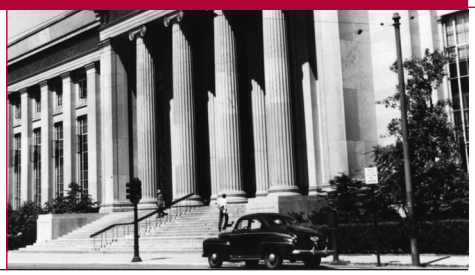
Massachusetts Institute of Technology

Vol. XVI No. 4
February/March 2004

MIT Faculty Newsletter

http://web.mit.edu/fnl

this issue includes Faculty Chair Rafael Bras on our system of governance (page 4), suggestions for improving the quality of faculty life (page 7), a reminiscence on 50 years as a faculty member (page 10), a recommendation to change the MIT motto (page 15), three articles in our continuing Research at MIT feature (beginning page 16), another MIT Poetry submission (page 24), reports by the Group on Community (page 25) and the Cambridge-MIT Undergraduate Student Exchange Program (page 27), an article on the merger of Information Systems and Financial Systems Services (page 30) and our M.I.T. Numbers feature highlighting campus growth over the last 20 years (back page).



Editorial

Following are two viewpoints on the presidency of the Institute, as presented by the Editorial Committee for this issue. We strongly encourage our colleagues to submit other points of view.

The New President

DURING THE PRESIDENCY OF CHUCK VEST, MIT saw significant expansion of its resources, which benefited the School of Humanities, Arts and Social Sciences along with the rest of the Institute. During the same years, MIT experienced an expansion of its academic mission. In response to the same historical pressures, peer institutions began to invest heavily in science and technology and to compete more vigorously for what MIT faculty formerly thought of as "our" students and faculty. This increased competition is a tribute to MIT's academic leadership but it is also a challenge to MIT, as our niche in higher education is becoming more crowded.

In order to meet this challenge, the next MIT president will need some special attributes. In the first place, she or he should be an outstanding academic with a first-rate record of scholarship. This is essential in affirming to all that academic excellence is the bedrock of MIT's past and future achievements. Second, the next MIT president should have significant experience in managing a large institution and large projects, and a track record of choosing excellent people in helping with this management. Whatever we want to accomplish as scholars and teachers

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The New President

THE NEW PRESIDENT OF MIT needs first and foremost to have a background of achievement as a scientist or engineer. Given that the primary asset of a university is its human resources – faculty, students, and staff – the new president must be an individual who understands this principle and who can listen, relate, and interact with the community in such a manner as to win their confidence.

The candidate must understand and appreciate the characteristics that distinguish MIT students and faculty. Included are a love of truth, passion for the sciences and engineering without neglecting the arts, humanities and social sciences, capacity for hard work, and a concern for service to society. The individual must be committed to create an atmosphere free from discrimination and to support collaboration without infringing upon the solitude required by lone scholars to dig deeply. The new president needs to understand the importance of supporting and recruiting faculty who love teaching in the undergraduate as well as the graduate classroom, can inspire in the research laboratory, and who can lead in seminars and small group discussions.

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The New President
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depends upon sound administration of MIT's enormous physical and human infrastructure.

Third, the next MIT president should have proven leadership in furthering core principles of the Institute. One such principle is equitable access to higher education; another is increasing the representation and influence of women and minorities; yet another is providing a welcoming environment for students, faculty, and staff of different gender identities and sexual orientations. Fourth, MIT's next president needs wisdom and maturity to encourage the inevitable evolution of MIT's mission while maintaining its distinctiveness. This requires an exceptional eye for managing change at a time when dramatic shifts in the competitive landscape of higher education profoundly affect MIT's place in it.

Surely the future of MIT depends upon its ability to flourish in the new ecology of higher education, in which many other leading institutions are investing significantly in science and technology. In order to improve its intellectual environment and the quality of its education, MIT must invest commensurately in the humanities, arts, and social sciences. MIT's advocacy of the larger public role of science and technology (which Chuck so notably advanced) will increasingly depend upon the ability of MIT's president to speak for and about the connections between science and engineering and the arts, humanities, and social sciences. The next president must therefore have the skills to communicate well (by speaking, writing, and especially listening) across disciplines, genders, races, and institutions.

MIT's next president must have experience that demonstrates respect for the intrinsic value of all disciplines represented at the Institute, in particular someone with experience in engaging with the humanities, arts, and social sciences as academic enterprises. This does not require having academic credentials in these areas, but it does require more than a generally supportive attitude toward them. In addition to having as a central goal the strengthening of the humanities, arts, and social sciences, the next president should also demonstrate awareness of the challenges of managing graduate education and research in these fields, since the models that dominate in scientific and engineering fields may be suboptimal or even counterproductive for them.

Editorial Committee

The New President
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The new president needs to continue work already begun on creating an environment that will encourage diversity among faculty, students, and staff, maintaining and enhancing MIT's mission of serving not only the West but the entire world. In the current environment of restricted international travel and communication, the new president will have to be able to argue persuasively for the internationalism and open communication that has enhanced the growth of scientific knowledge here and elsewhere.

Recent financial issues have brought considerable stress to the MIT community. The president will need to investigate the root causes of this situation, which extend beyond the whims of the financial markets and investment portfolio strategies, and fix them. MIT needs to be guided not by opportunities alone but, more importantly, by the development of strategies that best enhance its core values.

A balance must be struck between fashion and vision. The president will need to ensure that the management team is up to the task of making hard decisions and enforcing them. There must be sufficient talent to guide the many projects now in progress or envisioned for the near future and to limit the number of such activities to those that can be managed with the available resources. The president must realize that human resources are as important as physical ones, maintaining an environment that encourages faculty and staff loyalty to the Institute and inspires the generosity of its undergraduate and graduate alumni/ae.

Editorial Committee

Our Redesign

The redesign of the printed version of the *Newsletter* and our Website was done by Jan Moscowitz and Tim Moore of the Brookline design firm Moore Moscowitz, working in conjunction with editorial board member David Thorburn, Managing Editor David Lewis, Nancy Kelly of the President's Office, Cheryl Slowik of the Publishing Services Bureau, and Web consultants Jeff Reed and Margaret Wong of Information Services & Technology.

The headline font, Akzidenz Grotesk, designed by Günter Gerhard Lange in 1896, was chosen for its classic, no-frills aesthetic. The main text font, Minion, designed by Robert Slimbach for Adobe, was selected for its legibility and the diversity of its fonts, including fractions, an important consideration for a publication of MIT.

From The Faculty Chair

Improving Our System of Faculty Governance

Rafael L. Bras

"OUR SYSTEM [OF GOVERNANCE] is a peculiar MIT concoction: A unitary faculty meeting with real power and influence, but which draws more than 15% of the faculty, only when a hot item is on the agenda; a meeting designed to do the faculty's business, but which is chaired by the President on most occasions . . .." So begins Jake Jacoby's article "On Our Faculty Governance" in the May/June 1991 *Faculty Newsletter*. Jake acknowledges difficulties with the unconventional system of government but extols its benefits: blurring the boundary between faculty and administration; according great influence to minority opinions since poor attendance in meetings make any block of individuals significant; demanding "shoe leather cost" from those managing important issues since consensus is highly desirable before a poorly attended faculty meeting; forcing a conservative bias on decisions.

Jake felt that "most faculty are satisfied with the current arrangement" and since no "alternative is evidently better in our context, then we need to devote some real effort to search for ways that we can keep our own unique system vital, and responsive to evolving circumstances."

Other opinions have also appeared in the *Newsletter*. In March 1993, facing financial difficulties similar to the present one, the *Newsletter* Editorial Board wrote "Faculty Malaise: A Case of Learned Helplessness?" The comments were motivated by the feeling that "Time and time again we see ourselves and our MIT colleagues failing to react constructively and proactively to conditions under which we – as members of any community worthy of the name – would quite readily evince a sincere sense of shared concern and come together as responsible individuals to engage in socially responsible action." The article described "learned helplessness" in the following way: "When painful experience teaches us that it is beyond our power to bring about changes in the prevailing conditions, we learn to stop trying …. Once learned, the expectation that responsiveness to aversive conditions in a given environment generally proves futile, tends to inhibit present and future responsiveness in that situation by undermining both (1) the motivation to respond, and (2) the cognitive capacity to perceive the existence of opportunities to respond effectively if and when they become available." The piece ends with a call to change ". . . and it might as well begin with us . . .. Are we ready, willing, and able to join with the MIT administration in the process of shaping the future of this unique place? Are they ready, willing, and able to accept us as full partners in this task? And what is the Corporation's view of these issues?"

On August 25, 1997 (Vol. 117, No. 34), Anders Hove, opinion editor of *The Tech*, wrote "Excessive Committees Devalue Governance." The thesis is that the fragmentation of decisions into so many committees results in confusion and responsibility falling between the cracks and a situation where few people can tell what is going on.

All the quoted opinions have elements of truth. As I have written before, I summarize the reasons for poor attendance to faculty meetings as: all decisions are already made (helplessness); issues discussed are trivial (consensus of important issues is generally achieved by key players in committees), and there is an overall lack of knowledge of issues; we are too busy with more pressing issues, with the implication that we trust that good decisions are being made most of the time.

Before giving more opinions or suggesting actions, it is worth noting that there is at least one forum where faculty (not in committee) come together and engages in lively discussion of important issues. These are the monthly "random faculty dinners," hosted by Jay Keyser. Last September's dinner was representative, occurring the day after the budget and the educational commons discussion in the faculty meeting. The dinner was what the faculty meeting was not: an open, frank, generally fair, debate of the present financial difficulties and the planned review of the educational commons. It was great. The problem is lack of follow-up since, by design, those capable of answering the questions as ultimate decision makers are not present at those dinners.

Although I do not think that the system of governance is broken, I do think that changes are needed, as Jake Jacoby wrote, to keep the system of governance vital within the context of MIT's present reality. This feeling, I believe, is shared in some degree by Chuck Vest and Bob Brown, who very much want faculty input and spend innumerable hours trying to get that input, with varied success. Currently, I do not have a clear vision of all that needs to change or of how it needs to change. What follows are thoughts on sub-topics related to governance.

Let me begin with faculty meetings. Some state that the trust of the faculty on

the decisions of our colleagues in committees and the administration makes attendance at faculty meetings unnecessary. As evidence, they point out that the faculty does attend meetings when the occasion warrants it, particularly when an imminent or past decision is perceived as wrong. I would argue, though, that such reactive occasions are not healthy and for the most part serve for venting concerns, but rarely change or create policy. Let me then make the assumption that better-attended meetings and more open debate would lead to more information transfer and more informed decisions. Albeit not perfect, I like to compare faculty meetings to the venerable New England town meetings. After reaching a certain size, particularly in this day and age, many towns have found that the traditional town meeting meant the theoretical right of all to vote, but the responsibility of none. Representative town meetings are now common. What most of us do not want is a politicized representative faculty meeting that would become the realm of a few willing players. Maybe all senior faculty should share a rotating responsibility as attendees of meetings and reporters to their particular units. At the very least, this will guarantee a reasonable attendance and a more informed faculty.

All faculty meetings are currently opened to the MIT community. In practice, that means that they are opened to anybody. Many feel that this hampers the ability of the faculty to have honest and broad debate on sensitive issues. The bottom line is that most of us are not interested in having potentially embarrassing public discussions with colleagues and leaders. Maybe not all faculty meetings should be opened to the public; closed and open meetings could be scheduled ahead of time and the agendas appropriately determined. The reason the "random dinners" discussions are so wonderful, is because the social setting, the confidentiality, and the meeting of equals create a sense of security and trust.

All faculty meetings are currently opened to the MIT community. In practice, that means that they are opened to anybody. Many feel that this hampers the ability of the faculty to have honest and broad debate on sensitive issues.

In this age of electronic communications, it should be possible to conduct most of the routine business and votes outside of a formal meeting. The meetings, which after all are not held very often, could be reserved for the more hefty issues, open debate, and to promote information transfer and communication. Some have argued that some meetings could also serve as forums for faculty lectures. The suggestion has been made that the Killian lecture should be part of a formal gathering of the faculty, open to the public.

There is no doubt that the committee structure serves MIT well. Nevertheless, it leads to a system where a few, generally quite wise individuals, are fully informed of the issues and effectively make the ultimate decisions, because the broader debate does not occur in the faculty meetings. Most of the time this is fine. Many times it leads to surprises when faculty learn of policy of which they were unaware. You could argue that it's the fault of individuals for not keeping up with the issues. I would agree if this scenario were rare and isolated. When it is widespread and the norm, then I think it is the system that needs improvement. The fact is that there are reasonably few standing committees of the faculty. Some work very effectively and have hefty responsibilities. Others are lacking in significant agendas and do far less. In many ways the structures lack symmetry. For example, three major faculty committees, populated by elected faculty, lead undergraduate education. One committee deals with policy, another overviews curricula, yet another deals with admissions and financial aid. Graduate education has one committee, headed by the Dean and populated by departmental representatives. The result is two very different systems that place different emphases on commonly similar issues.

MIT is increasingly involved in international programs. These programs bring up questions about resources, administration, and adherence to MIT principles of openness and non-discrimination. Yet we have no standing faculty governance structure to provide the guidelines for MIT participation.

The Faculty Policy Committee (FPC), the over-arching committee in the existing structure, has the charge to "maintain a broad overview of the Institute's academic programs, deal with a wide range of policy issues of concern to the faculty, and coordinate the work of the faculty committees." Very quickly the FPC finds itself playing the role of gatekeeper to the faculty meetings, giving final approval to recommendations by other committees, or serving as a sounding board for ideas arising largely from the administration. Indeed, that is a necessary function – but what is lacking is the strategizing role, the faculty body who can think of issues and define positions to be taken by the faculty which in turn can help and guide the administration.

A related question is the relationship of the standing committees to presidential committees, task forces, councils, and the many other committees that the Institute appoints. The ability to appoint these "transient" committees is important. It provides flexibility; it provides opportunity for involvement of many faculty members, tapping the large majority of the faculty at some point or another. On the other hand, proliferation of committees can result in duplication, busy work, and at worst a "disconnect" from the activities of the permanent structures of governance. There is a need to reconcile and define this system of committees.

The presidential search process has provided an opportunity for the Institute

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Improving Our System of Faculty Governance
Bras, from preceding page

to explore alternative ways of decision-making through input from the larger community of faculty. The presidential search committees have engaged a process that has tapped grass roots participation, by visiting each academic unit and soliciting viewpoints about the presidency, potential candidates, and future directions of MIT. Each visit was moderated by one of the officers of the faculty or the chair of the Faculty Advisory Committee on the Presidency. The various academic units emerged from this process of discussion – and sometimes debate – with a sense of involvement, even empowerment, as they reflected not only on the larger requirements for the presidency, but also on their relationship to the Institute and the outside world. The discussions were usually frank and uninhibited, many times trenchant and probing, always informative and helpful. The challenge to the search committees is to find a strategy to use that grass roots input to reflect the sentiment of the faculty and to promote the best interests of the Institute. Faculty meetings, as presently constructed, could never elicit these kinds of invaluable suggestions and viewpoints. While this process was time-consuming and cumbersome in minor ways, similar, more streamlined ones could be created for certain major institutional decisions that would benefit from such faculty input.

MIT operates much better than most other academic institutions I know. Its system of governance allows for fairly fast decisions, it is not caught in too many political intrigues, and most importantly has always avoided the "them and us" syndrome between administration and faculty. After all, the academic administration is faculty. All of the above are characteristics that we must preserve. Nevertheless, the system must evolve and adjust to the times. If the faculty is to retain the responsibility of the academic well-being of the Institute, then it must become more involved and the system of governance should facilitate that involvement. ■

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Update on Women Faculty in the School of Engineering

Lorna J. Gibson

FOLLOWING THE REPORT OF the Committee on Women Faculty in the School of Engineering, the School has made substantial progress in hiring women faculty and in appointing women faculty to administrative positions. In 1990, there were 19 women on the faculty in the School of Engineering. At the time we started our study, in the fall of 1999, there were 31. Today, there are 50, making up 14% of the faculty in the School. At the time our committee reported in 2001, Mechanical Engineering and Electrical Engineering and Computer Science had particularly low percentages of faculty who were women. Since July 1 of 2002, Mechanical Engineering has hired five women faculty and EECS has hired six.

In addition, there have been several appointments of women faculty to administrative positions in the last few years. Martha Gray continues as co-director of the Health Sciences and Technology Program. Alice Gast is the vice president for research and associate provost. Barbara Liskov is associate head of EECS and Karen Gleason is the executive officer in Chemical Engineering. A number of women faculty have become leaders of centers: Leona Samson is the director of the Center for Environmental Health Sciences; Linda Griffith is the director of the Biotechnology Process Engineering Center; and Dava Newman heads the Technology and Policy Program. Cindy Barnhart was co-director of the Operations Research Center from 1999 to 2002 and was co-director of the Center for Transportation and Logistics from 2001 to 2003. ■

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Recommendations for Improving Faculty Quality of Life

Charles Stewart III
Gareth McKinley

"It is not enough to be busy, so are the ants. The question is: what are we busy about?"
– Henry David Thoreau

LIKE THE WEATHER, WE often talk about the quality of MIT faculty life, but rarely do anything about it. The Provost's Ad Hoc Committee on the Faculty Quality of Life is trying to reverse this tendency, by exploring a range of policies and programs that might ease some of the most vexing problems facing faculty members, all of whom are trying to lead successful professional *and* personal lives.

Several committees have studied faculty quality of life at MIT, most recently the Task Force on Family and Work. (For further details see the MIT report at ***http://web.mit.edu/faculty/reports/qol.html***.) Numerous committees have also studied the topic at universities we would consider our peers. Most recently studies were done at Stanford and Berkeley. These efforts have tended to identify a consistent set of themes that help characterize the pressures that buffet the connection between faculty professional and private lives. It is because past findings, at MIT and elsewhere, have been so consistent that the current Ad Hoc Committee has chosen primarily to re-articulate those themes, expending most of its effort on identifying and refining a proposed set of solutions.

The common themes from past studies on this subject include the following observations:

- MIT faculty members experience a great deal of stress – a level that exceeds that of senior managers in the private sector, though it remains to be seen if it exceeds that in other elite universities.
- Faculty members who consistently report the greatest stress include the following groups: women, those younger than 45 who have children at home, and those who are untenured. (These categories, of course, combine in interesting and important ways.)
- The nature of family-related stress is changing among the rising generation of tenured and tenure-track faculty, owing to larger societal changes. That means that as these faculty members age and their children move from home, family pressures will not abate as they did with prior generations.
- It is very difficult for MIT faculty members to afford a house that is close enough to the MIT campus so that they can be active in extra-curricular campus activities, or where they can take full advantage of the Boston/Cambridge cultural life and be satisfied with the schooling of their children.
- MIT faculty members usually feel obliged to take on more responsibilities than they should; MIT as an institution does this, too. There is no effective way to budget the use of time at the Institute, whether by individual faculty or by the Institute as a whole.

We all recognize that MIT is a high-pressure environment. Indeed, most of us chose to teach at MIT because of that environment. Yet as the famous quote by Thoreau about the ants suggests, the question is not whether we are pressured, but whether we feel pressure about the right things, and whether that pressure is conducive to our success, as colleagues, friends, and family members.

Thinking hard about the pressures facing MIT faculty, and adjusting policies and programs to accommodate those pressures, isn't just solipsistic, or at least needn't be. Evaluating the quality of life of MIT faculty is critical for the continued success of MIT as one of the elite institutions of higher education in the world. MIT's pressures don't exist in a vacuum [pun intended]. Other institutions and organizations that employ people who come from the same background as our faculty face them, too. The institutions that address the new challenges facing highly educated and driven professionals will continue to recruit and retain the best – whether they work in medicine, law, research institutions, or universities.

What is to be done? A place to start is to understand why a wide variety of MIT faculty members believe their personal and professional lives are out of balance. This has to do, of course, with MIT's well-known culture of intensity and hard work. To change that would require uncovering the assumptions on which the culture rests, critically challenging the institutional practices that emanate from them, and then experimenting with ways to retain MIT's excellence while easing people's lives.

This may well be important, but cultural change takes time. In the meantime, MIT needs to change some of its policies and procedures in order to ameliorate the culture in which we find ourselves. And the hope is that a new set of policies and

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Faculty Quality of Life
Stewart III and McKinley, from preceding page

procedures could help shore up a new set of cultural practices.

Whatever the mix between long- and medium-ranged goals, the Ad Hoc Committee on Faculty Quality of Life has identified five broad categories of areas where MIT needs to consider changing its policies, initiating new programs, or some combination of the two. These categories are (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) the career path. Below we list some proposals in each of these categories that the Committee has been discussing, based on ideas adapted from colleagues at MIT and elsewhere. We have only recently begun examining many of these in any depth, but they all deserve attention, if for no other reason than they start the conversation among faculty and with the administration about what sort of work environment we want to evolve to at MIT over the next decade.

Here are some ideas:

Housing

- Begin a mortgage program that will allow senior faculty to buy a home close enough to MIT that the commute isn't onerous, that they can partake more actively in Boston/Cambridge cultural settings, and can meet family school needs more flexibly.
- Enhance existing options available to junior faculty to create a mixed program, of mortgage assistance and rental subsidies, that will allow junior faculty also to live closer to campus, in better circumstances.
- Institute a housing relocation program that gives special assistance to junior and senior faculty when they are hired.
- Construct MIT-owned housing units in Cambridge and Boston, within walking distance of campus.
- Incorporate faculty housing in new residential construction, especially construction of graduate housing.
- Build mixed-use buildings close to campus that would incorporate academic and housing functions.
- Construct affordable short-term housing for faculty and research visitors.

Professional support

- Establish an allowance to faculty members, independent of departmental allocations, which would allow them to hire office support staff.
- Provide more lab managers and senior lab technicians to assist faculty in managing their laboratories and raising funds.
- Provide on-call information technology support for faculty home offices.
- Create more active support to help manage the deluge of junk e-mail inundating faculty.
- Expand departmental support for the creation of lecture demonstrations and presentations.

Extended personal and family support

- More actively assist spouses in finding employment – primarily for relocation but also to allow more spouses to work on campus or nearby.
- Sponsor after-school programs and summer camps for children of MIT faculty and staff that take advantage of MIT's strengths in science and technology.
- Provide subsidized childcare services for MIT faculty members for after-hours meetings and professional travel.
- Provide a clearinghouse and/or an allowance to assist in handling household duties.
- Enhance the retail establishments close to offices that provide household services, like dry cleaning.
- Enlarge the mandate, publicity, and budget of the MIT Work/Family Center.

Common faculty environment

- Establish a real Faculty Club as a common and central gathering place for faculty.
- Continue/renew support for on-campus medical services (MIT Medical).
- Sponsor housing so that retired faculty can live nearby and continue participating in campus life.
- Establish quality, dedicated office space, with support, to allow emeritus faculty to be regularly engaged in Institute life.

Career path

- Establish a part-time tenure track, for faculty who wish to devote considerable time to care for family members.
- Establish "re-entry post docs," to allow former faculty members or research staff to re-enter academic life after extended time off for family considerations.
- Require that funds retained by departments for faculty leaves be used to cover teaching responsibilities.
- Adapt the existing sabbatical system to provide one-semester sabbaticals after every six semesters of teaching.
- Allow sabbatical leaves to be "banked," up to some reasonable limit.
- Reduce the number of promotion steps, eliminating (pick one) the untenured associate professor promotion or the separate promotion to full professor.

Obviously these changes are far-reaching and span the gamut from relatively simple and cheap to implement to very complex and expensive. However, it is important to develop a spectrum of options focused on improving faculty quality of life that might be implemented long after the current (and hopefully short-term) budget difficulties abate. The goal of the Committee is to develop a lasting document that contains a series of well-developed ideas that can be prioritized by the faculty, to provide guidance to future administrations.

Have we identified the key issues that affect you? Have we missed anything? Later this spring we will be surveying the faculty in two ways: using a mass survey instrument to gain feedback from all faculty members, and conducting focus groups to discuss the idea outlined above in greater detail. Finally, we also welcome your comments and suggestions by e-mail or in person. The Committee has established a Website with a feedback forum to solicit input: ***http://web.mit.edu/fql/***.

While just as busy and teaming with activity, MIT differs from the anthill in one important way: unlike the ants, we can view our work with perspective, and potentially alter our environment if we believe the work is out of balance. We can even challenge the fundamental parameters that define our work. If we can attend to improving our work environment so that our personal and professional lives mesh more harmoniously, not only will current residents of our anthill benefit, but we will also be a more enticing place for future generations. ■

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FRADS Supports Faculty Fundraising

Janet Wasserstein

DID YOU KNOW THAT there is a department at MIT established to support school and faculty fundraising initiatives? The Department of Foundation Relations & Academic Development Support (FRADS), headed by Jack Oldham, manages MIT's relationships with foundations and supports a variety of project-driven fundraising activities. For those projects that have been designated as institutional priorities by the president, the provost, or deans, FRADS can:

- Work to develop a project from idea to fundable program.
- Conduct prospect research on foundations that are potential matches for a project.
- Contribute to identifying relevant program officers at foundations and facilitate contact with them.
- Provide background information on the history of MIT's relationship with specific foundations and devise strategies for approaching them.
- Travel to meet foundation representatives.
- Provide assistance in editing and drafting proposals.
- Raise awareness of a project's funding needs among other Resource Development staff on campus, e.g., Office of Corporate Relations, Office of Campaign Giving, etc.
- Connect those who are doing similar or related work on campus and brainstorm about ways to collaborate with others on related projects.
- Maintain contact with foundations, both during and after the grant-making cycle, and let administrators and faculty know of new developments regarding a proposal.

In other situations, FRADS can:

- Give an overview of foundation fundraising and information about recent news and trends in grant-making.
- Provide guidance on the print, CD, and online resources available in becoming familiar with private foundations.
- Inform when there are requests for proposals (RFPs) from foundations in a relevant field.
- Review and provide feedback on proposals to foundations.
- Assist with the procedures involved in submitting a proposal, including the submission of required supporting institutional documents.
- Track information about an award, provide reminders when a report is due, and provide advice with acknowledgement letters.
- Share information about foundations we have researched and/or visited.

FRADS has recently launched a new Website that can answer your questions about FRADS' services, provide fundraising resources and links, and alert you to new grants: ***http://web.mit.edu/frads***. For further information contact the associate director who works with your area, or call the FRADS office at 617-253-1433. ■

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Reminiscences: Fifty Years on the Engineering Faculty

Leon Trilling

LIKE ONE OF THE proverbial blind men who try to describe an elephant, I offer a personal account of what seemed most important in the intellectual and institutional life at MIT during my 50 years on the engineering and STS faculty.

I focus on three themes. In the fifties and sixties, stimulated by military needs, several MIT groups invented data processing, communication and control techniques and applied them to manage devices and to run increasingly complex technical and social systems.

The late sixties and seventies saw the flowering of the civil rights movement and the revulsion of the young and some of their elders from the Vietnam War. The MIT community sought a fair way to achieve greater diversity in its student body and its faculty while maintaining MIT standards of excellence. At the same time, it tried to define the social responsibility of scientists and engineers for uses of their work. It reached a consensus that all students must show awareness of ethical and social context as part of their professional education.

In the eighties and nineties, MIT rediscovered engineering. Renewed emphasis was put on the design of machines, on understanding how they work, and also on the management of large social-technical systems. The Institute broadened the range of its activities to include biotechnology, information technology, and most recently, nanotechnology. It also pursued initiatives which dramatize its leadership on the world scene.

The Fifties and Sixties: Computing, Communication and Control

World War II changed the way people thought about science and engineering.

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Both the technical community, led by Vannevar Bush, and the military concluded that the security and welfare of the U.S. required a continuing partnership of academia with the state, represented for now by the military. Even after the creation of NSF, NIH, NASA and the AEC, the military remained major sponsors of research, because they had built relations of trust with the scientific community and because it was easy to get appropriations through Congress under the heading of defense. Inevitably, the research agenda reflected that situation.

In part to define its policy under those conditions, in 1949 MIT appointed the Committee on Educational Survey, chaired by Professor W. K. Lewis. The Committee recommended that MIT participate cautiously in the new partnership with the state and expand its faculty and its graduate enrollment, particularly in fields of MIT strength. Most of the new faculty were alumni of wartime laboratories like MIT's own Radiation Laboratory (RadLab). The new graduate students were largely veterans financed under the GI Bill, an exceptionally mature, hard-working group of men.

In the course of reconversion to a peace which soon turned into the Cold War, both the MIT leaders and the military concluded that the RadLab team of experts should not be allowed to disperse. MIT then created, and the military funded, the Research Laboratory for Electronics (RLE), under terms which gave RLE considerable latitude in defining its agenda. Thus, Claude Shannon, Norbert Wiener, and their associates laid the foundations of information theory; Jay Stratton, Jerome Wiesner, Jerrold Zacharias, Al Hill, and their associates combined radar technology with a network of automatically controlled anti-aircraft guns to design the SAGE Air Defense system, and founded the Lincoln Laboratory to create an ever more sophisticated air defense.

Independently, the Servo-Mechanisms Laboratory, founded in 1940 by Gordon Brown, had developed automatically controlled gun sights and was designing a flight simulator. To extend the reach of the required electronic computers, Jay Forrester had invented a magnetic core memory element.

Also independently, at the Instrumentation Laboratory, Stark Draper applied

precision gyroscopes to stabilize naval firing platforms, and eventually to supply the measurements needed for inertial flight vehicle guidance, including those used on the Apollo missions.

By the early sixties, with support from ARPA, MIT's project MAC refined the time-shared use of computers and pioneered the use of computer networks which eventually led to the Internet.

Thus, several often competing, sometimes cooperating teams of younger faculty and staff developed all the elements of a communication, command and control system which could assist and even replace human agency. It could also be used as a metaphor to explain microbiological processes and the working of the genetic code. It might even provide a guide to understanding how the mind functions.

The ability to control large sets of data to carry out prescribed tasks automatically was valued by the market as well as by the military. Numerically controlled machine tools, for example, changed the way mechanical devices were manufactured and eventually reduced the need for skilled workers. Routine banking and financial operations could be automated, eliminating the need for some clerks.

Compton Hall, 1950s

This vision of systems control as a central task of engineering changed Institute life. Course 6 became the Department of Electrical Engineering and Computer Science (EECS) and emphasized communications, control systems, electronic materials, and computer hardware and software design. . .. Underlying this reform was the deeper notion that the nature of engineering was changing, at least at an elite school like MIT. New science, especially physics, should be applied to the design of very high performance devices and systems as quickly as possible to outclass any competition.

This vision of systems control as a central task of engineering changed Institute life. Course 6 became the Department of Electrical Engineering and Computer Science (EECS) and emphasized communications, control systems, electronic materials, and computer hardware and software design. This transformation, partly funded by the Ford Foundation, also included the writing of a series of new textbooks, the creation of new laboratories, and a large increase in enrollment. Department Head Gordon Brown proposed the creation of new Interdepartmental Centers for graduate research.

Underlying this reform was the deeper notion that the nature of engineering was changing, at least at an elite school like MIT. New science, especially physics, should be applied to the design of very high performance devices and systems as quickly as possible to outclass any competition. This view of engineering fitted the needs of the military and matched the nature of communication, command and control engineering.

The stress on applied science changed the MIT faculty. Young (almost exclusively) men with doctorates, often from MIT, caused some inbreeding – but where else could one find staff for the new EECS? The operation of this military-academic complex had two other notable consequences. When a faculty member came up with a particularly marketable idea or device, he might set up his private company to exploit it without giving up his faculty position, creating the potential for serious conflicts of interest. This practice was banned by 1969.

The military extended some of the research they were sponsoring to building and testing actual prototypes. Faculty such as Stark Draper considered such work the last step in the education of an engineer – an internship. The military also sent groups of officers to learn about the new technology first hand. Both of these practices required that classified research and teaching be conducted on campus. They were discontinued in 1969.

The students admitted during this period were mostly young middle-class men from public schools in medium-sized towns; they were excellent in mathematics and physics and considered an MIT degree an important step up the ladder. The mix, which had been mostly WASP before the war, now included many young men of immigrant background. In 1972, 6% of the undergraduate student body was female

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Fifty Years on the Engineering Faculty
Trilling, from preceding page

and minority undergraduates could be counted on the fingers of one hand.

The Late Sixties and Seventies: Diversity and the Importance of Context

The intellectual focus of the Institute in the late sixties and seventies reflected an emerging set of national concerns, illustrated by the civil rights movement, the women's movement, and the growing opposition to the Vietnam War.

While deploring the excessive rhetoric and occasional direct action of some student groups, the MIT community came to agree that a rethinking of priorities and some policies was needed. President Howard Johnson appointed a commission chaired by Professor Kenneth Hoffman to lead a dialogue within MIT and recommend appropriate changes.

The main effect was a reorientation in student admissions and faculty recruitment and a broadening of engineering education. The admission of a larger number of undergraduate women was originally held up by a shortage of separate housing on campus. The construction of McCormick Hall and a gradual change in sexual mores which made it possible to house women in sections of previously all-male dormitories removed that obstacle.

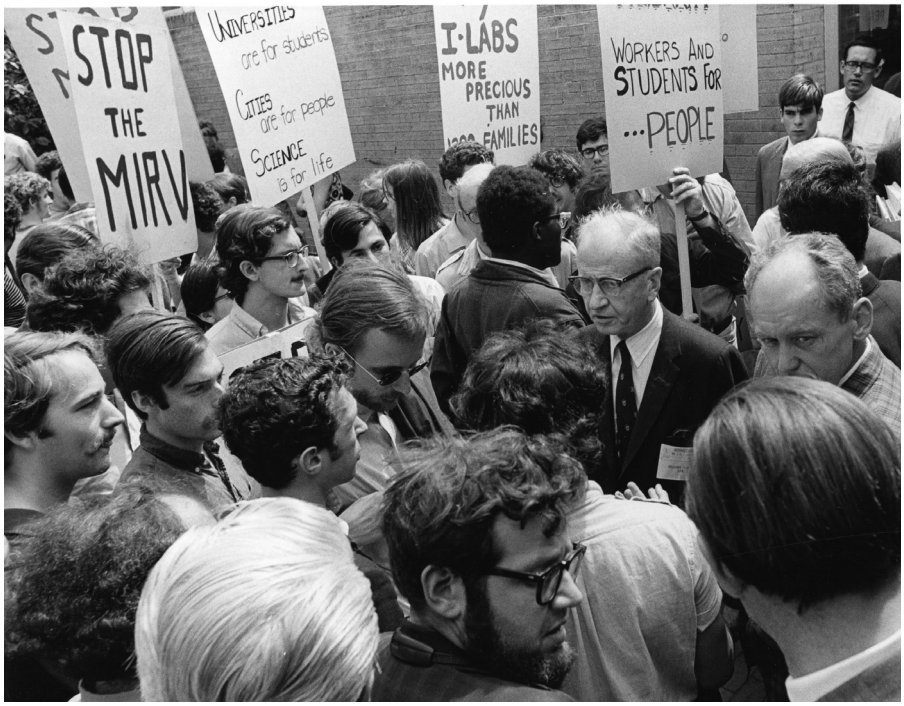
It was easy to identify many young women whose records met MIT admission standards. But some of them – and more often their parents – had to be persuaded that an MIT education and the implied career options were seemly for them, and that they had as good a chance of academic success as did the men. That problem was largely solved by personal recruitment, in which MIT women students' visits to their high schools played a major role. Gender diversity has now been achieved in the undergraduate student body, which includes 42% women. In graduate school, some 25% of the students are women. The academic performance of MIT women students has always been statistically indistinguishable from the performance of the men.

Increasing African-American, Hispanic, and Native American presence in the MIT student body was more difficult. The pool of qualified potential applicants was poorly known in the 1960s. Yet, MIT did feel a responsibility to provide equal opportunities to these young people, but was uncertain about the best way to proceed.

In 1967, four African-Americans and one Native American were admitted under the bittersweet label: Project Epsilon. Four graduated, and in a show of support for the integration of MIT, students elected one of them president of the Undergraduate Association. But all suffered serious adjustment problems.

Epsilon was the first step in a systematic recruitment and retention effort. The Admissions Office added several minority recruiters to their staff, expertise and contacts with a wide range of high schools were built up and young men and women were offered admission when their academic records and personal qualities identified them as likely to graduate. Their number grew to exceed 15% of the entering classes.

Still, for many, the step from high school to MIT included a substantial social adjustment and exposure to the legendary MIT academic fire hose To support them, them, MIT administration worked out a structure which included an optional pre-freshman eight-week Interphase program (now in its thirty-fifth year), an advising and tutoring system run through the Office of Minority Education, and a (hopefully) adequate financial aid package.



MIT Alumni Day, 1969

The student body did become more diverse. The proportion of White American male undergraduates dropped from 80% in the 1950s to 25% today. But the diversification of the faculty is proving more elusive. The proportion of women has reached 17% and they have gained equal treatment with their male colleagues. Minority faculty still number well below 5% of the total.

In the same period, the MIT community participated in the national debate over military policy, particularly the wisdom of developing an anti-ballistic missile system. An influential group of

graduate students and faculty dramatized their concern over the Institute's excessive concentration on military-related research by staging a symbolic work stoppage on March 4, 1969. This event dramatized the mutual disenchantment which was fraying the military-academic alliance.

As the campus discussion broadened to include the proper activities of scientists and engineers in a free society, Jerry Wiesner sought to design a framework for engineers and scientists, together with their humanist and social science colleagues, to study the role of science and technology in human societies. After several false starts, this effort led to the creation of the Program in Science, Technology and Society (STS) staffed by largely new faculty, and, on a shared basis, by a few resident scientists and engineers. The STS Program awards double BS degrees with any department, and a PhD with History and Anthropology.

The School of Engineering created the Technology and Policy Program (TPP) in which an engineer with some experience can earn a Master's Degree and occasionally a PhD, by studying in depth a situation which calls for a policy with important economic, cultural, regulatory, environmental, and ethical components. It also set up several interdepartmental centers to look at alternative ways to provide important social goods and services, such as energy or transportation, to diverse social organisms.

Most of the faculty accepted the greater diversity of the student body and the emphasis on the social context of their disciplines. They experimented with new subjects and tried to match the style and content of their teaching to the needs of their students.

An Early MIT Computer Lab

A major effort was made to loosen the freshman year. Pass/Fail or Pass/No Record grading was introduced and several experimental freshman year programs were created, mostly by younger faculty, to respond to students' diverse learning styles. They provided welcome alternatives for some 10% of the freshman class. Similarly, undergraduate seminars, sometimes combined with freshman advising, increased the range of available freshman options.

Many students had been frustrated by curricula which imposed on them nearly two years of applied science before they could approach the engineering which they had come to MIT to learn. Most engineering departments now introduced design exercises in the sophomore year, such as the Mechanical Engineering contest originally labeled 2.70.

The most important innovation in educational practice, which shifts the emphasis from teaching to learning by doing, is the Undergraduate Research Opportunities Program (UROP) founded in 1981 by Edwin Land, Paul Gray, and Margaret MacVicar.

The most important innovation in educational practice, which shifts the emphasis from teaching to learning by doing, is the Undergraduate Research Opportunities Program (UROP) founded in 1981 by Edwin Land, Paul Gray, and Margaret MacVicar. It enables any faculty member to invite an undergraduate to do research in his/her laboratory and any undergraduate to do research in a laboratory she/he chooses, for academic credit or for pay. The UROP program is extremely successful; over half the undergraduates take advantage of it in dozens of laboratories all over campus.

The appointment of new faculty, the stress on societal context, and the greater variety in teaching styles, led MIT to compete with Ivy League schools for applicants who displayed interest and competence in both the sciences and in humanistic disciplines. But in 1987, Physics Professor Anthony French and several colleagues reported a marked drop in student performance, especially in their ability to apply basic principles to specific problems. The outcome of the ensuing debate was a re-emphasis on numeracy skills among the diverse admission criteria. But broader trends still increased our overlap with the Ivies.

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Fifty Years on the Engineering Faculty
Trilling, from preceding page

The Eighties and Nineties: The Rediscovery of Engineering

In the eighties and nineties, the MIT School of Engineering refocused its attention on what engineering in a market-oriented society should be, and on how to teach it to the more diverse, more demanding students who chose to come to MIT.

The rediscovery of engineering had two distinct effects on the education of our students. It insisted on hands-on learning; on students, alone or more often in teams, designing, building and testing the performance of actual devices, coming into visual, tactile contact with real materials and mechanisms. It also stressed a utility function which balances performance, cost, and safety of devices and systems over their entire lifetimes. This combines design, production, operation, and maintenance, and takes account of the environmental, regulatory, and ethical constraints under which they operate.

In research as well, from multiple roots – the Harvard-MIT Health Sciences Program, the Biology, Chemistry, Chemical Engineering, EECS, Brain and Cognitive Science, Mechanical Engineering and other departments – an intense activity in biotechnology and health science and technology has developed at MIT over the last 20 years. Much of it is devoted to specific biological interactions, to their health consequences and to the design of diagnostic instrumentation and remedial apparatus.

Similarly, much research goes into the tailored design from first principles of structural, polymeric, electronic, and biological materials, into the nature and context of archaeological materials, into nanocircuits and materials, into electrical and electronic devices.

But communication, command and control techniques are needed to manage large technical-social systems subject to environmental, regulatory, and market constraints, whose design occupies the attention of many engineers. In the fifties and sixties, computer power was applied to the production and use of individual artifacts – numerically controlled machine tools to shape a turbine blade, for example – the new task was to organize a whole aircraft production line so that required parts arrived just in time from many places, and diverse operations at different locations were dovetailed to minimize cost and assembly time.

But two defining features of MIT have not changed [over the last 50 years]. All members of the MIT student and faculty community are selected on the basis of demonstrated academic excellence, and they work very hard, long hours at specific tasks. Also, there is an enduring tension between thinking in abstract terms – applied science or system dynamics – and interest in particular devices or phenomena for their own sake.

Conclusion

Over the last 50 years, the composition of the MIT undergraduate student body has become much more diverse, the graduate student body and the faculty less so. The range of academic and research fields has broadened. Learning and teaching take place in a greater variety of styles.

But two defining features of MIT have not changed. All members of the MIT student and faculty community are selected on the basis of demonstrated academic excellence, and they work very hard, long hours at specific tasks. Also, there is an enduring tension between thinking in abstract terms – applied science or system dynamics – and interest in particular devices or phenomena for their own sake. That tension often occurs within a single individual. It appears in the MIT Seal where "Mens" and "Manus" look away from each other.

There is a price to be paid for intense concentration of time and effort on specific professionally-related activities. Ken Keniston described it in a paper he presented in1982 as: "a selective inattention to feelings, fantasies and awareness of the nuances in the behavior of others," and Dean Silbey's Task Force on Student Life and Learning (1998) points out that "of the many difficult design problems MIT faces, promoting faculty and student participation in community activities is probably the most difficult."

The focus of MIT activities is instrumental. It is to provide the skills, knowledge, tools, and advice which particular actors in society need badly enough, to be willing to pay for them. Over the last 50 years, the emphasis has shifted from narrowly defined agendas (fire control of a gun, numerical control of a machine tool) to broad analyses meant to reduce the scope of unintended consequences and to foresee the counter-intuitive behavior of complex systems.

This broader definition of engineering calls for the ability to choose and design the components of a system and to point out the – not always quantifiable or unique – ways in which they interact. To specify the most appropriate model and to foresee the uncertainties and constraints under which the system may operate, the engineer needs a tolerance for ambiguity and a sensitivity to the range of human responses. We try to convey the importance of these uncertainties in our teaching. But we cannot fully succeed unless our students come with minds open to these uncertainties and explore the possible consequences of the diverse ways of using the tools which we give them. ■

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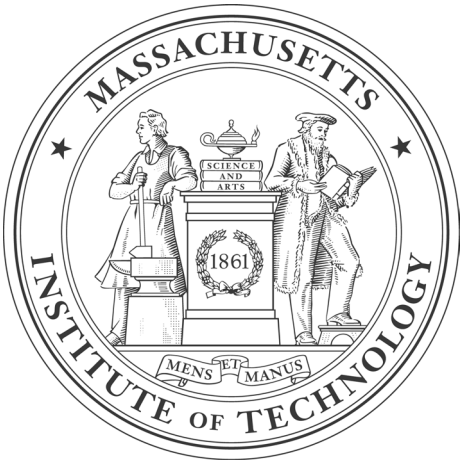
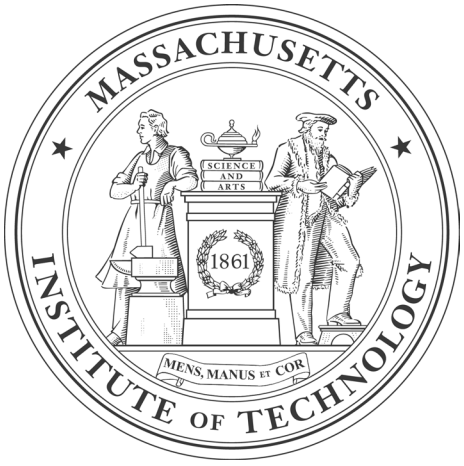
A Formal Recommendation to the MIT Corporation

James H. Williams, Jr.

DURING MY DECADES AS a student and faculty member, MIT has been fortunate to have had men of passion and extraordinary dedication as its presidents; individuals who have consistently governed in the spirit of the Institute's motto "Mens et Manus" (Latin for "Mind and Hand"). Throughout the presidency of Charles M. Vest, I have been repeatedly impressed by his steadfast embodiment of an additional and important element of eminent science and engineering, as well as numerous other disciplines such as architecture, media arts, humanities, economics, and political science that were not among the Institute's academic programs in 1864 when, during William Barton Rogers's first presidency, the Institute's official seal and motto were adopted. I believe Charles M. Vest has successfully – and to an unprecedented degree – integrated into his presidency striking sensibilities of empathy and love. By this article and without precluding other acknowledgments, I recommend to the MIT Corporation that in honor of President Charles Marstiller Vest the official MIT motto be amended to "Mens, Manus et Cor" (Latin for "Mind, Hand and Heart").



MIT's Official Seal



MIT's Future Seal?

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Research at MIT

The Center for International Studies

Richard J. Samuels

FOR 52 YEARS, MIT'S Center for International Studies (CIS) has played a central role in fostering social science research at MIT. It also has helped to define the way in which academic research centers conduct research on international affairs in the public interest. Today, while the Center's research portfolio is more wide-ranging than ever, we continue to capitalize on MIT's great strengths in science and engineering, examining the international aspects of these fields as they relate to both policy and practice, and focusing on those issues where science and engineering intersect most closely with foreign affairs. Our affiliates come from across the Institute, but faculty from the Departments of Political Science, Urban Studies and Planning, History, and STS predominate.

The Security Studies Program (SSP) is the Center's largest research and education program. Affiliated faculty teach subjects on Grand Strategy, Defense Technology, Arms Control, and Bureaucratic Politics. A special feature of the program is the integration of technical and political analyses in studies of international security problems. Faculty members advise or comment frequently on current policy problems, but the Program's prime task is educating the next generation of scholars and practitioners in international security policy making. SSP supports the research work of graduate students, faculty, and fellows, and sponsors seminars and conferences to bring the results of this work to the attention of academic and policy audiences.

Since 1974, CIS has chaired the Inter-University Committee on International Migration, which provides a focal point for migration and refugee studies in Greater Boston and features a small-grants program supported by the Andrew W. Mellon Foundation. These grants stimulate applied research on policy issues of concern to NGOs actively working in the field with refugees and the internally displaced; they also promote greater dialogue between these NGOs and researchers from the Committee's member institutions (Boston University, Tufts University, Wellesley College, and The Fletcher School of Law and Diplomacy). The Migration program also sponsors several working groups for students and practitioners.

CIS established the Program on Human Rights and Justice (PHRJ) in 2000 to conduct research on a range of subjects, including the impact of globalization on local democratic institutions, the integration of human rights and development, the relevance of human rights to new areas of science and technology, alternative models of accountability for mass crimes, corporate best practices, labor standards, and environmental assessment and monitoring. PHRJ is the first human rights program with a specific focus on the human rights aspects of economic, scientific, and technological developments.

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The newly-formed Cities in Conflict Working Group, a joint effort with the Department of Urban Studies and Planning, brings together faculty and graduate students to discuss the root causes of violence in cities and to consider innovative strategies for advancing a vision for peace in such cities as Jerusalem, Belfast, Mitrovica, and Jakarta. The overall aim is to build on deep, historical knowledge of the cosmopolitan dynamics of city life as a possible way of forming new practices or commitments that would contrast with (and hopefully counter-balance some of) the essentialist identities or social, ethnic, religious, or national allegiances that have led to vio-

lence, conflict, and public insecurity in so many cities around the world.

CIS also has several new research projects in the works. Looking ahead, we are particularly enthused about two initiatives: CIS and its partners in MIT's Technology and Policy Program, the Science, Technology and Society Program, and the Department of Political Science were recently awarded a $2.9 million NSF Integrative Graduate Education and Research Training program (IGERT) grant. This five-year award is for a multidisciplinary program on assessing effects of emerging technologies, such as ubiquitous computing, genetic engineering, and nanotechnologies. The emerging technologies program will develop three new core courses to develop competencies in evaluating economic, security, environmental, societal, and ethical consequences of technical change. It also will assemble multidisciplinary panels to develop methods used in training students to respond to emerging technologies and shaping faculty-student research on critical areas of uncertainty. The active participation of government, business, and NGOs will be an integral element of the IGERT project, and students from MIT and elsewhere will be eligible to apply.

Another promising initiative, "Making Peace: The Israeli-Palestinian Forum at MIT," is housed at CIS and led by faculty from Urban Studies and Planning. The Forum aims to enable dialogue between these two peoples to help to build trust and "peace from below." One aspect of the project is an offshoot of the Cities in Conflict working group – a project that will foster creative ideas about the kinds of institutions, practices, and uses of space in Jerusalem that might unite its citizens. Specifically, we are planning an international, juried design competition, "Jerusalem 2050," to facilitate these possibilities.

Perhaps the best known program within the CIS is the MIT Science and Technology Initiatives (MISTI), the nation's first and largest program of "applied area studies." For 50 years after WWII, education and research in science and technology proceeded under the assumption that theories, discoveries, and practices evolve independent of national or cultural context. Today, accepted ideas about scientific and technological progress are being transformed at MIT, where fundamentally new approaches to the organization of education and research are developed. At the heart of these new ideas is the recognition that context shapes both learning and the process of innovation. Context in the broadest sense means life experience (including, but not limited to) the nature of research and educational communities, practical experiences, life in the dormitory, and life in the workplace.

Context also means location in international networks of knowledge creation and technological applications. An MIT education linking research, life experience, and classroom learning enables students and faculty to participate in centers of technological, scientific, and economic advance outside our own society. For nearly two decades, since the creation of the MIT Japan Program, the CIS has been a leader in preparing scientists, technologists, and managers for professional lives and mental horizons that span national boundaries. The lives and careers of MISTI graduates are global and cross-cultural in ways and with consequences that we cannot yet fully imagine. Toward that end, MISTI prepares MIT students for internships at companies in Italy, France, Germany, China, Japan, and India.

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We at CIS welcome input on and participation in our research projects. Additional information is available on our Website, ***http://web.mit.edu/cis/***.

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Research at MIT

The Clinical Research Center

Richard J. Wurtman

IN ONE ROOM A normal volunteer, lying in bed for 12 hours, receives an intravenous infusion of an amino acid labeled with non-radioactive deuterium, part of a study to chart the compound's metabolism in people.

In an adjacent room an HIV-positive subject with disturbed fat metabolism is continuously administered intravenous insulin and glucose, to determine whether his abnormal accumulations of fatty tissues result from inadequate sensitivity to the hormone.

Down the hall a woman with osteoporosis undergoes a scan of her bones (see photo) to determine whether an experimental treatment really has strengthened them. Later in the day subjects with anorexia nervosa will undergo similar testing.

In a nearby testing room a patient who is recovering from a stroke practices a personalized computer game that may help to restore his ability to make normal hand movements. In one examining room a nurse weighs an obese subject to see whether taking a particular mixture of carbohydrates has made it easier for her to adhere to her weight-loss diet. In another a blood sample is obtained from a young woman who became hypertensive a year ago, while she was pregnant, to determine whether that elevation in blood pressure might have resulted from a persistent low-level inflammation. In one adjacent office two investigators are designing a protocol for testing whether a nutrient normally found in infant formulas can, if given in large doses, repair the memory loss sometimes seen in older people; in another, a professor and his assistant administer a unique training program which teaches young, board-certified physician-specialists how to become clinical investigators.

Perhaps contrary to the reader's expectations, these rooms are not in a Boston-area teaching hospital. Rather, they are on the fourth floor of buildings E17 and E18, within MIT's CRC, or Clinical Research Center.

The CRC admits about 1500 subjects each year, all of whom are outpatients. It finds its research patients by advertising – for example, on the Red Line – or through the hospital associations of its investigators; its normal volunteers most often are MIT students and fellows.

The CRC was founded in 1962, with major and continuing support from the National Institutes of Health. Its stated goal was to enable MIT investigators to do research on normal subjects and on patients with stable diseases. Ideally, much of this research would be "translational," determining whether discoveries made in MIT's basic science laboratories also applied to humans, and could yield insights for treating human diseases. (Since MIT's CRC lacked interns or residents, it was unable to take responsibility for studying acutely-ill patients until 2003 when, as described below, it administratively merged with the Massachusetts General Hospital's CRC; now it studies such patients at the MGH.) The CRC admits about 1500 subjects each year, all of whom are outpatients. It finds its research patients by advertising – for example, on the Red Line – or through the hospital associations of its investigators; its normal volunteers most often are MIT students and fellows.

All of the CRC's costs are covered by its NIH grant, hence the investigator's individual research grant need pay only for the honoraria of some of the subjects; the stipends of students and fellows directly involved in the research; the salaries of staff working solely on the specific CRC project; and – in exceptional cases – the costs of some of the special foods or of biochemical assays. Each year the CRC implements 50-70 active protocols, submitted by 20-30 investigators, involving a wide array of disciplines (e.g., biomedical engineering; neuropharmacology; nutrition-metabolism-endocrinology; psychiatry). All of the protocols have first been approved by the CRC's peer-review Scientific Advisory Committee and by MIT's Institutional Review Board (IRB), the Committee on the Use of Humans as Experimental Subjects (COUHES). All of the subjects receive a full explanation of the project in which they will participate, and sign a consent form. In some studies subjects receive a small honorarium for participating; in others they don't. In any case, their participation is largely altruis-

tic, since the honoraria are not large, and the patients with diseases are clearly informed that treatment of their individual medical problem is not the goal of admitting them to the study.

In fact, the immediate purpose of each study is solely to learn more about a pathological or physiological process. Before a study can even be considered by the CRC's Scientific Advisory Board it must have been approved by the CRC's resident, NIH-funded statistician (Dr. Mark Vangel) to affirm that the data thus generated will be interpretable. Although the implicit goal of each study is to generate publications in peer-reviewed journals, now and then – rarely – CRC research has led to an actual new treatment for a particular disease, e.g., REDUX for obesity; SARAFEM for severe PMS; melatonin for insomnia.

The day-to-day operations of the CRC are managed by an administrator (Susan Dalton), a nurse-manager (Marguerite Parkman), and a complement of research nurses, bionutrition experts, core laboratory personnel, informatics specialists, and various assistants. This staff is directed by five physician/investigators who constitute the CRC's program direction and who also hold academic appointments (indicated in parentheses) at Harvard Medical School, and staff appointments at the MGH. They are Dr. Lee Schwamm, a stroke specialist (and Associate Professor of Neurology) who serves as the CRC's Associate Director; and three Assistant Directors, Drs. Roger Pitman, a biological psychiatrist and expert on post-traumatic stress disorder (Professor of Psychiatry); Ravi Thadhani, a specialist in hypertension and kidney disease (Assistant Professor of Medicine); and Steven Grinspoon, a neuroendocrinologist who also investigates AIDS-related metabolic disorders (Associate Professor of Medicine). I serve as Program Director, and my own clinical studies relate to neurotransmitters and to endocrinology/nutrition. My main appointment is, of course, at MIT, but I'm also fortunate to hold appointments at Harvard and the MGH – where I took clinical training decades ago.

A bone scan utilizing a DEXA scanning device housed in the CRC

Since the CRC is a medical facility, and must thus satisfy state licensing requirements, it is considered to be a component of the MIT Medical Department, directed by Dr. William Kettyle, and obtains its periodic certifications and its license through that department. But the CRC is also an academic entity – offering an undergraduate course in clinical investigation; providing training opportunities for UROPs, graduate students, and fellows; and organizing annual symposia on "hot" topics in clinical research (e.g., "Neuroprotection in the Treatment of Stroke," "Insulin Resistance in Disease," "Post-Traumatic Stress Disorder," "Neuroimaging, a Toolbox for Clinical Neuroscience") for the broader MIT community. In its academic activities it is a component of the Harvard-MIT Division of Health Sciences & Technology (HST), directed by Drs. Martha Gray and Joseph Bonventre. Finally, the CRC is an MIT research center and reports in this regard to MIT's Vice President for Research and Associate Provost, Dr. Alice Gast. Direct oversight of how CRC protocols are implemented – to affirm that each is being conducted exactly as it was approved – is provided by the CRC's NIH-funded Research Subjects Advocates, Dr. Laurence Katznelson and Ms. Joyce Saturley. These Advocates and an MGH research pharmacist (John Vetrano) also review all protocols that administer experimental drugs (including "old" drugs being tested for "new" uses). Such protocols are also overseen by individual Data Safety Monitoring

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The Clinical Research Center
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Boards, organized through the CRC, and by the FDA (which must approve an IND – Investigational New Drug – application for the compound being tested). These additional levels of oversight have the salutary effect of enabling the Program Director to sleep more soundly at night.

About five years ago, with the strong encouragement of the NIH, the program staffs of the MIT and MGH CRCs began holding discussions on the possibility that the two institutions might merge administratively. It seemed that the abilities of both centers to implement the studies that their investigator-constituents were proposing could be materially enhanced if, when appropriate, the centers would share resources and personnel.

Any CRC activities that involve the expenditure of grant funds, or that impinge on NIH policies, are vigorously monitored by the NIH's Division of Clinical Research, a component of the National Center for Research Resources. This formidable list of friendly watchdogs notwithstanding, the CRC has almost always operated with a minimum of external input – reflecting, one hopes, the expectation of high standards and good common sense.

About five years ago, with the strong encouragement of the NIH, the program staffs of the MIT and MGH CRCs began holding discussions on the possibility that the two institutions might merge administratively. It seemed that the abilities of both centers to implement the studies that their investigator-constituents were proposing could be materially enhanced if, when appropriate, the centers would share resources and personnel. For example, MIT investigators might thereby become able to implement protocols involving acutely-sick subjects, and their counterparts at the MGH might have greater access to the specialized outpatient facilities of the MIT CRC; to its state-of-the-art metabolic techniques (e.g., for determining insulin sensitivity using euglycemic hyperinsulinemic clamps and nutrient trafficking by stable isotopes); and, more broadly, to the myriad medically-relevant discoveries being made in MIT basic-science laboratories. Moreover, MIT and the MGH were already well along in planning another joint biomedical venture, the Athinoula A. Martinos Center for Functional and Structural Biomedical Imaging, and MIT and Harvard Medical School had been collaborating for years in running the HST program. (Parenthetically, the MIT and MGH CRCs are about to open a small satellite operation at the Martinos Center, in Charlestown, Massachusetts; it will, for example, enable investigators to administer drugs to subjects in imaging studies.)

These discussions led to a formal administrative merger, followed by the successful submission of a single five-year renewal grant application, funded on December 1, 2002, that provides support for both institutions. Even prior to that award the two centers had established a pattern of sharing resources when appropriate: For example, in 1999, MGH CRC funds were used to purchase a DEXA scanning device (illustrated in the figure) that is housed within the MIT CRC and operated by MIT personnel. That device now performs about 1600 scans per year, principally to measure body fat content or bone density. In a sense, its operation proved that the MIT-MGH merger could work to everyone's benefit. In the last year, at least 14 new collaborative protocols have been generated for implementation by investigators at both centers.

Although the MIT CRC receives its own subcontract within the NIH grant that it shares with the MGH, NIH policies require that the larger party to such administrative mergers (i.e., the MGH) be identified as the senior partner and the other as a satellite; and that the program director (or directors) of the larger component serve as overall program director. Thus, from the standpoint of the NIH (but not MIT) the merger caused my "demotion" to Associate Program Director, and Lee Schwamm's to Assistant Program Director. The overall Program Directors are Dr. David Nathan, a distinguished diabetologist, and his Co-Director, Dr. Anne Klibanski, an equally-distinguished neuroendocrinologist; both are Professors of Medicine at Harvard. As far as I have been able to tell, this "demotion" has lacked significant consequences, and both the MIT and MGH CRCs continue to function as largely-independent entities, fully implementing the policies of their home institutions.

The CRC is first and foremost a service facility; its reason for existing is to enable MIT and MIT-affiliated researchers to conduct biomedical studies involving human subjects as efficiently as possible. It strives to be user-friendly. If the reader is interested in taking advantage of its resources, the CRC's program and operating staffs will happily provide whatever assistance is necessary. Please visit our Website for more information: ***http://web.mit.edu/crc/www***. ■

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Research at MIT

The Operations Research Center

James Orlin

THIS COMING APRIL TWENTY-FOURTH, the MIT Operations Research Center (OR Center) will celebrate its fiftieth anniversary. We will commemorate our anniversary with two speakers from each of the past five decades, providing their perspectives and memories of their time in the OR Center and the events in OR that helped shape the decade. The following day, we will continue our celebration by holding a joint meeting with the INstitute for Operations Research and the Management Sciences (INFORMS), which is our professional society in the United States.

In this article, I will discuss the beginning of the OR Center, the OR Center today, some research at the OR Center, and more information about the anniversary. But first, "What is Operations Research?"

What is Operations Research?

This question haunts many of us who refer to ourselves as Professors of Operations Research, because we don't have a satisfying answer. I remember trying to explain it to my mother so many times when I was an assistant professor, that I wrote up a 25-word description that she carried around in her wallet in case anyone would ask.

The difficulty of defining Operations Research is evidenced from a brief discussion that took place on the SCI.OP. Website in 1999 [SCI.OP-RESEARCH Digest V6 #37. ***http://mat.gsia.cmu.edu/ORCS/JUN1700/0890.html***], which is a site for discussions of topics in OR. One student from Italy wrote: "[Can] somebody tell me the definition of Operations Research?" The first response was "No, because there really isn't such a thing as THE definition of OR..." The second respondent to the query quoted from the 4th Edition of Hillier and Lieberman's text on Operations Research, which says the following:

"In summary, operations research is concerned with optimal decision making in, and modeling of, deterministic and probabilistic systems that originate from real life. These applications, which occur in government, business, engineering, economics, and the natural and social sciences, are largely characterized by the need to allocate limited resources. In these situations, considerable insight can be obtained from scientific analysis such as that provided by operations research."

The third respondent to the query said:

"Defining OR exactly is probably an NP-complete problem, requiring an exponentially expanding number of qualifications and exceptions. So… [I will give] you a close approximation. …'OR is the mathematics of decision-making.'"

While the phrases from Hillier and Lieberman are quite useful, I agree with the third respondent, and like his approximate definition, except that it omits any mention of the practice of decision making. I also like the following definition at the INFORMS Website: "Operations Research (OR) is the professional discipline that deals with the application of information technology for informed decision-making." Unfortunately, this definition omits the mathematics of decision-making. I think a combination of the previous two definitions would offer a better description, and so offer the following:

Operations Research is the professional discipline that develops and applies mathematics and scientific approaches to support informed decision-making and to improve processes.

Incidentally, it's fewer than 25 words long, and there is no way that my mother would remember it without having it written on a piece of paper.

The Operations Research Center

Professor Philip Morse, the founder of the Operations Research Center, played a pivotal role in the development of operations research in America. Morse's role in the development of operations research dated back to 1942, when he recruited a group of scientists to recommend actions for the U.S. Navy on antisubmarine warfare. This group's recommendations on resetting detonation depth for air-dropped depth charges, combined with better search tactics, increased the sinking of enemy submarines by a factor of five [J.D.C. Little, "Philip M. Morse and the Beginnings" *Operations Research* 50, (2002), 146–148]. Subsequently, the group expanded its role and became known as the Operations Research Group (ORG), the first group with that name in the U.S. By the end of the war the ORG had over 100 analysts. Morse was awarded the Presidential Medal of

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The Operations Research Center
Orlin, from preceding page

ORC Founder Philip Morse

Merit in 1946, the nation's highest civilian award.

Morse helped found the Operations Research Society of America (ORSA) in 1952, and served as its first president. ORSA was later merged with The Institute of Management Science (TIMS) in 1995 to form INFORMS. He also helped establish the International Federation of Operational Research Societies (IFORS) in 1953, the same year in which he started the OR Center at MIT. Morse's first doctoral student was John Little, who among his many honors, was the first president of INFORMS, and is one of 13 current MIT Institute Professors.

The OR Center is MIT's oldest running interdepartmental program, and has both a doctoral and an SM program. Today, it has more than 45 affiliated faculty, approximately 40 doctoral students, and 10 masters students. Most people agree that it has one of the best doctoral programs in OR in the world, and is arguably the best. (There are no official ratings.) The OR Center students are passionate about the field of operations research, and they genuinely support each other in their striving for academic excellence and their efforts to create community. To get a better sense of the OR Center students, I highly recommend reading some of their comments at ***http://web.mit.edu/orc/www/letters.html***.

Research at the OR Center

The OR Center is interdisciplinary, and our graduate students develop OR methodologies to advance research in many different disciplines. The fields of study to which OR students contribute is almost unlimited. Over just the past five years, OR Center students have written theses that contribute to each of the following areas: (1) Auctions and Pricing, (2) Finance, (3) Health Care Management, (4) Machine Learning, Statistics, and Data Mining, (5) Marketing, (6) Music, (7) Operations Management, and (8) Telecommunications. In addition, our students have developed methodologies that are not field specific.

Here are four examples of Ph.D. research carried out over the past five years. I chose them because they help give a sense of the breadth of research in the OR Center.

The OR Center is MIT's oldest running interdepartmental program, and has both a doctoral and an SM program. Today, it has more than 45 affiliated faculty, approximately 40 doctoral students, and 10 masters students…. Over just the past five years, OR Center students have written theses that contribute to each of the following areas: (1) Auctions and Pricing, (2) Finance, (3) Health Care Management, (4) Machine Learning, Statistics, and Data Mining, (5) Marketing, (6) Music, (7) Operations Management, and (8) Telecommunications.

Error-Based Clustering

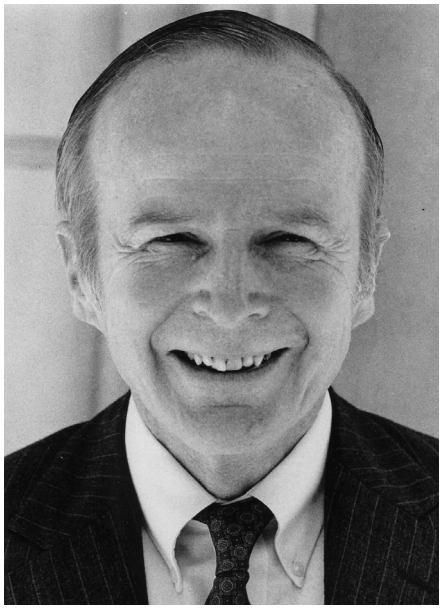
Clustering is a fundamental and widely applied methodology used to understand structures in large datasets. Clustering techniques generally assume (unrealistically) that there is no measurement error, or uncertainty, associated with data. Mahesh Kumar, in his PhD thesis entitled "Error-based Clustering and Its Application to Sales Forecasting in Retail Merchandising," developed a new clustering method that explicitly incorporates error information associated with data in cluster analysis. His technique outperforms traditional methods such as k-means and hierarchical clustering on simulated data. Kumar further demonstrated the effectiveness of the new clustering method in producing improved sales forecasts in retail merchandising.

Revenue Management for Telecommunication Networks

Airlines have made billions of dollars through the development of the science of yield/revenue management, viewing seats as perishable inventory and controlling fares intelligently based on available capacity. Can this experience be applied to telecom networks? Pundits believe "yes," but have yet to develop a framework for doing so. In his PhD thesis entitled "Yield Management for Telecommunication Networks: Defining a New Landscape," Salal Humair (i) argues for basing telecom yield management on "innovative" services explicitly designed to use only spare capacity; (ii) proposes a framework to simplify related decision modeling; and (iii) articulates several "innovative" telecom services and models illustrative of decision problems arising in their operation.

Optimal Influenza Vaccine Strain Selection

In recommending which strains of influenza to include in annual vaccines, the World Health Organization (WHO) attempts to match the vaccine strains with forecasted epidemic strains. This strategy



Institute Professor John Little

does not take into account expectations that a vaccine may be rejected by a vaccinee's immune system because of previous exposures to influenza. In his PhD thesis entitled "Optimization of Influenza Vaccine Strain Selection," Joseph Wu formulates the annual vaccine strain selection problem as a stochastic dynamic program while incorporating information on residual immunity. The optimal solution outperformed the WHO policy, but only marginally, and demonstrates that the WHO policy is nearly optimal.

Pricing a Derivative Security Using Partial Information

How should one estimate a random quantity when only partial information on its distribution is known? In her PhD thesis entitled "Moment Problems in Probability and Finance," Ioana Popescu addresses this estimation problem when only means, variances, or possibly other "moments" of the distribution of the random quantity are known. She develops efficient techniques for solving these moment problems using convex and semidefinite optimization. Her results answer important questions in financial economics such as how to price a derivative security given partial information on the underlying asset.

I expect our fiftieth anniversary celebration to be very accessible to all MIT faculty, and there is extra space available. Please contact me if you are interested in attending.

James Orlin is a Professor of Management Science, and Co-Director of the Operations Research Center *(jorlin@mit.edu)*.

The 50th Anniversary OR Center Symposium

On April 24th from 9 am to 5 pm, a symposium will be held that will include the following talks, with two alumni speaking from each decade.

- **John D. C. Little, "The ORC before there was an ORC — through 2054"**
- **Ron Howard, "Early Memories: 1956-1964"**
- **Al Drake, "Recalling the 60s at the OR Center"**
- **Ralph Keeney,"24-215, 6.27, and X in the 1960s"**
- **Bruce Golden, "Visualization in Operations Research"**
- **Margaret Brandeau, "From Venn Diagrams to Bioterrorism: An OR Journey"**
- **Jan Hammond, "ORC Values: Learning How to Learn"**
- **Ed Kaplan, "Getting Started"**
- **Mitchell H. Burman, "OR: Salvaging Lost Opportunities in Industry (or How to REALLY Sell OR to Industry Management!)"**
- **Jonathan Caulkins, "OR and the Drug War: Tales from the Trenches"**

MIT Poetry

Trilobite

n. Any of the numerous extinct marine arthropods of the class Trilobita, of the Paleozoic era, having a segmented exoskeleton divided by grooves or furrows into three longitudinal lobes.

– The American Heritage Dictionary

You had no cell phones–
the sea was sweet without
satellite communication or
the latest coffeehouse in Prague.
In fact, given fossil photographs–
shovel-headed centipede spider-thing–
you make the horseshoe crab
who lately spawned at Brigantine
appear the chic Manhattanite.

If, as I recall, you perished at the Permian frontier,
could you clear something up: what's death-by-asteroid
***feel* like? My species is conducting little tests.**
No asteroids–we're not Zeus yet,
but cowfart, Oldsmobiles, and the mysteries of Wal-Mart
pull a whack-job on the kingdoms of the living.
Anyway, annihilation:
Does it hurt?
Is it a hoot?
Do extinction-angels giggle as the last of you bite it?
Is it being sealed in glass,
Sleeping Beauty with no prince to kiss 'er?
Or driving Jersey's Turnpike when everyone has EZ-Pass
and you've got a quarter.

Maybe you should save your breath.
Just answer this:
Did you pardon the bullet that ended your age,
or sit at forever's big-dish TV
rooting for mammals to die in a blur
of scorched milk and burnt fur?

– Anthony Lioi

Anthony Lioi has just joined the faculty in the Writing Program *(lioi@mit.edu).*

Beyond Fuzzy Definitions of Community: A Report and an Invitation

Hazel Sive
John-Paul Clarke

THE GROUP ON COMMUNITY (GOC), an ad hoc group of faculty, students, and administrators, was convened in response to the Committee on Student Life (CSL) white paper on community (published in summary in the *Faculty Newsletter* of April/May 2003 [Vol. XV No. 5], and summarized further here (see next page). The GoC met over summer 2003 to discuss practical ways to strengthen our community, especially as it relates to faculty/undergraduate student interaction, with the goal of better guiding our students through the river (or whitewater rapid) that is MIT. The key suggestions made by the GoC are presented below, along with indications of the progress made towards implementing them. We conclude with an open invitation for comments and suggestions.

Philosophy of the GoC

A key consideration of the GoC was the question raised in the white paper – what is the definition of "community"? To many, community has become a "fuzzy" term, suggesting socializing that is superfluous to the real business of MIT – educating stunningly bright young people and defining new research frontiers. In this view, community-building activities have an expensive, frivolous cachet – dinners and lunches, or outings using considerable departmental or Institute "slush" funds, that are the first to dry up in fiscal crises.

However, a more useful, literal definition of community is that of a group of people with common purpose. In this more accurate view, community implies productive communication that contributes enormously to the progress of students and to the strength of a university. Another definition includes caring about other members of the community, which implies interest in good mentoring.

The GoC felt that the notion of community encompasses a continuum of interactions, extending from classroom teaching through formal advising to less formal mentoring to more casual social interactions. In particular, the GoC felt that students are looking for advice on how to navigate towards a degree within MIT, and suggestions on how to forge a career after leaving the Institute. Useful interactions include long-term relationships between faculty and students or one-time conversations. Students understand that faculty can offer a lot of good advice, not the least of which is to explain how they got to be MIT professors. There is also a sense by students that faculty are rather inaccessible, and a majority of MIT students asked would like more extensive interaction with faculty.

Emphasis

Two practical considerations were that changes in community structure must work within the existing fabric of MIT, including ongoing semesters and the tight schedules of students and faculty. It was therefore felt that only small changes at any one time were practical, but that collectively these would gradually strengthen this fabric, and with time, change its constitution. Further, the Group felt that meaningful changes could be made at low cost, within our current fiscal constraints.

Recommendations of the GoC, and progress towards implementation

The overriding conclusion was that while a huge number of opportunities exist for faculty/student interaction, these are not exploited fully (see ***http://web.mit.edu/-dsl/faculty/interaction.html*** for a partial list). This is both because a comprehensive list of opportunities does not exist and because these are not advertised effectively.

Collation of existing opportunities from many sources around campus is underway. These include opportunities that range from becoming a House Fellow to getting a UROP student to eating dinner at a dorm or becoming a faculty advisor for a club or athletic team.

A new Website to advertise these opportunities should be built that is closely linked to the main MIT site and is easy to use, informative, and current. The notion is to have separate access points for student and faculty opportunities. The student side would include ideas for interaction, as well as profiles of faculty willing to interact with students. A working group has designed a mock-up of a relatively low cost Website that is currently being circulated for suggestions.

Each faculty profile on the Website should include personal interests. This would help a student find common ground with faculty and allow him/her to feel comfortable contacting a faculty member for advice, for a research position, or with a lunch invitation. Discussions with UROP to facilitate setting up these profiles is underway.

Since many faculty/student interactions are awkward, it was suggested that "how to interact" guidelines be included, on both student and faculty sides of the site. For example, a student having dinner with a faculty member might be advised

continued on next page

Beyond Definitions of Community
Sive and Clarke from preceding page

to think about a topic for conversation, and plan some relevant questions beforehand.

It was suggested that randomly selected graduate students from different departments be invited to monthly dinners where a topic of interest would be discussed. The first of these dinners recently took place.

A recommendation was made that an entry be placed into the Incoming Faculty Orientation Folder, describing opportunities for faculty/student interaction, and reasons that junior faculty may be interested in these. This was done in August 2003.

Some other current efforts to improve faculty/student interaction

A joint CUP/CSL group has tackled the major question of upperclass mentoring and advising. The final report from this initiative will soon be written, and one of the conclusions will be a need for increased faculty/student interaction. Another initiative in progress by the CSL is to examine faculty/student interactions within departments, and to publish a "best practices" list that could furnish ideas for other departments.

An open invitation . . .

Suggestions that faculty be more accessible to students raises the complex question of incentives. Clearly, it is smart to look after our students, as low quality education and advising will fail to attract sparkling minds. But faculty are overcommitted, underpaid, and overwhelmed.

Please tell us what you think – either by answering one or more of the questions below, or by sending us other reflections. Your thoughts are crucial for establishing reasonable expectations to improve our MIT community.

- Who should set the tone for the level of faculty/student interaction at MIT? Does being an MIT faculty member carry an obligation to interact with students beyond the classroom?
- Should there be tangible (perhaps monetary) rewards for interactions outside of regular teaching?
- What quality of faculty life issues are relevant when trying to increase faculty/student interaction?
- What other reflections do you have regarding efforts to strengthen faculty/student interactions, or regarding community at MIT?
- E-mail your thoughts to *CSL_comments@mit.edu.*

Membership and a full report of the Group on Community can be found at ***http://web.mit.edu/dsl/***.

Hazel Sive is an Associate Professor of Biology; Co-chair, Committee on Student Life *(sive@wi.mit.edu)*.
John-Paul Clarke is an Associate Professor, Aeronautics & Astronautics; Co-chair, Committee on Student Life *(johnpaul@mit.edu)*.

Committee on Student Life on "Community"
Summarized from the article for the *Faculty Newsletter*, May 2003
Paul A. Lagace, Chair, CSL

There is remarkable consensus that informal, outside-the-classroom contact between faculty and students enriches the education and personal growth of our students. Consideration of the available information led to four key findings with regard to the issue of community at the Institute:

1. There is a lack of shared understanding of the meaning of "community";
2. Differences in the models of community . . . lead to very different actions in building our community;
3. There is wide disagreement as to whether contributing to the Institute community via participation in issues related to student life is an inherent part of being an MIT faculty member;
4. There continues to be a distinct lack of career rewards for faculty contributions to the Institute community via participation in issues related to student life.

The Committee recommends that the first step in addressing these issues is to create a campus-wide dialogue to determine what it means to be part of a common MIT community and to develop ways to build that community with full faculty participation. Initial thoughts on these issues, including potential attributes of the Institute community, potential qualities of "Institute community-building" activities, and some possible activities of this nature, are conveyed in a white paper entitled "Community" written by the Committee on Student Life. This can be found at the faculty Website ***http://web.mit.edu/faculty/reports/csl.pdf***. We hope that you as faculty at MIT will take ownership of these items and engage in open dialogue with colleagues, students, and all members of our Institute community.

Cambridge and MIT: Exchanging Students, Exchanging Ideas

Margaret S. Enders
Robert P. Redwine

IN THE SUMMER OF 2000, seven MIT undergraduates in Mechanical Engineering and Chemical Engineering were recruited to spend a year at Cambridge University as part of a pilot program; these plucky students had a great time and proved it was possible for MIT and Cambridge University – with the help and support of the Cambridge-MIT Institute (CMI) – to establish a student exchange.

We are now in the third full year of the Cambridge-MIT Undergraduate Student Exchange Program (CME). By the end of this academic year, about 220 students from both sides will have participated in the full-year program. Twelve MIT departments and a committed group of MIT faculty collaborate with their like-minded counterparts in Cambridge to provide the much needed support and guidance to the program and to the students in it.

The discussions between Cambridge and MIT that established the exchange program were taking place at about the same time that the Committee on the Undergraduate Program (CUP) was becoming more interested in the possibility of study abroad experiences as a way of providing educational enrichment for MIT students. (There are a few small study abroad programs within MIT departments, and the MIT International Science and Technology Initiatives (MISTI) program has had a long and successful record providing international internship opportunities. Roughly 30-40 undergraduates also choose to take a term or a year away from MIT on independent study abroad – that is, through programs not affiliated with MIT.) Cambridge, too, had been exploring connections beyond the Fens for its undergraduate programs and something similar was in the air. The UK government, who was the sponsor of the program, recognized the significance of the contribution that graduates of the university make to the society in which they live, an important part of the MIT effect. Both Cambridge and MIT recognized that the students on an exchange program would provide valuable insights into the strengths and weaknesses of both institutions and could be important sources of inspiration for change.

Central to overcoming the obstacles that have prevented both institutions from encouraging their students to study abroad was the unusual arrangement we put in place. Neither school wanted to consider an exchange program that extended the period of undergraduate study beyond the normal time-to-degree, nor did they wish to lose good students. Consequently, a fully reciprocal program was established where, for example, a Cambridge mechanical engineer would exchange places with an MIT Course 2 student who would take the place of the Cambridge student in his or her College and course. This closely interwoven arrangement produced a pattern of connection and intimacy between students and faculty from the two universities that is rarely seen in such programs. This design enabled our colleagues in Cambridge to quickly pilot the program through the CU system and proved that even ancient universities can be very nimble when a good opportunity presents itself.

An agreement was drawn up between Cambridge and MIT, and an assessment team was hired on both sides to monitor closely the student experiences as CME was established. MIT, with its more centralized student services, is better organized to initiate new programs, and the exchange became the responsibility of the Dean for Undergraduate Education.

Cambridge, however, operates on a much more distributed system, where responsibilities which are held centrally at MIT are managed by departments and Colleges. This produces a system that lacks homogeneity, but offers an interestingly different approach to the integration of student life and learning. The first two groups of students from MIT were totally dependent on this system, but from this year onwards it has been complemented by the new International Education Office at Cambridge. This office, which is being partially underwritten by CMI, now manages CME on the UK side.

The experiences of the exchange students revealed that we had a fairly shallow understanding of the differences between the two educational systems. MIT students going to Cambridge were sometimes disoriented by the more self-directed and independent teaching and learning environment – where the burden of learning is much more on the individual student. At Cambridge, the special educational ingredient is the Supervision – which is a tailored tutorial session between a member of the academic staff and a student. Students are obliged to come prepared to Supervision sessions, since it is here that students get a chance to get help with material they don't understand. Lectures at Cambridge tend to be "off the rack;" the Supervision is tailored to each student's needs. A typical course at Cambridge runs the length of at least two eight-week terms without examination, and Supervisions for upperclass students are not always offered weekly. There are long four- or five-week breaks between each of the three terms; students are expected to use this time for intensive study and not just as vacation. At the end

continued on next page

Exchanging Students, Exchanging Ideas
Enders and Redwine, from preceding page

of the year, a comprehensive "tripos" examination is given, covering the year's work.

Since typical MIT subjects have frequent, graded homework and tests, MIT students must adjust quickly to a very different style at Cambridge – one that provides them more apparent free time. The best MIT candidates for this exchange are ones who are personally quite resilient and adaptable and who don't mind the challenge of learning in a relatively unstructured but equally challenging academic environment. Each year we introduce improvements in the way we prepare both groups of students for their exchange year. MIT students are now given "mock" tripos exams in January to help them prepare for the year-end exams. This year, with the help of Professor Duane Boning, MIT engineering students participated in seminars held at MIT to prepare them for their Cambridge coursework, and we are working with staff in the MIT Writing Program to help students satisfy the Communications Requirement while at CU.

We worked closely with the program evaluators to examine both the mechanics of the exchange as well as the differences in the educational systems and the learning experience. Exchange program students have been invited to faculty committee meetings, dinners with senior academic administrators, and CMI-sponsored workshops. In March 2003 and again in August 2003, formal reports from the exchange evaluators discussed CU and MIT teaching and learning cultures based on surveys and interviews with students and faculty. These observations and recommendations resonate very strongly with what we hear in our individual conversations with students and are inspiring both institutions to examine their own educational practices. The students have been quite effective "probes," entering the exchange experience with a critical eye for the strengths and shortcomings of each system. Many comments from students have been memorable for their insights about MIT:

". . . at our [CU college] Matriculation dinner, the master advised students to put in a good day of work – which he recommended be 8-5 Monday through Friday with maybe some work on weekends – but he basically said that there was time to take to relax. At MIT…there is no unwind at the end of the day, ever, until the semester is over." [MIT student]

Students from Cambridge have had a lot to say about the strengths and weaknesses of the MIT approach to teaching and learning. They like much about MIT . . . and reserve much of their criticism for what many regard as "mindless" hard work. Students at MIT, they claim, tend to lose sight of everything but what is due the next day; there is status associated with how many all-nighters someone might have to pull in order to finish a project or problem set.

". . . at Cambridge I always try to celebrate my birthday by taking the day off . . . at MIT I looked up from my problem set in the middle of the night and realized it was my birthday . . .." [Cambridge student]

In the first year of the exchange, MIT students talked about having a quality and quantity of time available to them at Cambridge that, in the words of one student, provided "a chance to think about myself, figure out who I am" that the pace of life at MIT never allowed. As early as the first year of the CME student exchange, MIT students talked about the very different learning environment at Cambridge and, in many cases, how they have profited from being able to acquire a more independent learning style. When asked to describe the benefits of the Cambridge experience, MIT students responded that they found they had to acquire the ability to learn on their own; to be disciplined enough to study even though no graded assignment or test was approaching; to teach themselves material that at MIT would have been taught to them; to read deeply for a change (and from books in the library, since subjects at Cambridge do not use single textbooks nor are any books required to be purchased); to be prepared in the small group Supervisions in a manner that was not expected of them at MIT. In the words of one MIT student, "you learn to learn something really well," because the lack of emphasis on regular graded homework and tests directed attention toward improving understanding rather than focusing on the "right answer."

This is not to say that MIT students loved everything about their academic experience at Cambridge. They were particularly unhappy about the lack of feedback, given the absence of regular tests and graded assignments and the relative infrequency of Supervisions compared with class meetings and office hours at MIT; the unevenness of the supervision system; the reliance on the single exam at the end of the year as the only performance datapoint; what struck many as rather dry and overly-theoretical lecture teaching when compared with what they were used to at MIT. And some missed the chance to do undergraduate research, since there is no formal UROP program at Cambridge.

Students from Cambridge have had a lot to say about the strengths and weaknesses of the MIT approach to teaching and learning. They like much about MIT (including the positive aspects of working hard and being rewarded for it; the stimulation of passionate lecturers and lecture material that draws on real-world applications; the multiple opportunities for extra help; the chance to take HASS subjects; the exposure to undergraduate research, design competitions, and other co-curricular opportunities; the first-rate technical

facilities) and reserve much of their criticism for what many regard as "mindless" hard work. Students at MIT, they claim, tend to lose sight of everything but what is due the next day; there is status associated with how many all-nighters someone might have to pull in order to finish a project or problem set. MIT students, we have been told, don't talk readily about much else except their work. It is quite the opposite at Cambridge, they say, where it is considered less acceptable to talk about school work or how hard one is working.

A recurring theme during our conversations with Cambridge and MIT exchange students has been the difference in how students spend their living and learning time as undergraduates at MIT and at CU. At MIT, the amount of work has frustrated some Cambridge students who are used to more balance, but others are thrilled to discover that work – for example, a UROP project – can be play. Both MIT and Cambridge students talk about the "balanced" life that is possible at Cambridge, but many also acknowledge that the intensity of life at MIT is stimulating in a way that is not so easy to come by at Cambridge.

At a meeting where Cambridge students were asked to talk about their MIT experience, one student said he studies "… much more at MIT, spending a lot of time simply chugging through problems . . .. At MIT, the problem sets keep you extremely busy, and for the most part, the only way to complete the sets is to share information with others in your class…. Cambridge students have said they received A's on many of the problem sets but do not necessarily feel they learned the material."

At MIT, continued this student, there is so much pressure to get the correct answer that "understanding the material is forgotten." The Examples papers at Cambridge are very important to students, but they do not feel the benefit of or need for copying from others' papers. "…there is no penalty for arriving at a supervision with blanks, as long as it is clear the student has attempted to work the problems." The student pointed out that another difference is that at MIT he completes his problem sets with his peers; at Cambridge he pursues what he doesn't understand on his examples papers with a staff member during supervisions. The student suggested that problem sets would be a more effective tool if there was a process that allowed for feedback prior to final submission. At the present time, MIT students are given homework, told to learn the material, complete the problem set and hand it in. At Cambridge, the order is somewhat reversed.

"At Cambridge students must meet with their supervisor and cannot hide the fact when they don't understand the material." [MIT student]

"At CU you do the homework questions to learn stuff, whereas at MIT you do the questions to prove you know it." [Cambridge student]

In June 2003, a two-day workshop at Cambridge brought together nearly 40 faculty and a few exchange students from both Cambridge and MIT to review the program as well as to discuss possible changes to teaching and learning practices at both schools based on what has been revealed through the students' exchange experiences. Optimism was high about the future of the exchange and about the worth of the potential educational benefits for both institutions.

During the two-day meeting, discussions focused on certain recurring themes, including the great differences in the cultural values that undergird the educational practices of each institution. Cambridge and MIT are very different in the way they teach and expect students to learn – and in the way they expect students to spend their time as undergraduates. It was agreed generally that both institutions suffer from some of the deficiencies of certain rigid structures (at MIT, for example, the relentless nature of the problem set; at Cambridge, the dependence on the single end-of-year exam).

The exchange experiences of MIT and Cambridge students have stimulated a number of faculty and departments to think about ways to build on what has been learned to date about the strengths of the educational systems of both institutions. Several engineering and science departments at Cambridge are part of a CMI-underwritten summer UROP program. There is talk about experimenting with "hybrid" models that combine the best of both Cambridge and MIT teaching and learning systems. The School of Engineering, in particular, seems eager to profit from what the students (and faculty) have observed.

In 1985 MIT President Paul Gray spoke to students about his personal vision of the MIT of the future ["The Future of MIT as an Educational and Research Institution," Paul E. Gray in *The Tech*, October 1985]. His words have relevance to what we are learning and considering as a consequence of the Cambridge-MIT exchange:

"In 1980 I said we should review the character of the MIT educational experience: the pace, the coherence, and the intellectual impact. MIT students are highly motivated and committed to high achievement. Sustained hard work is the norm. The members of the faculty hold responsibilities to the Institute, to their professional commitments, and to their personal families. This produces all too often a frenetic pace of life, self-rewarding, mutually reinforcing. But it is not without its costs.

"It would be foolhardy to argue against the virtues of hard work. But should we not consider the possible benefits of more time for contemplation, for pursuit of interests and activities outside the professional realm and for developing friendships and a sense of community?"

As the new Task Force begins its review of our students' common educational experience, we expect that they, too, will be interested in what our exchange students have to tell us. ■

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Information Services & Technology (IS&T): The Focus is on Service

Jerrold M. Grochow

On November 1, Dr. Jerrold M. Grochow became MIT's Vice President for Information Services and Technology. He also became manager of the central computing service departments during their reorganization. The Information Services and Technology (IS&T) department has grown out of the merger of Information Systems (IS) and Financial Systems Services (FSS) – in conjunction with administrative budget cuts instituted for FY2004 and FY2005.

WHEN I ARRIVED AT MIT in November, I asked that the offered title, Vice President for Information Systems, be changed in an important, though perhaps symbolic, way. As I like to point out, "services" comes first because providing service to the MIT community is the primary role of information technology professionals in our central IT organization, as well as in the many other IT groups around campus. Providing IT service means:

- understanding the goals, missions, and work of the people we serve so that we can better help to find solutions to their IT problems and begin to anticipate their IT needs.
- listening to our clients so that we can provide better service in the future and leadership in advancing their IT agendas.
- becoming experts in our field and participating in its advancement.
- reaching out to the community and making commitments that we deliver.

It is also important to note that "technology doesn't come second" in IS&T – MIT needs to have a technologically advanced information infrastructure and that is very much part of IS&T's job, too.

One of my key goals is to follow through on the recommendations of the internal and external IS/FSS review committees convened in 2002. These committees, composed of members of the community and external experts, recognized that there is confusion on campus about the role of the various information services groups as well as the way that decisions are made regarding resource allocation, budgeting, and charging for information services. Dealing with these issues will require a high degree of collaboration among these many groups (at least 25 by my count) and I have asked the leaders of key IT organizations to join me in the IT Leaders group for regular discussion and information sharing. I am confident that many joint activities will grow out of these meetings.

We must also establish a new level of understanding and discussion with community advisory groups to improve the visibility of decision-making regarding information services on campus. IS&T will work closely with several existing advisory bodies, including the Council on Educational Technology, the Administrative Systems and Policies Coordinating Council, and the Administrative Advisory Council II. In addition, a new group, the Information Technology Coordinating Council (ITCC), will be appointed by Provost Robert Brown and Executive Vice President John Curry. I will chair this group, which will advise the Provost and Executive Vice President on Institute-wide IT issues and resource allocation decisions.

The Information Services and Technology department itself is in the final stages of absorbing its staff reductions and working through what I am confident will be temporary service issues. The leadership team consists of five directors with direct responsibility for key activities:

- Academic Computing – Vijay Kumar (*vkumar@mit.edu*)
- Administrative Computing – Wayne Turner (*wturner@mit.edu*)
- Client Support Services – Greg Anderson (*ganderso@mit.edu*)
- Operations and Infrastructure Services – Theresa Regan (*tregan@mit.edu*)
- Telephony Services – Allison Dolan (*adolan@mit.edu*)

The new IS&T organization structure, including group responsibilities, is posted at ***http://web.mit.edu/ist/about/***.

Potential Impacts of Budget Cuts

With support from community-based advisory committees, IS&T is reviewing all services in order to minimize effects of the budget cuts on faculty, staff, and students. We are also looking for better ways to provide existing services so that, over time, we can provide even better services at lower cost. However, there may be some short-term effects on service as work is reviewed and reassigned. Key issues that we are dealing with are:

- Ensuring the integrity of MIT's campus network: This is, of course, a top priority, but response times to some internal network outages may increase due to smaller staff size.
- Providing front-line help services: Work is being consolidated and assigned to a single team to improve service in the future.

- Presales advice and computer repairs: Contact will be relocated to Building N42 (rather than rental space).
- Athena cluster maintenance: Work is being reassigned and we will make the transition as seamless as possible.
- Equipment replacement programs for academic and administrative computing: These programs are being reviewed in the context of significantly reduced budgets.
- SAP upgrades and implementation of SAP-related systems: New and enhanced administrative systems will be developed, but development cycles may be longer.

IS&T will re-evaluate these changes in service as it adjusts to its budget constraints and as it receives feedback from the community. We will be working even harder to ensure that we understand the services that our community wants and that we can provide.

What's New in the Academic Computing Sphere

IS&T – in conjunction with other MIT units, such as Academic Media Production Services (AMPS) – provides a range of services to support the IT needs of faculty and students. The reorganized Academic Computing group in IS&T will focus on three areas:

1. **Installations and Spaces:** Delivery of infrastructure for student/educational computing – including Athena clusters, laptops, classrooms, and special-purpose facilities such as the Building 37 Cluster (***http://web.mit.edu/windows/cluster/***). *Contact:* Phil Long (*longpd@mit.edu*)
2. **Curriculum Integration Support:** Consultation for faculty in the use of educational technology and software tools for undergraduate instruction. This includes support for Stellar, MIT's course management system, as well as for specialized applications for spatial data services, geographic information systems, and mathematics. *Contact:* Phil Long (*longpd@mit.edu*)
3. **Academic Software Services:** Management of third-party software and locally developed software integrated into the Athena environment, as well as the delivery of site-licensed software (***http://web.mit.edu/acs/whereruns.html***). The software services group has begun outreach to software developers across campus to enable optimal use of the MIT infrastructure and to promote greater awareness of technology specifications and standards, such as the Open Knowledge Initiative (OKI). *Contact:* Jeff Merriman (*merriman@mit.edu*)

Key areas of engagement in the coming months for IS&T's academic computing group include the following:

- **High-Performance Computing (HPC):** A new Website is in place (***http://stellar.mit.edu/S/project/computationallyinten/***) to support a community of practice – faculty, students, and staff – engaged in research using computationally intensive computing. A pilot undergraduate HPC teaching cluster is also being planned.
- **Stellar™ and Sakai™:** In addition to continued improvements to Stellar, MIT is collaborating with the University of Michigan, Indiana University, and Stanford University in the Sakai course management system project (***http://www.sakaiproject.org***). This initiative, funded in part by the Mellon Foundation, leverages the work of MIT's OKI and provides direction for the ongoing work of Stellar. Stellar b1.6, released in January, is already hosting 270 courses for spring 2004.
- **One-to-One Computing:** MIT has begun to take steps to transform the current centrally-managed desktop workstation infrastructure (Athena) to a service-centric model capable of supporting both fixed workstations and mobile computers individually owned by students. As part of these efforts, Academic Computing maintains a loaner laptop program and is piloting a Tablet PC project. Academic Computing will also undertake the redesign of some traditional Athena clusters to pilot different approaches to support student computing needs and provide informal and flexible learning spaces.
- **Leveraging the Open Knowledge Initiative (OKI)** (***http://web.mit.edu/oki/***): OKI will be used for educational technology initiatives such as iLabs and other iCampus/d'Arbeloff projects. It will also be implemented as part of a coherent infrastructure for integrating initiatives such as Stellar, SloanSpace, OpenCourseWare, and DSpace.
- **Crosstalk Seminars and EdTech Partners User Group:** These forums will continue to bring educational technology providers and practitioners together to share educational technology strategy and solutions. For more information, see ***http:/web.mit.edu/acs/Crosstalk/*** or send e-mail to *longpd@mit.edu*.

WHERE TO GO FOR INFORMATION AND HELP

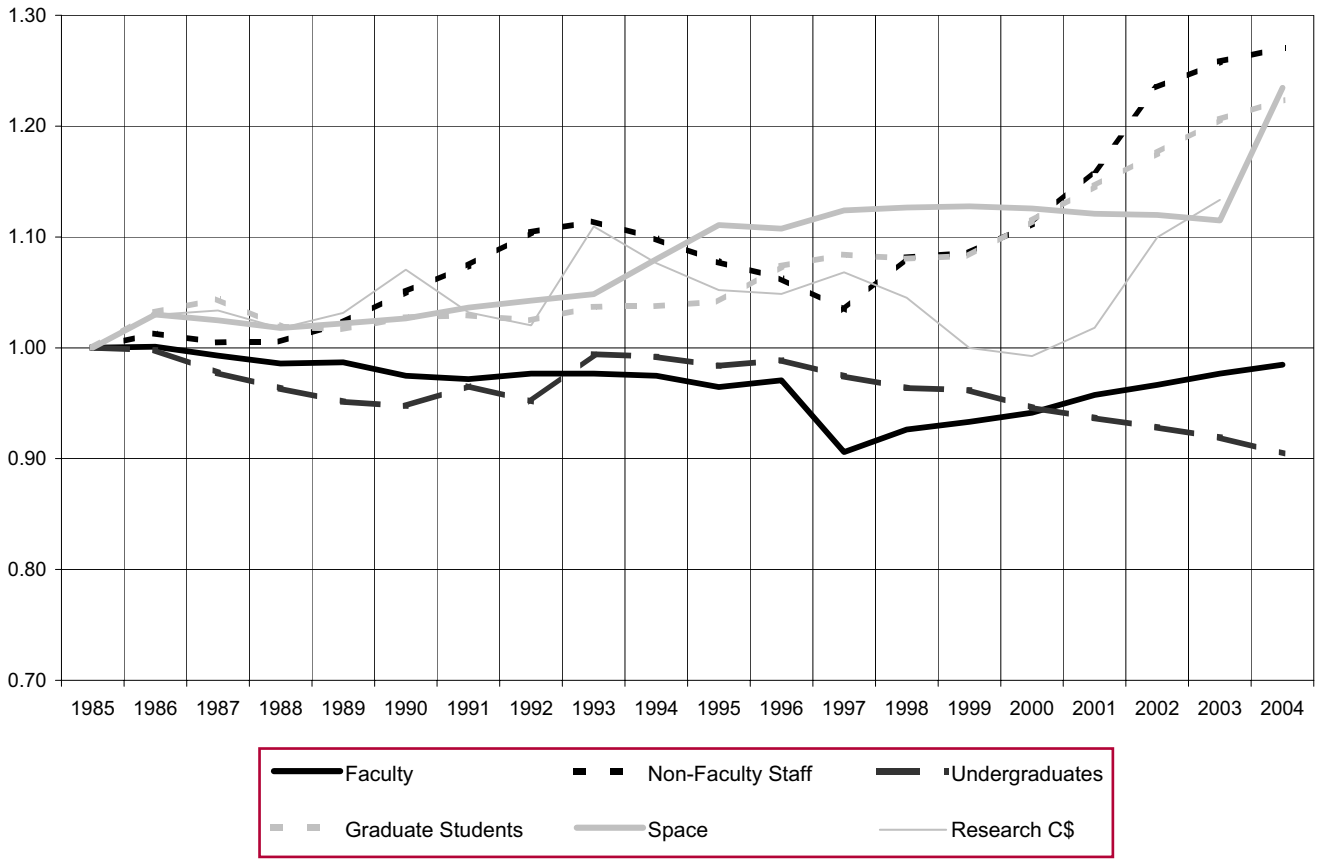
Numerous organizations across MIT provide educational technology services. For a one-stop guide to all of these resources, check out the new Teaching with Technology Website at http://web.mit.edu/teachtech/. This portal, developed by IS&T, covers everything from course management tools, to multimedia, to software and Web services. It spells out where to go for resources, support, and training.

Feedback

If you have comments about the reorganization of IS&T, or information technology services in general, please send e-mail to *ist-transition@mit.edu*. If you have specific questions about IT services related to academic computing, contact Vijay Kumar, IS&T's director of Academic Computing, at *vkumar@mit.edu* or x35023.

Jerrold M. Grochow is Vice President for Information Services and Technology *(jgrochow@mit.edu).*

M.I.T. Numbers
Campus Growth
(1985 – Present)



	1985	1990	1995	2000	2004
Faculty	989	964	954	931	974
Non-Faculty Staff	6,714	7,053	7,234	7,467	8,530
Undergraduates	4,546	4,307	4,472	4,300	4,112
Graduate Students	5,090	5,229	5,302	5,672	6,228
Space [sq. ft.] (000)	7,837.0	8,045.4	8,704.2	8,821.6	9,675.6
Research C$ (000,000)	$416.2	$445.6	$437.9	$413.1	$471.8*

*2003

Source: Office of the Provost