals with one of the thorniest of the Institute's problems: faculty retirement.

The end of mandatory retirement (as of January 1, 1994) raises serious issues of continuing intellectual renewal for universities. If no steps are taken to encourage retirement, MIT could experience a significant drop in faculty retirements over the next decade. At the same time the mean age of the faculty would increase. Since the Institute depends upon retirement to open up resources and space for new faculty, MIT would face a significant decrease in the number of creative young faculty who drive innovation.

As the Institute addresses this problem, it is essential that the faculty become informed as to the issues and participate in crafting policy. Over the past few years faculty and departmental committees have studied issues related to retirement. They have focused primarily on enhancing the position of Emeritus Professor in order to encourage retirement and have come up with some excellent suggestions which should be implemented.

At this time, MIT's Steering Committee for the Strategic Review of Benefits (SRB) is beginning to review the MIT Retirement Plan in connection with the issue of faculty retirement. Chaired by Senior Vice President Bill Dickson, the SRB brings together senior administration and faculty members and its purpose is to advise the administration on major issues of benefits policy. The SRB was created in 1988, when the new Retirement Plan was designed and several other benefits were realigned as a result of the tax legislation of the 80's. Several faculty members serve on the SRB: Vice President for Information Services Jim Bruce, Vice President and Dean for Research Dave Litster, Dean of Engineering Joel Moses, Chair of the Committee on Faculty-Administration John Hansman, and myself. Last year Rosalind Williams participated as associate chair of the faculty.

The Retirement Plan presents significant opportunities both for encouraging retirement and for improving the quality of life for older faculty. It is important for faculty of all ages to understand the Plan and possible changes which may bear on retirement and to collaborate on the development of new options.

The Retirement Plan presents significant opportunities both for encouraging retirement and for improving the quality of life for older faculty. It is important for faculty of all ages to understand the Plan and possible changes which may bear on retirement and to collaborate on the development of new options. The natural mechanism for faculty participation in this process is the Standing Faculty Committee on

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Faculty Retirement and Intellectual Renewal

(Jaffe, from preceding page)

Faculty-Administration (CFA). [See Box for the CFA'S membership.] Therefore, I have asked the CFA and its chair, John Hansman, to devote time this year to studying and reviewing the current MIT Retirement Plan with respect to its impact on the issue of faculty retirement.

After gaining an understanding of the Plan's structure, its purpose, and the legal framework within which it operates, the CFA will be asked to report on the impact of possible changes in the Plan from the point of view of the individual faculty member, the Institute, and the faculty as a whole. It will formulate priorities in light of MIT's institutional goals; and finally make any recommendations it deems appropriate to the Faculty Policy Committee, the officers of the faculty and the administration.

Committee on Faculty-Administration

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Robert J. Birgeneau
Leon Glicksman
Samuel J. Keyser
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Y. Richard Wang

The CFA will be undertaking this task in the coming months with the intention of reporting by the end of this academic year. Input from a broad range of our faculty will be an essential step in arriving at thoughtful and effective recommendations. At appropriate times during the year the CFA will be seeking input from the faculty.

I urge you to participate in this process.

The Smoking Gun

Lawrence M. Lidsky

One of the tasks of the Editorial Committee of each issue is the choice of interesting data for our M.I.T. Numbers page. As you can see, we chose to highlight the college board test scores of our entering class. This data cuts two ways – providing information both on the entering class and on our admissions policy. The table below sheds a more brilliant light on our admissions policy. I believe the "rank in class" data explains several of the troubling aspects of our undergraduate classes, and, at least for me raises serious questions about our admissions procedure.

Note that, for those students whose rank could be determined, only 11% below the top 10% of the class were offered admission, and that only seven students who ranked below the top 20% in their high school classes are in our freshman class.

While I do not doubt, as the Admissions Office claims, the secondary school record is a significant indicator of performance, I seriously doubt that there were no interesting, intelligent, talented students below the Admissions Office *de facto* cut-off line. The Admissions Office states that "We want students whose presence on campus will enhance the experience of the entire MIT community. Therefore, we value characteristics such as motivation, initiative, involvement and commitment." Surely this is not measured solely by rank in class. Were there no brilliant students in our applicant pool who couldn't be bothered with their class rank in high school?

I suspect that many, if not most, of the students in our entering class get good grades as naturally as they breathe, and that their high rank in class was an accidental by-product of their very real capabilities. I suspect also that we have specifically selected for a strong admixture of students that are most strongly motivated by grades and the competition for standing and against those who couldn't be bothered to think about grades.

We bemoan the fact that activities and courses that do not offer grade credit are undervalued by our students. Is there any wonder why that should be?

Rank in High School Class	Number of Applicants	Percent Admitted	Number in Class
#1 in class	995	59%	255
Top 5 percent (includes #1)	3,021	46%	702
2nd 5 percent	713	19%	79
2nd tenth	542	6%	17
3rd tenth	161	4%	6
4th tenth	83	1%	1
5th tenth	23	0%	0
Lower half of class	36	0%	0
Unranked	1,832	31%	288

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character and quality of the Institute. Two contrasting policies will illustrate:

• One policy permits over-commitment of resources, followed by administrative allocation of resources to equalize internal social and political pressures. An overcommitment policy favors short-term over long-term success.

• An alternative policy maintains undercommitment of resources by aggressively discontinuing aging activities, and then identifying and strongly favoring visions of the future that promise a leadership position in 20 to 30 years. Shifting resources away from competitive activities in current demand and toward development of future opportunities favors long-term over short-term strength.

MIT has for several decades followed the first alternative with resulting pressures on all activities. Such sustained pressures eventually degrade quality. Even so, growth can continue until past reputation is dissipated and can no longer sustain the required money flow. Such decline in reputation and resulting collapse has been demonstrated by General Motors and IBM. The policy amounts to the following scenario. Resources in terms of people, money, and space are continuously overcommitted. Overcommitment of resources both restrains expansion, especially of pioneering activities, and at the same time justifies the need for more financial support. Under this overcommitted mode, no conceivable amount of additional funding will reduce the internal pressures. Expansion continues up to the tolerable level of resource overcommitment.

The overcommitted mode at MIT has led to:

1. allowing expansion beyond the capacity of people, space, and finances,
2. focusing on fund raising rather than on matters of quality and selection of future directions for the Institute,
3. centralizing control to cope with internal social and financial pressures,
4. sustaining resource flow to aging activities because larger, older, entrenched activities exert more political pressure,
5. suppressing innovations because they are small and lack administrative influence,
6. declining flexibility as the organization becomes choked by increasing time devoted to bargaining for space and budget,
7. curtailing time to judge people for their pioneering and future leadership capability. Judging people for innovative potential requires close personal acquaintanceship and an opportunity for unhurried discussionof ideas and plans. Under resource pressures, personnel selection and promotion follow the easy route based on documentary evidence. A person is judged in terms of past publications and outside reputation. But while a person with a past and a reputation may be excellent for carrying on established activities, such a person is not necessarily an innovator for entirely new directions. Time devoted to resource acquisition diverts attention from evaluation of prospects for major future leadership directions,
8. increasing administrative levels, with communication channels becoming less able to respond to changing circumstances.

The overcommitted mode leads to a competitive mediocrity. An alternative policy would maintain flexibility and would free resources to support early stages of entirely new developments that lay foundations for future leadership. Such flexibility and attention to the future can be abetted by continuous operation in an undercommitted mode.

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4. sustaining resource flow to aging activities because larger, older, entrenched activities exert more political pressure,
5. suppressing innovations because they are small and lack administrative influence,...

The undercommitted mode should function by:

1. discontinuing aging activities to maintain the undercommitted condition,
2. seeking out and encouraging innovations that could develop into leadership activities one or more decades hence,

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3. focusing primary attention on quality and future directions for the Institute,

4. being skeptical of internal self-esteem,

5. pursuing criticism with openness and concern,

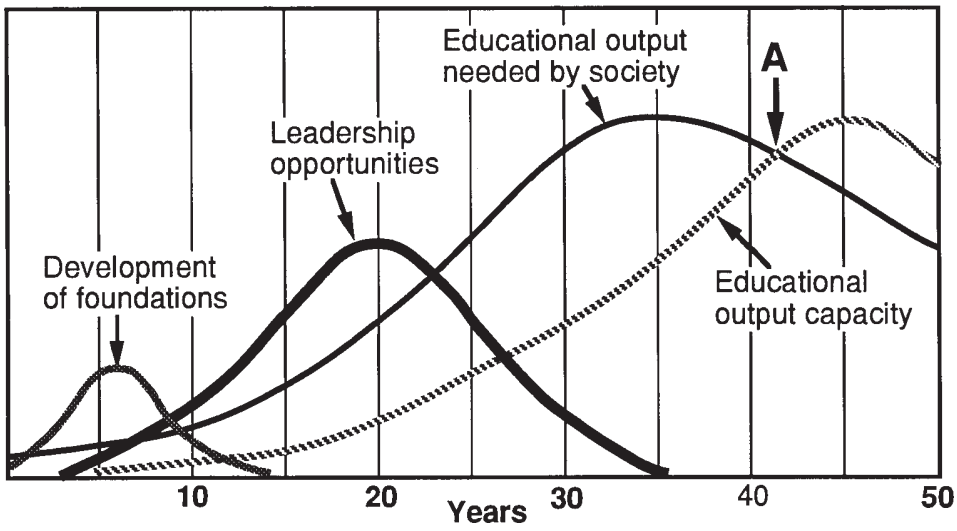
6. reducing administrative levels and decentralizing control to points where teaching and research are done,

7. maintaining a standing committee devoted exclusively to sustaining debate about what the Institute might become in 25 years, such committee to report twice a year to the faculty and administration on MIT's evolving vision and how a desirable future might be achieved.

Regarding a future for MIT, a possible goal would be attempting to perpetuate quality and uniqueness in already existing activities. However, sustaining leadership in a field becomes more and more difficult as time moves on.

MIT was founded to meet the need for a four-year college engineering education to support economic development of the United States. By the 1930s, it was no longer possible to maintain a superior position with nothing more than a four-year engineering curriculum. That which MIT had pioneered was already becoming commonplace. Maintaining a significant margin of quality in a four-year program to justify a preeminent position became increasingly difficult. As others followed in MIT's footsteps, the quality differential became less and less. MIT then became a leader in Master's degree education and, when that became commonplace, the leadership role shifted to Ph.D programs.

Such a large fraction of a lifetime is now being spent in study that the trend toward longer and longer educational programs cannot be continued. In fact, for many purposes the trend has already overshot the optimum. For a time, new research, as in computers, guidance, and radar, provided a frontier for MIT leadership. However, by now, scientific research and engineering development are well understood and widely practiced. Scientific and engineering skills have become commonplace. The possible margin of superiority in the whole area of science and technology is steadily narrowing.



MIT now faces the question: Is the Institute simply satisfied to be one more education institution among many with no sharply distinguished character, or is the Institute to be unique in some clearly understood and accepted way? To avoid being just one competitor among many, an alternative goal would be to maintain the pioneering and leadership position which has characterized MIT through its first century. Where then are the frontiers for such pioneering?

The attached figure shows time phasing for successive stages in research and education following a specific innovation. The time scale will differ depending on how fundamental, revolutionary, and sweeping a new field may be. For some innovations the entire time scale might be as short as 20 years. More typical is the 50 years as shown. For an entire profession, such as engineering, the time scale may extend through 150 years.

The curve "educational output needed by society" is taken here somewhat incorrectly as being fixed in time for a specific innovation, and as being created by the forward pace of worldwide social and economic development, and being unaffected by the details of the related development of foundations and leadership opportunities. During the first decade, the impending needs of society are perceived by a few innovators who begin to develop foundations for future research and teaching. The major "leadership opportunities," centering at the 20th year, represent the time when innovative institutions can move to the forefront in research and in the new educational field. Following the leadership period, "educational output capacity" proliferates in many places. The output capacity is driven ever more rapidly upward by the perceived gap between output capacity and the greater "educational output needed by society."

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(Forrester, from preceding page)

However, as point A is approached, the momentum for expansion of output is still rising, even though the output needed by society has begun to decline. In the late phase, after point A, educational capacity comes under pressure from having overexpanded, from having outlived its usefulness, and from coming under stresses created by declining need and revenue.

For illustrative purposes, the time scale in the figure might be identified for various fields of research and education. For digital computers, the zero point on the graph could be the year 1940, and the period in which an educational institution can exert unique leadership is now passing. Peripheral technical innovations are possible, but such can be done in many educational institutions and industrial companies. The field of operations research might equate the zero point on the graph to 1945. For management education, in its current form of training operators for corporations, the zero point may have been around 1920.

MIT, if it is to maintain a leadership position, must identify and encourage ideas in the "development of foundations" stage in the diagram. The foundation phase requires few people and minor resources but does require a maximum of encouragement, perceptiveness, and administrative flexibility. The foundation-development stage will have little outside recognition. The ideas are not yet in the main stream of established activity. A peer review process does not deal effectively with ideas in the foundation-development phase because very few people have the vision to see the future possibilities. In the early stage, truly revolutionary ideas are difficult to distinguish from "crackpot" suggestions. Support for this early phase must arise from careful and extended discussion with a few people in the Institute who are attuned to the nature of major innovations.

Substantial resource allocation should go into the "leadership opportunities" phase. Again, such activities, by their early developmental nature, lack a substantial outside constituency. They will not have developed the strength to exert strong pressure for resource allocation. The Institute would need a formal and aggressive process to support the early part of the leadership phase.

MIT should be forcefully withdrawing from activities that are in the phases after year 30 on the graph. This means reduction at the very time that public demand seems the greatest.

The local folklore of the superior MIT education is not supported by any studies of which I am aware. Most investigations of precursors to later success of college graduates, in terms of such criteria as salary, published papers, or public recognition, show little correlation to the academic institutions from which the individuals graduated. As with corporations that have been running into trouble, the internal belief in superior status can extend well past the time when remedial action should have begun.

MIT should find a way to continuously reexamine and redefine long-range goals. The vision of a moving future 15 to 30 years hence should evolve as issues are clarified and new inputs become available. An organization needs a goal that reaches far beyond the present. With no goal, an organization becomes diffuse, internally contradictory, ill-defined, and ambiguous. Almost any goal is better than none. Traditionally, goals were set by strong leaders who could unify people toward an objective. But that seems less possible today. Leadership is out of fashion. Also, executives occupy office for shorter time periods in both academia and business. A significant goal can take ten years to articulate and accept and one or more decades to implement. If goal creation is to transcend the tenure of leaders, then goal-setting must be an ongoing process established within the organization.

(To be continued next issue.)

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The Presidents Conference Car and Academic Computing

Gregory A. Jackson

By the 1930s, streetcars and interurban rail systems made it possible to travel from just north of Portland, Maine, to Washington, DC by transferring from line to line – a fact that EL Doctorow brought vividly to life in his novel *Ragtime*.

The rail systems were highly compatible, but they weren't unified. Uncoordinated streetcar purchases and design gradually spawned inefficiency, The enterprise didn't scale. And so presidents of major streetcar lines gathered, and agreed on a simple and elegant solution: define the ideal streetcar, design a car that meets those specifications, and buy enough of the new cars to get consistency and economy of scale.

Hundreds of Presidents Conference Cars (PCCs) were built, restoring consistency and efficiency to light rail. They dominated urban transit. For example, I grew up riding PCCs in Mexico City, which, I later learned, had bought them from Los Angeles when the latter ripped up its tracks and switched to buses. PCCs still equip the Ashmont-Mattapan line in Boston (or will, after the line is renovated).

But why, if the PCC was so successful, was I riding Los Angeles discards in Mexico City? The reason is simple: the PCC remained an elegant solution to a problem, but the context changed and urban transit didn't respond. Parkways replaced railways. Cars and buses replaced streetcars. Expressways replaced parkways. As cars choked expressways that had widened to twelve lanes, and exhausts polluted urban air, it became clear that streetcars and interurban rail lines were the more sustainable solution. But by then it was too late.

But I'd better get to my point. Athena and related facilities provide our students probably the richest educational computing environment available on any campus in the world today. And our students use the computing environment heavily: this past spring, for example, on a typical weekday over 6,000 distinct individuals used Athena or other authenticated services each day. On busy days there were lines of people waiting to use Athena workstations. By registration day this fall, 94% of all incoming freshmen had begun to use their Athena accounts – more, perhaps, than had permanent housing assignments at that point! Athena has been a PCC for educational computing and electronic community at MIT, drawing individuals onto an efficiently common path.

We know now that letting light rail fail was a mistake. By analogy, I think that losing a coherent educational-computing environment would be a mistake for MIT. We can't force anyone to join the Institute-wide electronic community. Our challenge is to serve diverse educational needs attractively within a common framework.

A year ago I wrote excitedly in these pages about Athena hardware and software: new workstations to handle student computing efficiently, and new applications to enrich the analytic context for MIT education.

Equipment renewal continues, with Sun workstations and Hewlett-Packard printers in Athena for the first time (plus new IBM and Digital workstations), and virtually all old workstations and printers replaced in public clusters. Software acquisition continues too: we've expanded access to powerful and popular software such as *AutoCAD* and *SAS*; deployed additional software including *FrameMaker*, an extremely flexible and capable document-preparation system, and *TecPlot*, a sophisticated system for translating data into multidimensional graphs; and installed upgrades to widely used programs such as *Maple* and *Matlab*.

With the provost's support, we've almost completed ResNet, the extension of MIT's network to undergraduate dormitories and other living groups. By January, ResNet will permit students to do much of their network-based computing from the comfort of their rooms.

The lesson of the PCC is that we must continue to draw individuals if we are to retain coherent electronic community. As local-area networking becomes simpler and computing applications diversify, coherence and functionality can conflict. If they conflict, then computing at MIT may go the way of interurban transit: it may optimize for small subgroups at the expense of

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(Jackson, from preceding page)

community, much as cars and buses did to eventual detriment of urban life.

We know now that letting light rail fail was a mistake. By analogy, I think that losing a coherent educational-computing environment would be a mistake for MIT. We can't force anyone to join the Institute-wide electronic community. Our challenge is to serve diverse educational needs attractively within a common framework. To do that, we need to understand the diverse needs educational computing must meet.

I thus don't want to write about computers, software, and networks today. Instead, I want to explore the diverse ways that faculty, students, and staff use computing facilities educationally. I've been doing this formally and informally over the past few months to help guide our strategic planning in Information Systems. It seems appropriate to share some stories from that work here.

At the end of the stories I'll return to my central argument: that MIT benefits from a powerful, encompassing, educational-computing environment, and that we must continue to increase the attractiveness of that environment to faculty and students. I will sketch several important foci for our efforts: education, connectivity, tools, collaboration, and diversity. My central conclusion is this: we've got to move from a focus on *systems* to complementary foci on the *substance* of MIT education and the *support* it requires.

Four Stories

I'll choose four stories that span an interesting array of technologies, services, and subject matter.

Story 1: OWL

I was to teach the data-and-methodology segment of a Quality Awareness Workshop one afternoon (I'm trained as a statistician). That morning, it occurred to me that I should talk about the Hawthorne Effect (whereby experimentation *per se* causes positive outcomes). I remembered some specifics (experimenters increased light levels and productivity increased, they decreased them and productivity increased again, and so on, all because workers were being interviewed after each change) but not where the eponymous Hawthorne factory was.

I logged in at an Athena workstation, and invoked *Online With Libraries (OWL)*. I typed "What was the Hawthorne Effect named for?" The program informed me that no one was available to answer my question right then, that I should check back later.

About an hour later I logged in at a different workstation. My answer was waiting: the Hawthorne Works of the Western Electric Company, outside Chicago. The reference librarian who answered my question went further, though. She provided some more detail, gave me citations to the original studies [Jules Fritz Roethlisberger,*Management and the Worker; An Account of a Research Program Conducted by the Western Electric Company Hawthorne Works, Chicago* (Cambridge MA: Harvard University Press, 1939)] and to several confirming and disconfirming re-analyses of the data, and told about a Hawthorne aficionado elsewhere in the Libraries.

OWL complements more traditional online library services, such as online catalogs and periodical indexes (which I also use extensively). It grows out of two other Athena services: *On Line Consulting (OLC)*, which connects users to consultants for help with Athena or other computing activities, and *On Line Teaching Assistant (OLTA)*, which connects students with teaching assistants in subjects that use it. The *OLxx* services (as we call the set of three) currently are available on Athena, and will shortly be available for networked Macintoshes. A Windows version is about a year away. We in Information Systems worked closely with the staff of the MIT Libraries to design and build software for *OWL*; reference librarians in the MIT Libraries use the software to communicate with patrons. The service just won the MIT Library Council Special Achievement Award for exemplary library service.

Story 2: 4.203

Our new dean of Architecture and Planning believes strongly that his students must work with the technological tools of their trades while they are here. One of his faculty members wanted to incorporate very substantial use of *AutoCAD*, a commercial drawing and design software package, and some ray-tracing software into 4.203 *Computers and Architecture*. The dean asked us to help out.

Since the faculty member's needs were focused and pressing, and since we thought *AutoCAD* would work well for diverse users on Athena, we decided to buy a limited number of licenses and let his students use them for the fall. We also did a quick (but costly) switch and put color workstations into 1-115 primarily for 4.203.

AutoCAD didn't work perfectly on Athena at the outset, and the problems were difficult to pin down. One of my professional staff ended up spending almost a quarter of her time debugging *AutoCAD* and providing other assistance to 4.203 – a much larger level of support than we usually provide any single subject. Moreover, it turned out that students needed filespace allocations much larger than usual to use *AutoCAD* effectively, and this consumed additional

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(Jackson, from preceding page)

resources that might have been distributed more broadly. Sometimes 4.203 and *AutoCAD* seemed to be distorting our commitments, thereby depriving others of their fair share.

But *AutoCAD* had helped a faculty member transform the way his subject was taught, helping students to use technology routinely and to understand their profession better. This is precisely the kind of educational outcome we seek from computing initiatives. 4.203 had used not only *AutoCAD*, but also *On Line Teaching Assistant (OLTA)* and online handouts and assignments (most including graphics). 4.203 had helped us to understand what it would mean to provide Athena-wide *AutoCAD*, from both a service and a resource perspective. And in the end the faculty member and his dean had been extremely appreciative, letting both us and others know that they valued the services we had provided.

Story 3: Management Finance

This past spring a group of faculty in the Sloan School concluded that students in finance needed better exposure to the real world of financial transactions.

Today this world – a world many of us know only from fictional renditions such as *Bonfire of the Vanities* – depends on time-critical electronic transactions following quick decisions based on intensely concentrated electronic news and information about markets, exchange rates, banking activity, and commerce. Exposing students to this world means either taking them to it, or bringing it here. The faculty group decided to try the latter: to build a simulated trading floor at MIT. A trading floor requires a constant stream of information flowing in, sophisticated computers to process, store, and retrieve that information, complex displays to make it readily accessible to traders, and high-speed worldwide communications to execute deals.

Sloan is seeking hardware and software grants from vendors who equip "real" trading floors. The associate dean and a staff member approached us about their plans. After several discussions, it became clear that there were ways that MITnet might serve the trading floor, both for interconnecting machines and for bringing data in and out. Some of the data collected for the trading floor might also be useful to others at MIT, and therefore the trading floor's file servers might be made more widely accessible than the trading floor itself.

We provided some advice on these technological questions, and on the type and number of staff that an educational trading floor might require. Ultimately, Sloan and we concluded that the trading floor need have no integral connection to Athena. Rather, it should operate autonomously, with special links to important data or communications where necessary.

MIT's flexible, entrepreneurial computing environment encourages educational interchanges like this: explorations of possible overlap between central and departmental efforts, with friendly autonomy a perfectly acceptable outcome.

Story 4: 2-032

A vocal and active group of MIT faculty likes to use Macintoshes educationally, and a less vocal but perhaps larger group of faculty likes to use DOS or WINDOWS machines. We've never provided either group much help, since Athena, our principal academic-computing environment, uses UNIX workstations. But a couple of years ago we installed a few Macintoshes in a small cluster for class use. As use of that facility grew, we began to reconsider public Macintosh facilities.

To keep Macintoshes operating and accessible, most other universities either restrict or staff their Macintosh facilities – neither being a promising solution for us, since we provide essentially unrestricted public facilities without staffing them. (This is one reason we can offer so much more academic computing to MIT faculty and students than other research universities offer to theirs, without spending more than they do.) We identified software and developed

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It's easy to see from these stories that faculty and departments can easily go their own ways, junking the PCC and buying buses. It's also easy to see, I think, that small investments in collaboration and consultation can offset centrifugality in useful ways. This leads me to several summary propositions, which inform our work in Academic Computing Services....

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operating procedures that would permit us to have an unattended, public Macintosh cluster. Productive collaboration ensued: the School of Science generously provided space for the Macintosh cluster, CRSP (Committee for Review of Space Planning) renovated it, and Information Systems bought furniture and equipment. The result is 2-032, a well-equipped, networked Macintosh cluster available for scheduled classes or for public use by students.

Users of this new facility have included several freshman seminars, a few astronomy subjects in Earth and Planetary Science, some Biology subjects, some Physics classes in alternative freshman programs, and assorted other classes. Within about a year the facility has gone from unknown to scarce resource. We have begun to talk about more such facilities, and different ones, ranging from public workspaces where faculty and students can plug in portable computers to clusters with personal computers to facilities with special computational, display, input, or interactive capabilities.

Promoting Community

It's easy to see from these stories that faculty and departments can easily go their own ways, junking the PCC and buying buses. It's also easy to see, I think, that small investments in collaboration and consultation can offset centrifugality in useful ways. This leads me to several summary propositions, which inform our work in Academic Computing Services – my organization within Information Systems:

1. *We need to provide widely useful tools centrally*. We can provide widely useful tools only if we know what tools are widely useful. To this end it's important for us to know what faculty want, even when we can't provide it right now. *SAS* and *AutoCAD* have taught us this; so have our several new tools for foreign-language instruction, including a document-preparation system with spellcheckers and other support for numerous languages (*International FrameMaker*), and editors and other software to work with and display Japanese Kanji characters online.

2. *Everything should be on the network*. It's sometimes expensive for us to make information and services available network-wide, as opposed to confining them to particular machines. And it costs money – but not much – for individuals or departments to connect their computers to MIT's network. But we see again and again that if everyone is on the network, then the electronic community functions productively and efficiently.

3. *Collaboration is essential*. Departments often can't afford to deploy the equipment and tools they need; we can help. We often can't discern important substantive trends and how they might interact with computing needs; faculty can help. Using educational computing effectively requires substantive knowledge, pedagogical insight, and technological skill; bringing these together requires different kinds of individuals to work together. The Faculty Liaisons in my organization (x3-0115, f_l@mit.edu) do just this.

4. *Computing must serve education, not vice versa*. This one speaks for itself, but it's easy to forget. Whenever we become too intrigued with technology for its own sake, education suffers.

5. *Educational computers are going to diversify*. They always have, of course, but we haven't always recognized that fact. We are planning ways to incorporate specialized workstations and personal computers into the common environment without requiring users to sacrifice their autonomy.

I began by talking about streetcars, and the urban and interurban rail networks they spawned. Had cars and buses integrated more effectively with rail networks, rather than replaced them, many of our cities would be much better off – if only because they would be maintaining and operating existing mass transit, rather than redeveloping it as Los Angeles and other cities have had to do.

In much the same way, we must make sure that increasingly attractive individual and departmental computing options, which already are proliferating at MIT, integrate with one another and with central facilities. We must understand what basic level of network service is necessary to draw individuals and departments, what additional layers of service are desirable, and how to continue improving education at MIT through separate, collective, and central decisions about information technology. As I wrote last year, we're excited about collaborating with faculty and other MIT educators to this end.

For a related article on Athena and a description of this fall's Minicourses, see "Athena Training Opportunities For Your Students" on page 19.

Indirect Costs and Graduate Student Tuition

(Weinberg, from Page 1)

on grants and contracts of on-campus, sponsored research. This change will have profound consequences on the Institute's ability to support its graduate student body, in that contributions from sponsored research at Lincoln Laboratory resulted in as much as a $13 million annual infusion of funds into the EB pool that was used for graduate student support.

One Possible Response

The $13 million shortfall resulting from this change in research funding rules will be sustained in addition to the estimated $20 million shortfall in the Institute's anticipated operating budget. For this reason, the provost convened a committee of faculty and administrators that met over a period of eighteen months to advise him on appropriate future policies for the support of RAs at the Institute. The conclusions of this committee were included in a report that was submitted in its final form to the provost in July.

One obvious response to this change would be to increase the percentage of the total tuition charged directly to our graduate students. In effect, the net tuition cost for graduate students has been subsidized through the EB pool mechanism by both Lincoln Laboratories and MIT Institute General Funds (IGF). The latter represent the operating funds of the Institute and include income raised from tuition, from sponsored programs, and from outside donors.

While these changes would only be implemented in 1998, they are discussed here in terms of 1993 dollars and the annual costs required to support an RA by a research grant. At present this cost is about $33 thousand. In the absence of a subsidized tuition, the costs of tuition and stipend would rise to $47 thousand, a 42% increase.

Such a dramatic increase in the costs of supporting an RA would have profound effects on the Institute's on-campus activities. The number of RAs on campus, currently about 2,200, would drop substantially, reflecting the inability of many research grants to support them. This would especially affect smaller research programs, which might respond by employing post-doctoral associates in their stead. The Institute's mission in providing post-baccalaureate education would be severely compromised and its ability to attract and retain top quality faculty would be substantially affected. Moreover, a number of research sponsors might also be reluctant to support research whose costs they would view as being unreasonably high.

Alternative Solutions

Having examined and rejected the above solution of full tuition charges, the Committee sought alternative solutions by querying a number of faculty and administrators across campus. One overriding conclusion emerged from these consultations. A direct response to substantial increases in the cost of an RA would be a compensating decrease in the number of RAs employed by the Institute's sponsored research programs. The diminution in the number of RAs would in turn result in decreased tuition revenues for the Institute. In the end, the Committee concluded that the $13 million shortfall could not be eliminated or even substantially addressed by adjustments in tuition charges. This or a similar shortfall would remain in all scenarios that were contemplated.

The compromise solution finally embraced by the Committee involves several changes. To begin, the annual cost of an RA to a research grant would increase from its current level of ca. $33 thousand to almost $37 thousand. Under such a scenario, IGF would subsidize 45% of the tuition costs of an RA while the remaining 55% would be charged directly to a research grant.

The Committee anticipates a decrease of about 10% in the number of RAs on campus would result from this tuition increase. This decrease should be viewed in the context of the historical increases in the campus' RA population. In 1976, there were 1366 on campus. In the period 1983 to 1985, the RAs on campus grew from 1515 to 1886. The Committee believes that this dramatic increase and the increases that followed were made possible, in substantial part, by the EB-derived subsidy of tuitions that will be discontinued in 1998.

This increase in cost of an RA to a research grant will allow the Institute's graduate programs to remain competitive with those of other comparable institutions across the country. A survey of these other programs indicates that the total costs of RA support at other institutions (taken together with anticipated increases at these other institutions) will place MIT well within the broad spectrum of costs charged by its most directly competing institutions.

The Indirect Cost Rate will rise by about 3% due to this change. At the same time the EB rate, currently at 41.4%, will fall to 34.0% This decrease is due in substantial part to stopping the use of EB funds for tuition support.

Finally, this level of tuition subsidy will require a $13.5 million subsidy of tuition from IGF in addition to the $9 million currently provided by IGF funds for this purpose. The Committee understands that other savings in the Institute's operations will be required to enable IGF to sustain this level of tuition subsidy. Part of these savings may be realized through the lower level of support services required once the Institute's RA population undergoes the adjustments anticipated to occur in 1997 and thereafter.

Were Any Heads, Deans, or Provosts There?

Peggy Enders and Travis Merritt

Teaching and Faculty Development is a relatively new endeavor at MIT, and is the umbrella term for a set of programs organized to support and promote better teaching in the classroom and in a variety of other instructional settings. This is a cooperative effort by faculty and staff from around the Institute. The MIT Classroom Videotaping Program is part of it, providing the opportunity for most MIT faculty (and other instructors, in some cases) to see themselves in action in the classroom (and, if desired, to review the tape with a colleague or consultant).

Another activity is our on-going seminar series, "Better Teaching at MIT," consisting of talks and workshops by well-regarded faculty on topics ranging from running a good recitation section to helping troubled students.

Our 12-talk fall series has already started (see schedule below) and is the reason we were inspired to write this *Newsletter* piece.

These talks are *good and relevant*. (Well publicized, too.) Last year, for example, Sheila Widnall talked about honesty in the classroom. Hermann Haus and Frank Solomon swapped ideas about how they work their research into their teaching.

Events at MIT are often regarded as successful or noteworthy if the audience includes a respectable number of faculty, and – perhaps even better – department heads and school deans. The presence of a faculty critical mass says, "this is an important event," and thus transmits clear signals about what's mainstream at MIT. Time is a valuable commodity for MIT faculty, and time is spent at what's important.

The dilemma – and, frankly, the disappointment – is that these series, intended for all MIT teachers (who are principally faculty) are attended mostly by graduate students. (Ironically, the faculty who do attend are almost always highly regarded teachers in their own right who drop by to listen in and lend a voice.)

Bottom line: We'd like to see more of you at these talks. We'd like to see the senior members of the faculty encouraging new teachers to be videotaped. We think it would be valuable if faculty (including department heads, school deans, provosts, et al.) visited each other's classes and watched teaching in progress, maybe to learn something, maybe to offer advice, certainly to help build constructive dialogue about an important part of everyone's professional life.

Becoming a first-rate teacher doesn't mean diminished quantity or quality of research; taking advantage of some of the existing resources would not require a huge time sink. It's a matter of being willing to be more conscious of what "quality teaching" can be, and cultivating your own and others' teaching skill and talent. It's not enough to have a colloquium on the topic. Let's put our time where our good intentions are. ✣

Better Teaching @ MIT: The Schedule

(Each talk starts at 4:15 pm)

Wednesday, September 29 (Room 2-105) TA's and Faculty: Teaching Better Together
Alvin Drake & Company

Tuesday, October 5 (Room 6-120)
Teaching Recitation Sections
Donald Sadoway and Jackie Acho

Wednesday, October 6 (Room 2-105)
Blind-Sided: Racism in the Classroom
Muhammad Abdus-Sabur and Clarence G. Williams

Wednesday, October 13 (Room TBA)
Dynamics of very small group (vsg) Learning
Travis Merritt and Amy Pritchett

Tuesday, October 19 (Room 6-120)
Working with Students (and with Students' Problems)
Robert Randolph and John Southard

Thursday, October 21 (Room 2-105)
Integrating Teaching with Research
Hermann Haus and Frank Solomon

Tuesday, October 26 (Room 6-120)
Elements of Lecturing Style
Patrick Winston

Tuesday, November 2 (Room 6-120)
Teaching through UROP
James Williamson

Tuesday, November 4 (Room 2-105)
Other Resources: Project Athena, MIT Libraries, and Classroom Videotaping

1993 Industry Summit

Fred Moavenzadeh

Why was it held?

The Industry Summit was convened at MIT on the premise that major changes of global scale and scope had taken place during the past several years, significantly affecting the broader environment within which we work and the issues of concern to us. Such changes include the end of the Cold War, the disintegration of the former Soviet Union, a significant reduction in concentrated nuclear capabilities, and the emergence of new centers of economic power worldwide. In essence a new world order seems to be taking shape, with far-reaching implications for the global economy.

Who were the participants?

A group of six hundred business leaders, close to one hundred government officials, and several hundred scholars and academicians from over fifty-five countries and all five continents participated in the Industry Summit.

The program was structured in three plenary sessions, fifty interactive sessions, and over sixty meetings in eleven economic sectors which served as the core of the Summit. The program was designed and organized by MIT faculty. Over ninety MIT faculty members served as chairs or panel members and close to seventy additional faculty members participated in the sectoral meetings. In addition, over one hundred graduate students either participated in the sector meetings directly or served as note-takers.

Extensive community participation took place. Over two hundred seats were reserved for the MIT/Harvard community as participants (not speakers or chairs), and a large number of others were invited in on a standby basis as seating became available. A special luncheon with some thirty to forty CEOs was held (entirely on a voluntary basis) with one hundred graduate students from all parts of the Institute. Overall, well over two hundred faculty members, an equal number of staff, and nearly three hundred students participated in the Summit.

How was it organized?

The responsibility for substantive intellectual content as well as for major organizational decisions rested with three faculty committees. Over forty MIT faculty members served in one capacity or another, and all of them met on a regular basis to oversee both design and implementation for the Summit. Both the president and the provost of MIT were consulted frequently, as were other members of the MIT administration.

What was discussed?

The core of the Summit consisted of eleven sectoral meetings. These were chosen as key economic sectors for the nation as well as the international community as a whole. The sectors were: automotive, energy, engineering and construction, financial services, food and agro, health industry, information technologies, media and communication, mining and metals, textile trade and industry, and transportation and logistics. For nine of the eleven sectors there already exists a set of activities at MIT, organized in a center or laboratory, thus enabling them to pursue their interactions with their constituencies, governments, and industry as the case might be. For two sectors, the Summit provided an opportunity for new relationships and the framing of a new agenda.

In addition, there were four interactive, or cross-sectoral sets of sessions. These focused on (1) economics and trade; (2) environment; (3) organization and management; and (4) technology, productivity, and competitiveness.

Integrating this specialized program, composed of sectoral and interactive meetings, were three plenary sessions designed around themes of importance to all the economic sectors as well as to the global economy more broadly construed. These were "What is the best role for national government in global industry?"; "Ecological governance: who is in charge?"; "The new world divide: is technology the gap or the bridge?"

The social agenda of concern to all nations – to governments, industry, and non-profit entities – was integrated into the fabric of the program. In making this decision, we believed it important to bring issues of inequality, poverty, discrimination, job distortion, obstacles to sustainability, among others, to the forefront by incorporating these into the program.

We consciously rejected the strategy of segmentation, i.e., of segregating these issues and separating them out of the main venue of the Summit. On balance, however, the program could not be described as ecumenical in scope: There were indeed a specific set of sectors, interactive meetings, and plenary sessions. It was not designed as a program for all seasons and all reasons.

What were the results?

The Summit brought into focus the following issues, highlighting their importance across the individual economic sectors as well as their centrality to the global economy. These were:

• Job Creation: the need to focus on expansion of skills, location of jobs, the quality of employment, and retooling requirements for new jobs.

• Environment: sources and consequences of global change; the

(Continued on Page 18)

Public Statement

[The following statement was submitted to the *Faculty Newsletter* by several of the faculty members listed below who wished to directly share their concerns with their colleagues.]

September 8, 1993

As members of the MIT community, we are concerned that the World Industry Summit about to take place in our midst reflects neither the actual range of expertise at the Institute nor the commitment many of us feel to social welfare.

We are concerned that the "Summit" agenda does not adequately address the genuine complexity of the issues to be discussed September 9-12. The activities of corporate and governmental bodies transform the social, physical, and economic environment in ways that have broad social impact. Technological and industrial changes are linked to large scale unemployment, growing disparity between rich and poor (both within the U.S. and between countries in the Northern and Southern hemispheres) and the shattering of communities as we see in the spread of drugs and violence at home and abroad.

We believe that we have a responsibility not only to government and corporate leaders, but to leaders of employee associations, unions, consumer groups, youth groups, community associations and organizations protecting civil rights, women's interests, public education and the environment. Our responsibilities as teachers and scholars extend to all people whose lives will be impacted by policies formulated at the "World Industry Summit."

In the past decade many at MIT successfully pressed the Institute to abandon its dependence on weapons development and turn its resources toward technology for peaceful economic development. In the present period we believe we must resist the tendency represented by the Summit to couple the Institute too closely to the private appropriation of social wealth and human resources.

Many at MIT and in the larger community who are not represented at the Summit have valuable expertise and insight into the matters of the conference. We invite our colleagues to join us in addressing the emerging technological and industrial transformations with the fullest concern for individual human development and the entire social fabric.

Jeanne Bamberger - *Prof. of Music & Urban Education*
Stephen Brophy - *Staff, Libraries*
Bernard Campbell - *Catholic Chaplain*
Jennifer Carson - *Undergraduate Student, Physics*
Noam Chomsky - *Institute Professor*
Stephen Chorover - *Prof. of Brain & Cognitive Science*
Joshua Cohen - *Prof. of Philosophy & Political Science*
Steven Cohn - *Visiting Research Associate*
Rebecca Cooprider - *Staff*
Lisa Court - *Mathematics*
Louise Dunlap - *Senior Lecturer, Urban Studies*
Alford Dyson Jr**.** - *Education Staff*
Suzanne Flynn - *Prof. of Foreign Languages & Literature*
Jonathan Fox - *Graduate Student, Mechanical Engineering*
Archon Fung - *Graduate Student, Political Science*
Kenneth Hale - *Prof. of Linguistics*
Louis Kampf - *Prof. of Literature*
Evelyn Keller - *Prof. of Science, Technology, & Society*
Dan Kemp - *Prof. of Chemistry*
Jonathan King - *Prof. of Molecular Biology*
Mel King - *Director, Community Fellows Program*
Vera Kistiakowsky - *Prof. of Physics*
Heather Lechtman - *Prof. of Material Science*
Sandy Martin - *Staff, Women's Studies*
Lynn McCormick - *Graduate Student, DUSP*
Laurie McLaughlin - *Staff, Mechanical Engineering*
Mary Ni - *Asst. Dean for Student Affairs*
Wayne O'Neil - *Prof. of Linguistics & Philosophy*
Connie Ozawa - *Lecturer, DUSP*
Scott Paradise - *Episcopal Chaplain*
Lisa Peattie - *Prof. of Urban Studies & Planning, Emeritus*
Ruth Perry - *Prof. of Literature*
Yale Rabin - *DUSP*
Jesse Ribot - *Lecturer, DUSP*
Jean Riesman - *Graduate Student, DUSP*
Alan Shihadeh - *Graduate Student, Mechanical Engineering*
Arthur Steinberg - *Prof. of Anthropology & Archaeology*
Jesse Stickold-Sarah - *Undergraduate Student*
Chris Thomas - *Staff, Center for Energy Policy*
Theresa Tobin - *Staff, Libraries*
Leon Trilling - *Prof. of Aeronautics & Astronautics*
The Alternative News Collective

1993 Industry Summit

(Moavenzadeh, from Page 16)

importance of international accountability in effluence and emission; the role of sanctions, incentives, and new policy requisites; the requirements of recyclability; new fuels for the future; and imperatives of sustainability.

• Trade: tensions regarding open and/or fair trade vs. managed trade; regional versus global markets; environment/trade "trade-offs"; institutional initiatives for international coordination.

• Defense conversion: requisites of dual technology, knowledge transfer, job implications, national strategies, and regional implications.

• Competitiveness: identification of core competency, determinants of productivity, importance of value-added jobs, and implications of international interdependence.

• Economic restructuring: re-orientation of economic structure, functions and performance in Eastern Europe, in the United States, and in the Far East with differing national and regional consequences, as well as differing global implications.

• Technology: reframing the role of television, structure of the news of the future, salience of parallel processing, organization of the information marketplace, and new directions in molecular science in the twenty-first century.

• Health: present crisis versus future potentials, contentions on priorities, costs, and management strategies, equality vs. economic priorities, new visions of the future.

What emerged as the consensus?

Overall there was a notable sense of optimism about the challenges posed at the Summit. Many of the problems encountered were not impossible to resolve. A sense of common purpose emerged, with shared objectives and a new orientation that propelled the participants in the same direction. Everyone involved seemed to agree that collectively we can come to grips with the major issues of concern and address, even resolve, such compelling problems.

But there were two notable layers of disquiet that surfaced forcefully as a result of the Summit and may well serve as the basis for concerted action – and research and education – for the future.

The first was for us to appreciate and respond effectively to the global scope of the substantive issues and to their inherent interdependence. The Summit drew attention to the stress between parochial interests and global imperatives. To be effective, strategies have to be framed, devised, and implemented on a global basis. There can be little place for parochialism when the issues at hand are of a global scale.

The second was the stark crystallization of the need to appreciate the complementarity of resources available to government, business, and academia, leading to the importance of forging shared and even joint solutions to common problems. It was all too clear that collaboration could lead to a robust synergy that would enhance social benefits and limit the expansion of attendant costs.

What does it mean for MIT?

For MIT as a whole, the Summit contributed to creating a network with industry, corporations, and governments. With this network came a large reservoir of goodwill so necessary for forging effective collaboration in the future. MIT may well contribute to the formation of new alliances on a global scale, and to consolidating the linkages already put in place.

The Summit brought out in an exemplary way the many facets of global interdependence and the critical need for academic institutions to broaden their vision and take on an international perspective for both educational and research purposes. The Summit also demonstrated that many of our most pressing concerns – job creation, environment, competitiveness, productivity, and so on – have strong global dimensions supported by robust networks of interdependence that cannot be set aside for education, research, or policy purposes.

What next?

The faculty is currently engaged in an extensive assessment of the Summit. What will be done next, if anything, is yet to be determined. I am personally aware of numerous constructive suggestions for future meetings, for modification of procedure, and for changes in the scale and scope of the program. Suggestions made have been very valuable.

I suspect that if MIT continued with this type of activity in the future, many of the concerns expressed to date will be effectively taken care of. I am certain that the MIT administration would always welcome additional and constructive suggestions on any aspect of this initiative.

Athena Training Opportunities For Your Students

Jeanne A. Cavanaugh

The Athena Computing Environment has become an integral part of the MIT educational experience. One quarter of the MIT community is currently using Athena on a daily basis. During the last academic year, 97% of the undergraduate students and 81% of the graduate students had Athena accounts.

Electronic mail, NEOS (the Networked Educational Online System) for electronic submission, exchange, annotation, grading and return of assignments and course handouts, and OLTA (On-Line Teaching Assistant) are proven ways faculty members have successfully used Athena to work more closely with their students. Many classes also make use of MIT-developed or third-party educational software as part of their curriculum. Two electronic classrooms, with Athena workstations at each desk and a projector for the faculty workstations, as well as a cluster of Macintosh computers and projector can be reserved for lectures and labs. (Some Institute classrooms are also equipped with an Athena workstation and projector; these rooms are reserved through the Registrar's office like any other classroom.) New software is added regularly to Athena software suite. If you wish to learn more about how Athena can be used in classes, please contact the Athena Faculty Liaison Office, E40-357/359, x3-0115, <f_l@mit.edu>.

In order for MIT students to successfully use Athena, Information Systems (IS) offers a comprehensive series of short courses (called minicourses) on a variety of Athena-related topics. These courses are offered frequently throughout the academic year.

During R/O week, incoming freshman, graduate, and transfer students had the opportunity to attend four basic courses: How To Get Around Athena, Basic Word Processing and Electronic Mail, Advanced Word Processing with LaTeX and Advanced Word Processing with EZ. These courses are offered before classes start, so new MIT students can become familiar with the system before they receive their first problem sets and paper assignments.

During the coming year, IS is offering new and revised minicourses for all levels of users. Minicourses are held the first six weeks of each semester, the week after Thanksgiving and spring break, and the first three weeks of IAP. The courses are offered Monday through Thursday at noon, 7 pm, and 8 pm in Room 3-343. No registration is necessary, and they are free.

We would like to encourage you to remind your students to take advantage of this excellent opportunity to learn more about the computer system that will be part of their MIT experience.

Following are descriptions of the courses.

Minicourse Descriptions

How To Get Around Athena
Prerequisites: None
An introduction to Athena and Athena workstations. Topics include: getting an Athena account, logging in, using files and directories, windows, sending messages, finding help and documentation.

Basic Word Processing
Prerequisites: How to Get Around
Elementary text editing with Emacs, sending and receiving electronic mail, and using the Athena printers.

Advanced Word Processing: EZ
Prerequisites: Basic WP
Introduction to EZ, a combination text editor and formatter, with text-editing commands that are similar to Emacs. As a formatter, it is menu-driven and easy to learn, in the style of the "What You See Is (pretty much) What You Get" packages made popular by the Macintosh.

Advanced Word Processing: LaTeX
Prerequisites: Basic WP
An introduction to Latex, a widely-used text formatter, used for converting text files into attractive, professional-looking documents. It is a powerful, flexible program, with the capability to typeset many foreign characters and very complex mathematical text.

LaTeX Thesis
Prerequisites: Latex, some Latex experience
Using the Latex text formatter to produce a fully-featured thesis that meets all MIT format requirements.

Information Resources on Athena
Prerequisites: Basic WP
A survey of the communications, help, and other resources available on Athena.

Customization on Athena
Prerequisites: Serious Emacs, some Athena experience
Intended for the intermediate-level Athena user, this course will discuss the Athena login sequence and the user-configuration files (dotfiles) that affect it, as well as changes the user can make to those and other files to customize their working environment.

Serious Emacs
Prerequisites: Basic WP, some Emacs experience
The text editor introduced in Basic Word Processing has many useful features not covered in that course. This course is a must for anyone who uses Emacs more than an hour or two each week.

Math Software Overview Prerequisites: Basic WP
A survey of major mathematics and graphing packages available on Athena.

Matlab
Prerequisites: Basic WP
An interactive program for scientific and engineering numeric calculation. Applications include: matrix manipulation, digital signal processing, and 3-dimensional graphics.

Xess
Prerequisites: Basic WP
A powerful and easy-to-learn spreadsheet, with a full range of mathematical, statistical, matrix, and string functions. It will be useful for scientific and engineering computations, as well as to general and financial users.

Maple
Prerequisites: Basic WP
A mathematics program that can perform numerical and symbolic calculations, including formal and numerical integration, solving algebraic or transcendental systems and differential equations, and series expansion and matrix manipulation. It also has extensive graphics capabilities.

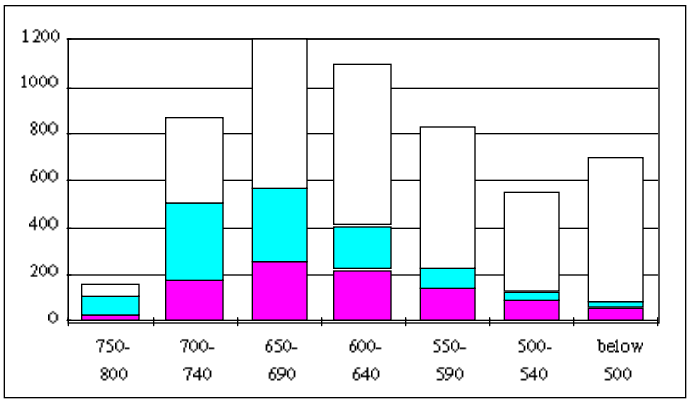
For more information, send e-mail to <training@athena> or call x3-0184.

M.I.T. Numbers

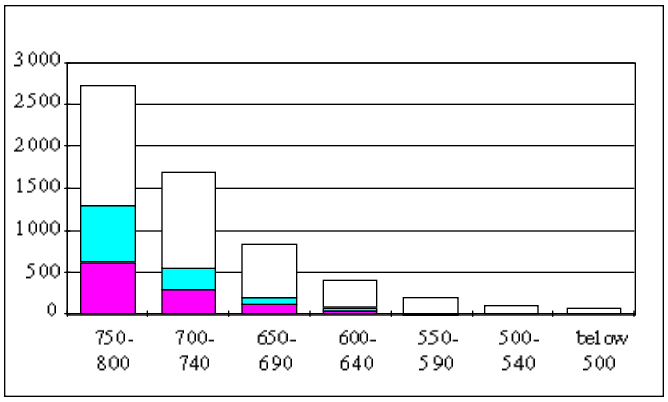
College Board Test Scores
1993 Freshman Class

ScholasticAptitudeTest(SAT)

Verbal

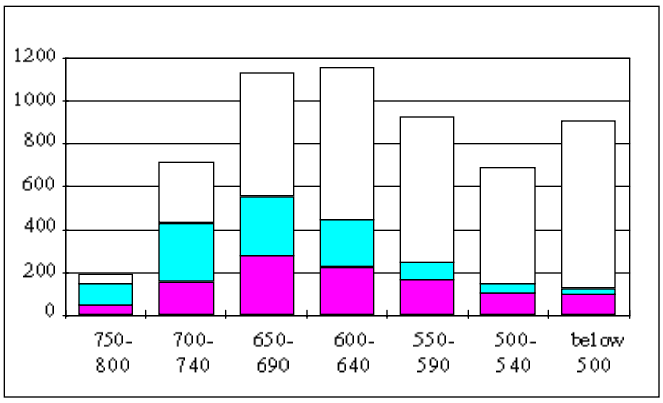


Math

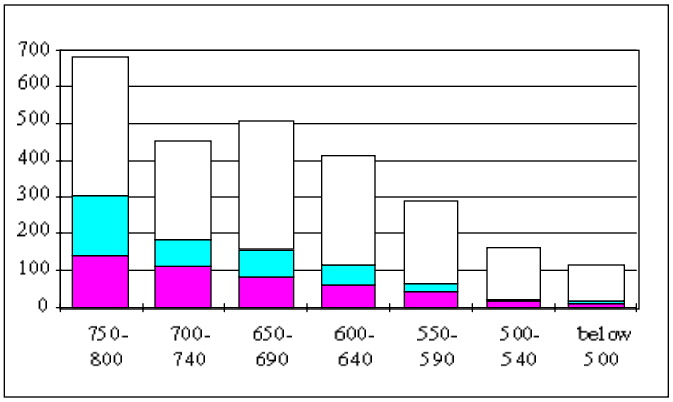


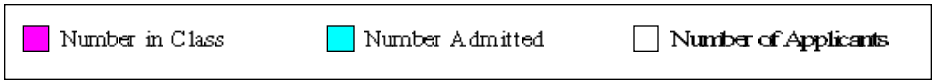
Achievement Tests

English Composition or History



Physics





Source: MIT Admissions Office