

# MIT Faculty Newsletter

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

**in this issue** we offer “A Letter to the Class of 2015” and an editorial addressing the intertwining of local, national, and international politics (below and page 3); Steven Hall’s “Reflections on My Time as Chair of the Faculty” (page 4); an In Memoriam to Professor Stephan Chorover (page 16); and a piece exploring a next generation sustainability framework at MIT (page 17).



MIT Corporation Chairman Robert Millard

## Is Research the Soul of MIT?

Thomas W. Eagar

**RECENTLY, I WAS THUMBING** through the pamphlet *MIT Facts 2015* distributed to visitors by the MIT Information Office, when I read on page 40 that “*The soul of MIT is research.*” After more than 45 years at MIT, this was a fact that I had not known. It certainly was not a fact when I arrived as a freshman in 1968 and it was not something that was true when I stepped down as Department Head in 2000. Clearly something has changed over the past 15 years.

Moreover, something has changed in the original conception of MIT: for the first 80 years, from 1865 to 1945, the mission of MIT was not very different from what is currently on page 6 of the *MIT Facts* booklet:

*“The mission of MIT is to advance knowledge and educate students in science, tech-*

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## Interview with New MIT Corporation Chairman Robert Millard

**THE FOLLOWING INTERVIEW BY** the *Faculty Newsletter* (FNL) with MIT Corporation Chairman Robert Millard (RM) was held on April 14 of this year.

**FNL:** *Why don’t we begin with MITx in particular, and the future of higher education in general.*

**RM:** I think there’s been an emphasis in developing MIT’s online capability, but I don’t think that the administration has ever said that MITx is actually the future of higher education. Just to be fair about it, I think the administration has said it’s part of the future of education, and that, at some level, is undeniable.

Frankly I think there was more speculative excitement two years ago about the threat of MOOCs replacing residential

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Editorial

## A Letter to the Class of 2015

**GREETINGS TO YOU, THE GRADUATES!**

– and to your families.

Together with the thousands of family members and friends gathered for Commencement, we share the excitement of this passage. Faculty both respect and take pride in your accomplishments as MIT’s new 2015 graduates. In teaching and mentoring you, we on the faculty have also learned and grown and received new insights. As you launch your own careers, your contributions to your communities and to humanity will be among the most gratifying products of our academic labors.

We hope you will look back on your years at the Institute with a positive feeling, and the sense that you have contributed to enhancing the MIT environment and experience for the coming classes. As you transition to other oppor-

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**Photo credit:** Page 1: Courtesy of Robert Millard; Page 6: Justin Knight; Page 16: Josh Kastorf

## Address

MIT Faculty Newsletter  
Bldg. 10-335  
Cambridge, MA 02139

## Website

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

**Telephone** 617-253-7303

**Fax** 617-253-0458

**E-mail** [fnl@mit.edu](mailto:fnl@mit.edu)

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**A Letter to the Class of 2015**  
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tunities and challenges, MIT and other universities are in the midst of a vigorous and healthy reexamination of how and what and when we teach. You will be entering a world where digital distance learning, new forms of academic and social communication, and global interactions are the norm. Issues such as climate change, nuclear disarmament, and reducing global poverty, once in

the distance, have now established themselves as requiring the urgent attention of us all. Instabilities in nations that may have once seemed very far away now emerge as problems that the world – and this nation – cannot ignore.

During your years with us, we on the faculty have directly encountered your manifold talents, your serious ambitions, your resilience in the face of setbacks, your thoughtful and quirky self-expression, your creative and entrepreneurial energy, and

your myriad achievements. We hope that as your various individual paths unfold, you will put your powers to work on solving some of the problems that confront us, and making our society more responsibly productive and more supportive to those in need. On behalf of the entire faculty, we wish you vision, strength, commitment, and success in the challenges you take on. ■

The Editorial Board  
of the MIT Faculty Newsletter

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## Federal Budget Priorities: Public Transit Rather Than Nuclear Submarines

Frederick P. Salvucci  
Jonathan King

**THIS PAST WINTER**, hundreds of MIT staff, students, and faculty had difficulty getting to and from work because of the inability of the transit system to handle the unusually heavy snows. This reflected, in part, many years of inadequate federal and state investment in public transit. *The Boston Globe* (Tuesday, May 19) reported on ways traffic and transit congestion is limiting Kendall Square and MIT function and growth.

While the MBTA is seen as a state-provided local service, during the Nixon administration 15 percent of operating subsidies and 80 percent of capital funding for large systems such as the MBTA came from the federal government. Today the federal government provides no operating cost to the MBTA, and capital assistance is very hard to get, slow to come, and usually no better than 50 percent.

On May 13, tragedy struck when an Amtrak regional train headed to Boston derailed outside Philadelphia, partly due to failure to upgrade track safety, again reflecting inadequate federal investment. The next day a Senate committee supported further *reduction* in Amtrak investment. The sums under discussion were in the \$1-2 billion range.

The same week, the Senate proposed more than \$600 billion in military funding, more than the total military budgets of the next six largest nations together, and more than 55% of total Congressional discretionary spending. A significant fraction of this budget is for upgrading our nuclear weapons arsenal. An article by physics professor Aron Bernstein in last month's *Faculty Newsletter* described the international efforts just ended in New York – the Non-Proliferation Treaty Review – in which more than 100 nations were pushing for reductions in nuclear arms by those nations maintaining nuclear weapons arsenals. The U.S. arsenal, together with Russia's, includes bomber-based, land-based, and submarine missiles. Our fleet of 14 nuclear-armed submarines, the world's largest, each carry multiple warhead missiles representing more than 1000x the destructive power of the bombs dropped on Hiroshima and Nagasaki. The current budget – more than a decade after the fall of the Berlin Wall – proposes buying 12 additional Ohio class submarines at \$8 billion each.

It seems extraordinary that our nation lacks the funds to upgrade its transit – helping people get to work, to school, to healthcare facilities – while the administration is planning to spend \$300 billion over

the next 10 years maintaining and *modernizing* our nuclear weapons and the infrastructure to produce them.

If a fraction of the \$96 billion cost of new Ohio class nuclear weapons submarines were transferred to Amtrak, the entire East Coast rail system could be brought up to modern standards, increasing safety and the quality of life for millions of Americans. These nuclear weapon systems don't feed us, don't clothe us, don't get us to work, don't mitigate our energy needs, and don't contribute to needed scientific or engineering developments. Many believe they decrease rather than increase national security.

It would be far better to increase our national security by bringing our transit and transportation systems up to modern standards, rather than continuing to expand our nuclear arsenal. Maybe then we could even afford new subway cars, signals, and power stations for the Red Line serving MIT and Kendall Square, improving the quality of life and productivity of MIT students, staff, and faculty. ■

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**Frederick P. Salvucci** is a Senior Lecturer in the Department of Civil and Environmental Engineering ([salvucci@mit.edu](mailto:salvucci@mit.edu)); **Jonathan King** is a Professor in the Department of Biology and MIT Faculty Newsletter Chair ([jaking@mit.edu](mailto:jaking@mit.edu)).

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## From The Faculty Chair Reflections on My Time as Chair of the Faculty

Steven Hall

**MY TERM AS CHAIR** of the MIT faculty ends this summer, and it has been a joy and an honor to serve in that role. For my last column as Faculty Chair, I'd like to reflect briefly on the role, and talk about a few issues of ongoing interest for the faculty as a whole.

Around the time I agreed to become Chair, I realized I had spent two-thirds of my life at MIT. I was here for eight years as a student, earning SB, SM, and ScD degrees. I've been a member of the faculty for 30 years, active in faculty governance for many years, and an associate housemaster of Simmons Hall for seven years. Nonetheless, the role of Faculty Chair has brought some unique opportunities and given me new perspective on the institution I have called home for many years, by allowing me to see things I otherwise would not. The result has been confidence in the many areas where things are going well, and an opportunity to try to engage other faculty in areas where we might have more to contribute.

During my time as Chair, the administration has taken a positive and constructive approach to consulting the faculty on important issues, ranging from potential legal strategies to the challenging decisions around reorganizing academic units. Even when there are different views, having insight on decision-making processes has given me an appreciation for the administration's commitment to acting in a deliberate, decisive, and principled way.

One responsibility of the Chair is to serve as a member of Academic Council and the Academic Appointments Subgroup. This is the Institute-wide council that hears appointment, promotion, and tenure cases after they have been

heard by the appropriate School council. Over the past two years, I have been repeatedly amazed at the quality and achievements of our faculty colleagues. Our newly tenured faculty are doing brilliant and innovative work. They are naturally multidisciplinary, blurring the lines

Meejin Yoon and engineered in collaboration with Professor John Ochsendorf, beautifully captures that vision. All of us who served on the memorial committee are honored to have had a small part in the process.

The death of Officer Sean Collier was a blow to MIT and the larger community. The memorial committee sought input from the MIT community, and the response was inspiring, both for the depth of feeling for Officer Collier, and for the vision the community had for a fitting memorial. . . All of us who served on the memorial committee are honored to have had a small part in the process.

between departments and Schools. They care deeply about research and teaching, and the work they do is bold and audacious. They choose to tackle difficult and important problems that will have huge impacts on society and the planet. The chance to see just a slice of what our colleagues are doing across the Institute has been a joy.

I have also worked to represent faculty interests and concerns on such committees as the International Advisory Committee, the Task Force on the Future of MIT Education, and the Collier Permanent Memorial Committee. The latter deserves a special word. The death of Officer Sean Collier was a blow to MIT and the larger community. The memorial committee sought input from the MIT community, and the response was inspiring, both for the depth of feeling for Officer Collier, and for the vision the community had for a fitting memorial. The memorial, designed by Professor

### **MITx and edX**

There are three issues that have dominated discussions over the past two years and can be expected to remain priorities in the near future. The first is *MITx* and, more generally, online learning. At almost every Random Faculty Dinner this year, the conversation seemed to turn to new technologies and concerns, that someday soon students will be taking all of their subjects in a dorm room instead of interacting with others in the classroom.

Debates about technology-driven educational initiatives aren't new to MIT. When Project Athena was created in the 1980s, there were many projections about how it would change the residential classroom, but its ultimate impact was largely to provide ubiquitous computing to students, rather than on the classroom itself. The TEAL (Technology Enabled Active Learning) project was launched in 2000 at the dawn of Web 2.0. TEAL has been enormously successful, but over time it's

become clear that TEAL is about active learning as much as the use of enabling technology.

Today, we are in the midst of the *MITx* and edX initiatives, driven in part by many of the technologies described by some as Web 3.0: efficient sharing of rich content, especially video; the near universal reach of the Internet, both to populations and personal devices; very high network speeds; and social networking. Many colleges see these technologies both as an opportunity to expand their reach, and as an existential threat if others are more successful at doing so. It's too early to tell how this revolution will play out. If past experience is a guide, there will be valuable lessons learned for how we teach, and no doubt some technologies will emerge as essential components of future education.

Meanwhile, *MITx* has thrown a spotlight on inherent tensions in our mission and helped launch a number of important conversations about priorities. One trade-off is finding a middle ground between the desire to move quickly in developing innovative ideas and the desire to protect the quality of our existing residential education system. One approach that the faculty committees have taken is to approve curricular experiments, while seeking data to help understand different classroom experiences and outcomes.

*MITx* is driving important conversations about how we can improve residential education, and at the same time reach more learners across the world. Here there is a real opportunity for faculty to join the conversation. Everyone recognizes the promise and potential of lifelong learning, but how do we match our aspiration to provide broad access to education with the resources required to do so? How can new digital tools benefit our residential educational system? Is there an opportunity to rethink the structure of our programs, for example, by making them more modular, and if so, what does modularity really mean? In short, we need to continue developing the business case for online education and find the right fit with our residential system.

### **Campus Planning and Capital Renewal**

A second issue that has topped the faculty governance agenda is campus planning. Here again, I think a lot of progress has been made. The new faculty Committee on Campus Planning was stood up this past fall, and despite an inherently steep curve in getting up to speed, they have done important work in informing themselves about the many capital projects in progress and planned throughout the campus, and the issues raised by those projects. The members of the committee

If there is one issue on my list that would benefit from greater faculty involvement, residential culture would be it. From sexual misconduct to mental health to housing policy, student life has been an increasingly visible topic of conversation on campus.

also serve on other standing and ad hoc committees, such as the Building Committee and the West Campus Study Steering Committee. Their role is to serve as a point of contact for anyone with questions or concerns and to ensure that faculty perspectives are heard before decisions are made. The committee has taken this charge very seriously and has been actively reaching out to hear from stakeholders.

On a related point, I think many faculty will agree that there has been significant progress in addressing capital renewal needs. MIT has for many years deferred maintenance on its buildings, and the results are apparent to anyone walking through campus. In the last few years, the administration has formulated a plan for reducing the levels of deferred maintenance, and has allocated significant resources for the repair and renewal of our physical plant. By next year, MIT will have completed the renovation and renewal of Building E52 (Economics) and Building 2 (Mathematics), as well as the landmark Kresge Auditorium and MIT Chapel. The renovation of Building 2 is especially significant, as it marks the

beginning of the renovation of MIT's Main Group, the historic buildings built 100 years ago when MIT moved from Boston to Cambridge.

In the longer term, work on the MIT.nano building has begun with the demolition of Building 12. Less visible are the numerous upgrades to the utilities infrastructure that will support MIT.nano and the rest of the MIT campus. MIT also has ambitious plans for the renewal of the East Campus area and Kendall Square, and for new dormitory space for both undergraduate and graduate students.

There will certainly be many changes to campus during the term of the next Chair of the Faculty, and no doubt some disruption due to construction as well.

### **Student Life Issues**

If there is one issue on my list that would benefit from greater faculty involvement, residential culture would be it. From sexual misconduct to mental health to housing policy, student life has been an increasingly visible topic of conversation on campus.

MIT's unique residential culture forces us to make daily choices in how we manage competing values. For example, how do we balance autonomy of living groups with the need for discipline and safety? What is the right balance between making our residences welcoming and inclusive versus encouraging and allowing freedom of expression? Between individual choice and diversity? The debate around these issues is sometimes framed as issues of communication and transparency. I would argue that the central points of disagreement among students,

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**Reflections on My Time as Faculty Chair**  
Hall, from preceding page

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faculty, and the administration are not around communication and process, but around values, and the choices that those values imply. To take one small example, in the last two years, MIT has substantially increased security in the dorms. As a housemaster, I no longer find people who don't belong in Simmons Hall wandering its corridors, and I believe that our students are safer as a result. On the other hand, students miss the ability to spontaneously visit a friend in another dorm without signing in. No one is opposed to safety and security, or freedom and spontaneity, but people naturally may place higher emphasis on one or the other. If we

as faculty think that the magic of MIT is partly about learning outside the classroom, then we should all be concerned with the experience of students in our residences, and there is an opportunity for the faculty to help define that experience through shared principles and values.

On all these issues (online learning, campus planning, student life), it is difficult to imagine that conversations could be managed by the administration or the Corporation alone. All three are fundamental to the academic mission of MIT and will require the serious participation of faculty and students.

**Thanks!**

In closing, I would like to wish my successor, Professor Krishna Rajagopal of

Physics, all the best for the next two years. I would also like to offer my deepest thanks to my fellow officers, Associate Chair John Belcher and Secretary JoAnne Yates, and also to Lynsey Fitzpatrick, the Faculty Governance Administrator. Most of the work of faculty governance is done through faculty committees, and I've been especially fortunate to have had an extraordinarily good set of faculty chairs. Nearly every person I've asked to join or chair a committee has agreed to do so, and I've been enormously grateful to work with a faculty that cares so deeply about governance issues. ■

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**Steven Hall** is a Professor in the Department of Aeronautics and Astronautics and Faculty Chair ([srhall@mit.edu](mailto:srhall@mit.edu)).

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## Krishna Rajagopal New Faculty Chair

Newsletter Staff



**KRISHNA RAJAGOPAL**, Professor of Physics, will become Chair of the Faculty on July 1, 2015 after serving as Chair-Elect for the past year. He has been learning the ropes from the current Chair, Steve Hall, whose example he sees as setting a high bar. Joining Krishna as faculty officers this summer will be Leslie Kolodziejski, Professor of Electrical Engineering and Computer Science (Associate Chair) and Chris Capozzola, Professor of History (Secretary).

Krishna grew up in suburban Toronto; his family moved there from Munich when he was less than a year old. His mother and father, who taught at different

Toronto universities, are originally from Germany and India. Influenced by an outstanding teacher who brought pioneering advances in recombinant DNA and molecular biology into his public high school biology class, Krishna arrived at Queen's University in Kingston, Ontario planning to major in biology. His freshman physics class rekindled his earlier interest in physics. He much appreciates the formative educational influences that shaped his own experience. He graduated from Queen's in 1988 and completed his PhD at Princeton in 1993. After stints as a Junior Fellow at Harvard and a Fairchild Fellow at Caltech he joined the MIT

faculty in 1997. He was elected a Fellow of the American Physical Society in 2004. Krishna has spent one year each at UC Berkeley and at CERN, the physics laboratory outside Geneva, Switzerland.

Krishna is a theoretical physicist who asks how the quarks that in ordinary matter are found confined within protons and neutrons behave in extraordinary conditions, conditions that provide a testbed for understanding how a complex world can emerge from simple underlying laws. His work links nuclear and particle physics, condensed matter physics, astrophysics, and string theory. Experiments that recreate droplets of the trillions-of-degrees-hot matter that filled the microseconds-old universe show that it is an almost ideal liquid, nothing like the gas of quarks that was originally anticipated. Krishna analyzes the properties of this hot quark soup, by seeing how they emerge from the elementary forces between quarks and via repurposing techniques from string theory to understand how hot quark soup is created and probed in high energy collisions, the subject of his recently completed first book. He is the author of about 100 papers and has mentored more than two-dozen PhD students and postdocs. Krishna's work has also illuminated the cold, dense, quark matter that may lie at the centers of neutron stars, showing that matter at the highest densities imaginable is a transparent superconductor. Krishna has made predictions for the phase diagram of quark matter, hot and cold, and has helped to define the experimental program that is currently mapping it.

Krishna was named a Margaret MacVicar Faculty Fellow in 2010 and won the Baker Award for Excellence in Undergraduate Education in 2011. All of his classroom teaching has been at the freshman, sophomore, or junior level. He has taught quantum mechanics, relativity, thermodynamics, and statistical mechanics and is currently teaching freshman

and junior lab, as well as the first Open Online Courses on intermediate quantum mechanics at a level suitable for MIT juniors and advanced quantum field theory at a level suitable for second- and third-year theoretical physics PhD students.

What Krishna has most valued about his Institute service, for example as the

Krishna is a theoretical physicist who asks how the quarks that in ordinary matter are found confined within protons and neutrons behave in extraordinary conditions, conditions that provide a testbed for understanding how a complex world can emerge from simple underlying laws. His work links nuclear and particle physics, condensed matter physics, astrophysics, and string theory.

electricity and magnetism. What he most enjoys is opening students' eyes, for the first time, to powerful and far-reaching ways of understanding the natural and technological world around them.

Until this past January, Krishna was the Associate Head for Education in the Department of Physics, responsible for the stewardship of all of its educational efforts, from the freshman level through to the PhD, helping his departmental colleagues and students to optimize the use of their talents and to realize their educational goals. He has facilitated and supported new *MITx*-enabled activities within the Department of Physics. These included efforts that have improved the on-campus teaching of freshman physics

chair of the Committee on Academic Performance and as a member of a number of *ad hoc* committees, has been the people he has met; the staff, students and faculty whose character knits our community together and makes MIT MIT. He looks forward to getting to know, and help, many more in the coming two years.

Krishna lives in Arlington with his wife, Dana Ansel, who was for many years the Research Director at the Massachusetts Institute for a New Commonwealth (MassINC) and is now an education policy research consultant, and with their two sons, who will be in 5th and 7th grade this fall. ■

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**Is Research the Soul of MIT?**

Eagar, from page 1

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*nology, and other areas of scholarship that will best serve the nation and the world . . .”*

“Research” doesn’t appear in this mission. This is a mission statement that I can endorse. Education of students, post-docs, other faculty and professionals is the soul of MIT. Research may be a by-product of MIT’s educational mission, but it is not its “soul.”

As I read further in *MIT Facts 2015*, “For more than 150 years, the Institute has married teaching with engineering and scientific studies . . .” Again, this is a statement with which I can agree; this is not a marriage of education and research. Reading further, the booklet listed 15 examples of MIT research, some dating back as far as Doc Edgerton’s invention of the stroboscope in the 1930s or engineering of radar during World War II. About a third were singular MIT breakthroughs, but the rest were a rehash of recent *MIT Press* news articles, the long-term consequence of which is unproven. Even the cover of the *MIT Facts* booklet, given as a first impression to visitors, failed to impress me as an MIT “lifer.” The cover consists of the imprint of the soles of two hiking boots with two more on the back. Of all the images that might symbolize MIT’s significant contributions to society, I cannot fathom how hiking boots convey the message of MIT.

Many of us believe that the essence of MIT consists of the faculty and the students. When asked about his steel empire, Andrew Carnegie said, “Take away my people, but leave my factories, and soon grass will grow on the factory floors. Take away my factories, but leave my people, and soon we will have a new and better factory.” So it is with MIT. The columns and dome of Building 10 are a worldwide symbol for excellence in engineering, science, and a number of other disciplines, but this building by itself is merely a mass of sandstone slowly eroding in acid rain.

As a new faculty member in 1976, there were none of the generous startup packages given to junior faculty today. I used to say “MIT gives you a desk, a local phone [individual faculty had to pay their long distance phone bills until the 1990s when the Internet made long distance phone calls inexpensive], and the MIT name. The only one of value is the MIT name and our job is to make sure we leave the MIT reputation stronger than when we came.”

Up to the mid-1970s in my department (Course III, Materials Science and

There were no word processors for faculty in 1976 and personal computers had not been invented. I would handwrite a letter, walk it over to Cathy, my secretary a few buildings away, and wait a week for her to type it. (I was third priority behind two more senior faculty.)

Engineering), new faculty were expected to work with a senior faculty mentor, who would provide laboratory space, a few graduate students to supervise, some research funds and the opportunity to help teach the senior faculty member’s subjects and write joint proposals. In their spare time, the junior faculty members were expected to develop their own subjects, write their own proposals, and establish independence from their mentor before the beginning of the tenure decision process six years later. I saw it as a feudal system and I elected to start as an independent rather than a serf. As a result, I had no research money, no students, and no laboratory my first year as a faculty member. I concentrated on teaching and writing proposals.

I was also assigned 25 percent of a secretary located on the fifth floor of Building 13, while I shared Room 8-137 (the short door just off the Infinite Corridor) with a few graduate students. There were no word processors for faculty in 1976 and personal computers had not been invented. I would handwrite a letter, walk it over to Cathy, my secretary a few buildings away, and wait a week for her to

type it. (I was third priority behind two more senior faculty.)

In the fall of the first year, Cathy brought one of my letters for me to sign. She asked what research account number she should use to purchase the stamps. I had none. Maybe this is what the *MIT Facts* booklet means when it says, “*The soul of MIT is research.*”; without an account number you could (and can) do nothing.

I immediately went to my Department Head, Professor Walter Owen, to ask how I would get funding to pay for my long

distance phone bills. Walter said, “We’ll give you an advance on your ILP (Industrial Liaison Program) funds,” which I had not yet accumulated.

Unimpressed with Walter’s response, I crossed the suite of offices to see our Department Administrative Officer, Joe Dhosi. Posing a new question so as not to be playing one person’s negative answer against another, I said “Joe, Cathy says she needs an account number to buy stamps for me.” Joe responded, “Why don’t you ask some of the other secretaries if they will give you some stamps?”

Feeling discouraged but knowing that Professor Mert Flemings was the senior mentor that everyone expected me to assist, I walked up to Mert’s office on the fourth floor. I told Mert that I did not have an account number to copy my proposals. Mert hemmed and hawed a bit, but then said, “I’ll give you an account number but let me know if you spend more than fifty dollars.”

Today, most people would consider this incredible, but it is most assuredly accurate. I returned to my office, sat at my desk, clasped my hands together and said to myself, “So this is what it means to be

an assistant professor at MIT – it's sink or swim!" I determined that I would strive to swim, but I promised myself that if I was successful, I would make sure that no other junior faculty member would go through what I was experiencing.

The first opportunity came two years later when Professor Don Sadoway was hired. Don had come from the University of Toronto and did not know the culture of junior faculty support in our department. Don was given the desk, the local phone and the MIT name, but Don wanted a credenza for his office and the department said no. Don came to me since I had been mentoring him on navigating MIT. Always ready to teach with a story, I told Don about my \$50 first-year budget. After two years I now had three research contracts and grants from the Office of Naval Research, the DoE Office of Basic Energy Sciences and the NSF, but none of these accounts would permit purchase of office furniture. Don said the credenza cost \$200 and I agreed to buy it from the \$600 I had in my ILP account. There have been ample opportunities over the past 37 years to assist junior faculty, and the Institute has progressed beyond refusing stamps and credenzas. Mentoring has improved greatly but it could still be better.

A few years later I had another opportunity to learn about research funding. Robert Seamans was the Dean of Engineering and he decided it would be helpful to meet with all of the untenured faculty in the School. About 30 or 40 of us had lunch with the Dean and Associate Deans at the Faculty Club. At the end of the meal Bob Seamans stood and expressed his appreciation for all of us. Then he announced he had to leave for the airport and his Associates could answer any questions.

One of the first questions was "How important is research funding in the tenure decision?" It should be noted that for my first 15 years on the faculty, all faculty, senior or junior, except those who had gone into administration, were expected to pay 50 percent of their academic year salary plus benefits and over-

head from research, and if there was something left over you could pay two months of summer salary.

All of the faculty, but especially the junior faculty, found that a tremendous burden. It was no burden at all for the administration. These faculty were paid for 12 months with no research funding requirement.

The response from the Associate Dean was "I have never heard the question of research funding come up in a tenure decision at Engineering Council." Several junior faculty tried to clarify because they could not believe their ears. We were always under pressure to "help" the department budget by paying more of our academic year salary.

The response from the Associate Dean was "I have never heard the question of research funding come up in a tenure decision at Engineering Council." Several junior faculty tried to clarify because they could not believe their ears. We were always under pressure to "help" the department budget by paying more of our academic year salary. The Deans were adamant; research funding was never a topic of discussion. The dining room was in an uproar of incredulity. I leaned over to the junior faculty member next to me and said "That's because if you do not have a lot of funding, your tenure case will never get out of your department for Engineering Council to discuss!"

Fortunately, MIT saw the handwriting from NSF and Congress and hardened academic year salaries in the 1990s. As hard as it is for junior faculty to secure funds for basic research today, the pressures of the 1960s, 1970s and 1980s were merely of a different sort. Today there are huge resources for applied research from non-governmental sources. Junior faculty have to do some basic research with these funds while also working on applied problems. Frankly, that was always my approach to receiving 80 percent of my funding from basic research agencies of the government. They wanted basic

research that had an opportunity to be applied. The funding pendulum swings over the decades.

But this history begs the question of whether research is the soul of MIT. Going back further in time to pre-WWII, research was not the soul of MIT. Review of the research funding or its corollary, number of graduate students and post-

docs, indicates that the research emphasis was nearly non-existent prior to WWII (and later Sputnik).

As a Department Head and Center Director serving on Engineering Council for over a decade, I always knew that Deans Gerry Wilson and Joel Moses understood the primacy of the educational mission. Budgets were determined by numbers of undergraduate students taught, and not by research funds accumulated nor graduate student/post-doc population. Faculty considered for promotion were judged in part on the number of student theses supervised and not on the amount of research funding. The graduate student-to-post-doc ratio had to be greater than one and preferably two to three.

When I read that "*The soul of MIT is research*" I must correct this misconception. The soul of MIT relates to education and knowledge creation. Research is merely a by-product of the "*marriage of teaching with engineering and scientific studies.*" Research can be beneficial or harmful depending on how we manage it; it is not our soul. ■

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**Thomas W. Eagar** is a Professor of Materials Engineering and Engineering Management ([twearag@mit.edu](mailto:twearag@mit.edu)).

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education than there is today. I think the proliferation of MOOCs has developed over the last two years, but the fear has subsided a bit. I can't exactly explain why that is.

*FNL: What do you think of MOOCs?*

**RM:** I myself have taken a MOOC and completed the course, and I have a certificate to prove it! It was Eric Lander's [MIT biology professor] course. So I have great respect for the power of the method. Ultimately, it's a very effective, new type of textbook. But I don't think it replaces the actual experience of being in class among cohorts.

I believe there are a lot of people who feel they instantly understand what it's like to learn through a MOOC, who've never taken a MOOC. And although I think they largely get it, there are some subtleties you don't get until you've tried it, until you've really done it yourself.

*FNL: What type of subtleties?*

**RM:** One thing is that quality really matters. It's hard to devote yourself to that kind of an investment of time and effort, if the course lacks quality.

I understand that most of the people who take MOOCs are older than college age. That might have been a little surprising to some people.

When I took the MOOC, I was surprised at how easy it was, compared to trying to learn the material on my own. One doesn't realize how easy college is compared to the real world; how neatly and efficiently things that you need to learn are laid out. But having a professor and being among classmates has immeasurable value.

*FNL: It's hard to quantify.*

**RM:** It is. So the idea that MOOCs are going to replace college, because it makes the knowledge more available and it's free, is just not correct. The information was always available and it was always free. All you had to do was go to the public library and sit there, because there's nothing, at

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least as an undergraduate, that you learned at MIT that you couldn't have learned by sitting by yourself in a public library. So a good MOOC can replicate a classroom in many respects, but it can't replicate the residential college experience.

I don't think anybody has ever said that MITx is the future of higher education. It has a role and that role, for our students, for example, is a way of supplementing their course work.

*FNL: Let's cycle back. You talked about the importance of quality. Let's talk about the financial model. That course that you took was in the Biology Department, and so the development of it was reported.*

*One of the things they reported early on is that it was much more expensive than had been planned. It wasn't in the Biology Department teaching budget. And Professor Lander used his private funds to supplement the course. But there aren't that many professors around to do that. So what's your sense of the financial model going forward? There's not tuition being collected, etc.*

**RM:** I don't think there was ever really a financial model when we started MITx or OCW [OpenCourseWare]. Everything we

do here at MIT, and at other schools like our own, is a money loser. Well, perhaps not a complete money loser, or otherwise we'd all go bankrupt!

So money is a factor, but it's never been the primary motivator. When we started

MITx, and I was there at the beginning, there was no revenue model. No one sat down with a spreadsheet to say, well, this is how much we invested in this and this is what we're going to make and this is where we're going and this is the breakeven point. No one ever said that.

What people did say, is look, this is part of the future, this technology exists, it's going to happen with us or without us. And indeed it was. Actually, we were not first out of the gate. I think Coursera was. Maybe Udacity. And either we can choose to try to lead this, or just ignore it. We made the right decision to be part of the initial development.

But what is unique, is that we were the only people who did it as a not-for-profit. And that added quality and substance to the experience. I'm proud of MIT for having done this. We never had a revenue model. There was always a supposition that at some point in the future there'd be some way to potentially recoup our costs, but we viewed it as a pure expense.

*FNL: But MITx is much more expensive than OCW. All the interactive components, videos, etc. make it a much more costly product. And faculty recognize that it both*

*costs a lot of money and takes a lot of time. So they ask where is the money going to come from? Regardless of the percentage of the overall education that MITx might ultimately evolve into, where is the time going to come from? Are we going to hire more faculty? Are we going to hire people to work with faculty to do MITx?*

**RM:** I'm not sure you're asking the right person those questions. As I understand it, faculty are invited to participate in this experience, not compelled to. So various departments, various disciplines, have been variously enthusiastic about this, and have approached it from a variety of ways.

**FNL:** *Do you think there is a "grand plan" for how we're going to proceed?*

**RM:** I haven't heard of a grand plan.

**FNL:** *On a somewhat related issue, for a long time the Humanities faculty here have felt very separate from the science and technology and engineering people. And as part of MITx, a lot of feedback that we've gotten is that the whole concept of MITx seems to be geared and works well with science and engineering courses and not so well with humanities courses. Do you have any thoughts about that?*

**RM:** I do. Obviously there are courses where an online format simply doesn't work. If you're going to have a big vocal screaming argument about what Plato really meant, I don't think a MOOC works. And there are some courses, not necessarily all taught here, which are ideally suited to online teaching: music courses, theory courses, because you can actually hear, you can have instant feedback. So I think there's some validity to it and there's some not. I think it goes both ways.

And as far as science versus the arts goes, there are a lot of people in history who thought that the one can't do without the other. I mean, what's the point of all this unless we express our humanity? And cer-

tainly no inquiry, no scientific inquiry into the human condition, into how humans work, is complete without some understanding of the humanities. There's a beauty and a grace in science and in engineering, and science excites me in the same way that the arts do. You know I have an architecture degree. Music and architecture. Am I being too romantic?

**FNL:** *So to sum up MITx...?*

**RM:** It's always going to be sort of an add-on here. It's never going to replace the residential university.

**FNL:** *Let's move on. Over the last decade and more MIT has collaborated with several other countries to form research programs, etc. There's Singapore, Russia, Abu Dhabi, to name just three. This is a dramatic change from the Cold War days. What are your thoughts on these international collaborations? Are they discussed at the Corporation meetings?*

**RM:** These collaborations are definitely discussed at Corporation meetings. And there have been varying degrees of success. The Skolkovo Institute [in Russia] has been a work in progress. You know, I wasn't around here five years after MIT was founded, but maybe people were saying the same thing about MIT back then.

Singapore is more mature; we've been there 20 years now. And I want to be clear that nowhere are we trying to create another MIT with the Institute's name. We all agree, everybody agrees, especially the Corporation, that the MIT brand should never be diluted or imperiled.

To have international engagements seems reasonable. The world's a big place. It used to not be quite as big. And we distinguish – and I'm sure the faculty does as well – between educational endeavor and research endeavor. So we do research in a lot of different places, funded by a lot of different sources. Some foreign, some government, some philanthropic. So, it's

MIT research, and I don't think we are ever that sensitive about letting people say that they are paying for our research.

But we have not set up a residential educational institute anywhere else. Those are just the facts, as I understand them. We are not granting MIT degrees anywhere else in the world. We are, however, doing MIT research at other places in the world. So, with that distinction in mind, as to whether or not we should, someday, extend our education reach beyond Cambridge, MA, that's a question more for the faculty and administration. Is that a down payment on the answer?

**FNL:** *It is.*

**RM:** This is what I did say to the Corporation: After World War II, which is basically when MIT really got going, the United States had 50% of the world's GDP. And in terms of the kind of GDP that you need in order to sustain the sorts of things we do at MIT, like a disposable sort of advanced GDP, we were probably three-quarters of the world's GDP.

There are certain things you can track linearly to the GDP of a country. Basically what a country can afford, like its defense budget or its R&D budget. And our government was incredibly enlightened in making a major investment in research. But it was also a function of the fact that we could afford it. The rest of the world simply couldn't. So, our international strategy after WWII was just to be in America. And in particular, this was true for MIT, because what we were doing was what the world needed, because the world had turned scientific and technological.

So we were in the perfect place at the perfect time, and this was the perfect institution to take advantage of that. But today, you wake up and the U.S. is 23% of the world's GDP. And it's going down. Our GDP is still growing, but the rest of the world is growing faster. So for us to

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have an effective monopoly now is just not going to happen.

Back when we were young, even though we were 50% of the world's GDP, we were getting an even greater share of the world's talent. Our grad students would come from all over the world, and then they would stay here. Now, the world's changed. There's a middle-class in most of these countries, and the grad students are returning to their own countries. If you think of it as a market share exercise, we have a big headwind, whereas before we had a tailwind. Now, I think that's an international strategy question and this Institute would be very remiss not to carefully consider what the implications of these incontrovertible facts will be over the next 50 or 100 years.

**FNL:** *We hear concern from some faculty that these international collaborations are financially based versus research based, or intellectually based, or humanities based.*

**RM:** I don't believe that. I think they are grounded in research. There is some financial component that flows through the Institute to compensate the Institute for the allocation of resources – for both time and attention.

There are a lot of places in the world that would love to have MIT be present and sprinkle a little bit of our magic dust on them, so they can say they are keeping pace with MIT and that we are attracted to them. But the thing that attracts us is research dollars.

If the NSF gives a faculty member research dollars to go study something on top of a mountain, then I guess we might do that. And if someone gives us research dollars to study something in Singapore, I don't see that as a whole lot different.

There's a structural component where we have been helpful to others from manage-

rial and organizational points of view. And for that we've been paid beyond the price tag on the sponsored research. That is logical and consistent. We've not sold our brand to anyone. I don't think we've had to do that.

**FNL:** *A question we were asked to submit to you is what do you think can be done about the extent of rape and sexual assault on campuses – MIT as well as well as others? How can undergraduate women be protected?*

**RM:** Men and women are no different than they've been for perhaps the last 3000 years. So whatever is causing this problem has been around for an awfully long time. But we're doing a lot more now than we've ever done before. I do think we're hearing more about it, which is a good thing, and part of the solution and, thus, doing more about it.

We've done a lot on this campus. We had the study on sexual assault. We were leaders in this. We got high marks from it, we've been open, we've been honest. We're doing, frankly, what we should be doing. And we did discuss this seriously at the Corporation.

**FNL:** *It's important for people to hear that the Corporation is concerned and discusses it.*

**RM:** And, as usual, that MIT is handling things well, handling things objectively. Openly. Without emotional overreactions. We've done better than some other universities in this general area.

**FNL:** *How about if we talk about campus planning – MITIMCo [MIT Investment Management Company], graduate student housing, etc.*

**RM:** That is something I can be more specific about.

**FNL:** *Although it may not be exactly accurate, we had gotten the impression during Susan Hockfield's administration that in essence the campus planning functions got turned over to MITIMCo. At least that's*

*how faculty heard it. The Institute used to have a Planning Office that was abolished in 2000, and it seemed that all of their functions were reassigned to MITIMCo.*

*We do finally have a faculty campus planning committee, and it was quite a battle to get it as a standing committee of the faculty. It's a committee that every other major university in the United States has as a standing committee of the faculty – campus planning. There was a lot of resistance.*

*And perhaps the major issue among graduate students and post-docs is the issue of housing. It's absolutely a systematic theme at MIT. As the rentals have gone up, and the Novartis and Pfizers and the Googles have moved in, they price out the grad students. It's one of the most common coffee table gossip among graduate students, when your landlord says you have to move out, what about your lease, somebody else had to move in, etc. So, this decision, the decision about graduate housing on the campus, that such an important decision should be made by MITIMCo. . . .*

**RM:** OK. So, first of all, I have been reading the *Faculty Newsletter*, and I think that it's served a very useful, invaluable purpose, and I'm not just being patronizing. It has illuminated, articulated, the issues that you just described.

But some of the things I read in the *Faculty Newsletter* about campus planning are just simply wrong. And I'm happy to rigorously develop that, and perhaps offer a better understanding, which could be the most useful part of this discussion. And you know I've been involved in all parts of this.

So, first of all, MITIMCo is not running campus planning. And it never has. MITIMCo does have a lot of real estate, and it has a lot of expertise in how to build things and how to run real estate.

Campus planning is done by the administration, drawing on MITIMCo's expertise. I know all these people well. MITIMCo

has never been confused about the goals of campus planning. I think they've been accused of things, which are just wrong.

I don't think the administration was as clear as it could have been. And the *Faculty Newsletter* was useful in getting that controversy out. And hopefully, it's in a better place now.

OK. So which branch should we go down? In terms of graduate student housing, last spring the Graduate Student Housing Working Group, led by Phil Clay, published their report. And probably as a consequence of that report, 270 net new graduate student housing units are being constructed as part of the most recent plan.

There is a temptation to dwell upon what people think is a cultural divide between MITIMCo and MIT...that one is a profit-seeking enterprise and the other is a do-good kind of place; that one group wears black hats and the other wears white hats; good guys and bad guys. And that is naïve, simplistic, and frankly counterproductive.

There is no confusion at MITIMCo. I know these people, and I chaired this Corporation committee and there is no confusion at MITIMCo about whom they're working for, and what the object of their mission is – it's this academic/research enterprise. There is no confusion about that. There isn't a person at MITIMCo who couldn't make more money going to work in the private sector. That's just a fact.

And it's also a fact that our 30-year returns through MITIMCo – and it doesn't matter whether you look at one year, three years, 10 years, or 30 years – our 30-year returns have been 12.9%. And a portfolio of the traditional 60/40 model that a university would use, has been 10.4%.

Among the 150 or so universities to which we're compared, we've been in the 99th percentile for the last three years in terms of return, and in the 98th percentile over the past 10 years. These are facts.

So when you talk about the quality of those people, every one of them could get a job making more money, but they're all here because they love MIT and they believe in this mission. And frankly I'm very sympathetic to that, because I gave up my career doing stuff like that to come do this. Because I love this, and I think this is what's saving the world; this changes the world. And I think they feel that too. And to sometimes be painted with a brush that suggests that they're these evil, money-grubbing people is just terrible.

My worst fear, during all the controversy about Kendall Square, was that they were just going to leave because, as they say, no good deed goes unpunished, and they were certainly getting the punishment. And as loyal to MIT as they are, they were really hurting.

*FNL: That's a very interesting notion that they were feeling bad; no one has ever presented that perspective before.*

**RM:** They really were hurt.

*FNL: I can believe that.*

**RM:** So, there's no black hats/white hats thing. Now, getting back to campus planning: I remember the first time this MIT 2030 plan was laid out. It started with what were our long-term projected academic needs, in terms of square feet. The all-day discussion concluded that MIT's growth was geometric and they came up with a range of projections about how much academic space we'd need on this campus for the next 100 years. I believe it was a 100-year projection.

That was the beginning point of the conversation. We will take the upper bound of what we could conceivably need over the next 100 years, and make sure that whatever we do, we have that capacity.

*FNL: How does that connect with MIT's real estate holdings?*

**RM:** Well we've got this other real estate, which we have wisely assembled over the years from a lot of adjacent, largely derelict properties. And what should we do with it? One of these miraculous virtuous circles that you occasionally see is this MITIMCo real estate/academic thing that we've been doing. And it's been going on for a long time. One of the smartest things I ever heard in real estate, is that real estate next to you is worth more to you than to someone else. Well, so it was to MIT.

So, wisely, MIT, before we got here, bought up real estate for more than enough of its future academic needs. And some of the leftover real estate was developed in a way that was consonant with our academic mission. They didn't let someone open a Walmart or something like that. And we retain ownership of the underlying land. We still own the lease. We still own the real estate underneath.

For example, this Novartis building that's getting built has a 60-year lease. They're putting in a better part of a billion dollars to build their world research headquarters there. Yes, it will compete for some housing and some secretaries and some other support service. But the reason they're doing it, and paying us a lot of money for the land, is to be near us.

I mean, Walmart wouldn't pay us. So, as it turns out, the highest and best use for this excess real estate is for people who want to be near us. And you know, MIT has embraced this industry/academic connection like few others in the world. It's sort of how MIT started 150 years ago, by partnering in industrial research, being a dimension of industry when a lot of other universities treat companies as the enemy.

So, we've leased land to people who've built some buildings and some of them may be beautiful, but we eventually get them back in 60 years. And meanwhile, they're occupied by people who are somehow contributing, I think, to our

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enterprise, or as I said, are consonant. And they're making the neighborhood nicer.

To me, it's this virtuous circle. But it's always been the academic institution first. And no one at MITIMCo has ever proposed putting a tenant in or using a piece of real estate for a commercial purpose that the administration didn't want to.

**FNL:** *You're obviously very knowledgeable about real estate, and we don't disagree with anything you said. On the other hand, if you're one of the 4500 graduate students who has to find housing off campus, the consequence of what you've described is now you have to commute from Everett or Somerville or Medford, because you can't possibly compete with Novartis and Pfizer and Google. So the fact of the matter, is they are spending more time commuting, often they can't afford a car, and it can be quite difficult.*

*And so the whole reason, of course, that Novartis and Pfizer want to be here is because of all these talented, hardworking grad students and postdoctoral fellows. And it's a fact that the lives of graduate students are being made more difficult. They are not benefitting from what you just described. They are seeing a reduction in their quality of life in order that MIT can grow in this way. And there is enough land there that MIT could build on. The Clay Commission actually calls for 1000 units; 600 new and 400 swing. And to many graduate students it feels like the burden of the growth has been put on their backs. That's what it feels like to many.*

*They don't see any benefits from Novartis or Pfizer. A few of them might get employed, but for most of them finding a place to live is absolutely key, and they need to be close to campus, so they can be productive. And we have never heard MITIMCo express a scintilla of concern about those graduate students.*

*It's always going to be a cost plus operation. A subsidy in some way. So, we have never known anybody in MITIMCo to show any understanding of the life of people who have to work in a laboratory, getting things done maybe late at night, seven days a week.*

**RM:** I certainly understand the thrust of your concern. We have close to 7,000 graduate students here, even more graduate students than undergraduates. And it's the graduate students who make the research possible. It's the research that makes MIT possible. So, I get that. I'm not arguing with that at all. But MITIMCo does not decide how to spend, it does not decide the academic priorities that the administration administers.

**FNL:** *So there used to be a Planning Office. It got abolished. So who makes those decisions now?*

**RM:** You mean, a real estate planning office?

**FNL:** *Yes. It was abolished. Now there is a committee consisting of members of the high-level administration. So if MITIMCo doesn't make those decisions, who does? Does the Corporation?*

**RM:** No, the Corporation does not make those decisions. The administration makes those decisions. And I can't tell you what office. I know there's a building committee. I don't know who gets to decide whether we should have a Collier memorial or if we should have more graduate student housing, or should we restore Kresge Auditorium. But the administration does that, not the Corporation. And I think that you, as faculty, need to engage with the administration.

**FNL:** *But it is a little odd. I mean, MITIMCo is an institutional form that the faculty have no relationship with or oversight of, as it should be. But they do think that decisions about housing are absolutely something that the faculty should be centrally involved in. And we would say that in the four years of discussions that we've been*

*in concerning these things, you're the first person who said that the MITIMCo people were not making those decisions. Because what we generally were told was those are the people who know how to use the campus real estate.*

**RM:** So consider the current Kendall Square project. There are some academic buildings in there, and there's some commercial stuff in there. And the academic stuff is not going to be owned and run by MITIMCo.

**FNL:** *Right.*

**RM:** There is going to be a proper accounting from the endowment to the university. And the university has to put up the money to build its portion of that. MITIMCo does what it's supposed to be doing, which is making money off of the investments. It's not investing in the academic plant.

**FNL:** *So, MITIMCo doesn't say it's a 20-year lease, it's a 40-year lease, it's a 60-year lease. The MIT administration makes that decision.*

**RM:** No, I wouldn't say it's that black and white. Like with Novartis. The Corporation and the administration and MITIMCo decided that was best served going to a 60-year lease. So, I think that MITIMCo is acting in MIT's best interest at all times, trying to maximize whatever value can be created on MIT's behalf. But it is never making the decision.

**FNL:** *So, in terms of should something be rented, should we build a lab, should we build housing, should we build classrooms, should we upgrade 10-250 – all of those kinds of decisions are not made by the Corporation, they're made by the administration. And they may talk to MITIMCo about that, but . . .*

**RM:** No, let me be more precise about that. They will talk to MITIMCo to gain expertise. The decisions are proposed by the administration. The administration

sets the priorities, describes the priorities, and they then go to the Corporation Executive Committee, which acts for the Corporation.

Those decisions are proposed by the administration and approved by the Corporation via the Executive Committee. We do have serious discussions at the Executive Committee that reflect the academic priorities of the Institute, balanced against its resources. When they were planning the Nano Building, for example, we argued a lot of the points. There were three different versions, each going to cost in increments of 100 million dollars, more or less. We spent a lot of time on that. The Executive Committee approved the final decision.

**FNL:** *So, all those things are run by the Executive Committee.*

**RM:** Oh, absolutely. Every building project that's more than five or 10 million dollars.

**FNL:** *Moving on. What do you think about MIT divesting from fossil fuel companies?*

**RM:** Well, we have a campus conversation going on. *The Boston Globe* called me last night and asked me to comment on the fossil fuel divestment issue. I said as far as MIT's concerned, we have a very open, ongoing, campus conversation. There was a debate in Kresge about divestment, about what we should do, what the proper response is for MIT. So, we're engaged in that, and we don't have a position yet, because we're not finished with the conversation.

**FNL:** *Well said.*

**RM:** But they wanted to know my personal opinion. And I said, my opinion is a personal matter, and I wasn't hired to be chairman for my personal charm. They hired me for my inclusiveness. But I did say that I think it's unfortunate what's going on at Harvard. It's unfortunate, because this question about divestment is

being phrased in moral terms. And I don't think it's a morality issue. I haven't heard anybody, neither Harvard nor MIT, disagree with the importance of the issue.

The climate is changing. The science says that humans have contributed mightily to this. No one is denying that. We have a crisis on our hands that is perhaps one of the worst crises humanity's ever faced. No one's arguing with that. It's only about tactics.

And how can you impugn people's moral standing about a legitimate discussion about tactics? I think that's unfortunate. I said we don't have that yet, at least not at MIT. And I hope we never have that. I think we've gone to great lengths to include everybody, to consider it, to be open. And we'll make some decisions.

I think the word divestment is a simple word. I think divesting from a big endowment is not simple – you don't just press the divestment button and it happens. What I find lacking from all of the conversations, including from our own debate in Kresge Auditorium, is any discussion about the practical aspects of it: the cost, the time, the tradeoffs. So I think we need more work on that.

**FNL:** *Ultimately, assuming petitions, faculty in favor of, votes, whatever it is, will the Corporation decide whether or not to do anything relative to divestment?*

**RM:** The first line of decision-making, as with most things, is the administration. I don't think the Corporation decides these things on its own and then imposes it upon the administration. There'll be the usual train of progression of decision-making. The administration, working with the Executive Committee – and we discuss it at every Executive Committee meeting. We've discussed it at great length.

**FNL:** *There does seem to be an attempt to get some kind of consensus, if there is a consensus. And we think the faculty may be surveyed about it.*

**RM:** I would like to see a little bit more detailed discussion about the practicalities of divestment before the faculty. A little less of an emotional symbolism, and a little bit more of the practical part of it discussed. Although symbolism has value.

**FNL:** *It is being driven by the students. You know, it's not something that's coming from the faculty. It's driven from below.*

**RM:** I think both sides in the debate have acknowledged that it's only symbolic. That it's not likely to have a practical effect.

**FNL:** *In closing, is there any particular area about which the Executive Committee and the Corporation is interested in receiving input from the faculty?*

**RM:** I think that's a really, really great question. And I'd like to answer it now. But I'd also like to think about it a little bit more. Because I think it's a great question. First of all, from my perspective, it's an incredibly flattering invitation.

I've devoted the next big portion of my life to this job because I love what we do here. What we love, what we do here, is what the faculty does. And the students. But the faculty. So I have many friends on the faculty, and I have to say that if you ask me what, and I really, really mean this, if you ask me what's the best part of the job? Without a doubt, it's dealing with my faculty friends, with getting to know faculty.

One question I'd ask is what the faculty think about the size of our undergraduate population remaining basically the same for so many years.

**FNL:** *The world has grown, everything has grown, MIT is still the same size, and so some think that's a good thing, we should protect that. Other people think it's some kind of anomaly. Clearly there are more bright people out there than we thought*

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*there were. Why shouldn't the campus grow?*

**RM:** I think it's a great question. It's not for me to answer, but it's for me to ask. And I have asked.

**FNL:** *And the faculty is the same size, also. The undergraduates and the faculty are the same size, and the graduate students have grown almost exponentially.*

**RM:** I think the sizing question is not unrelated to the economics question. The economics question around here is what have we got here? We have a cost structure that rises disproportionately, because there are no gains in productivity the way there are in the rest of the economy.

So our cost structure rises faster than inflation. I'm not the only one who sees that, but I'm surprised at how few people understand it. It's just true. The world has gotten bigger, which means our competition has gotten bigger, or better, and more expensive. Which affects the cost structure yet again.

Research funding, which is what this place was really supercharged on, is flattening. We've got a lot of headwinds in a lot of different directions. So is this economic model sustainable long term? I think that's a faculty question.

**FNL:** *Thank you so much for allowing us to interview you for the Faculty Newsletter. I'm sure our colleagues will find it most interesting.*

**RM:** Thank you. The pleasure was all mine. ■

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## In Memoriam Professor Stephan Chorover

Jonathan King



**STEVE CHOROVER, WHO PASSED AWAY** on February 20 at age 82, was a founding member of the *MIT Faculty Newsletter*. Instrumental in the development of the Brain and Cognitive Science faculty, Steve was also one of the faculty leaders who pressed for the establishment of the

Program in Science, Technology and Society.

Steve was an astute observer of the social context of scientific and academic work, and of the human dimensions of those engaged. His book *From Genesis to Genocide*, which critiqued the import of pseudo-scientific determinism into social and political policy, was influential among the generation of biological and social scientists responding to the civil rights movement and resistance to the war in Vietnam.

Steve was very sensitive not only to the danger of authoritarian aspects of federal policies, but also their reflection within university administrations. He was one of the first senior faculty to voice opposition

to then-Provost John Deutch's termination of the Department of Applied Biological Science in 1988. This led to his participation in the establishment of the *Faculty Newsletter*.

Steve was unusually sympathetic and attuned to the personal concerns of students, faculty, and staff, and always brought this dimension into the discussions of the FNL Editorial Board. He was one of those rare faculty members, who, after inquiring how your research and teaching were going, inquired about how you were doing in general. He will be sorely missed by all who knew him. ■

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**Jonathan King** is a Professor in the Department of Biology and *MIT Faculty Newsletter* Chair ([jaking@mit.edu](mailto:jaking@mit.edu)).

## Launching a Next Generation Sustainability Framework at MIT

Julie Newman

**MIT FOSTERS A RICH** network of departments and initiatives working toward advancing sustainability on campus, locally, and around the world at all levels and scales. Students, staff, faculty, and a multitude of institutional and community-based partners collaborate across disciplines to discover innovative solutions that improve the well-being of people and the environment. Research related to sustainability spans the development of clean energy systems, to the optimization of urban food production, to the design of smart mobility systems.

Many of the urgent issues our students, researchers, and faculty are grappling with have relevancy to the day-to-day and long-term decision-making of a dense, urban campus defined by the Charles River and its ecosystem. This synergy among our education, research, and how we manage our campus operations has the potential to profoundly impact the sustainability of our campus and, in turn, systems throughout the world.

Building on the momentum of the past and with an influx of new partners and projects, it is an opportune moment at MIT to take sustainability innovation to scale on campus, locally, and beyond. We are now positioned to ask ourselves: How can MIT become a game-changing force for campus sustainability in the twenty-first century?

MIT has a history of prioritizing the sustainability of its buildings and the study, research, and implementation of transformative energy systems. The Campus Energy Taskforce and the MIT Energy Initiative (both established in

2006) and a commitment to constructing and renovating LEED (Leadership in Energy and Environmental Design) certified buildings on campus have set a strong foundation for current and future efforts. Most significantly, the Institute has embarked on the initial phases of a campus renewal program that will continue through 2030. Plans for renewal and expansion of the Central Utilities Plant align our campus energy generation, distribution, and building power usage in

tively move the global and national agendas forward” on effective climate change mitigation, thereby launching the MIT Conversation on Climate Change ([climatechange.mit.edu](http://climatechange.mit.edu)). At the city level, Cambridge is advancing toward building energy use disclosure, understanding net zero building emissions, exploring an EcoDistrict in Kendall Square, and climate action planning. The Office is now positioned as a connecting force in this network of sustainability-related initiatives.

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support of an ever-expanded mission – one that is “right-sized” to the natural resource constraints of a changing economy and climate and to the needs of a first-class research campus.

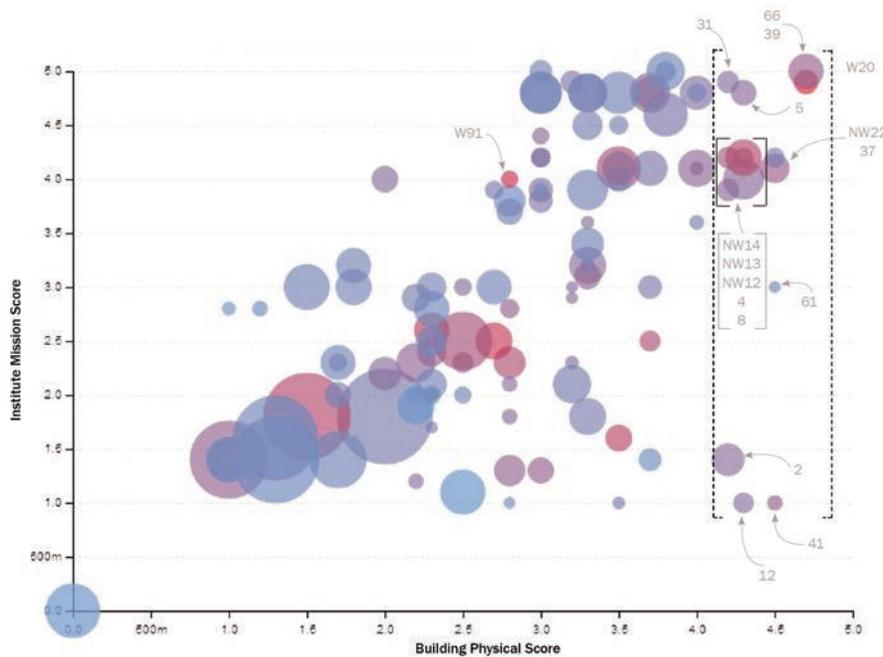
In the last two years, MIT has exponentially increased its capacity to drive sustainable solutions. The Office of Sustainability was established in the summer of 2013, followed by the MIT Environmental Solutions Initiative ([environmentalsolutions.mit.edu/contact-us](http://environmentalsolutions.mit.edu/contact-us)) that fall. A year later, President Reif called for an exploration into “how the MIT community – through education, research and campus engagement – can construc-

### Calling for a Next Generation Sustainability Framework at MIT

The creation of an Office of Sustainability, under the leadership of the Executive Vice President and Treasurer’s Office, has given MIT the unique opportunity to redefine the field of campus sustainability. MIT’s commitment to applied research, technology, and policy innovation combined with lessons from peer institutions, now enables us to frame a “next generation” approach to campus sustainability that moves the entire field forward.

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**Launching a Sustainability Framework**  
Newman, from preceding page



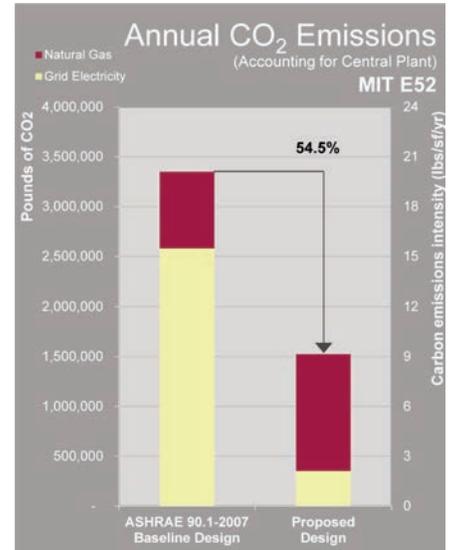
**Figure 1.** Students, faculty, and researchers collaborating with facilities project teams are gathering and analyzing building systems data. These metrics viewed through the lens of resource conservation will enable us to consider and establish renewal priorities. This graph shows building gross square footage correlated to academic mission relevance, and energy intensity, allowing teams to make decisions on future energy use and building updates at the intersection of performance and sustainability.

A core component of a next generation approach is the creation of a decision-making platform for the campus that is founded on systems thinking and powered by responsive, robust data and metrics. The interactions between human health, environmental quality, and fiscal responsibility, are increasingly complex. Even routine decisions become complicated when we take into account the interconnectedness of the systems that sustain us. How do our decisions about campus design impact the Charles River Watershed? What is the relationship between the materials that flow into campus via procurement systems and those that flow out via waste management? A commitment to sustainability allows us to consider near- and long-term fiscal, environmental, and human health impacts when making decisions, and we are currently building the capacity to create this process.

By developing tools like those shown in Figure 1, we are working across infrastructure investments and decision-making to ensure sustainability is inherent – not additional – to the way we operate our campus. Sustainability and energy use are now an integral part of ongoing discussions, with new emphasis on downscaling inefficiency in buildings, and scaling up our ability to operate a campus on the cutting edge of sustainable infrastructure. A comprehensive operational greenhouse gas inventory completed for FY2014, also gives us new data to help manage, plan, and prepare to reduce our contribution to climate change.

**Building Capacity for a Sustainable Future**

In the fall of 2014, we launched our first set of Sustainability Working Groups with systems thinking at their core, charged



**Figure 2.** Full building renovations provide significant opportunities to incorporate sustainable systems that reduce energy usage and emissions. Once renovated, E52 is expected to reduce carbon emissions by more than half the standard for comparable buildings.

with re-examining the management of the campus and recommending strategies the Institute can take to advance sustainability to its highest potential. The first set of priorities includes: Sustainable Design and Construction, Green Labs, Materials Management, and Stormwater and Land Management. The recommendations developed by these Working Groups this spring will seek to align campus operations along a core set of sustainability principles, setting a strong foundation for rigorous and innovative Institute-wide goal-setting, measurement and verification, and implementation strategies.

In March 2015, “SustainabilityConnect 2015” ([sustainability.mit.edu/sustainabilityconnect](http://sustainability.mit.edu/sustainabilityconnect)) convened the staff, faculty, and administrative Working Group participants and sponsors, as well as four additional groups and committees tasked with developing related recommendations, including the Climate Change Conversation. The first event of its kind at MIT, this forum combined presentations



**Figure 3.** A depiction of the Sustainability Governance structure now in place.

from topical experts with concrete working sessions covering topics such as climate vulnerability in Cambridge and the power of innovation to transform campus sustainability. The purpose of the day was to set a foundation for the development of an integrated and innovative set of recommendations this spring. New and old colleagues came together – over 125 students, staff, and faculty were in attendance.

During one of the event’s talks, Henry “Jake” Jacoby, Professor Emeritus of Management and member of the Climate Conversation Committee said: “We see ourselves as a catalyst for change, and there are a lot of people in the world looking at what we do.” If the Institute can find solutions on campus that are scalable and replicable, he said, “We can have an influence.” This recognition that we can have a global impact through our campus actions is driving the working groups

forward as they craft their next generation recommendations.

The recommendations that the Working Groups develop this spring – and all recommendations from future working groups – will head to the newly established Campus Sustainability Task Force, made up of students, staff, and faculty from the five Schools. The Task Force will work under the auspices of the Campus Sustainability Steering Committee to shape the vision and plan of action for campus sustainability at MIT.

The Task Force, working with the Office of Sustainability, will connect the leadership of the MIT Energy Initiative, MIT Environmental Initiative, and Committee on the MIT Climate Change Conversation. Its membership will enable the MIT community – faculty, students, and staff from across the Schools and interdisciplinary laboratories – to set a

vision for MIT. The Task Force commenced in April 2015 and will regularly submit recommendations to the Campus Sustainability Steering Committee for review and endorsement.

### **Harnessing the power of the collective toward a sustainable future at MIT**

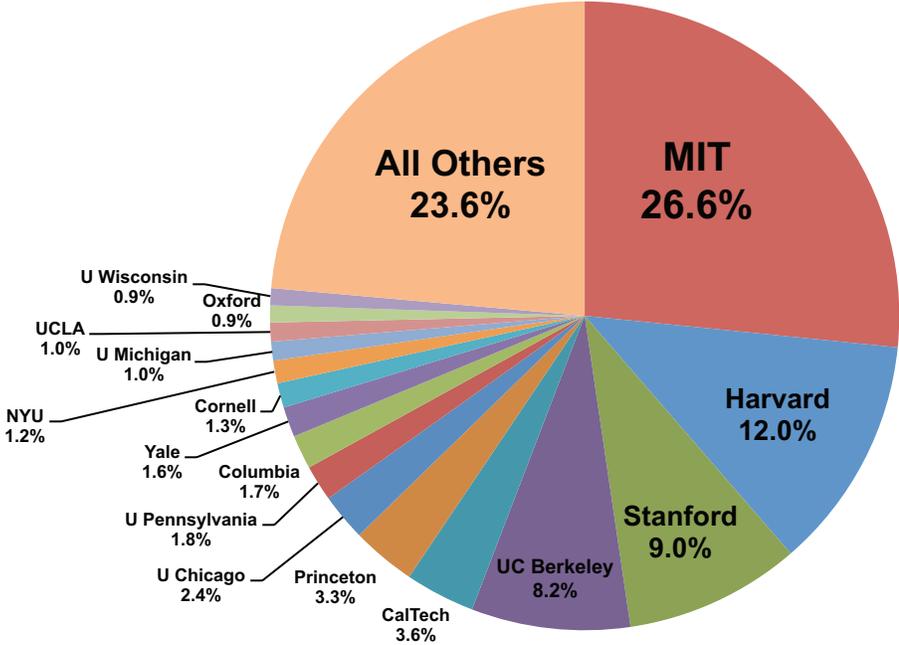
MIT is well positioned to excel in a next generation approach to campus sustainability given its collaborative fabric of researchers, entrepreneurs, inventors, and community partners. We are poised to transform the campus and its surroundings into a scalable laboratory, in which to devise, pilot, implement and evaluate the sustainable urban strategies of today and the emerging next generation strategies for tomorrow.

As a community, we now need to determine together which game-changing questions to pursue. How can we connect the campus to the cutting edge research on solar energy and hydrocarbon production, on global systems and nanostructured materials? MIT is positioned to take the lead in this arena and build a new narrative. ■

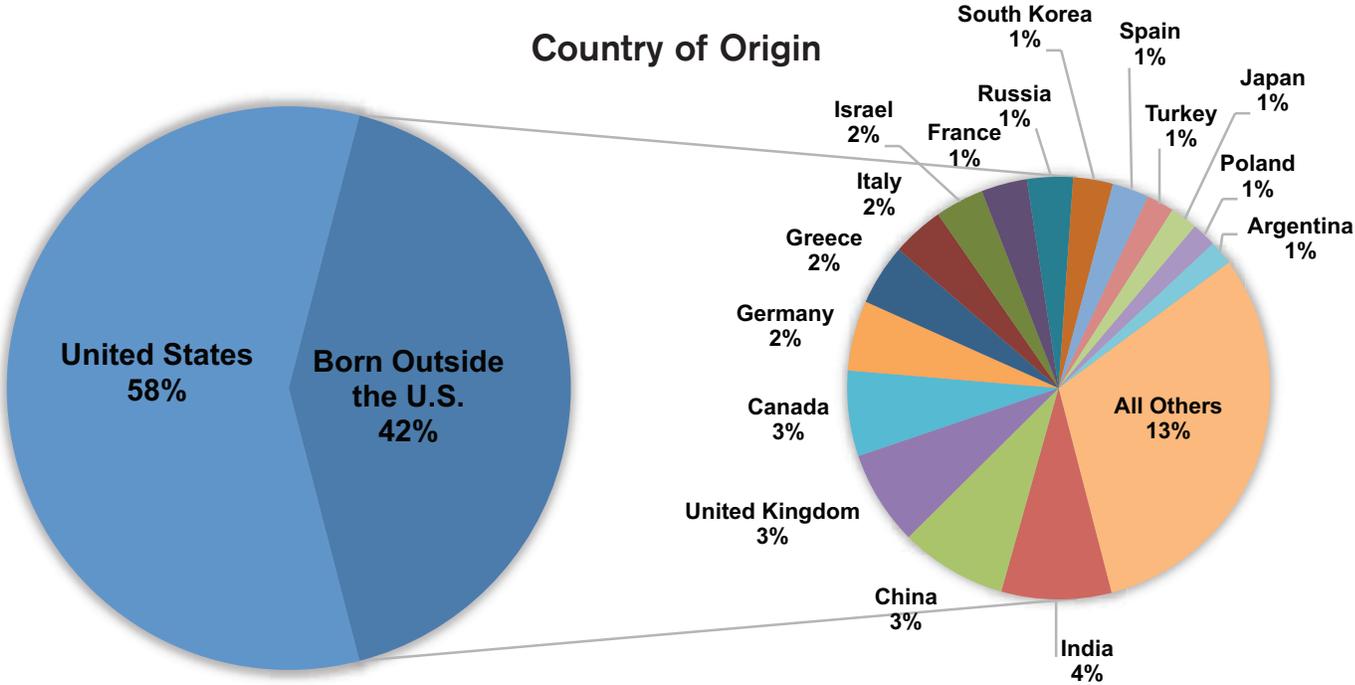
**Julie Newman** is Director of Sustainability in the Office of the Executive Vice President and Treasurer ([j\\_newman@mit.edu](mailto:j_newman@mit.edu)).

M.I.T. Numbers  
**Faculty Demographics**

**Institution of Highest Degree**



**Country of Origin**



Source: Office of the Provost/Institutional Research