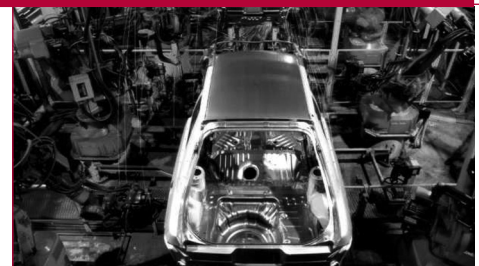


# MIT Faculty Newsletter

<http://web.mit.edu/fnl>

**this issue** features a summary report from the Ad Hoc Committee on the Faculty Quality of Life (page 5); "When Everything is Secret, There is No Truth" by Ted Postol (page 9); another installment on Professors of the Practice by Oli de Weck (page 12); a retrospective by Barbara Stowe on the recently completed fundraising campaign (page 16); and a Student Leaders Report (page 18).



## From The Faculty Chair Marginalization and Discrimination at MIT

Rafael L. Bras

**TWO INCIDENTS THAT OCCURRED** at the Institute this month disturb me a great deal. In the first, a group of male students walked out in protest during the unveiling of the new class ring. The ring depicts a woman in a modified MIT seal. In the second incident, posters announcing activities of the Campus Committee on Race Relations were defaced with racial slurs. Allegedly this followed a disruption in a public meeting. This type of threatening, ignorant, and intolerant behavior is not what this community stands for. Unfortunately, it is not as rare as one would expect. It happens every year.

This is not the first time a woman has been depicted on the class ring. The perpetrators of the "protest" argue that they do not object to the image of the woman, but to the modification of the Institute

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## Editorial MIT 2040

Erik Demaine and Olivier de Weck

**IT IS ONE OF THOSE** crisp, frigid Cambridge mornings in early March. The Charles River is still frozen solid and the sky is saturated a deep blue as students scurry across campus for the first week of classes. IAP just finished two days ago. Gone are the days when IAP lasted only four weeks. The extension from four to eight weeks was approved in 2017 after much debate among faculty and administrators, but remains controversial even after two decades. Ultimately, the wisdom of enhancing IAP as a unique MIT experience has prevailed, allowing students to experience fields far from their intellectual centers of gravity. It also allows them to take a number of half courses (six credit units), which now outnumber what had traditionally been full courses (12 credit units). This extension of IAP forced MIT to postpone the spring semester by a

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## Academic Responsibility and Gender Bias

Nancy Hopkins

**ON JANUARY 14, THE** President of Harvard, Lawrence Summers, stopped in at a conference held by the National Bureau of Economic Research (NBER) to deliver a luncheon speech to about 40 experts and scholars gathered to discuss the under-representation of women and minorities in the Science and Engineering workforce in the U.S. A stated purpose of the meeting was to address the question: "What programs and policies can further the process of diversifying the science workforce?" Earlier in the day I had spoken about MIT's efforts to address this question.

Several months before this meeting, the media had reported that during Summers' leadership there has been a sharp decline in tenured faculty offers to women in Harvard's Faculty of Arts and Sciences (FAS) in all fields of the humanities and social sciences, as well as in

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\$15/year on campus  
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**Photo credits:** Page 1 Ford-MIT Alliance (J. Saleh), Page 14, Ford Motor Company

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**MIT 2040**

Demaine and de Weck, from page 1

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month, with commencement now being held at the end of June.

There have been other changes too, some very visible, others much more subtle. The campus has grown significantly over the last four decades. The waterfront along Memorial Drive was already owned by MIT in the twentieth century from the Longfellow Bridge to the Western end of campus (where the old Hyatt had once stood). So, the enlargement of the Institute was fueled by expanding across the railroad tracks towards Central Square and Kendall Square. There are now more buildings carrying NW, N, and NE numbers than there are buildings on the main campus around Killian Court. Ironically, MIT's and Harvard's campuses are on the verge of entanglement, after being held at arms length for the last two centuries. MIT is still the leading university for science and technology in the country and perhaps in the world, with total student enrollment peaking at 13,840 last year. The percentage of undergraduate women has also increased to 50%. (In contrast, the number of female students has plummeted at Harvard since 2005, except at the Harvard Medical School.)

The biggest change at MIT was probably the reorganization of the Institute in 2025 with the dissolution of the departmental structures. While the traditional schools (Architecture and Planning, Engineering, Humanities, Arts and Social Sciences, Sloan School of Management, and the School of Science) still exist, their internal structure was transformed from the traditional hierarchical tree-like departmental structure into a network-like structure of loosely connected knowledge centers. Despite vehement opposition by some, MIT was the first university in the United States to muster the courage to break down the barriers between traditional departments and disciplines (e.g., between mechanical, electrical, and nuclear engineering; organic-inorganic chemistry; molecular biology and genet-

ics) and to organize its research units around the interdisciplinary center structure. The success of both the Biological Engineering Division and the Engineering Systems Division contributed to this trend. The change caused great difficulty initially because of the ambiguity in allocating faculty positions and other resources, centrally controlling a network structure, as well as mapping MIT's units to the traditional professional societies. But it also gave MIT and its faculty the ability to be significantly more nimble and aggressive in their pursuit of new research opportunities relative to its domestic and international competitors. It became clear by 2010 that so-called "interdisciplinary" work had become the norm, rather than the exception.

This flexibility allowed MIT to actively impact a number of significant technological breakthroughs in the first half of the twenty-first century: MIT spearheaded decentralized energy production and distribution based on multi-source hydrogen production and ultra-high-efficiency photovoltaics, and the control of personal digital devices and computers via brain waves and voice commands. (Keyboards and other oddities such as the computer mouse are still on display at the MIT Museum.) A growing population of cyborgs around the world and especially at MIT no longer use computer monitors, and project digital images directly to their visual cortex, thanks to the difference-mending collaboration between the Media Laboratory and the Computer Science and Artificial Intelligence Laboratory, before those units were dissolved. Two of the six astronauts executing the first human landing on Mars in 2032 were MIT graduates (one from Aeronautics and Astronautics, one from Earth, Atmospheric, and Planetary Sciences). World hunger fell 30% in just one year when, in 2034, MIT pioneered the light and efficient "pan-nutrition every-flavor bean."

Technology has also permeated teaching and learning at MIT, with OpenCourseWare (OCW) now serving as the main portal for students within and outside of MIT. All MIT lectures are now

being broadcast and archived automatically on OCW, with the site receiving over 500 million visits daily. The virtual TA system allows for interactive Q&A sessions between remote students and on-campus teaching assistants and faculty. At other universities, students organize "MIT OCW Clubs" which meet twice weekly to watch MIT lectures, discuss problem sets, and take exams. OCW grades students automatically where possible, and a current matter of debate is whether eager students who prove themselves online should receive certificates of learning. Meanwhile, top high-school students attain OCW experience to improve their admission portfolios.

The network-centric focus in both research and learning has radiated outward from MIT, with the Institute serving as the hub of an international network of premier universities forming a global alliance, with intellectual reach into the farthest corners of the planet. MIT's links with Cambridge University in the U.K., the Singapore-MIT Alliance, the Malaysia University of Science and Technology (MUST), and others have been unified and broadened to include Stanford University, École Polytechnique in Paris, Tsinghua University in China, and other partner institutions on all continents, including a virtual outpost at the new Antarctic research station.

This network had become not only desirable, but necessary after applications to U.S. universities from international students had declined by 36% (Engineering), 24% (Business), and between 20–24% in other fields starting in the 2003/2004 academic year. This decline continued rapidly until 2009, after which time the U.S. government eased restrictions on foreign students. While foreign graduate enrollment in the United States leveled off at 250,000 by 2010, most of the damage had already been done. In contrast to many of its peer institutions, MIT remained relatively unaffected by maintaining its high level of excellence and selectivity and by offering increased study options to foreign students through its

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**Marginalization and Discrimination**

Bras, from page 1

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seal. This argument, it seems to me, is disingenuous, at best. The MIT seal has been modernized before, and the tradition is for every class to design a distinctive ring. There is a process in place for implementing the ring design and this process has led to many permutations of the basic concept, including having a woman on the seal. The MIT undergraduate population is nearly half women. It is obvious to me that, given the open and unrestricted process of the ring design, women would want clear recognition of their influence in MIT life. This type of “protest” by men is insensitive and seeks to promote a history that has no place in our present or our future. Some of our women undergraduates feel threatened. They are frustrated and angry at the disrespect of some of their male colleagues.

The reality is that this incident is but the tip of the iceberg of a much deeper problem. Gender bias remains an issue, even when women are no longer a minority in the undergraduate class.

People of color, however, still are a minority. That members of our community would deface a poster with racial slurs is to me a sign that there is significant intolerance in our midst. As I said earlier, these incidents are not that rare. Insensitivity, insults, marginalization, and demeaning treatment happen all the time, at all levels of the Institute. Some of the incidents become subjects of public debate, most we never hear about. I am not naïve; society-at-large is full of bigots and hence a community like MIT will have its share. I would hope, though, it would be a smaller than normal share and that there could be civilized debate.

I do not believe in mandating education to all in order to address the ignorant

few. I do believe in the power of the community to illuminate some of our friends in need. This should involve plenty of opportunity for voluntary debate. It should involve institutional zero tolerance for bigotry and constant reinforcement of our non-discriminatory values. More importantly, it must involve the active participation of the great majority of the community that condemns this behavior. Note that I did not use the colloquial “has no time for this behavior,” because one thing we fail at, particularly the faculty, is to give these important issues the time they require. I call on you, my colleagues, to be vocal in supporting the rights of women and minorities at MIT. Lead by example, eliminating the discrimination and marginalization that still exist. ■

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**MIT 2040**

Demaine and de Weck, from preceding page

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international network. This allowed foreign students affiliated with MIT’s knowledge centers to choose between full-time on-campus study at MIT and full-time study at a partner institution with virtual classroom participation through the real-time OCW system, combined with short-term visits to MIT for intense face-to-face encounters with faculty and fellow students from across the globe.

Another benefit of the global collaborative network of universities is the reduced impact of fluctuations in local markets and federal funding. When the U.S. government lost track of the importance of fundamental research (starting as early as 2004) MIT had to turn to other sources. One of those sources was created by forming a larger, combined endowment between the partner universities, which now totals what would have been

the equivalent of \$1 trillion in 2005. By 2030, the university network created its own funding agency, which now provides the majority of research funding for all universities in the network and many universities outside the network. The resulting freedom has enabled MIT to lower its tuition substantially, realizing the principle that good education cannot be bought. Current predictions suggest that increasing government support of the agency will be a central issue of the U.S. elections later this year. But whatever external funding does come in, MIT and its network have the power to reject any strings attached to the money, and preserve its academic freedom.

But other things around MIT have stayed reassuringly the same. The Red Sox have not been able to reclaim their World Series title from the 2004 season and are still looking for a repeat over three decades later. It seems as though the curse had only been temporarily reversed in

that one magical year. The Big Dig, as it is still called, was completed by 2008, but the occasional leak and tunnel closure remains. Food trucks are still the most popular form of nutrition for students and some of the staff around campus. And the sunset has a particular brilliance over the Charles River on this cold night, March 1st, 2040. ■

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**Editor’s Note:** This editorial was written by two of the “younger generation” of MIT faculty. We always welcome articles by all MIT faculty, but particularly wish to encourage submission of pieces by this “younger generation.”

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## Summary Report from the Ad Hoc Committee on the Faculty Quality of Life

**FOR THE PAST YEAR**, the provost's Ad Hoc Committee on the Faculty Quality of Life (FQL) has been working to understand how satisfied MIT faculty members are with their roles at MIT, how well they negotiate the stresses of family and career, and what MIT might do to help faculty alleviate the stresses that interfere with their achieving a sense of success. This report is a summary of the committee's activities, findings, and recommendations.

The committee was assembled, first, to establish a benchmark of the current satisfaction and stress levels of the faculty and, second, to recommend changes to MIT's policies and administrative practices that would help to raise the satisfaction of faculty with their professional and personal lives and to alleviate the stress that detracts from their work. The current Ad Hoc Committee is one of a series of groups that have studied faculty quality of life at MIT, the most recent antecedent being the surveys conducted by the MIT Council on Family and Work in October 2001. (The final report from December 2002 may be viewed at <http://web.mit.edu/faculty/reports/fqol.pdf>.) Numerous committees have also studied the topic at universities we would consider our peers including, recently, Stanford and Berkeley. Finally, there is an extensive literature of studies that have examined "life and work" among college professors and other professions with similar educational backgrounds and social standings. These include the New Scholars project at Harvard and the recent Agenda for Excellence report from the American Council on Education. The present committee has assembled a number of these

documents and other URLs at <http://web.mit.edu/fql> for convenient examination.

These studies have identified a consistent set of themes that buffet the connection between faculty professional and private lives. The current Committee's work (including its own new data gathering activities) has re-confirmed these general findings in the MIT context, and has also identified a few issues that appear to be specific to the Institute.

To provide a factual grounding to the current Committee's work, we structured input from the faculty in two different systematic settings. The first was a survey administered to all faculty members in April 2004. Even though the survey instrument was extensive, a record-breaking 70% of faculty members filled out the questionnaire. The second approach involved a series of focus groups – facilitated professionally with assistance from MIT's Human Resources department – in which we were able to explore topics related to faculty quality of life and work in more depth. We held eight of these focus groups: five organized for randomly-chosen groups of faculty members from each of the five schools, and three additional groups of randomly selected faculty targeted to address issues of interest and concern to specific age groups (younger than 35, mid-career faculty aged 35-55, and senior faculty aged 55 and older).

A complete and extensive report of our findings (including statistical analysis of the data) and our recommendations is presently being crafted by the ad hoc committee. However, we also wished to make the faculty aware of a number of general

themes through the present forum. The following pages provide a summary of the key findings that emerged from the survey and the focus groups:

### *Background factors relevant to the life-work interface*

- MIT faculty members are generally satisfied with their roles at the Institute, expressing levels of satisfaction that exceed at least two peer institutions.
- MIT faculty members experience a great deal of stress, at levels that exceed those of senior managers in the private sector. This level of stress appears to be common among faculty at research universities, even those we would not directly consider our peers. However the stress indicators at MIT are at the very top of the scale.
- Differences between men and women, and between tenured and untenured faculty members, are generally small, both substantively and statistically. Satisfaction levels are the greatest among the youngest and oldest faculty; however, there is a dip in satisfaction among the broad middle-career group, aged 35 to 55.
- MIT faculty members who experience the greatest household stress include women, faculty with children of school age, the untenured, and the young. Of course these demographic groupings also combine in important ways.
- Middle-career faculty members are more likely to report stress associated with managing research and to believe that the resources provided by the Institute for teaching and research are inadequate. The combinations of limited salary increases and the oppressive cost

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**Faculty Quality of Life**  
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of living in the local area – coupled with the fiscal pressures of maintaining a healthy and vibrant research program that might ultimately lead to personal career advancement – result in a growing feeling of “career stagnation” that results in the drop in satisfaction noted above.

- Traditional gender roles have not changed appreciably among the youngest generation of MIT faculty members. Both younger and mid-career faculty members report that, on average, the female partner is responsible for a greater share of household duties. As a result of the changes in the demographic composition of our faculty, the issues that are raised by this distribution of tasks will continue to grow in importance.
- Faculty members who have an active social life and who get more sleep report being more satisfied with their roles as faculty members.
- It is very difficult for MIT faculty members to afford a house where they can take full advantage of the Boston/Cambridge cultural life and still be satisfied with the schooling of their children.

On the whole, MIT faculty members express a slightly greater satisfaction with their professional lives than with their personal lives. We are busy and work long hours, but for many faculty this is what attracted them to MIT in the first place. Sources of stress arise most commonly at the juncture between the home and the Institute and negotiating the frequently-competing demands of both. Most unfortunately, less than half of MIT faculty members express satisfaction with efforts that MIT is making toward increasing their quality of life. So, the general picture we gather is one in which the faculty are very satisfied on campus and at home, but very dissatisfied with the extent of the effort needed to manage the interface between the two. We must therefore take a holistic viewpoint to the faculty’s quality of life.

## Steps need to be taken in five areas: housing, professional support, extended personal and family support, common faculty environment, and career path.

What can be done to help MIT faculty members strike a better balance between life outside the Institute and their roles as faculty members? To the extent that improvements can be made at the Institute in order to make the job of a faculty member more rewarding and less stressful, what are those?

Based on our own committee deliberations, statistical evidence from the survey, and discussions with faculty members in the eight focus groups, we recommend that clear and concrete steps be taken in each of five different areas. These areas are, in approximate order of importance; (1) housing, (2) professional support for traditional on-campus roles, (3) extended personal and family support beyond MIT, (4) the common faculty environment, and (5) adjustments to the career path.

### Housing

- *MIT should immediately and substantially revise its faculty housing program to assist faculty members of all ranks.* The focus group sessions drove home the common observation that the greatest personal stress facing an MIT faculty member is finding a place to live that is convenient to MIT. It was also widely agreed that the high housing cost in the Boston area is the greatest competitive disadvantage MIT faces in recruiting top faculty members and graduate students. Both junior and senior faculty expressed this sentiment, though junior faculty members were more likely to express a desire to live very close to the Institute (i.e., in Cambridge or along the “Red Line corridor”).

- *MIT’s housing program should consist of a well-integrated portfolio of options.* These options should cover the spectrum from developing rental property that would be available at subsidized rates to MIT faculty members, through MIT-owned apartments and condominiums close to campus that could be sold and re-sold exclusively to MIT faculty, to subsidized mortgage plans. Rental faculty apartments should be incorporated in all new construction of graduate student housing. The greatest interest is in subsidized mortgage plans, but it was also recognized that faculty members in transitional situations (recently hired, undergoing divorce, experiencing newly “empty nests,” or nearing retirement) might find the options provided by well-equipped and new construction in close proximity to campus very attractive. MIT should make every effort to support private third-party efforts aimed to address this lack of modern housing options close to campus.
- *Mortgage subsidy plans should be broadly inclusive of existing faculty members.* It is tempting to begin a new mortgage subsidy plan by focusing benefits on untenured and newly-tenured faculty members who are clearly most severely affected by the present cost of housing in the greater Boston area. However, even faculty members who were lucky enough to buy their houses at the bottom of the housing slump in the early 1990s bought into a market that was significantly higher than the national average. Therefore, many middle-aged and middle-career faculty members now live further from campus than they choose, resulting in long commutes, less engagement with the campus, and less time with their families. While competitive pressures make addressing the housing situation of new hires and newly-tenured faculty members the most pressing, we predict serious morale problems among the faculty if a new mortgage subsidy program excludes those who have been on the faculty for more than 10 years.

- *MIT's housing programs should be designed to facilitate faculty members living "close" to MIT.* "Close to MIT" is a relative term and open to further deliberation, but there was positive sentiment expressed in favor of MIT further enhancing its housing programs to especially assist faculty living close by. In the long term, MIT, the faculty, and the surrounding cities and towns will all gain if Institute faculty lived closer to campus, even those faculty members who bought their houses a decade ago.

### Professional support

- *The provost should make available to the Schools additional funds that will be used to increase the level of professional support available to faculty members in carrying out their core responsibilities as faculty, in both teaching and research.* The Committee encountered many comments from faculty members to the effect that the number of senior/professional staff members available to help them do their jobs has steadily dwindled over the past decade-and-a-half. The specific jobs these individuals held vary across schools and departments, but generally go beyond secretarial support towards the level of lab managers and senior technical/laboratory professionals, and grant-writers. It was also noted that although numerous funds exist for developing innovative new courses the first time around, ongoing support for preparing lectures/demonstrations and developing visual aids is often lacking. One option we explored was providing faculty members with an account that could be pooled with other like-minded faculty to purchase such assistance, but we met with firm resistance to this idea from the faculty. The additional managerial overhead overwhelms the perceived benefit. A better strategy would be for the Institute to provide new funding, to be available to departments and Schools, in order to exclusively hire new staff members who would provide these services out of a common pool.

### Extended personal and family support

- *The Institute should provide dedicated resources to assist new faculty members to relocate in the Boston area and to assist faculty spouses in finding jobs close to the MIT campus.* The recruitment of new faculty members is a major source of stress for department heads, who must often rely on their own wiles and ad hoc contacts to help with such things as real estate, schooling for children, and employment for spouses and partners. The Institute should establish a single office that would provide one-stop referrals to help with faculty recruitment. Such an office could also assist existing faculty members. (The Center for Work, Family and Personal Life provides some of these services, but not all, and is not dedicated to faculty recruitment.)
- *The Institute should take the lead in establishing a new Massachusetts Bay Academic Opportunities consortium that facilitates the frequently frustrating, stressful, and time-consuming searches for postdoctoral/professional and academic job openings by the spouses of existing MIT faculty members and faculty candidates.* Similar consortia already exist in both Northern and Southern California.
- *The Institute should actively and fully participate in external organizations in the local area that provide resources targeted at managing the work-family interface.* These organizations include family-related operations such as "Parents in a Pinch" in addition to professional-related activities such as PartnerJob.com.
- *The Institute should work harder to publicize existing work-family policies (for example, maternity/paternity leave, elderly care, and mental health policies) and also ensure that there are no penalties, real or perceived, for taking full use of such benefits.*
- *The Institute should provide a venue for safe and fun activities for faculty member children (and the children of other employees) on days when public schools are closed.* An acknowledged point of stress at the Institute for both faculty and staff concerns "snow days," when local

schools are closed, but the Institute remains open. One source of stress is that faculty members often have responsibilities that require their presence on campus on such days. If the Institute is going to retain its tradition of remaining open in all but the direst of weather emergencies, then it should develop contingency plans for the care of children (for both faculty and staff members) on such days. Another interesting proposal regarding a weekly "MIT-night" was raised in the last issue of the *Faculty Newsletter* by Prof. Jacquelyn Yanch (<https://web.mit.edu/fnl/vol/173/yanch.htm>).

### Common faculty environment

- *The Institute should establish a real Faculty Club as a common and centrally-located gathering place for faculty.* The newly-established faculty lunch room in the Stata Center is recognized as a major step in the right direction, by providing a comfortable, pleasant venue to socialize with colleagues. However, the lunch room does not serve the larger set of needs that an actual Faculty Club would address, including a venue for small meetings and recruitment activities.
- *The Institute should continue the support of an independent medical center on campus, available for faculty members and staff.* Aside from housing, the issue the Committee heard the most concern about was the perceived erosion of services at the MIT Medical Center. Many of these comments were focused on recent losses in ob/gyn services, but the broader concerns went well beyond these. It was widely recognized that having a full-service medical clinic on campus was a major time-saver, for both faculty members and the staff who work for them. Closing or severely curtailing the services of the Medical Center would be considered a major reduction in the quality of life of Institute faculty members.
- *The Institute should consider the need to provide office space for emeritus faculty members to be an integral part of good departmental management.* Both

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**Faculty Quality of Life**  
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younger and older faculty members expressed a desire that MIT take a more comprehensive and generous stance toward its emeritus faculty, in terms of the office space provided for them. Presently, the treatment of our emeriti varies greatly across the campus. Some departments have surplus space they can allocate to retired faculty members, but not all do, and a successful recruitment season can wipe it out in an instant. Rather than being an afterthought, MIT should plan on its emeritus faculty members retaining an office presence and should provide that space on a regular basis. We considered, but rejected, the idea that MIT create a special center dedicated to providing the office needs of the emeritus faculty, because the greatest benefit of providing emeritus offices is in continuing departmental interactions and the mentoring of junior faculty.

- *As the Institute continues to expand into the City of Cambridge it should work hard to plan and consider its place and context in the immediate environs.* A vibrant, healthy local community with residential buildings (for faculty and students), cafes, markets, shops, and stores is to be greatly preferred to a “biotech ghetto” that is devoid of life outside of business hours.

**Career path**

- *The Institute should change its sabbatical policy to allow the “banking” of leaves.* Like most universities, MIT’s sabbatical policy allows faculty to apply for a sabbatical leave after 12 semesters of teaching. If this leave is taken after a faculty member is entitled to it, the subsequent leaves are pushed back by a corresponding amount. Because of the added complexities of modern family life (e.g., the competing employment constraints of two-career couples) and the needs of departments for their faculty to be flexible in taking leave, it makes sense to allow leaves to accumulate, whether they are taken or

not. We envision a system in which credits are accumulated in proportion to the number of classes and terms taught. In some cases, this will result in faculty members waiting 12 years in order to earn a full year off at full salary. We believe it more likely that faculty members would still take half-year sabbaticals, just at slightly more irregular intervals that serve their needs and the needs of the department better. The ability of the Institute to compete with external market factors such as changes in sabbatical leave policies at other local universities can also be actively addressed through such a credit-based system.

- *The Institute should experiment with “re-entry post docs,” to allow former faculty members or research staff to re-enter academic life after a time off for family considerations.* One of the ways the “career pipeline” leaks is when women faculty members leave the academy to have children. Having left, it is often impossible to locate an appropriate “on-ramp” for returning to the academy in fast-moving fields. One of the most interesting ideas being tried in the University of California system is “re-entry post docs” that allow individuals who have been away from the academy for family reasons to regain a footing back on the academic track. MIT should learn from such experiments and decide in the near future whether to adapt such an approach for this campus. A number of other novel ideas including the option of variable 10-year tenure clocks are discussed by the ACE in their report on “An Agenda for Excellence: Creating Flexibility in Tenure-Track Faculty Careers” ([http://www.acenet.edu/bookstore/pdf/2005\\_tenure\\_flex\\_summary.pdf](http://www.acenet.edu/bookstore/pdf/2005_tenure_flex_summary.pdf)).
- *The Institute should re-establish funds that allow faculty members to “re-engineer themselves.”* The Institute has a number of funding sources that allow faculty members to innovate in teaching and research (e.g., the D’Arbeloff Fund), but few sources of funds in smaller amounts to allow moderate-scaled adjustments to one’s own career. For instance, funding and support appear

hard to come by when faculty members want to upgrade their classes in an incremental way, or when they want to travel to conferences or take classes in new and emerging fields in which they are not professionally active. To remedy this, the Provost could, for instance, establish a fund that would provide \$1,000 to faculty members who wanted to travel to a conference or workshop, not to present a paper, but to partake of the program. Or, a fund could be established by the Provost to provide one-semester teaching relief for faculty members who wish to revamp course materials in a significant, but not revolutionary way.

In conclusion, we would like to thank all of those faculty who have participated in this process so far, including all of you who completed the survey and those who attended the focus groups. We also encourage you to respond to these suggestions by e-mailing the committee at [fql@mit.edu](mailto:fql@mit.edu). The quality of life challenges facing the MIT faculty are not always unique, but our attention to the challenges should be unique. The opportunity, should we seize it, is to be a leader in addressing these important work-family challenges that face faculty in all top research universities. Being a leader in this domain will provide the double benefit of advancing the quality of life of MIT’s faculty and enhancing our competitive position in recruiting the best faculty in the future. ■

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**Ad Hoc Committee on the  
Faculty Quality of Life**

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## An Open Letter to the MIT Faculty When Everything is Secret, There is No Truth

Theodore A. Postol

**IN NOVEMBER 2002**, Professor Edward Crawley recommended a full investigation of my allegations of fraud in Lincoln Laboratory's evaluation of a critical National Missile Defense (NMD) test that was aimed at determining whether the NMD would ever be able to tell the difference between warheads and simple decoys. For two years, the MIT administration took no action on the recommendation despite its implications for academic integrity and national security. Then, as a parting gesture, President Vest declared in December 2004, that the investigation could not proceed because it depended on classified information that the Missile Defense Agency (MDA) would not let MIT use – even though the information was already held by Lincoln Laboratory.

In addition, MIT says it cannot provide the names of the individuals it claims to have “identified” for its “ongoing” investigation, nor can MIT explain why its ongoing investigation has no mechanism to review and assess information already in-hand and available. MIT can also not explain why the investigation process is now secret and opaque, nor can it demonstrate that the process is being implemented with impartial and independent investigators, or even that there is an investigative process.

The basic facts are either known, or available, to MIT investigators and could be used to investigate this matter using open, transparent, and peer-reviewed methods, rather than those that have been adopted.

In his play, “All My Sons,” Arthur Miller depicts Joe Keller, a World War II manu-

facturer of aircraft engines who knowingly ships defective engines to combat units. As a result, 21 planes and their pilots are lost, and one of Keller's sons, a serving combat pilot, kills himself when he learns of his father's deception. Joe Keller's morality placed his short-term financial interests above his duty to country.

Letters that MIT have in hand . . . show that Lincoln repeatedly failed to comply with requests for information from the lead federal investigator.

MIT's unwillingness to investigate its own role in concealing fundamental flaws in the National Missile Defense system raises the same moral issues; what is MIT's obligation to the country when it knows that the Institute may have lied about a defense that is supposed to protect the nation?

In what follows, I will address the question whether there is sufficient evidence that could be used by MIT to determine that Lincoln Laboratory misled federal agents during an investigation of possible fraud in the National Missile Defense system that is now being deployed by the Bush Administration.

The document that initially caused me to conclude that federal investigators were misled by Lincoln Laboratory management and staff was produced by Lincoln during the summer of 1998 to support a federal investigation of possible fraud by a

defense contractor, known as TRW. Lincoln was supporting the investigators in its statutory capacity as a Federally Funded Research and Development Center (FFRDC). The title of the report Lincoln produced for the investigators is an “Independent Review of TRW Discrimination Techniques.”

The statement of work (SOW) that set out the tasks for the study required that the study “be done in cooperation with the . . . Department of Defense Inspector General” as well as with various defense contractors and agencies associated with the Ballistic Missile Defense Organization (now known as the Missile Defense Agency). The basic tasks for the Lincoln Laboratory-led study was to “review the . . . [ability of computer algorithms to discriminate between warheads and decoys using] . . . the data from [the] IFT-1A [experiment] and [to] evaluate(s) the [accuracy of claims about performance] . . . reported by TRW to the government . . .”

At issue was the Baseline Algorithm (or BLA). The algorithm was designed to examine signals collected by an infrared sensor that had been launched into space from the Lincoln Laboratory-run missile test site on Kwajalein atoll in the South Pacific. The experiment was to test the ability of infrared sensors to observe mock warheads that are accompanied by balloons and rigid objects that could serve as decoys to fool the infrared homing interceptors that are being used in what is now the Bush National Missile Defense system. If this experiment, and the closely related IFT-2 experiment, could not demonstrate that the “Kill Vehicle” could

continued on next page

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**There is No Truth**  
Postol, from preceding page

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## The Baseline Algorithm had incorrectly identified a two-foot diameter inflated balloon for the warhead.

discriminate between the mock warhead and these simple decoys, the NMD system would have little or no chance of working in real combat.

The Baseline Algorithm was supposed to work in a way that is roughly analogous to computer programs that are designed to “recognize” text on printed pages.

An obvious requirement for recognizing the text is a good prior knowledge of the geometry and variations in geometry of the letters and symbols that the computer program is trying to “recognize” (or more accurately, match). In the case of the Baseline Algorithm, the distant objects to be “recognized” appear as dots when observed at hundreds of kilometers range. The objects are recognized by first making careful physics-based calculations to determine the infrared signals from the objects when they are in space. These calculations are then used to create “templates” that predict the “color,” brightness, and twinkling of the signal from each object as seen by the sensor. In order to make a match, the sensor must be able to accurately measure the color and brightness of each object. The predictions of how each object looks to the sensor must be accurate and closely match what the sensor actually sees.

In March of 2002, the General Accountability Office (GAO) issued two investigation reports that found that sensor in the IFT-1A had lost calibration due to the failure of its supporting cooling system.

Without calibration, red dots might look green, green might appear yellow, and the colors of the other dots would also be distorted. Without information

on how to correct the color and brightness distortions, there was no way to match what was seen to what was expected. In turn, it was not possible to demonstrate that the Baseline Algorithm could select the right objects. In spite of this situation, the GAO reported that Lincoln Laboratory had told the federal agents that the Baseline Algorithm had worked well.

Prior to the GAO report, I had written to MIT’s then Chair of the Corporation, Alex D’Arbeloff, warning him that the sensor in the IFT-1A had lost calibration and that Lincoln’s claims to the federal agents could not possibly have been true. Provost Robert Brown acknowledged my warning in a letter to me dated February 11, 2002. When the GAO reports confirming my warning were published weeks later, I provided MIT with carefully annotated versions of the reports. As a result, MIT was informed of the problem and the issues with Lincoln Laboratory even before the GAO issued its reports confirming my warnings.

Letters that MIT have in hand between the Defense Criminal Investigative Service and Lincoln Laboratory show that Lincoln repeatedly failed to comply with requests for information from the lead federal investigator. The particular information that was requested from Lincoln would have immediately and distressingly indicated that fraud had occurred at TRW.

For example, the lead federal agent believed that there were 60 seconds of data from the experiment. When he asked Lincoln about the first 30 seconds of data, he was not told that there was no data for this period because the sensor had malfunctioned. When he asked about the last 11 seconds of data, he was not told that the Baseline Algorithm had incorrectly identified a two-foot diameter inflated balloon for the warhead. When he asked about a 16-second time interval in the experiment that Lincoln claimed to be analyzing, he was not told that the templates for matching the expected signals to the measured signals had been altered to make it appear that the warhead was cor-

rectly selected. In other words, documentation that MIT has in hand shows that Lincoln not only did not reveal critical information to the federal agents, but made claims to the agents that could not possibly be true.

Over the past four years I have spoken numerous times with the federal agent who led the investigation at Lincoln. He has repeatedly told me that he was not informed by Lincoln of the problems with the sensor, the loss in calibration, nor the dramatic increase in noise that obscured the signals in some cases and distorted the signals in others. I provided MIT with the name and contact information for the federal agent nearly three years ago; as yet no one from MIT has contacted him.

Independent investigators will need to examine MIT’s own interim inquiry report, which was provided to me roughly 15 months after this matter was brought to the attention of MIT’s then President Vest, and four months after the GAO had issued its two damaging reports.

Information from the MIT interim report and from discussions I had with the then Chairman of the Senate Armed Services Committee Senator Carl Levin, and with one of his aides, indicate that in the spring of 2001 a five-member team of MIT Lincoln Laboratory management and staff, including an assistant division head, went to Washington to brief Senate Armed Services Committee members and staff. The Lincoln briefing, which was unknown to me at the time, was aimed at debunking allegations I had made in a widely-publicized letter to the White House about scientific fraud in the integrated Flight Test 1A (IFT-1A).

Among those briefed by the Lincoln team were Senator Jack Reed, the then chairman of the Subcommittee on Strategic Forces, and staff members who worked for Senator Levin. The Lincoln Laboratory team told the audience that the allegations of fraud were bogus, and that the NMD would have no serious problems telling warheads from decoys. When the Lincoln team presented its analysis of why the allegations of fraud were bogus, they failed to inform the

audience that the data from the IFT-1A experiment was corrupted by a failure of a cooling system, and that the experiment could not possibly have been used to prove their conclusion.

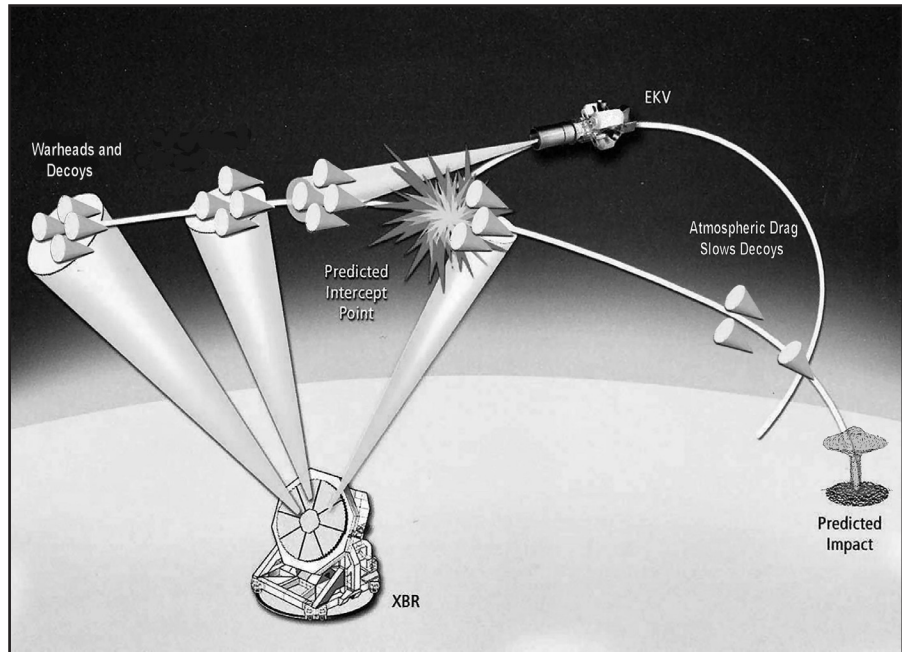
As Senator Levin explained to me when we later talked about the Lincoln briefing, “I have one MIT professor who tells me that the NMD system has problems, and a group of MIT professors from Lincoln who tell me the system will work fine.”

An MIT investigation could surely determine, without access to secret information, why Lincoln personnel produced a misleading briefing for senior members of the Senate, who told them to do it, and how they were mistakenly taken for MIT faculty.

The MIT interim report asserts that every material fact central to whether or not Lincoln was involved in a cover-up of contractor fraud contradicted the facts reported by the GAO. Since the GAO had obtained almost all of the technical material for its investigation at Lincoln Laboratory, the GAO followed its normal procedure of providing Lincoln with its factual findings so that any inaccuracies could be corrected. Before I was allowed to see the MIT interim report, the MIT fact finder provided it to the same managers and staff at Lincoln who had reviewed the GAO report for accuracy. Yet the facts in the MIT interim report contradicted those in the GAO report. In addition, the interim report was also reviewed by MIT legal counsel before it was provided to me. I provided MIT with an extensive analysis of the interim report, pointing out specifically where the report appeared to indicate fraud in the management of MIT’s internal investigation, but MIT has yet to review and respond to the materials I provided. These materials are not secret and need to be reviewed in an independent investigation of this matter.

Further post-flight documentation available to MIT provides detailed temperature records of the malfunctioning cooling system during the IFT-1A test.

Other post-flight data shows that a few tens of seconds after the failed one minute



**In the near-vacuum of space there is no aerodynamic drag to cause light objects to slow up relative to heavy ones. Such light balloons and rigid objects can easily be made to look like warheads. As a result, an attacker can use such “decoys” to greatly reduce the effectiveness, or completely exhaust such “high-altitude” defenses.**

attempt to collect data on the objects in space, the sensor was turned to look at the brightest infrared star in the Northern Hemisphere, Arcturus, a red giant with a very strong and well known spectrum. This star sighting would provide data on a known object that could then be used to improve the precision (or calibration) of measurements made on the mock warhead and decoys.

The post-flight data from the star sighting shows that the observation of the star was swamped with noise. In addition, infrared data from the mock warhead shows that it too was swamped with very high levels of noise. The large amounts of noise in the data from the mock warhead, and from Arcturus, would have immediately indicated to researchers that the experiment had failed, since the precise data needed to derive results from the experiment was not obtained. The failure of the experiment would also have been immediately evident to the researchers monitoring the flight of the sensor, because the temperature of the sensor transmitted from the space experiment showed that there had been a failure in the

cooling system. All this information is available to MIT, but has yet to be examined or evaluated.

So MIT’s assertion that it cannot access information necessary to investigate this matter is simply not supported by even a cursory review of the extensive body of information that is already available to investigators. This matter can be resolved without access to secret information. To argue otherwise impairs the credibility of the Institute.

MIT’s new president, Susan Hockfield, has the authority to reverse this ill-considered policy. She should do so in the interest of our nation’s security and the integrity and reputation of academic research at MIT. ■

**Editor’s Note:** We have asked the MIT administration to respond to Prof. Postol’s article above and the one he wrote in the previous issue of the *Faculty Newsletter*. We hope to have their response for the next issue.

**Theodore A. Postol** is Professor of Science, Technology, and National Security Policy ([postol@mit.edu](mailto:postol@mit.edu)).

## Professors of the Practice: Bridging Industry and Academia

Olivier de Weck

**THIS IS THE SECOND ARTICLE** in a series on non-traditional faculty appointments at MIT. In the first article (*MIT Faculty Newsletter*, Vol. XVII No. 3, November/December 2004) we discussed how Professors of the Practice are bringing a sense of the Real World to MIT, thanks to their extensive professional experience. In this article we discuss in more detail the complex relationship between academia and industry, and argue that Professors of the Practice are able to act as a unique bridge between MIT and industry.

### Industry and Academia: Complex Interactions

Some may say that it is futile to map the intricate web of relationships between academia and industry because of the dynamic nature of interactions. Others may argue that close ties between industry and academia are undesirable because they create conflicts of interest (of a primarily financial nature) and rob the university of its freedom to pursue “pure” research independent of economic interests. Although everyone is entitled to their opinion, a close association between academia and industry is undeniable, both in fact and tradition. This is particularly true for MIT:

- MIT maintains strategic research alliances with a number of corporations such as Microsoft, Ford, and Dupont, among others.
- MIT has strong internal organizations that foster collaborations and exchange of personnel, research ideas, and results, as well as licensing of new technologies: the Office of Corporate

Relations, the Industrial Liaison Program, the Technology Licensing Office, and the Industrial Performance Center.

- MIT features educational programs focused on mid-career to executive level students: the Leaders for Manufacturing Program, the MIT Sloan Fellows program in Innovation and Global Leadership, and the System Design and Management program.
- MIT’s research is funded by industry on the order of \$60-80 million per year, which has historically represented between 11.4% (2004) and 19.7% (2000) of the Institute’s total research expenditures.
- A 1997 study conducted by BankBoston revealed that MIT graduates have founded 4,000 companies, creating 1.1 million jobs worldwide and generating annual sales of \$232 billion.
- MIT has the ability to appoint exceptional industrial leaders as Professors of the Practice. This gives these individuals the ability to pursue a second career in academia with rights and obligations equivalent to a tenured faculty member. But what’s in it for MIT?

### How does MIT interact with industrial firms?

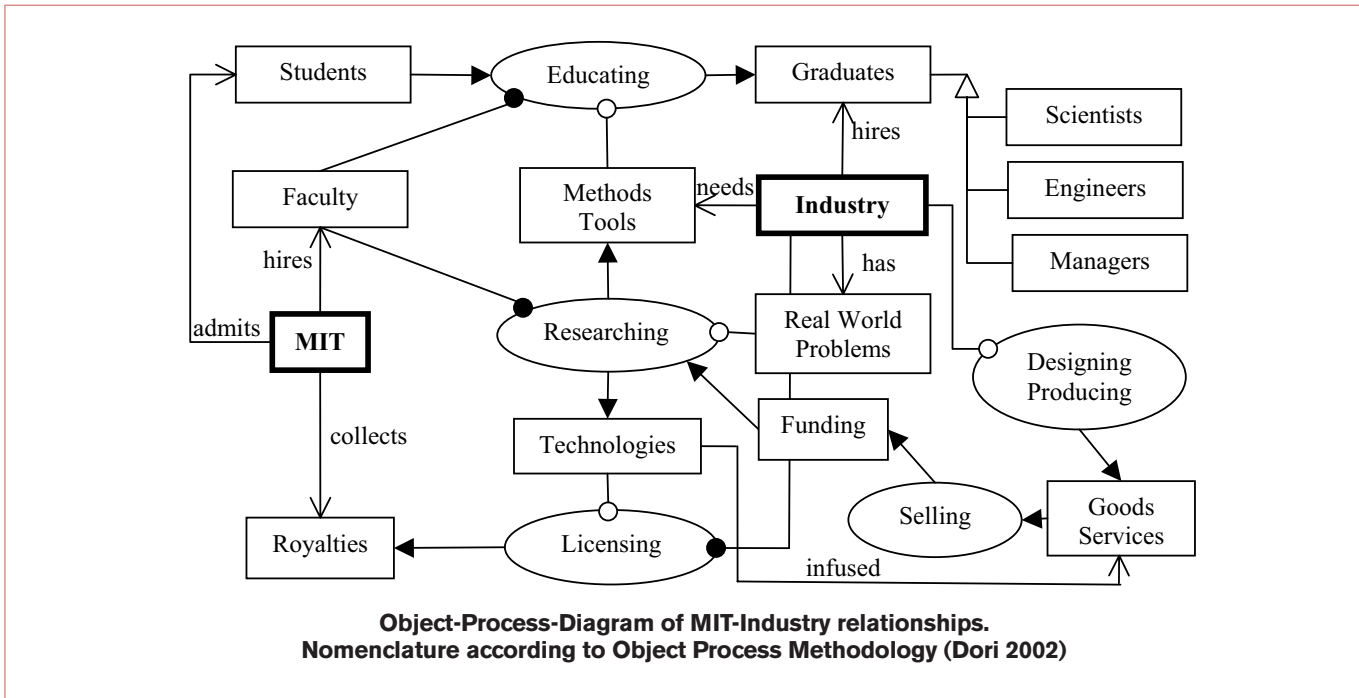
The primary purpose of industry is to design, produce, and sell goods (products) and services for a profit. In order to do this they hire a workforce, consisting of scientists, engineers, and managers, among others. These graduates are primarily pro-

vided by the Institute through the educational process, which transmits to them a body of knowledge about the workings of the physical world and, perhaps more importantly, methods and tools to design and produce better goods and services. In the messy reality of industrial practice, situations frequently arise which are not properly addressed by existing methods, tools, or technologies. It is the existence of these real-world problems which gives the impetus for new research, fueled directly by industry funding, and in some cases indirectly via government funding. MIT hires faculty to educate admitted students and conduct research which will produce new methods, tools, and technologies to address important problems. Occasionally technologies are licensed by industry for a royalty in order to infuse them in new or existing goods and services.

The figure on the next page shows the relationships between MIT and industry in a simplified fashion as an Object Process Diagram. In this view rectangles are objects and ovals represent processes. Various links connect objects to processes and objects to objects.

What makes MIT different from many other universities is that both teaching and research are derived from real-world problems and the desire to have an impact on industrial practice. In this context, Professors of the Practice can play a catalytic role as members of our faculty. As former decision-makers and leaders, they have an in-depth understanding of current, past, and potential future problems that industry is facing. They can transmit years of experience and hard lessons learned to our students. They can





act as messengers for the Institute and carry new research results back to industry with credibility and increased awareness of new thoughts and ideas born in the less constrained world of academia. What follows is a brief perspective on two of our colleagues, Prof. Chris Magee and Prof. Debbie Nightingale.

**Prof. Christopher Magee**

Chris Magee sees parallels between fundamental research in engineering science and research in large-scale systems, which are often designed and/or operated by industry and government. His background in materials science taught him that the properties and behavior of a material are not only a function of its molecular structure, but also shaped by the processes (e.g., heat treatments) that are applied to it throughout its life. Similarly, he sees intricate relationships between form and function in complex systems and products, which also exhibit strong path dependencies, which are introduced during the product development process.

Despite early opportunities to join academia in the 1960s and '70s, Prof. Magee decided to make his career in industry where he saw more of an opportunity to

make a real-world impact. After joining Ford Motor Company in 1966, he started in a fundamental research position in materials science. As he gradually moved to greater levels of responsibility in the company, his work also became more applied. This included nonlinear finite element modeling, the use of lightweight materials in car bodies and crashworthiness, among others. Finally, in 1981 he became the manager of advanced vehicle and concept development at Ford. During the 1980s and 1990s he led the technical development of major new vehicle programs such as the Explorer, Mondeo, Focus, F-Series trucks and the new Taurus, among others. At the end of 2001, he retired from Ford, but wanted to remain active as an academic to continue to learn and to share his insights with students and others operating at the intersection of industry and academia.

At MIT, Prof. Magee enjoys the intellectual stimulation he gets from teaching both at the graduate and undergraduate level (in Mechanical Engineering and in the UPOP program) as well as the ability to pursue his research. He is helping shape an intellectual agenda for the field of Engineering Systems, e.g., through the doctoral seminar ESD.83. This course

focuses on doctoral-level analysis of scholarship on key concepts such as complexity, uncertainty, fragility, and robustness, as well as related areas such as systems engineering, systems dynamics, agent modeling, and systems simulations.

Prof. Magee candidly admits that some aspects of being a Professor of the Practice are challenging; one of these is the slow pace of decision-making in academia. Whereas decisions in industry are made frequently, with only partial information and under considerable time pressure, this is rarely the case in a university setting. At a place like MIT, the power of individual, executive decision-makers is replaced by the need for extensive deliberation and consensus building among the faculty. This can be frustrating at times, but it is also essential for the long-term survival of the university.

Dr. Magee has a PhD in Metallurgy & Materials Science from Carnegie Mellon University and an MBA from Michigan State University. Among his areas of expertise are vehicle design, systems engineering, application of computer-aided engineering, and computer-aided design. The application of materials, vehicle crashworthiness, manufacturing-product

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**Professors of the Practice**  
de Weck, from preceding page

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interface, and all aspects of the product development process are also areas of significant personal experience and knowledge. Dr. Magee is a member of the National Academy of Engineering, a Fellow of ASM, and a Ford Technical Fellow. He is currently a Professor of the Practice with dual appointments between the Department of Mechanical Engineering and the Engineering Systems Division. He is director of the Center for Innovation in Product Development (<http://cipd.mit.edu>).

**Prof. Deborah Nightingale**

Deborah Nightingale contends that in some cases industry is actually ahead of academia. One area where this might apply is Integrated Product and Process Development. Industry has incorporated collaborative development processes involving design engineers, manufacturing engineers, suppliers and customers long before we began teaching this approach in university courses. Should academia and MIT, in particular, give up any research activities in such areas?

Quite the contrary, says Prof. Nightingale. Her philosophy is to use industry as a laboratory, as a research testbed, so to speak. This has been the main thrust of the Lean Aerospace Initiative (LAI) which is now headed by Nightingale as co-director. The Lean Aerospace Initiative was born out of practicality and necessity, as declining defense procurement budgets collided with rising costs and military industrial overcapacity in the 1990s, prompting a new defense acquisition imperative: affordability rather than performance at any cost (<http://lean.mit.edu>).

Over the last several years, LAI's efforts have been broadened beyond manufacturing to include applying lean principles to the entire enterprise, including product development, supply chain management, software development, and enabling administrative processes such as IT, human resources, and finance. It is often



**Ford Motor Company Assembly Plant**

at the interfaces of these enterprise processes that the key opportunities and research issues lie. The dominant research paradigm in LAI is the case study method. In this context, however, Prof. Nightingale contends that traditional academia is often working in the “silos,” rather than across organizational boundaries. Also, conventional research is primarily focused on documenting and collecting data on historical facts and describing pathologies in current industrial settings. Her ambition and research methodology go beyond this by (i) creating new enterprise operating models, (ii) identifying pockets in industry and government where these operating models can be implemented as prototypes, (iii) observing and measuring the impact of these new operating models, and (iv) feeding the resulting insights back to key decision-makers and into future projects.

The results of this research also flow into her teaching at the Institute. Her course ESD.61J “Integrating the Lean Enterprise” addresses some of the important issues involved with the planning, development, and implementation of lean enterprises. This course started in 1998 as a seminar in Aeronautics and Astronautics, and has since expanded to include students in various graduate programs in the

Engineering Systems Division as well as other engineering disciplines. People, technology, process, information, and leadership dimensions of an effective lean enterprise are considered in a unified framework. This kind of broad learning experience is particularly popular with students who possess prior work experience (e.g., those in the System Design and Management program or the Leaders for Manufacturing program). Since most of MIT's students go into industry positions, Professors of the Practice can also serve as role models and mentors to both graduate and undergraduate students.

Prof. Nightingale holds a PhD in Industrial and Systems Engineering from Ohio State University, and MS and BS degrees in Computer and Information Science. Prior to joining MIT, she headed Strategic Planning and Global Business Development for AlliedSignal Engines. Prior to joining AlliedSignal she worked as a researcher in the Human Engineering Lab at Wright Patterson AFB. Dr. Nightingale is a member of the National Academy of Engineering and a Past-President and Fellow of the Institute of Industrial Engineers. ■

**Olivier de Weck** is an Assistant Professor of Aeronautics and Astronautics and Engineering Systems ([deweck@mit.edu](mailto:deweck@mit.edu)).

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## MIT Poetry

by Steven Cramer

### GOODBYE TO THE ORCHARD

Beautiful from the get-go, we were  
incarnations of the new, and pure sex.  
I'll miss that, along with the unicorns.  
The organic bower of our garden grew  
into anybody's memory of a bed  
or a mattress, in a shack near a lake.  
Mistakes, like love, are to be *made*,  
you said. I hadn't thought of that.

That first autumn was easy, the liquor  
of decay headiest at noon. And the orchard,  
let's face it, had begun to resemble a casino,  
all its tables rigged in our favor. The yoke  
of being cared for is what cast us out,  
not that immense, bearded librarian,  
our curator, and not our having learned  
how to get on one another's nerves.

Goodbye to the orchard: green  
one day, the next day blood. We know  
to stiffen at a voice; how to tell the truth  
from an untruth; what's sweet, what stinks.  
Behind each sleeping dog, another to let lie.  
Who knew an innocence taking ages to perfect  
could fall so short when time came to live?  
You knew, and then you let me know.

### SINGER

I knew trouble and endured it,  
grief and desire my companions.  
In winter my enemy attacked.  
The better of the two, I was bound  
in rope made from my own sinew.  
All that has passed, and so may this.

There was a man condemned to live  
outside the city he loved – even death  
meant less in exile – and a woman  
who dreaded the child inside her.  
Her dreams were dreams of drowning.  
All that has passed, and so may this.

If the mind becomes a wolf's mind,  
it will force misery on misery,  
make cowards heroes. If courtiers  
want the kingdom overthrown, yet fail  
to speak, they will remain courtiers.  
All that has passed, and so may this.

At first doom sees, wherever it turns,  
more doom. Then, in time: joy.  
I'll say this about myself: my name  
was a name you knew, and I sang  
until another singer took my place.  
All that has passed, and so will this.

*after the Anglo-Saxon poem, "Deor"*

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**Steven Cramer** taught in MIT's Writing Program in 1982-83 and in the Literature Section in 2000-02. He currently directs the MFA Creative Writing Program at Lesley University. His fourth book of poetry is *Goodbye to the Orchard* (2004), from which these poems are reprinted.

## A Retrospective Look at The Campaign for MIT

Barbara Stowe

**THE END OF THE CALENDAR YEAR** marked the conclusion of the Institute's seven-year capital campaign. Reaching our \$2 billion goal with another \$53 million in change to our credit, The Campaign for MIT brought an important transformation in private support to MIT and set the stage for a new level of fundraising in the years to come.

Back in 1994 when Chuck Vest and I first began quiet conversations about a campaign, we were only two years out from the completion of the \$710 million Campaign for the Future. But Chuck was very concerned about the federal funding climate in Washington and it was increasingly clear that MIT required additional financial wherewithal for undergraduate scholarships, graduate fellowships, faculty chairs, and renewing the campus infrastructure. And so began a parallel process of assessing the demand and supply side of MIT's agenda. Then Provost Joel Moses led the deans and faculty in a review of the most critical institutional needs while the senior leaders in Resource Development analyzed MIT's fundraising history and the current trends that would inform how ambitious we could be in seeking support from our donor constituency.

Historically, and in contrast to the Ivy League schools, MIT has relied heavily on support from corporate and foundation donors. But in 1997, we knew that to succeed with a campaign that met MIT's needs would require turning to our alumni in unprecedented ways. As we set the stage for a \$1.5 billion campaign, we knew we would need to raise at least \$1 billion from individual donors – which at that time was twice the cumulative giving of all of MIT's living alumni. With a strong economy and Chuck's optimism and leadership, we set forth on a course that took us from the height of the market

in the late '90s through the uncertain economic and political landscape that followed shortly thereafter. Happily, our alumni and friends more than met the challenge. When we reached our original target two years early, we took a deep breath and raised the goal to \$2 billion, and in doing so joined the ranks of a small number of topflight fundraising institutions.

MIT, of course, is a younger institution than many of those with which we compete and compare ourselves. And our fundraising program reflects our origins and an evolution that spans 55 years and five capital campaigns. The Mid Century Fund, launched in 1949, raised \$25 million, three-quarters of which came from corporations and foundations. During the next three campaigns, this constituency continued to provide roughly 60% of our fund-raising dollars. In recent years, as we greatly expanded and strengthened engagement with our alumni, we shifted the balance dramatically, and in the just completed campaign 66% of our gifts – \$1.35 billion – came from individual donors.

During the course of The Campaign for MIT, we found ourselves in the select company of just nine other universities with campaign goals of \$2 billion. Most had alumni populations considerably larger than ours; most had large professional schools – like medicine and law; many had big-time athletic programs. All of these factors shape an institution's fundraising culture. If you calculate these campaign goals on a per alumnus basis, MIT's tops the list at \$19,976 per graduate, which is an extraordinary achievement in this peer group. [See chart, next page.]

Overall, the campaign benefited from the generosity of some 65,000 individual donors. Fifty-four percent of our alumni participated in the campaign; and gifts of

\$1 million or more from 208 alumni and friends totaled \$1 billion. Members of the MIT Corporation contributed \$425 million – 21% of the campaign, and our corporate and foundation constituency added \$650 million.

We did extremely well in meeting some of our goals and wish we could've done a bit better in some other areas. But at the end of the day, one-in-five faculty chairs were endowed during the campaign, and 275 new scholarship funds and 345 endowed and expendable graduate fellowships were created. The campaign helped to support the addition of nearly one-and-a-half million square feet of space in five new buildings. And cash giving to MIT on an annual basis more than doubled over these seven years. [See chart, next page.]

These results naturally involved close collaboration among the staff in Resource Development, the Alumni Association, and our school-based fundraising colleagues. They also reflect the generous participation of many faculty across the Institute who worked with us in a whole range of ways. Our alumni volunteers also made important contacts and contributions to the effort and we all owe a great debt of gratitude to Ray Stata and Alex d'Arbeloff, both of whom turned in yeoman service meeting alumni all around the country on MIT's behalf.

Above and beyond the dollar and donor metrics we use to measure a campaign's success, there are two additional factors that will give shape to MIT in the years ahead. First, we are reminded time and again about the importance of long-standing relationships. Having been a member of the MIT community for nearly 25 years, I was privileged to have the opportunity to work with Jim Killian, Jerry Wiesner, and Howard Johnson in the



	# Alumni	Goal	\$Goal/Alum	Dates	Status	\$ Achieved
MIT	100,372	\$2.0B	\$19,926	1997-2004	Completed	\$2.05B*
Univ. of Chicago	114,993	\$2.0B	\$17,392	2000-2006		\$1.12B
Johns Hopkins	118,619	\$2.0B	\$16,861	2000-2007		\$1.59B
Duke	125,897	\$2.0B	\$15,886	1996-2003	Completed	\$2.36B
USC	179,619	\$2.0B	\$11,135	1993-2002	Completed	\$2.85B
UCLA	233,037	\$2.4B	\$10,299	1995-2005		\$2.65B
Columbia	221,747	\$2.2B	\$9,921	1990-2000	Completed	\$2.79B
Harvard	269,497	\$2.1B	\$7,792	1994-1999	Completed	\$2.60B
Univ. of Washington	267,179	\$2.0B	\$7,486	2000-2008		\$1.22B
Univ. of Michigan	401,418	\$2.5B	\$6,228	2000-2008		\$1.60B

\*MIT's \$ Achieved as of 12/31/2004

**\$2B Comparative Campaigns [as of 11/30/2004]**

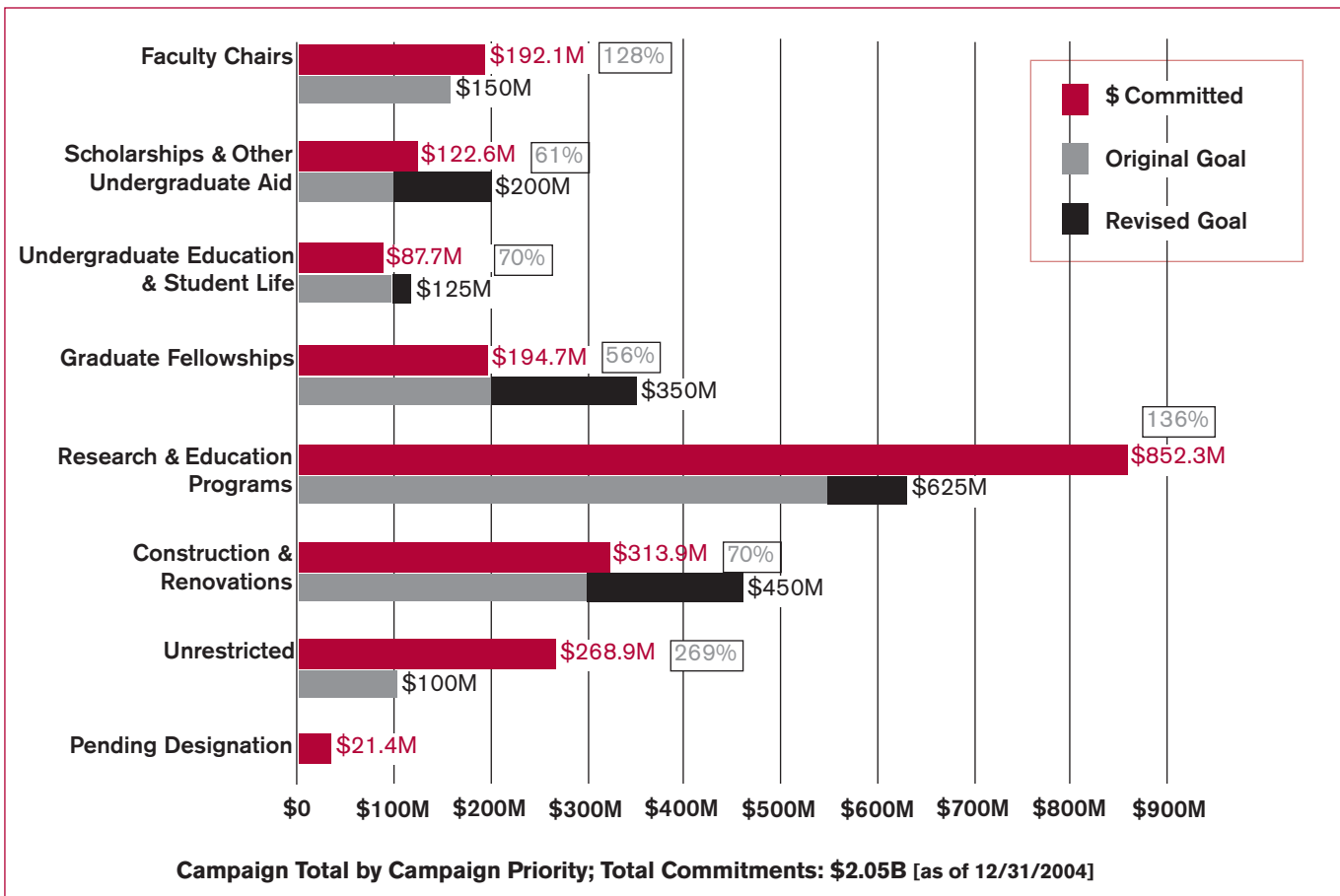
early 1980s. And it was a great pleasure for me to see gifts arrive all these years later from people who were brought closer to MIT through their efforts. Many of our

most generous donors in the last 7 years are alumni whose real engagement with the Institute began during the last campaign through the efforts of Paul Gray and

my predecessors, Glenn Strehle and Sam Goldblith. And the number of people whose respect and regard for MIT grew even greater during Chuck Vest's 14-year presidency is beyond calculation. As Susan Hockfield begins her tenure at MIT, she inherits a legacy of strong leadership and a wonderful community of Institute supporters which will serve MIT well in the years to come.

Another of the less tangible but vitally important by-products of this campaign is the new level of confidence it gave all of us in MIT's ability to attract high-level gifts and to appeal to a broad constituency of supporters around the country and around the world. Taken together, this legacy of leadership and generosity combined with a heightened confidence sets the stage for an ambitious and bold next chapter in private support to MIT. ■

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## Student Leaders Report Improving the Graduate Student Academic Experience

Barun Singh

### HOW DO GRADUATE STUDENTS

rate MIT faculty support for academic and professional advising? Are they learning the skills and getting the training and advice they need for future success? Where can we do better?

The Graduate Student Council (GSC) has worked over the course of this year to actively engage students, faculty, and staff to start answering these questions, and we are now in the unprecedented position of being able to do so in a meaningful way. Over 50% of all MIT graduate students responded to the 2004 Graduate Student Survey in which the GSC placed a number of questions related to graduate advising, training, and support. Over 85 faculty, students, and administrators from 25 academic departments participated in focus groups held by the GSC to discuss how MIT might be able to improve in these areas. Both the survey data and focus group discussions show that while there are many things MIT can be proud of, there is certainly room for improvement. This article highlights some central themes that have emerged.

### The Advisor/Advisee Relationship

A student's relationship with their research advisor can often be the single most influential factor in their graduate and professional career. When asked whom they turn to for support, the advisor ranked higher in students' responses than even their parents and family – only peers and spouses were more frequent sources of support. A positive relationship based on trust, mutual understanding, open and honest communication, and a shared set of goals allows a student to be inspired, to

The good news: 85% of graduate students are satisfied with their research advisor. The bad news: nearly 1,000 students are not.

learn, and to grow to their full potential. A negative relationship can leave a student feeling isolated, unsupported, and, in the extreme, unable to succeed in their post-graduate careers.

The good news is that approximately 85% of graduate students say they are satisfied with their relationship with their research advisor. The bad news is that nearly 1,000 current graduate students (15%) are dissatisfied.

The root of students' dissatisfaction with their advisors is almost always the level of personal attention, feedback, and mentoring they receive, and the quality of communication between them. How often do you meet with your students? A third of the graduate students at MIT feel that they do not meet with their advisors enough, and 56% report availability of faculty as an obstacle to their academic progress. How much of your discussion with your students revolves around what you expect of them, or what they expect of you? 44% of graduate students say that their advisor does not communicate expectations clearly. Most striking of all, perhaps, is that over half of all MIT graduate students believe their advisor considers them to be a source of labor to advance their own research.

The quality of an advisor/advisee relationship is based on the personal interaction between those individuals, and cannot be dictated by the department, school, or Institute. There are, however, mechanisms which could do well to reinforce positive relationships. A common theme to emerge from the focus groups has been to emphasize the importance of mentoring and communication in the orientation of new faculty. Well-respected senior faculty, or faculty members who have demonstrated excellence in advising (e.g., Perkins Award winners) could play vital roles in such orientation programs. In addition, creating and enforcing some standard format for evaluating student research progress could go a long way towards ensuring some basic level of regular communication.

### Skills, Training, and Advice

For a student to reach their full potential, a good relationship with their advisor must be accompanied by training in essential skills and advice to assist with their professional development. In the technical arena, students fare well – 92% of graduate students who are planning to graduate by the end of the current academic year feel that their critical thinking skills have “greatly” or “somewhat” developed during their time at MIT, and 85% say the same about their research skills. When it comes to the development of “soft skills” (communication, writing, leadership, teamwork, time management, etc.), however, there is considerable room for improvement.

Students rank soft skills to be as important as or more important than

research skills; yet they are not able to adequately develop themselves in those skills.

- In the best case of soft skill development, 19% of MIT graduate students at the end of their programs will not have learned the critical communication skills they think they will need for the future (i.e., they rank the skill as “very” or “somewhat” important but have developed “very little” or “not at all”).
- Students are least developed in ethical issues – only 48% of those at the end of their programs have developed in their understanding of ethical issues, while 86% believe the topic to be important.
- Only 39% of students report having received advice related to ethics.

It is important to note that while graduate students overall receive very little advice related to research ethics, this number varies a great deal by school. In the Whitaker School, for example, 70% of students reported receiving advice on ethics. The Schools of Architecture & Planning, and Science, also provide more advice on the topic of ethics than the average. These schools are not doing better than the rest by accident – in each case some form of formal training is integrated into their curricula.

In the area of professional development, students are left wanting. Less than 40% have received advice on how to find a job, prepare a résumé, or develop professional contacts outside of their program. We can, however, once again identify a best practice at the school level. Because of a very conscious decision on the part of the Sloan faculty, nearly 70% of Sloan students report having received advice on how to develop professional contacts outside of their program.

It is clear that there are solutions to the problems of how to teach students the skills they deem important and how to give advice on topics essential to their future progress. Best practices from one school or department should be examined by others, and adapted in a way that makes sense given that community’s

culture and needs. In addition, the focus groups emphasized the importance of regular discussions – among faculty, students, and graduate administrators – to assess the state of advising and to seek out best practices from other departments or schools.

### **Resources and the Importance of Peer Support**

Though there are many Institute resources meant to improve student life and learning, utilization of these resources varies widely. Most self-service (e.g., library) and essential (e.g., health care) resources are heavily utilized (over 75%) while the number of students who take advantage of resources such as MIT Mental Health (19%), Counseling and Support Services (11%) and the Ombudsperson’s Office (4%) is much lower. Among those who do use these resources, a large majority (over 75%, and in many cases over 80%) rank them to be of “good”, “very good” or “excellent” quality (except dining and parking, which fare much worse). It is difficult to gauge exactly what a “good” utilization level is or should be for many of these resources. What is clear, based on the focus group discussions, is that many of these resources, particularly those related to conflict resolution, could benefit from increased publicity of their existence and purpose.

On the departmental level, the same trends can be seen (high satisfaction levels and varied use of resources) but things are complicated by the fact that departments do not all offer the same resources and do not publicize the resources they do offer to the same extent. For example, one-in-five students does not have an academic advisor distinct from their research advisor, 40% are not aware of the existence of a faculty member serving as graduate officer in their department, and only 21% of students know of any sort of counseling or mediation services within their department. Departmental resources can often play an even more significant role than those offered by the Institute, and should not be overlooked when considering how to provide more support for graduate students.

Finally, one must not forget that the most valuable resource for graduate students, and their primary source of support, are their peers. In many cases, the best way to support graduate students is to empower them to help themselves as a community. Among nearly all of the resources available to them, graduate students are most satisfied with their departmental graduate student groups and graduate support groups. Beyond their direct effect, these groups also create a supportive community for graduate students throughout the department. All departments should seek to encourage and foster peer support – this can occur on a variety of levels ranging from personal mentorship to formalized mediation programs that involve students. For each of these there are again a number of best practices to learn from.

### **How Do We Do Better?**

Improving the graduate academic experience will require work to be done at all levels. There are five primary areas in which we can be most effective. The importance of personal guidance and mentoring must be emphasized to faculty through orientation and training programs. We must do better at developing graduate students in their soft skills, and learn from best practices in doing so. Resources should be better publicized, and expanded where needed, particularly in departments that are lacking. Peer support should be very much encouraged and supported at the local level and in a variety of forms. Finally, departments should perform regular assessments and discussions among faculty, students, and administrators regarding the state of graduate advising. Overall, MIT is doing well for its graduate students – but there is still much work to be done in order for us to be doing as well as we could be doing to provide the most rewarding graduate academic experience possible. ■

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## Making the Green Grade

William C. Van Schalkwyk

### What faculty members can do to advance the Institute's sustainability objectives

**HOW WOULD MIT'S PREMIER** ranking for research and education excellence compute if metrics measuring an institution's environmental performance were included in the ranking equation? Would MIT's performance in recycling, greenhouse gas emissions, and energy efficiency help or hinder our competitive position? Current efforts are moving us in the right direction, but additional leadership and participation by faculty members are essential ingredients to achieve more sustainable operations on our campus.

In a time of escalating resource consumption and unprecedented pressures on our ecosystems, the traditional metrics for ranking institutional excellence may well broaden to include a measure of an institution's impact on the well-being of the environment, society, and the economy – typical measures of sustainability. A major challenge for MIT is to bring the same shared commitment that we have toward research and education to our sustainability performance. Achieving this is a shared responsibility distributed among our students, staff, and faculty, with each group bringing unique qualifications to bear on the challenge. MIT's faculty have a key role in advancing the Institute's sustainability objectives, whether or not they are working in traditional environmental disciplines.

In 2001, MIT pledged its commitment to environmental excellence with the adoption of the MIT Environment, Health and Safety Policy by the Academic Council. This Policy lays the framework for simultaneously promoting excellence in research and education while minimiz-

ing the environmental and occupational health and safety impacts of our operations. President Vest said many times that MIT's operations should strive to match our recognized leadership and excellence in research and education. We are making great strides towards our sustainability goals, but we have much to do.

In our operations, the installation of an advanced electricity cogeneration facility increased generation efficiency 18% while reducing our regulated air emissions by 45% and our greenhouse gas emissions by 60,000 tons per year. The Institute has partnered with and committed to the City of Cambridge to advance its bold and integrated approach to reduce the City's emission of greenhouse gases below 1990 levels. Innovative programs to increase commuter options at MIT have significantly reduced local air pollution and the burden on Boston's crowded roadways. Food composting programs on campus remove more than 17 tons of waste per month from MIT's expensive waste stream and help return healthy soils to stressed agricultural systems. The Institute has adopted the City of Cambridge's aggressive recycling target of capturing 40% of the total waste generated on campus and diverting it to recycling operations. To help address excessive storm water runoff into the City's sewer system, MIT has employed an innovative, state-of-the-art storm water control and treatment system that uses biofiltration. The technology allows this water to be recycled as toilet-flushing water in the new Stata Center via solar-powered pumps, saving thousands of gallons of water each month.

The Institute's environmental programs continue to improve every year. We have more than quadrupled the amount of waste we recycle in the past five years. The overall trend is very positive and our recycling rate today is approximately 26%, compared with about 5% in 1999.

In our classes, faculty members have designed and employed innovative approaches to investigate real-life opportunities for advancing sustainability goals. A recent IAP course sponsored by the Laboratory for Energy and the Environment taught students how to use community-based marketing techniques to identify and develop practical projects to help implement the City of Cambridge's Climate Protection Plan. The Department of Chemistry has developed an undergraduate course that examines approaches and methods for promoting "green chemistry" in laboratories. There are numerous other classes in diverse disciplines that address environmental and sustainability topics.

However, for the Institute to make a significant and lasting impact on the sustainability of our operations and beyond, additional actions and commitments need to be made. Incorporating concepts of sustainability into our teaching and actions into our operations can be driven by a variety of equally important reasons: not only is it the "right thing to do," but sustainability also is based on the efficient and rational use of resources, which can be driven by a desire to minimize costs. You do not need to be a preservationist, a conservationist, or otherwise a "green" person to have a reason to behave "green" or to encourage more sustainable per-



Simply turning off computer monitors at the end of the workday could save between \$500,000 - \$750,000 per year in energy costs.

formance at class, work, or home. For example, it costs the Institute approximately 50% less to recycle our waste than it would cost to dispose of the same waste materials as trash. This translates into a potential annual savings to the Institute of more than \$200,000 if we were to reach our current recycling goal of 40%. Employing double-sided printing would take a sizable bite out of the over \$900,000 spent annually on office paper at MIT. Simply turning off computer monitors at the end of the workday could save between \$500,000 - \$750,000 per year in energy costs (based on EPA figures).

Purchasing more environmentally preferable products not only promotes our sustainability goals but also can lead to significant cost-savings that accrue directly to individual departments, labs, and centers. Simply switching from purchasing traditional office printer toner cartridges to refilled or remanufactured cartridges could collectively save the Institute upwards of \$115,000 per year. In 2003, MIT purchased almost \$380,000 in conventional toner cartridges that could have been substituted with an equally performing and warranted remanufactured equivalent. A typical 30% savings on these purchases adds up to more than \$114,000. This number will grow as the availability of other recycled products increases.

Current initiatives to reduce MIT's environmental footprint are just scratching the surface of efforts needed to create a truly sustainable enterprise. As we seek out opportunities beyond the "low-hanging fruit," we will have to work harder, smarter, and more creatively. We need to enlist the help of all students, staff, and faculty, and deploy the creative energies that make MIT such a remarkable hotbed of innovation. Only then will

we be able to achieve a green ranking that we can consider truly leadership-quality and on par with our research and education excellence.

What can faculty members do to help in this effort? There are several ways to show leadership and commitment, while not increasing the burden on people's busy schedules. These include:

1. **Commit and Communicate to Conserve Resources.** Simply making it clear to staff and students that you believe sustainable behavior is efficient, less wasteful, cost effective, and the "right thing to do" will go a long way. Faculty at MIT are perceived as the lifeblood and leadership of the Institute, and you can influence the actions of many.
2. **Adopt Sustainability Practices in Your Daily Work.** Remember and act on the Rs of sustainability: *Refuse* to use wasteful products, *Reduce* the use of resources and generation of waste, *Reuse* products whenever possible, and *Recycle* materials that can be recycled. For example:
  - Refuse to buy paper products with little or no recycled content;
  - Reuse packing and shipping material;
  - Utilize the MIT Furniture Exchange, Equipment Exchange, and the [reuse@mit.edu](mailto:reuse@mit.edu) e-mail listing for buying, trading, and donating all types of reusable materials;
  - Reduce energy consumption by turning out lights when you leave, turning off the air conditioning for the weekend, and shutting down unnecessary computers and other equipment;
  - Recycle your discarded computers and electronics equipment by contacting [recycling@mit.edu](mailto:recycling@mit.edu). Familiarize yourself with what can be recycled at MIT by going to <http://mit.edu/environment/pdf/flyer.pdf>.
3. **Put Your Sustainability-Related Research Into Action on Campus.** Use MIT's facilities and operations as a laboratory to collect and study data and phenomena. MIT's campus embodies all of the functions of a town or small city and is open

24 hours a day.

4. **Integrate Sustainability Into Existing Course Work.** Incorporate concepts of sustainability and environmental stewardship into existing and future classes and curriculum. Develop teaching examples that demonstrate sustainability concepts.
5. **Develop New Green Classes and Projects.** Develop new classes and projects that specifically focus on environmental and sustainability themes. This can be done in all disciplines and courses.
6. **Work with Student Groups.** Engage campus student groups that focus on sustainability issues, such as SAVE (Share A Vital Earth), and SfGS (Students for Global Sustainability) by integrating shared activities or interests into course work; or help them shape their goals, objectives, and actions to be more effective organizations.
7. **Support Staff Efforts.** Encourage your staff to become involved in the Recycling AmbassadorsPLUS program sponsored by the Working Group Recycling Committee. For more information, go to [http://web.mit.edu/wgrecycling/ambassadors\\_plus.shtml](http://web.mit.edu/wgrecycling/ambassadors_plus.shtml).
8. **Encourage use of the Department of Facilities Resources.** Request large blue totes for paper recycling when your office or department conducts a major file clean-out or relocation. Contact [recycling@mit.edu](mailto:recycling@mit.edu) for more information.
9. **Get Involved.** Go to <http://web.mit.edu/> environment for more information on current initiatives and ways to get involved. Please contact me in the Environmental Programs Office for more information. I can be reached at 617-253-9492 or [billy@mit.edu](mailto:billy@mit.edu). ■

Note: This article was prepared with the assistance of the Working Group for Recycling, MIT Libraries, MIT EHS office, the Laboratory for Energy and the Environment, and the MIT Environmental Programs office.

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**Academic Responsibility and Gender Bias**  
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science and engineering. Given the topic of the NBER meeting I expected to hear Summers' thoughts on this recent decline, or possibly innovative approaches to solving well-documented problems that drive women from science and engineering careers.

Instead, in what have become widely known comments, Summers offered three hypotheses to explain the absence of women from the top of many professions, including specifically academic science, math, and engineering. As discussed below, much of what he said flies in the face of decades of research. Furthermore, research shows that the unfounded attitudes Summers expressed can lower women's expectations in the classroom and the workplace, and negatively impact judgments about their performance and merit.

I walked out of Summers' talk in personal protest. As a molecular biologist and geneticist for over 40 years who has spent 10 years studying the under-representation of women in the high end of the science professoriate, I knew that many of Summers' remarks were factually wrong, contradicted by decades of research, and deeply damaging to women. As a Harvard alumna (BA and PhD) I was personally offended. Later that day I happened to receive an e-mail from a *Boston Globe* reporter about an unrelated matter. At the bottom she queried: "PS: Did today's conference turn out to be anything interesting?" I told her about Summers' talk. She tracked down other NBER participants and gathered their responses to the speech. On January 17th the *Globe* published her story. The news sped round the world and has occupied front and editorial pages for more than eight weeks. On February 17, Summers published a transcript of his remarks (<http://www.president.harvard.edu/speeches/2005/nber.html>) with a cover letter (<http://www.president.harvard.edu/speeches/2005/facletter.html>) modifying and apologizing for the comments. While gracious, the letter did not

explain why the comments were both wrong and damaging. It also failed to allay unwarranted public concerns about academic freedom.

Because of the media frenzy and public misunderstandings about this incident, the Editorial Sub-Committee asked me to write a piece for the *MIT Faculty Newsletter*. I take this opportunity to describe some of the background and research that may have caused Summers to apologize for his comments, and to explain why this incident is not about "political correctness" or "academic freedom."

**Why I was a speaker at the NBER conference**

I have been a professor of molecular biology and genetics at MIT for 31 years. For 17 years my lab studied genes involved in cancer. For the past 14 we have studied genes required for vertebrate development. I am a member of the National Academy of Sciences, Institute of Medicine, and American Academy of Arts and Sciences.

I entered science convinced that civil rights laws had eliminated gender discrimination from the work place, including from academia. However, I learned I was wrong. I gradually came to realize that women and men who made equally important scientific discoveries often were not valued equally by our system. In 1994, as described in an article in this newsletter in 1999 (<http://web.mit.edu/fnl/women/women.html>), I discovered that other tenured women faculty in the School of Science at MIT had come to the same realization that I had. Then Dean of Science Bob Birgeneau (now the chancellor at Berkeley) established a committee to study the problem systematically. The committee, which I chaired, consisted of six tenured female faculty and three tenured male professors of science. We interviewed tenured and untenured women faculty in Science and gathered data on lab space, committee membership, salaries, etc. The resulting 150-page report presented vivid evidence of how women professors enter science believing that gender discrimination is a thing of

the past, but, as they approach the age of the men in power, suffer marginalization and day-in and day-out biases. These small inequities, as they accumulate, make doing science and attaining top positions much more difficult for women.

The committee report was detailed and personal, and hence needed to remain confidential, but in 1999, then chair of the faculty Professor Lotte Bailyn, asked our committee to provide a narrative report of what we had done and found, and how the Institute had responded. This summary, which was published in a special edition of the *MIT Faculty Newsletter* [Vol. XI No. 4, March 1999], came to be known as the MIT Report on Women in Science. A sentence that President Vest wrote in comment proved to be of particular importance: "I have always believed that contemporary gender discrimination within universities is part reality and part perception. True, but I now understand that reality is by far the greater part of the balance." The Report was covered widely in the press and elicited an outpouring of e-mail from women scientists in the U.S. and abroad noting that they too had experienced discrimination but had been unable to get their administrators even to acknowledge, much less to address, the problem.

Following publication of the MIT Report, and with support from the Ford Foundation, President Vest convened a meeting of presidents, provosts, deans, and leading female scientists and engineers from eight other leading research universities. They met in January 2001, returned to their campuses to study the problem, and met again in the spring of 2004. Most universities analyzing the problem found results very similar to those at MIT, although five years after the MIT Report was made public, easily measurable inequities in compensations or resource allocations to women have become relatively uncommon.

MIT also established a Council on Faculty Diversity, which Provost Bob Brown and I co-chair. Its goal is to prevent and eliminate inequities that arise from bias, to increase the flexibility in academic

careers to help both male and female faculty better manage family and work goals, to attract more minority students to PhD programs in science and engineering, and to ensure that search committees seek to identify outstanding women and minority candidates. Yet, despite real progress at MIT and many other universities, marginalization and unintended gender bias remain a serious problem.

A further consequence of the publication of the MIT Report was that I have received nearly 500 invitations to talk on this topic at universities, research institutes, and conferences. I have accepted 90. One was the NBER meeting.

**A landmark report on women scientists in Europe and research in psychology have documented the impact of unintentional gender bias**

Tenured women faculty at MIT were not alone in identifying gender bias as a barrier to women trying to advance in science careers. In 1997, a landmark study by Wenneras and Wold opened Europe's eyes to the magnitude of gender discrimination there (*Nature* 397, 341-343 (1997)). Wenneras and Wold asked why a much smaller fraction of female than male applicants obtained postdoctoral fellowships in biomedical research from the Swedish Medical Research Council. They re-examined the merit of applicants using quantitative criteria of accomplishment. They examined applicants' publication records using impact factors of the journals the applicants had published in, and the number of publications and first author publications of each applicant. (They used legal means to obtain the data since the granting agency refused their request to provide it.) Wenneras and Wold's stunning finding was that a woman had to be 2.5 times more productive than a man to receive an equal score in scientific competence. This meant, for example, that she had to have published the equivalent of three more *Nature* or *Science* papers to be judged equal to a man.

What is so striking about the Swedish study is that many people assume that

women often receive special *advantages*. While sometimes true, data show that in highly significant ways, throughout their careers, the opposite is more often true. How could this be? Importantly, while these studies were in progress, another line of research was advancing which provided an intellectual basis for the surprising findings of reports such as those from MIT and Sweden. This research comes from the field of psychology. Much of the relevant work has been summarized in Virginia Valian's book, *Why So Slow*.

Over recent decades, psychologists have demonstrated that identical intellectual work performed by men and women is frequently not valued equally. For example, if one xeroxes a manuscript and puts a man's name on one copy and a woman's on the other and sends the two articles out for review, the identical work receives a higher score or more positive comments if reviewers think it was authored by a man. Strikingly, it does not matter whether the reviewers are men or women! Most of us – women and men alike – tend to under-value work if we think it was performed by a woman. *It does not take research or imagination to understand the devastating impact on professional women, of having their work judged inferior when in truth it is at least equal in merit. The inability of most people to believe they are capable of such unconscious bias and unfair judgment is perhaps the greatest obstacle to equality in the workplace.*

But there is some good news: Research shows that unconscious bias can be alleviated by societal changes and by recognition of the problem. Judgments of women's work have of late become more equitable, presumably due to society's acceptance of women's competence in the workplace. In addition, work by Harvard psychologist Professor Mahzarin Banaji and others has shown that making people aware of their unconscious bias can reduce its magnitude.

Recently, NSF established a program called ADVANCE to address bias and other well-documented barriers to women's careers in science and engineer-

ing. The program has awarded \$50 million in grants over the past three years to support efforts at 19 universities aimed at institutional changes that might level the playing field for women, and also for minorities, who face some of the same barriers as women in entering science and engineering fields. Women (including minority women) are 50% of the U.S. workforce and minority males are an additional 15% of the population. In failing to draw on this pool, we squander two-thirds of the available science talent in America. Encouraging women and minorities to enter science and engineering is deemed critical by the NSF to future U.S. competitiveness.

**President Summers' NBER remarks**

It was in the above context that Summers made his remarks to the NBER audience. He was listed on the program as "Lawrence Summers, President, Harvard University." Summers' remarks were of particular importance because the views and leadership of a President are critical to making significant progress in this endeavor. Furthermore, women faculty at Harvard's FAS had expressed concern last year that Summers may not understand these issues. I had already discussed the poor record in hiring female molecular biologists in the FAS with Summers in the fall of 2004.

Summers told the NBER audience that he would offer three hypotheses to explain the under-representation of women in tenured positions on the faculties of leading universities, particularly in the fields of science, math, and engineering. As set forth in the transcript of his remarks, the three, in order of importance, were: 1. Women's family responsibilities and unwillingness to work the 80-hour week it takes to get to the top; 2. Differences in "intrinsic aptitude" between men and women; and 3. Socialization and discrimination in hiring. Summers dismissed the third hypothesis as unimportant, saying that we overestimate the impact of socialization, and that market forces would work to

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remove gender bias in hiring within academia. As Summers continued, I became convinced that these hypotheses were in fact his personal beliefs. To those who work in this field, and to many women who worked their way to the top of elite science or engineering, Summers' comments were astonishing because: a) they ignore decades of research that have already disproven much of what he said; and b) they embody the very attitudes that constitute gender bias and that have been shown to hold women back. This man seemed to be using the power of his office to deny women their fundamental fair treatment. One woman who heard the talk told me she felt as if she had been assaulted.

Below I explain what is factually wrong and what is right with Summers' three hypotheses, according to current research. To summarize, research has identified two important, and even related, barriers to women striving to reach the top in science and engineering: greater family responsibilities, as Summers put forward in hypothesis #1, and socialization and gender bias, which Summers incorrectly dismissed. In contrast, and despite decades of research, intrinsic differences in aptitude that could explain the small numbers of women professors of science and engineering have not been found.

**Hypothesis 1:** As Summers proposed, the greater family responsibilities that have traditionally fallen to women vs. men have been a significant factor in causing women to opt out of high-powered careers in science and engineering. However, some women have always been able to "have or do it all." Furthermore, significant changes in recent decades have improved the situation for many more women. New expectations, goals, economic realities, reproductive technologies, and the length and variability of careers have changed the picture. Today young professional women and men demand more equal involvement in both family and work, and universities

compete to accommodate them. Still, I personally believe that there is not yet enough change in universities or in society to create equality for men and women in this regard, so I believe that Summers' hypothesis #1 has merit. However, I found his implication that women are not willing to work hard enough to get to the top both insulting and wrong.

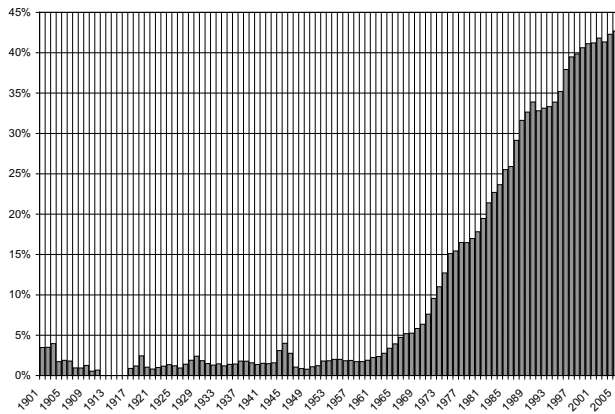
**Hypothesis 2:** "Intrinsic aptitude" differences means genetic differences. Not one shred of scientific evidence supports the assertion that women as a group are genetically inferior to men in the math, science, or engineering ability required to attain the top of the profession. Nor is this from a lack of research effort to find such differences. Of course there are myriad biological differences between men and women, including in brain and other anatomy, hormones, etc. However, none of these has been linked to any intellectual ability which itself has a causal link to achievement at the highest levels in any intellectual pursuit. In sharp contrast, decades of research demonstrate that socialization and bias are powerful factors in determining career choice and academic success, including differences between men and women. To explain the decades of research on this topic in biology and psychology is beyond the scope of this article. However, several key findings that argue against significant genetic differences in intellectual ability of men and women, as well as flaws in Summers' argument and facts are below. (See also *Nature Neuroscience* 8, 253 (2005) for an excellent brief summary.)

1. Women's demonstrated ability to perform at a very high level in science and math has changed too rapidly to be explicable by genetic changes. For example, the figure (next page) shows the percent of women undergraduates and graduate students at MIT each year for the past century. The percent of women PhDs in science and engineering nationally has increased similarly.
2. Summers asserted that research universities only hire exceptional people, and

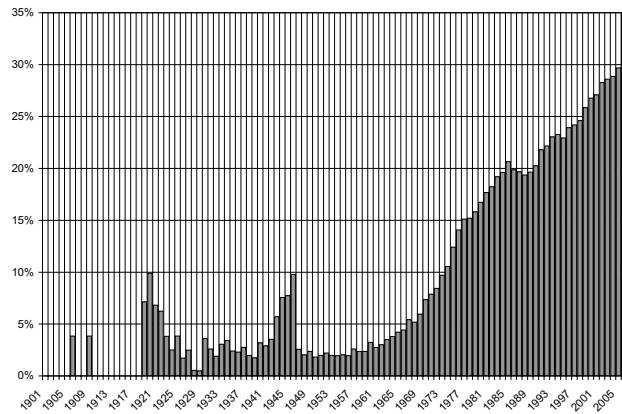
used as the measure of being exceptional, math SAT scores. He said that there are more men out on the tail of the bell curve of math ability than women, that this may reflect differences in intrinsic aptitude between men and women, and thus may explain the under-representation of women on science, math, and engineering faculties of elite universities. However, the tests he referred to are SAT tests taken by teenagers. By this age it is not possible to differentiate innate ability from the impact of society and its expectations on students' choices or performance. In contrast to tests of teenagers, tests of very young children have failed to detect significant differences between the cognitive abilities of males and females. Minor differences have been found, for example, in spatial rotation (favoring boys) and verbal skills (favoring girls) but even in these cases, there are no correlations of these skills to later career choices or success, and the differences detected are tiny compared to the impact of social factors.

3. Women near the high end of the SAT bell curve take the same math classes as men in college and do equally well in them. This was not true several decades ago, but has come about as women began to receive similar encouragement in school. Such a rapid change in women's math ability again argues against genetic changes and in favor of societal expectations and how boys and girls are educated. These changes also make long-term studies of high SAT scorers, which have sometimes been used to try to bolster Summers arguments, problematic.
4. Some women have extreme math ability as traditionally measured. For example, there are female winners of the Putnam award now, although for many years there were none. This is an award made to the top five college students in math in the U.S. and Canada each year. Strikingly, this year 4 of the top 15 students in the competition





Percentage of MIT Undergraduates Who Are Women



Percentage of MIT Graduate Students Who Are Women

Source: Office of the Provost

were women. This award is so elite that even on the most elite math faculties only about 5 to 10% of the professors were Putnam winners. Furthermore, while Putnam winners as a group are enormously successful academically, not all (or even most?) become academic math superstars. Nonetheless, given that some women can perform at this level, and thus must always have been capable of it, why has there never been a tenured woman professor in math at Harvard in its 369-year history (and only three ever at MIT)? I am told that three women have been offered tenured positions in math at Harvard in recent years. I spoke to one who told me she would not accept the job at Harvard or “in the math departments of any of those other elite east coast schools either” because of the gender discrimination. She said that in these departments faculty think that only men can be great mathematicians and she was not willing to work in such a biased environment. While anecdotal, such testimonies from women with this ability are important, and they are common among this elite group.

But *could there be* genetic differences between men and women which we might discover in the future and which might affect the ability or inclination of men vs. women to pursue certain fields? Yes. After socialization and bias are cor-

rected for, perhaps girls will prove to be better at math than boys. But we can’t use these unfounded possibilities to explain the lop-sided under-representation of women (or minorities) on current science, math, and engineering faculties. Worse, it is actively irresponsible to do so, because evidence from research in psychology demonstrates that such attitudes negatively impact performance and judgments of merit of those who belong to the group that is seen as genetically inferior (see, for example the work of Claude Steele). It has proven difficult to dissociate exceptional individuals from their group stereotype.

Although there are obvious biological differences between the sexes, including anatomical brain differences, making the leap from gross anatomical findings to explanations of subtle cognitive functions, let alone to complex career choices and outcomes is impossible (except perhaps where disease or damage to the brain is involved.) Such simplistic, unfounded leaps are junk science. Genetics has been one of the most powerful tools in modern biology. But so far, genetic analysis of even simple behaviors in animals has been an almost complete failure. It will be extremely hard, if even possible, to identify math ability genes, if they exist. Currently, to speak seriously of using genetics to justify negative societal outcomes in intellectual pursuits for groups of people, amounts to academic folly.

**Hypothesis 3.** As discussed above, socialization and bias, including, importantly, unintentional bias, are powerful factors that shape and can limit the careers of men and women. While we have seen extraordinary changes in the status of women and under-represented minorities in the past several decades, research unequivocally documents that full equality of opportunity has not yet been attained for these and other groups at the highest levels of our society.

**This incident is not about academic freedom**

While initial reports and commentary focused on Summers’ remarks, a second wave of press tried to make the critics of Summers’ speech the focus of this story. These individuals were accused of suppressing academic freedom. But this affair is not about academic freedom at all. It’s about the role and responsibilities of a University President, and secondarily about responsibility in research.

A university needs a president and it needs one 24/7. Summers speaks as the voice of Harvard every time he utters a public word. So, is it acceptable behavior for the President of Harvard to make undocumented, incorrect comments outside his field when such comments damage and demean half his constituency? Of course he has the freedom to do so. The question is whether he *should*.

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**Academic Responsibility and Gender Bias**  
Hopkins, from preceding page

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The second purported issue of academic freedom here is whether experts must stand up and argue with the President in a public forum in order to educate him about a field in which he does not work. If they fail to do so, or disagree afterwards, have they infringed on the President's academic freedom? The answer is no, precisely because he is President. Were Summers merely a professor who wanted to advance the genetic inferiority of women to do math and science at elite universities, the processes that accompany academic freedom and enable the academy ultimately to discover the truth, would kick in. The speaker would be required to present data, others would present contradicting data, replication of experiments would ensue: ideas would be tested and those found wanting would ultimately be weeded out. *But the President is not a researcher in the field, and the processes associated with academic freedom of faculty to do research do not pertain when he speaks. Summers is the boss. His words are the pronouncements and opinions of Harvard University.* At no time during his talk did I doubt that these were the beliefs of the President of Harvard. Given my knowledge of these fields, I felt a moral obligation to protest, and a desire to leave. I asked the women sitting to either side of me if they thought we should all walk out, but they were the speakers following Summers and so, although one said she would like to, they felt they could not leave.

**My critics in the press**

I have been criticized in the national press for my role in bringing Summers' comments to light. My critics seem to have a diversity of motives. The identity of some of the critics could have been predicted; for example, the ultra-conservative Independent Women's Forum and associated voices such as those of Judith Kleinfeld, Phyliss Shafly, even Cathy Young. Some of these women have long

attempted to discredit the MIT Report, apparently for political or ideological reasons, and some have used deliberately false information to do so. So their reactions were not terribly surprising.

Harder to understand, at first, are certain Harvard faculty critics, particularly our former colleague Steven Pinker, who has portrayed me in the press as being opposed to academic debate and inquiry (*The New Republic*, February 14, pg 15, 2005) and see <http://www.thecrimson.com/article.aspx?ref=505366>. Why would Steve imply such an obvious untruth? Some Harvard faculty told me that Pinker and his popular-press book *The Blank Slate* were the source for Summers' NBER comments. Having now read the poorly reasoned and unsupported section on gender in Pinker's book, this seems likely. If so, Pinker's defense of Summers makes sense. In fact I think he owes Summers an apology. But he owes me one as well. Ironically, Harvard psychologist Professor Elizabeth Spelke and I were scheduled to debate with Pinker on the Charlie Rose show about research in biology, genetics, and psychology that debunks Pinker's views, but Pinker backed out. The show was cancelled because, they told me, they could not find a psychologist to take Pinker's viewpoint who was willing to appear.

But my most visible and also semi-mainstream critic was columnist George Will, who labeled me a "hysteric," and did so before the text of Summers' remarks had even been released (<http://www.washingtonpost.com/wp-dyn/articles/A40073-2005Jan26.html>). It was a classic male response in many ways, since women who complain of gender discrimination have long been told they are "difficult women," even crazy. Will labeling me the old-fashioned female hysteric is how some men have tried to gag women forever. I think the explanation for his remarks is summed up well in a letter written by a female reader to Will and cc'd to me:

*"Do you have some kind of personal grudge against Ms Hopkins, Mr. Will? Or is it just women and their progressiveness in general?... So Ms Hopkins got upset. So*

*what? Many women get emotional. Know why?... When people don't listen its frustrating... By the way, would you have written your piece had you been speaking of a Jew getting upset about the Holocaust, or an African American reeling over some injustice? I doubt it. But we ALL know that women are fair game, right??? THINK, Mr. Will. THINK... You (and many other controlling, power-hungry males) would find any way, any excuse to keep women down and from getting ahead – even when it's in the best interest of humankind and the world."*

Hundreds of women who learned of the NBER incident from press reports wrote me to say, "Thank you, thank you for your courage," while only about two dozen women criticized my actions or words. In contrast, I received fewer than 30 e-mails from men supporting my actions and a couple of hundred that echo Will: some say they can't take me seriously because I'm a weak whining woman; some say they can't take me seriously because I didn't stay to argue with Summers – as if centuries of women had not argued with such men for long enough. These men do not understand that leaving was my reply, or why it was important to tell the exact truth when the *Globe* reporter asked me how this speech had made me feel: how else could I guarantee that those who do not understand gender bias would comprehend the impact it has on those who usually have to bear it in silence? But if everyone understood gender bias, this whole affair would never have happened. George Will shows us how far women still have to go to achieve equality – and he seems worried enough to write about it. Like Summers' NBER comments, he's the problem.

**Outcomes**

So the Summers flap is not about some obvious hot-button items: suppression of academic freedom, quotas, or lowering academic standards by admitting women to the top who don't belong there (which should never be permissible at the faculty level in universities). So what is it about? It's certainly about trying to make people

understand that unintentional gender bias is real, that it keeps women from the top, and that it can be remedied. But still, given that so many people could care less about gender bias, why has this story held the interest of the press and public for over two months?

I think the fascination with this story is that we may be witnessing a skirmish in the final battle – a battle to get to the top, the last step in a process that has gone on for millennia. As Summers so accurately noted, women aren't at the top of any powerful profession in the U.S. It's not just

the science or engineering faculties of elite universities where they are under-represented, but at the top of business, politics, law, the media – where the real power resides. And no one could believe that SAT scores explain why there has never been a female president of the United States!

Men hold at least 95% of the institutional power in America, and it's not easy to give that up. What many of us are waiting to see in this symbolic struggle is whether women are finally going to achieve equality or not. And I think it's not only men who fear such an outcome. I

think many women do, too. If men and women shared power equally the world would be a different place. I for one think it would be better than anything we can imagine. But none of us knows for sure what it would look like. Given this uncertainty, it's easier to see why this story has tapped into so much fear, and provoked such anger and hostility – and among some of us, so much hope. ■

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## MIT Retirement Programs

Ellen Weiss

**MIT'S RETIREMENT BENEFITS** can help you build long-term savings and provide you with sources of income when you retire from the Institute. Both the MIT Basic Retirement Plan and the MIT Supplemental 401(k) Plan provide opportunities for you to plan for your future.

The Basic Retirement Plan is a defined benefit plan that provides you with monthly lifetime income at retirement. MIT pays the full cost of the Plan and enrollment in the Plan is automatic. You are vested in the Basic Retirement Plan after you are employed by MIT for five years.

The Supplemental 401(k) Plan is a voluntary plan that allows you to contribute a percentage of your pay. MIT matches your contributions up to 5% of your pay. Federal law imposes annual dollar limits on your contributions: \$14,000 for 2005 if you are below age 50 and \$18,000 if on December 31st you are age 50 or older. The dollar limit will increase to \$15,000 (under age 50) and \$20,000 (age 50 or older) in 2006. Similarly, it is important to note that federal law also limits the pay that can be considered for pension plans, including 401(k) Plans. In 2005, MIT considers only the first \$210,000 of pay you

receive. You are always 100% vested in all 401(k) contributions made by you and MIT.

With the increased need for retirement planning, it is important to know that the MIT Retirement Programs Office offers retirement counseling. Our goal is to assist faculty in making informed decisions about retirement.

It is never too early to learn about the MIT retirement plans. The amount you contribute to the 401(k) Plan and the investments you choose can make a difference, over time, in your retirement assets. It is also important to understand investment diversification, investment risk, and the expenses associated with different investment options. As you approach retirement, investment decisions you made earlier may need to be reevaluated. The Retirement Programs Office counselors and Paul Gunning, a Fidelity Investment Counselor, are available for one-on-one counseling.

“When can I afford to retire?” and “When I retire, what benefit options are available?”

Invariably our response is contact us. Our retirement counselors are available to provide you with information that will help you make informed decisions.

Are you within five years of retiring? You may want to meet with a retirement counselor to discuss the full range of distribution options available under both plans and retiree health and welfare benefits. Our office can provide projected estimates of lifetime income options from both the Basic Retirement Plan and the 401(k) Plan.

Have you decided to retire? It is important to meet with a Retirement Counselor to discuss payment options from the Basic Retirement Plan and the various distribution options from the 401(k) Plan. Our counselors will help guide you through Social Security, retirement income strategies, and how benefits from the MIT retirement plans can be structured to meet your individual needs.

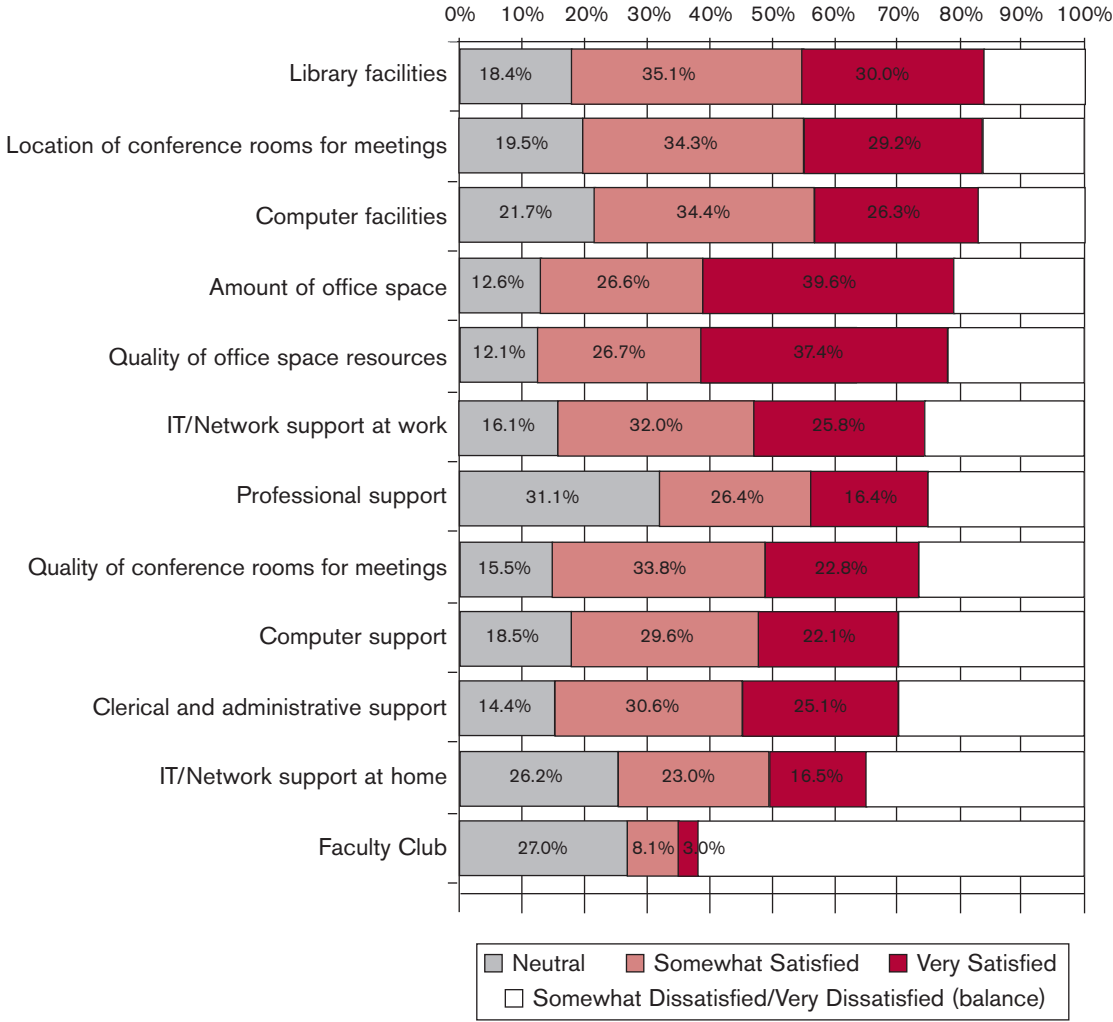
MIT Retirement Counselors are located at the Benefits Office in E19-215 and can be reached at 617-253-4272.

Paul Gunning, the Fidelity Representative, is also at the Benefits Office on Tuesdays, Wednesdays, and Thursdays. To meet with Paul, please call him directly at 617-258-8872. ■

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M.I.T. Numbers

**Satisfaction with resources that support research and teaching  
 [from the 2004 Faculty Survey]**



Source: Office of the Provost