

Bernard M. Gordon–MIT Engineering Leadership Program/ Undergraduate Practice Opportunities Program

Launched in July 2007 through a \$20 million pledge (with a matching component) from the Bernard M. Gordon Foundation (the largest gift made to MIT's School of Engineering for curriculum development), the [Bernard M. Gordon–MIT Engineering Leadership Program](#) (Gordon ELP) was established to educate and develop the character of outstanding MIT students as potential future leaders in the world of engineering practice and development, and to endeavor to transform engineering leadership in the nation, thereby significantly increasing product development capability.

The [Undergraduate Practice Opportunities Program](#) (UPOP) was launched in 2001 as an initiative of the then-dean of engineering, Thomas Magnanti. UPOP is a yearlong program that prepares MIT sophomores to enter and thrive in the professional world through experiential learning, individual coaching, and mentoring relationships with MIT alumni and industry partners.

A UPOP organizational restructuring late in AY2013 streamlined the alignment of UPOP and Gordon ELP, setting the stage for increased efficiencies and improved use of resources.

Gordon–MIT Engineering Leadership Program

The curriculum to meet Gordon ELP's mission is derived from the belief that engineering leadership can best be developed by timely and systematically linking the following components:

- Immersive experiences on and off campus in which students practice, observe, and discuss engineering leadership
- Courses that provide conceptual and analytical models and frameworks that support engineering leadership
- Reflection, evaluation, and feedback from peers, faculty, and experienced engineering industry mentors on lessons learned from leadership activities

Students participate in Gordon ELP to enrich their departmental education; the program provides opportunities in leadership and innovation, invention, and implementation. Gordon ELP is delivered through an alliance of MIT departments, other MIT programs, industry, and alumni interacting synergistically with undergraduates and maturing engineers in professional master's degree programs.

Sustained program growth during AY2013 resulted in increasing relevance both within the Institute and beyond, and considerable progress toward program goals.

Goal: Educate and prepare the potential future leaders of engineering innovation, invention, and implementation efforts.

While Gordon ELP's primary focus remains on MIT undergraduate students (see specific program numerics and assessment analysis below), in AY2013 the program also planned, developed, and delivered several programs specifically designed to educate and prepare early career engineering professionals in industry.

A highlight of Gordon ELP's efforts to meet this goal was an Institute lecture in April 2013 delivered by program benefactor Bernard M. Gordon. The lecture attracted more than 300 members of the MIT community.

Within the Institute, students can participate in one or two years of the Gordon ELP. MIT sophomores seeking to become Gordon engineering leaders (GELs) enter either through UPOP (in AY2013, 70% of incoming GELs came from UPOP) or by having demonstrated commensurate experience in an engineering project in an industrial or academic setting.

Gordon Engineering Leader Years One and Two: Continued Growth

The first year of the GEL program (GEL Year One) is open to a competitively chosen cohort of MIT engineering juniors and seniors. During GEL Year One, approximately 100–120 students participate in a set of elective subjects and immersive learning experiences that, taken together, approximate the level of an MIT concentration.

For those GEL participants who successfully complete the first-year program requirements and elect to advance (20–30 students), GEL Year Two offers an array of highly personalized leadership development activities featuring a high degree of interaction with industry leaders, faculty, and fellow students. The aggregate two-year program requirements approximate the level of an MIT minor.

During AY2013, Gordon ELP's growth trajectory accelerated. Student applications to GEL Year One remained high and continued to trend upward, reflecting increased student demand for Gordon ELP offerings. In AY2013, a record 163 students applied for admission to GEL Year One, up from 149 in AY2012 and 153 in AY2011. Program leadership anticipates that as MIT undergraduates become more aware of Gordon ELP offerings, applications (and demand) will continue to grow.

In terms of preparing potential future leaders, 59 GEL participants earned certificates of completion in May 2013. Of these, 22 were from the two-year program and 37 from the one-year program (up from 43 who earned certificates in May 2012 and 30 in May 2011). We project that 120 students will enter GEL Year One in fall 2013, up from an initial cohort of 22 GELs in the fall of 2008. GELs entering the program this fall represent 15 departments across the Institute, including all departments within the School of Engineering.

In terms of results, students found a significant improvement in a number of their abilities, starting with the ability to work more effectively on teams. In particular, GELs reported that they:

- Listened more carefully to others, including those with whom they disagreed
- Were more likely to acknowledge useful contributions made by others
- Were more objective when their own ideas were criticized
- Improved their ability to help team members resolve differences of opinion

Program assessment further revealed an increase in leadership capabilities of GELs—both as members of a team as well as in formally designated leadership roles. This improvement was demonstrated by the ability to establish a team process for decision making and, when necessary, make decisions in the face of uncertainty.

Perhaps one of the most important ways the Gordon ELP is educating and preparing MIT students to be potential future leaders of engineering innovation, invention, and implementation is through the statistically significant success the program has had in developing GELs who consistently deliver projects on time, on budget, and to specifications. In exit assessments, GELs express increased confidence in their ability to create a process to arrive at a shared vision for a project.

Professional Education and Development: Expansion

Beyond the Institute, Gordon ELP has significantly enhanced relationships with industry as industry has become more aware of the program and of the high-quality students the program produces. Industry is now more actively involved in collaborating with program leaders in order to meet, engage with, mentor, and hire GELs. The program also received more donations from industry this past academic year (e.g. from Orbital Sciences Corporation and others).

As a result of industry demand, Gordon ELP expanded its offerings to early career professionals currently working in industry. Program faculty and staff developed and delivered three courses on engineering leadership for early career professionals:

- A weeklong workshop delivered in Florida for NextEra Energy (30 participants)
- A weeklong MIT Professional Education Program short subject on engineering leadership (25 participants)
- A three-day MIT Professional Education Program short subject on engineering innovation & design (48 participants)

Goal: Prepare all MIT engineering students to be more inclined to contribute to engineering innovation, invention, and implementation efforts and to be more effective contributors to such efforts.

Gordon ELP continues to meet this goal by supporting and enriching departmental programs throughout the Institute as well as through Gordon ELP's sophomore-year program, UPOP. In the aggregate, more than 1,200 students have benefited from Gordon ELP activities in MIT's School of Engineering over the 2013 academic year. During AY2013, the program:

- Funded 14 leadership teaching assistants (TAs) in the following subjects: 2.009 Product Engineering Processes; 6.S076 Secrets of Innovation: How to Design Anything; 10.26 Chemical Engineering Projects Lab; 16.00 Introduction to Aerospace and Design; 20.020/20.385 Introduction to Biological Design/ Understanding Current Research in Synthetic Biology; 2.009 Product Engineering Processes; 3.042 Materials Project Laboratory; 16.831 Space Systems Engineering; and 2.00b Toy Product Design. These 14 TAs, plus additional unfunded TAs who were invited to attend, received "teach-the-teacher" training in leadership, project planning, and effective teamwork, and then relayed that material to more than 400 students in the listed subjects.
- Provided a two-hour "project team success workshop" (project planning and introduction to effective teamwork) to students in professor Barry Johnson's short subject, 10.10 Introduction to Chemical Engineering; approximately 75 students attended this workshop in AY2013.
- Engaged throughout the summer and academic year with student project teams (e.g., Solar Car, Rocket Team, Design-Build-Fly), helping team leaders and members hone their team skills.

Goal: Increase the focus of national engineering education on the development of leaders of engineering innovation, invention, and implementation.

During AY2013, Gordon ELP continued to advance the Community of Practice for Leadership Education for Twenty-first-century Engineers (COMPLETE) by participating in two engineering leadership meetings, one at the University of California San Diego's Gordon Center and one at Southern Methodist University (SMU). A founding member of COMPLETE, Gordon ELP remains a driving force behind advancing the agenda of this growing group.

Key outcomes in AY2013 of Gordon ELP's participation in COMPLETE included the election of Gordon ELP faculty member Richard Schuhmann to serve as COMPLETE's liaison officer to a newly created constituent committee in the American Society of Engineering Education (ASEE), and the delivery of an engineering leadership laboratory to 50 students at SMU.

The ongoing COMPLETE meetings—the purpose of which is to share best practices and advance the practice of engineering leadership—gather representatives from 10 institutes in North America with engineering leadership programs. Creative public

relations efforts augmented the program's visibility in numerous national and trade publications, reinforcing Gordon ELP's position as the "thought leader" in engineering leadership.

As a widely recognized thought leader in the field of engineering leadership education, Gordon ELP hosted multiple visits from other colleges or universities that either have, or are seeking to establish, engineering leadership programs. Program leaders visited Rice University and delivered an engineering leadership laboratory to 50 students. These outreach activities respond to the program's mission to disseminate "best practices" in engineering leadership education.

Gordon ELP faculty and staff:

- Offered workshops at regional meetings of the ASEE on the role of experiential learning in leadership and innovation, and how it can be assessed
- Delivered a peer-reviewed paper on engineering leadership at the ASEE National Conference in Atlanta, GA
- Were significantly involved in activities during the 9th International Worldwide Conceive-Design-Implement-Operate (CDIO) Conference, where they delivered a hands-on engineering leadership laboratory to more than 40 participants, presented a peer-reviewed paper, "The Gordon-MIT Engineering Leadership Program: Relationship to CDIO Syllabus v2," and designed and delivered a day-long CDIO post-conference workshop on the Gordon ELP that was attended by more than 50 people from 10 countries
- Delivered a talk on engineering "designership" (leadership in design) by invitation of the D-School at the Hasso-Plattner-Institute in Potsdam, Germany
- Collaborated with the Skolkovo Institute of Science and Technology to provide an innovation workshop program that was delivered to 36 students in summer 2012

Undergraduate Practice Opportunities Program

The Undergraduate Practice Opportunities Program supported a record number of MIT sophomores during AY2013. Attracting students from all Institute majors, the program had more than 500 applications in fall 2012, representing almost half the sophomore class. UPOP enrollment has increased steadily since 2006, reflecting a higher demand by MIT undergraduates for the unique programming UPOP provides: abundant opportunities to practice and integrate the key skills they will need for career success.

Three hundred twenty students of the class of 2015 completed all the program requirements. These include individual coaching sessions with UPOP staff; an intense weeklong "boot camp" workshop during MIT's independent activities period, with experiential modules taught by MIT faculty; topical seminars led by staff, industry professionals, and MIT alumni; securing a career-relevant summer practicum; and submitting written reflective reports over summer during the practicum.

UPOP students went to summer practicums both domestic and international, from large corporations to small start-ups, from industry to research.

- Total participants in domestic industry internships not connected with MIT International Science and Technology Initiatives (MISTI): 173 (compared with 118 in AY2012)
- Total students who participated in MISTI internships or practicums: 41 (33 in AY2012)
- Students who participated in international non-MISTI industry or research: 13 (six in AY2012)
- Total number of students who did an MIT UPOP (for example with the Computer Science and Artificial Intelligence Laboratory, the intercollegiate Genetically Engineered Machine, and the Electric Vehicle Team): 66 (63 in AY2012)
- Students who did research at other universities: 16 (nine in AY2012)

In AY2013, UPOP adjusted its programming to provide more “high touch” support for participants to practice their professional skills with UPOP staff, volunteer employers, and industry experts (typically MIT alumni, known within UPOP as “mentor-instructors”). Programming changes included more individual coaching sessions, more topical seminars and practice sessions, and more opportunities to interact with industry employers through field trips, lectures, networking events, and mock interviews.

UPOP achieved several notable goals in AY2013:

- Recruiting and retention efforts resulted in 320 students completing the program, an increase of more than 100 compared with AY2012
- The employer outreach program expanded to include more than 2,000 companies that engage with UPOP and its students via information sessions, field trips, industry-relevant roundtables, sponsorship of events, and hiring students
- Mentor-instructor recruitment brought in more MIT alumni; mentors now better reflect UPOP students both demographically and in academic pursuits

Accomplishments and Awards

- Gordon ELP received applications from 163 students to join GEL Year One in fall 2013 and accepted 124 students representing 15 MIT departments (including all departments in the School of Engineering)
- 59 GELs earned program completion certificates in May 2013
- Gordon ELP recruited 40 System Design and Management/Leaders for Global Operations to serve as mentors for students in GEL Year Two
- The combined programs coached more than 30 GELs to obtain summer InternshipPlus experiences (InternshipPlus is a program completion requirement for students in the GEL Year Two program)

- Designed and delivered a day-long CDIO post-conference workshop on the Gordon ELP (attended by more than 50 people representing 10 countries)
- Gordon ELP hired additional staff to meet increased program demand and service both internal and external clients
- Gordon ELP held three Industry Advisory Board meetings to receive input from engineering industry leaders
- Gordon ELP added members to the Industry Advisory Board to improve the representation of women and other minorities (and thus better reflect student demographics)
- Gordon ELP developed new measures to assess engineering leadership education; the results are useful for identifying areas where efforts could be invested to improve the program, and to further document the success of the program for external communities interested in adopting elements of the Gordon ELP model
- UPOP received a record number of applications (more than 500) from all courses; it retained the largest number of students thus far (320) through the year-long course
- UPOP delivered more than 30 workshops, speaker series, and employer events to students
- The combined programs planned and executed an industry outreach campaign to substantially increase industry collaboration and partnership
- The combined programs earned corporate funding in the form of grants and company sponsorships as well as from a pool of committed individual donors—including program alumni
- The combined programs affected more than 1,200 students throughout the Institute

Future Plans

- Continue to work closely and actively with MIT Resource Development to solicit potential program supporters to meet fund-matching goals (the program has a matching-fund requirement and is currently behind schedule in terms of meeting this obligation)
- Continue to market the UPOP program widely to recruit a large and diverse class of students
- Collaborate with Gordon ELP staff to continue develop UPOP curriculum and assessment tools
- Establish a UPOP advisory board consisting of mentor-instructors and other stakeholders who are committed to advancing the mission and vision of UPOP

- Establish a continuing role for UPOP alumni both to help the next generation of UPOP students and to further entrench skills learned in UPOP – “learning by teaching”
- Continue to expand the number of GELs completing the GEL Year One and GEL Year Two programs
- Expand external and internal engagement with MIT departments by offering more workshops, creating and offering more project-based subjects, and taking advantage of emerging synergies with EdX, OpenCourseWare, and other distance-learning platforms
- Broaden the offerings of engineering leadership workshops for early career professionals
- Explore the possibility of offering workshops to universities contemplating starting their own engineering leadership program
- Coordinate with appropriate MIT personnel to obtain permanent space for office and Gordon ELP staff

Joel Schindall

Codirector

Bernard Gordon Professor of the Practice, Electrical Engineering and Computer Science