

## Dean, School of Engineering

Globally acknowledged as the foremost in its field, MIT's School of Engineering has a four-part mission: to lead the profession by setting new directions through innovative models for education and research, to create new engineering knowledge and technologies, to transform and impact society through engineering practice and research, and to produce and train the next generation of pioneers in engineering education, research, and industry. To advance this mission, the MIT School of Engineering has a vision and a set of strategies for its implementation that move forward all of these components as a single, unified, interconnected objective.

The faculty, students, and staff in the School of Engineering perform cutting-edge research that advances scientific frontiers and solves major and complex technological and social problems and serves to train future innovators and leaders in engineering, science, and technology who will transform society. We continue to compete successfully against a growing number of institutions that aspire to MIT's leadership position in science, technology, and engineering.

The 2008–2009 academic year saw dramatic changes in world financial markets and a corresponding shift in the Institute's own finances. The School of Engineering has been a willing and aggressive partner in the Institute's response to the financial crisis, and its deans, faculty, and staff will continue to participate as MIT plans for the future. As the plans evolve, we expect they will correspond with the School's standing need to make commitments and conduct activities that are capable of touching the broadest range of fields, researchers, and disciplines. Our moment of economic uncertainty corresponds with an intellectual landscape in which it is crucial to create systems, spaces, and opportunities that nucleate and broaden interdisciplinary activities while simultaneously solidifying and enhancing deep disciplinary programs and activities.

Currently, the School's nine academic departments and divisions, its many research centers and laboratories and rich array of interdisciplinary graduate degree programs encompass a community of some of the world's brightest and most inventive thinkers—about 36% of the Institute's faculty, more than 46% of MIT graduate students, and about 45% of MIT's undergraduate majors, collaborating in over 16 undergraduate degree programs, 91 graduate programs, and a faculty research base of nearly \$269 million in FY2009. The achievements of the School's departments, laboratories, centers, and programs are extensive. Separate reports that highlight the activities and the accomplishments of the faculty and researchers in each of these units over the past year follow this report.

As a result of this year's faculty searches, 17 candidates have accepted faculty appointments in the School of Engineering. Their appointments will infuse all nine academic units in the School with the excellence, excitement, and energy critical to maintaining the high standards we have always set for ourselves. Of particular note among this year's new faculty: over 50% of them are women (10 of 17), following a year in which the School hired an unprecedented number of underrepresented minorities. The School has made significant efforts to recruit the best young faculty to MIT from

the broadest range of backgrounds. We are gratified to see such positive results in these efforts. (Please see the section on School of Engineering Initiatives below for more information about this year's faculty searches.)

There were also a number of important leadership transitions within the School: Richard Lester, founding director of the Industrial Performance Center and a professor of nuclear science and engineering was named head of his department; Alan S. Willsky, the Edwin S. Webster professor of electrical engineering, was named the director of the Laboratory for Information and Decision Systems; and Michael J. Cima, Sumitomo Electric Industries professor of engineering in the Department of Materials Science and Engineering and the Koch Institute for Integrative Cancer Research, was named faculty director of the Lemelson-MIT Program. Carl V. Thompson, Stavros Salapatas professor of materials science and engineering, was named director of the Materials Processing Center. And Joel Schindall, Bernard M. Gordon professor of the practice in the Department of Electrical Engineering and Computer Science, was named acting director of the Laboratory for Electromagnetic and Electronic Systems (LEES); as of July 1, 2009, LEES will be officially merged with the Research Laboratory for Electronics.

### **School of Engineering Initiatives**

The School of Engineering remains a key driver and participant in the Institute's initiatives on energy, the intersection of life sciences and engineering, and internationalization; faculty from each of the School's departments are actively directing, participating in, and shaping each of these initiatives. In addition, the School launched a number of its own initiatives in 2008–2009, using the data and observations collected during its year-long strategic planning exercise that integrated input from the Engineering Council (comprising the Dean, the associate deans, and the engineering department and division heads) and the directors of School of Engineering research centers and laboratories, as well as a faculty-driven Strategic Planning Council that sought broad input and suggestions on key issues from within and outside MIT.

Last fall, the School launched four faculty searches in broad areas: transportation, energy, green technologies, and computational engineering. These searches were designed to be School-wide rather than department-based, and the faculty members serving on the search committees came from every academic department in the School. Freed of the departmental structures that, while traditional and efficient, can be somewhat restrictive, these searches were uniquely designed to benefit from the widest range of faculty input, and helped the School discover new paths and methods for collaboration. Successful candidates for the school-wide searches, of which there were four, were selected based on the quality of their work and their vision, and upon hiring, each of these new faculty members was asked to select a home department for their appointments.

In September, the Dean announced the establishment of the Center for Computational Engineering (CCE). This center will create expanded educational and research activities and opportunities for faculty and students within the School and beyond in the broad area of computational engineering. Anthony Patera, Ford professor of engineering in the Department of Mechanical Engineering, and Karen Willcox, associate professor of aeronautics and astronautics, served as the codirectors of the new center. Professor

Patera has been recruited to lead another effort. Therefore, over AY2010 Professor Willcox will work with Jaime Peraire, professor of aeronautics and astronautics, to incorporate and integrate the Computation for Design and Optimization program into CCE. It is our hope that CCE will evolve as a vibrant community of scholars engaged in educational and research activities at MIT in the area of computational engineering with active participation from every unit in the School of Engineering. (See the CEE report regarding their activities for this year.)

In March, in concert with the deans of the MIT Sloan School of Management and the School of Architecture and Planning, the dean announced the establishment of Transportation@MIT, a new three-school initiative representing 15 academic departments and more than 26% of MIT faculty members who identified themselves as being engaged in transportation-related research. Transportation@MIT has an urgent and impactful charter: to mobilize the Institute's resources and intellectual capital in an effort to transform global transportation systems and meet the environmental and mobility needs of the 21st century. The initiative is directed by Cynthia Barnhart, associate dean for academic affairs in the School of Engineering and professor of civil and environmental engineering and engineering systems. Its first major event was a March National Academy of Engineering seminar and workshop on the future of sustainable transportation. (See the Transportation@MIT report regarding their activities since March.)

### **New Research Collaborations**

In June, as part of the Institute's broader initiative for global engagement and the School's own priorities to encourage innovation and novel research opportunities, the dean announced a collaboration with the International Iberian Nanotechnology Laboratory (INL), a joint project of the governments of Portugal and Spain located in Baraga, Portugal. The MIT-INL collaboration will enrich each institution's research activities in nanoscience and nanotechnology and enable approximately \$35 million (25 million euro) of new sponsored research with MIT in its first five years. The first phase in the collaboration will involve a number of current MIT research projects in the Microsystems Technology Laboratories and the Materials Processing Center. The collaboration will allow for exploring not only nanomaterials and devices but also how to integrate them in systems. These initial projects include projects on nanoparticles that can selectively adsorb water contaminants, autonomous microsystems that can move around water supplies and sense contaminants (while sustaining themselves on power scavenged from their environments), new materials for energy storage, and novel tools and technologies for monitoring our food supply. In addition, students can apply for summer or Independent Activities Period research internships through MIT-INL, and there will be periodic Institute-wide calls for proposals from faculty for new research projects.

Faculty members and researchers from the School of Engineering were crucial partners in the formation this year of the Phillip T. and Susan M. Ragon Institute, a new research institute formed to find new ways of preventing and curing human disease through harnessing the power of the immune system. A partnership between MIT, the Massachusetts General Hospital, and Harvard University, and funded through a \$100 million gift from the Phillip T. and Susan M. Ragon Institute Foundation, the Ragon

Institute will bring scientists and clinicians together with engineers using the latest technologies in an interdisciplinary effort to better understand how the body fights infections and ultimately to apply that understanding against a wide range of infectious diseases and cancers. The initial focus of the institute will be the need for an effective vaccine against HIV/AIDS. Arup Chakraborty, Robert T. Haslam professor of chemical engineering, chemistry, and biological engineering, and Darrell Irvine, the Eugene Bell associate professor of materials science and engineering and biological engineering, are members of the faculty steering committee that is planning for the new institute.

### **Education Innovation and Assessment**

The School of Engineering continues to make progress in the development of new programs to improve and enhance undergraduate engineering education. Following the School's strategic retreat in 2008, the dean formed the Strategic Planning Council, chaired by Professor Chakraborty. The council's education team developed initial recommendations for creating a more flexible engineering degree that permits undergraduates to integrate engineering knowledge and abilities with cross-disciplinary study across the Institute, while still maintaining the intellectual rigor of an MIT engineering education. The committee's work was developed further by the Dean's Education Committee, chaired by professor Ian Waitz. That committee has developed a working proposal for department-based flexible engineering degrees, similar to the Course 2-A degree, that integrate an engineering disciplinary core with a theme-based concentration that can include subjects from across the Institute. The new proposal permits each department to tailor the key ideas of a flexible engineering degree and theme-based concentrations to their specific disciplines and interests. The School will coordinate and support efforts, particularly in creation of new subjects and teaching support for theme-based subjects, through a new School-wide committee.

The Office of Education Innovation and Assessment (EIA) continues to successfully manage the Accreditation Board for Engineering and Technology (ABET) reporting process for the School's 14 accredited undergraduate programs. EIA continues to administer the engineering senior, alumni, and employer surveys to support continuous program improvement. EIA also continues to support programs in development and administration of direct measures of student learning, including senior capstone review and focus groups. This year, EIA began work with two departments, Mechanical Engineering and Chemical Engineering, to develop a portfolio assessment tool as a more precise, direct assessment method.

The EIA web-based database, developed and improved each year since 2002 contains longitudinal data from the School's surveys, MIT surveys, and other direct assessment data; the longitudinal data is also organized by each program's learning outcome. This organization permits departments to review quickly all assessment data for a learning outcome and determine if educational improvements are needed. The system, which also includes tools for faculty to develop subject-based assessment tools, was presented at the Rose-Hulman Institute of Technology's annual assessment conference to more than 100 participants. It was also presented at the École Polytechnique in Montreal to faculty from several Canadian universities. These universities plan to develop a similar

system as Canada's engineering accreditation board begins implementation of standards similar to ABET's Engineering Criteria 2000.

The EIA director worked with the dean for undergraduate education and the Office of the Provost's Institutional Research section in development of a freshman survey that permitted students to self-assess abilities at the beginning and end of their freshman year. The director's research and analysis of survey data looked specifically at the impact of the pilot freshman design experiences on self-efficacy in engineering-related abilities, choice of major, and impact by gender. The paper was presented at the American Society for Engineering Education annual conference in 2009, and received a best paper nomination. As a follow-up, EIA has developed a research relationship with Olin College of Engineering to continue in depth research on women and engineering.

Once again, the School of Engineering offered its Teaching Assistant Workshop in September and January. EIA worked closely with department graduate administrators and the Graduate Student Council to widely publicize the workshops. This year, the four-hour workshops were attended by 142 new teaching assistants in the School, up from 105 in AY2008. This year, 85% of all new teaching assistants attended the School's workshops. Teaching assistant survey feedback on the workshops was very positive.

The EIA continues full assessment of the School's Undergraduate Practice Opportunities Program (UPOP). This year, an expanded UPOP assessment tool was created. The expanded tool, with additional measures of engineering-related self-efficacy, will permit the EIA to carry out its plan for longitudinal assessment that will capture students' changing sense of self-efficacy in engineering related abilities from their freshman year to their alumni years.

### **Undergraduate Practice Opportunities Program**

The Undergraduate Practice Opportunities Program is a full-year co-curricular experience that helps MIT sophomores gain the knowledge, skills, and attitudes they need in order to effectively apply their classroom learning to successful careers in engineering leadership. Curriculum topics include project management, engineering specifications, team decision-making, conflict resolution, principled negotiation, agile engineering, persuasive presentations, professional etiquette, and win-win networking. The program is delivered in five phases beginning with a fall term of workshops and individual coaching on tools and techniques for career management. Phase 2 is a weeklong intensive professional development workshop held during January's Independent Activities Period (IAP). For this workshop of "serious fun" teams of 7-9 students are assigned mentor-instructors who provide group and individual coaching to ensure that each student masters the learning objectives behind the active exercises. The third phase of UPOP is a spring term of guided practice in the job acquisition process resulting in a summer internship. That internship serves as the fourth phase of UPOP, the hands-on practicum. Finally, students return to MIT in their junior year for a program of guided reflection to relate events and observations from the summer of practice to principles covered in the prior year of UPOP. UPOP's eighth year began in fall 2008, when 305 members of the Class of 2011 applied to the program. Of those, over 200 completed the IAP workshop and 196 completed the course requirements

culminating in a summer internship. This year 68% of UPOP students worked in industry (down from 85% most years) and nearly 100% of our employers report that they would rehire their UPOP intern. Beginning this year, UPOP has been designated as the sophomore component of the Gordon-MIT Engineering Leadership Program and serves as a foundation and prerequisite for the junior and senior years of that program.

## **Development and Communications**

Engagement with the School's alumni community remains a priority for the School of Engineering and for its development and communications staff. Effective, timely, and compelling communications about MIT, the School, and about engineering in general are crucial to these efforts and to the continued success of the School. More generally, as a leadership institution in engineering research and education, the School has a unique capacity to reach and inform the general public on issues related to science, technology, and education.

The primary communications vehicle and outreach mechanism for the School of Engineering is its website. The School's current site was launched in mid-September 2008, attracts approximately 35,000 visitors a month, and has seen traffic from every country in the world. We have been interested to observe that only 3.5% of the site's traffic originates from MIT network locations, indicating that it truly is operating as a gateway to engineering for audiences beyond the MIT campus. The site has received numerous functional upgrades since its launch, and these updates will continue for the foreseeable future.

This year the School also advanced a range of more specific and targeted communications from the dean, both internal to the Institute and externally in an effort to foster a sense of engagement among alumni. In January, the dean was a guest blogger on the website of *Technology Review*, in May he published a School overview in the MIT Faculty Newsletter, and in May he sent a message to all of the School's 58,000 alumni. The publication of each of these communications, especially the email to alumni, led to large increases in traffic to the School's website. This year also saw the introduction of a new repeating event, the School of Engineering Distinguished Lecture; our inaugural speaker was Irwin Jacobs, the founder of Qualcomm Inc. and a graduate alumnus of Electrical Engineering and Computer Science.

Lastly, the School's sponsorship and launch of MIT TechTV, a website for sharing online video within the MIT community, was fully realized this year when the service was acquired, and its ongoing costs internalized, by the MIT Libraries.

## **Statistics for 2008–2009**

### **Undergraduate Enrollment**

- 1,851 students
- 40% women
- 23% underrepresented minorities

### **Graduate Enrollment**

- 2,807 students
- 711 women
- 145 underrepresented minorities

### **Degrees Awarded, 2009**

- 626 bachelor's degrees
- 708 master's degrees
- 313 doctoral and professional degrees

### **Faculty**

- 255 professors
- 73 associate professors
- 40 assistant professors

**Subra Suresh**

**Dean**

**Vannevar Bush Professor of Engineering**

*More information about the School of Engineering can be found at <http://engineering.mit.edu/>.*