

## An Overview of MIT's Undergraduate Practice Opportunities Program (UPOP)

Susann Luperfoy  
MIT

### ABSTRACT

MIT's Undergraduate Practice Opportunities Program (UPOP) is a full year, co-curricular program that introduces second-year students to "Firm Skills": the foundational knowledge, tools and cognitive frameworks they need to effectively apply the "hard" science, math and engineering learning from their core disciplinary studies, to leadership careers that they themselves actively design. Now in its twelfth academic year, UPOP continues to evolve and grow to meet the changing educational needs of burgeoning enrollment, while also responding to the shifting priorities of the employers who hire students as interns and later recruit them as regular employees upon graduation. This paper outlines the five segments comprising the UPOP curriculum with focus, respectively, on (1) self-analysis, (2) team performance, (3) opportunity generation, (4) enterprise awareness, and (5) career strategy. The activities and learning objectives will be reviewed in brief with an emphasis on the defining properties of the overall pedagogical approach: immersive design of experiential learning exercises and active involvement of an enthusiastic community of MIT alums and other senior professionals who assist in the delivery of educational content in all five segments.

Keywords: STEM, Conference Proceedings, Partnering, Critical Thinking

### INTRODUCTION AND BACKGROUND

Exposing university students to hands-on practice in parallel to their classroom learning is arguably as old as engineering education itself. Internship work can supplement core disciplinary studies and, at the same time, serve to motivate and reinforce the learning objectives set for students in their science, math and technology coursework. Students apply concepts and transfer knowledge from their studies in science, technology, engineering and math (STEM) to their work on their internship and return to school with enhanced context for continued learning.

Internships serve other functions as well. First, exposure to life in a chosen field can help the students better understand their own strengths and preferences relative to the world outside academia while they fine tune their definition of the ideal working environment and articulate their career objectives. Second, documented experience in the world of work demonstrates to prospective employers a level of preparedness for putting their acquired training to use. Third, a recommendation from a mentor who has supervised the student intern can be decisive in the job acquisition process. According to the National Association of Colleges and Employers (NACE), just 19.7 percent of college graduates who applied for jobs in 2009 had procured positions by

May of that year.<sup>1</sup> A hiring manager may wisely rely on the impressions of someone who closely supervised a student worker for an entire summer.

Internship experience gives students a competitive edge in the job market and provides employers with early access to top talent. Even graduates of leading schools like MIT have faced stiff competition for scarce openings over the past several years. According to the same NACE study, over 75 percent of employers prefer to hire new college graduates who have relevant work experience, and nearly 20 percent of employers prefer any type of work experience to none at all. For many employers, summer interns are the primary source of regular staff. In fact, employers surveyed by NACE reported that more than one-third of the new college graduates they hired in 2008 came from their internship programs.

Internship programs vary widely, from placement services that match students with appropriate employers, to multi-year co-op programs in which faculty advisors and industry mentors collaborate to ensure educational outcomes. There are several internship programs at MIT for graduate and undergraduate students, reaching diverse industries and academic disciplines. This paper describes one of those offerings: UPOP is an educational program in the School of Engineering with a practicum requirement that is fulfilled by a summer internship.

### MOTIVATION

In addition to the hands-on practice offered by internships, students trained in science and engineering need specific help to prepare for the inevitable culture shock entailed in the move from elite academia to any of the many “real worlds” that define the context of a working career, whether a large company, an early stage startup, a nonprofit organization, a hospital or law firm. Here are just a few examples of cultural contrast.

1. Acceptance into and success within academia require students to focus on individual achievement. Individual students present their standardized test scores, transcripts with GPA, autobiographic essays, athletic awards and volunteer service hours to get into MIT and once enrolled, submit own work to classroom instructors. In contrast, success in the world outside academia depends on the achievements of a team or organization. With a few notable exceptions—such as writing a best-selling novel—success in the world of work inevitably requires participation, leadership and inspiration of team members, partners and coworkers. Whether in a startup, a research lab a Fortune-500 company, non-profit, or government agency, individuals prosper only when their organizations succeed.

2. Professors are clear about requirements and unbiased in grading; a syllabus is distributed on Day 1 and it does not change; whereas, customers, review panels and entire markets are often capricious, irrational and unfair in a strict sense of meritocracy. A client is free to buy an inferior product at a higher price and may change their mind without notice or justification. Staff promotions and opportunities for career advancement are often assigned based on subjective

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<sup>1</sup> <http://www.nacweb.org/press/display.asp?year=&prid=301>

factors and chance encounters; intelligent, well-intentioned managers can make bad decisions, change priorities suddenly, or cancel projects.

3. Homework problem sets in science, engineering, physics and math are well defined and have known solutions. Your professor can solve them; other students before you have derived solutions; and you are guaranteed to have sufficient background skills and training required based on reliable curriculum sequencing and prerequisites. On the other hand, projects at work often require that you first define the problem yourself and negotiate terms of an adequate solution with stakeholders. If your team is breaking new ground, the challenge may actually be beyond your ability, the current state of the art, or your organization's budget scope and delivery schedule. Your team may lack the skills to solve the problem or your organization may be working on the wrong problem.

4. In the culture of higher education, analytic argument is valued for its own sake. In academia we love to argue about whether, in principle, a problem could ever be solved; we prefer to be on the cutting edge, advancing frontiers in the state of the art. In contrast, the world of product delivery is strongly biased toward action, and market viability trumps novelty of the technical solution every time. Your manager, your venture funder or your shareholders would prefer to see you get started on building the product rather than hearing your formal depiction of the many roadblocks that could, in principle, interfere.

5. As a student, you can resign yourself to a low grade one semester knowing that you will start with a clean slate, a new professor, new material, a fresh syllabus the next semester. In industry, however, poor performance accumulates; if you deliver a flawed product this release, you are likely to incur punitive costs and added scrutiny by an oversight entity, with time-consuming reporting requirements. At the very least, you will be expected to fix the prior flaws while delivering on commitments already made for the next version of your product or service.

6. Student teams are homogenous and short-lived, most often enduring only a few months. Term projects involve teammates who are nearly identical in age, academic background, and test scores. But in the world outside academia, teams are often diverse, amorphous, constantly changing and they may exist for years. People with diverse educational backgrounds, roles in the company, ambitions, working styles, etc. enter and depart from the team and exhibit varying degrees of attention, power and motivation. They go on vacation, start families, get pulled off the project to work on something else temporarily, or leave the team.

7. A term project at school that is desperately behind schedule can usually be recovered in one heroic effort at the end of the semester, possibly involving an all-nighter or two, whereas product delivery most often involves suppliers, manufacturers, regulatory officials and other partners who have their own schedules. So individual heroics do not constitute a fallback plan.

8. Professors may give partial credit for a good effort and, if you show your work, a near miss could get you full credit. That is because the entire enterprise of undergraduate education is aimed at furthering the student's success. You are to learn and demonstrate mastery over the material. However, legal contracts, government grants, regulatory agencies and review panels are unforgiving. Your personal edification or enhanced future capability at their expense is not acceptable, and cannot make up for an incomplete or tardy delivery. Your efforts must contribute to the flow of funding or they (and you) can become irrelevant.

9. Undergraduates at MIT must work hard but they can be fairly passive in decision-making. It is safe to trust the four-year curriculum sequence and each syllabus within it, knowing that it has all been designed by world-class experts and heavily vetted through conscientious

oversight committees. The entire enterprise is designed to advance society's knowledge and capabilities and to help the student prepare to contribute. Therefore, the student need only learn and demonstrate learning so that in four years a degree will result. Outside academia, however, the world is mostly brutally oblivious to the individual and there is no structured career waiting for the brilliant graduate who diligently keeps their head down and works hard. Careers are full of surprises: disruptions and obstacles on the one hand and sudden opportunities and tough life-changing decisions that emerge unexpectedly with brief decision horizons.

### APPROACH

To prepare students for this inevitable culture shock, MIT's Undergraduate Practice Opportunities Program (UPOP) introduces students to "Firm Skills": the knowledge, tools and cognitive frameworks they need to effectively apply the "hard" science, math and engineering learning from their core disciplinary studies, to leadership careers that they themselves actively design (Luperfoy, forthcoming). One can think of "firm skills" as, roughly, the interface between hard and soft skills and, depending on how the Venn diagram is drawn, resides in the overlap or the gap between the two.

UPOP is a credit-bearing co-curricular program delivered in five segments spanning a full calendar year, each with a distinct focus of attention: (1) self, (2) team, (3) opportunity, (4) enterprise and (5) career. Each segment involves a combination of hands-on practice, individual and small group coaching, reflection exercises, and classroom instruction using experiential learning modules designed to supplement and reinforce learning from the core disciplinary studies. UPOP **prepares** sophomores for a summer internship in what is in many cases the student's first job experience, provides **coaching** and **mentoring** during the summer internship, and then upon return to campus in the fall, guides the student through a process of **reflection** to help connect their internship experiences and observations to the learning objectives of the learning exercises.

#### **(1) Self Understanding.**

During the fall semester of their sophomore year, UPOP students attend workshops, take field trips to local employers, attend networking events and receive individual and small-group coaching from UPOP staff members and former students. All activities are designed to further the students' understanding of their own strengths, proclivities and preferences. During this segment, the student is encouraged to view oneself as an object worthy of analytic study.

Students learn basic principles of personal branding and reputation protection and they receive coached practice in describing themselves in spoken and written communication. Students author and/or revise a compelling résumé and/or electronic portfolio in preparation for applying for summer internships. They learn how to tailor a cover letter to the interests expressed in a specific job opening. They also have the chance to rehearse job interview dialogs with volunteers from local industry who act as hiring managers in a job interview role-play followed by ten minutes of detailed, out-of-character feedback from volunteer to student. This feedback can include

anything from posture, poise and voice modulation, to quality, length and articulation of response given a technical challenge from the interviewer.

UPOP students have the option of attending one of several field trips to local industry during the fall semester. This gives the employers an opportunity to raise their corporate profile on campus. The primary educational purpose, however, is to reveal to the student the many dimensions along which work environments vary beyond industry, corporation size, geographical location etc., and to impress on them the importance of considering the right fit for themselves. Would they thrive better in a culture where people work in closed offices allowing focused concentration, or in an open-format shared room where teams collaborate constantly; would they prefer a 9-to-5 expectation with clear deliverables and schedules in order to ensure work-life balance or a team environment where workers eat meals together, play volleyball over lunch and work all night or all weekend when necessary. Field trips offer a context for imagining life in the workplace and serve as a light introduction to the concept of fit that will get explored the following summer.

At the end of the semester students complete a cognitive-style self-analysis instrument that intends to reveal individual preference profiles in mental approach to new problem situations. Using the Herrmann Brain Dominance Instrument (HBDI) students generate their own analysis, the results of which are to be revealed during the January Team Training Camp workshop.

### **(2) Team Orientation**

In the January break between MIT's fall and spring semesters UPOP students complete an intensive, one-week course of experiential learning in teams. The purpose is to help students achieve the shift in orientation from individual achievement to optimum team performance. The workshop engages a group of MIT alums and industry leaders who serve as "mentor-instructors." After two days of intensive teacher training and armed with a notebook of teaching notes, mentor-instructors assume primary responsibility for teams of 7-11 students each, assigned to them for the full week.

Experiential learning modules for the Team Training Camp are designed variably as team competitions, role-plays and individual representation of team interests. Topics include engineering specification, principled negotiation, project management, agile engineering, risk assessment, leadership visioning, structured communication for maximizing team creativity, group decision making, conflict detection and resolution, user-centered product design, and public speaking.

Exercises are introduced by faculty and facilitated by UPOP staff and former students who serve as teaching assistants. After each learning module each mentor-instructor debriefs the activity with their team, ensuring that the learning objectives have been met for each student at the table.

During networking breaks, students are challenged to meet as many mentor-instructors as possible practicing unwritten rules of professional etiquette in STEM environments. This allows students to establish a strong foundation for their professional network and indeed, many students stay in active communication with their UPOP mentor-instructor through the remainder of the year and beyond.

#### **(3) Opportunity Generation**

During the spring semester of their sophomore year, students learn how to find or create opportunities by actually securing summer employment. In this learn-by-doing approach to job acquisition students are exposed to the hidden job market where an internship can be created by invoking the student's own nascent professional network, which now includes the entire UPOP community. They secure summer internship assignments suited to their individual needs and career aspirations, take field trips to local employers and attend a series of technical dinner colloquia for practice in professional etiquette. The skills presented here are tailored to common environments encountered by STEM professionals, such as conferences, review panels, standards committees and invited talks.

While UPOP is not a placement service and does not guarantee internships, the commitment to the student is that "UPOP won't give up on you until you give up yourself." In a typical year nearly all UPOP sophomores find hands-on work related to their course of study. This is good news in a market that, quite understandably, prefers juniors, seniors and graduate students as interns. Beyond helping the student secure an internship, UPOP teaches sophomores how to identify (or create) opportunities, obtain the offer, negotiate terms and prepare for their summer job. Summer internships offer few points of negotiation with little controversy so it provides good practice: start and end dates, hourly pay rate and assistance with housing or travel.

#### **(4) Enterprise Awareness**

In a 10- to 12-week summer practicum students apply their technical and organizational skills in the workplace. They learn to shift from the individualistic mindset to an enterprise orientation. Paradoxically, to maximize their results from the summer they must shift from the mindset that asks, "How can I get the most out of my summer?" to one that considers the structure, constraints and objectives of the enterprise and their own contribution to the chain of value.

To inspire the kind of reflection that improves learning assimilation and later transfer of learning, each student submits three progress reports over the course of the summer. These reports require the students to make observations and reflect on their own experiences, making connections to learning outcomes from the first nine months of UPOP. Students document results of their own analysis of the enterprise—its history, purpose, sources of funding, and organizational structure. They conduct an informational interview of one leader or role model and report the results. Finally students are prompted to reflect on their own performance documenting surprises, difficulties and mistakes that have led to greater awareness.

During the summer, selected students have the opportunity to host a site visit by a UPOP staff member who meets with the student, their supervisor, and a human resources representative to ensure a positive outcome for all participants. This task also gives the student authentic experience in hosting a visitor to their organization: making introductions, coordinating schedules, reserving rooms, arranging parking and providing directions for the visitor.

#### **(5) Strategic Career Planning**

The job acquisition and team performance skills practiced in UPOP prepare students to navigate future career transitions, but the UPOP year is also meant to instill students with strategic thinking skills to position them to drive the process of career planning and help them lead others in creating opportunities. The fifth segment of UPOP is devoted to reflection and assimilation of learning objectives, culminating in a strategic action plan for their subsequent summer.

The reflection process, begun over the summer with progress reports, continues when students return to campus in the fall of their junior year. Students attend a reflection banquet where they report back on their practicum experiences to each other and to a team of industry mentors. Students receive a closing interview with UPOP staff to chart a course for the next year building toward a well-designed career. Juniors, seniors, and graduate students who have completed the program are welcome to return to the UPOP office for continued support, and they frequently do.

#### **Community Engagement**

The UPOP curriculum is delivered through a combination of classroom instruction by MIT faculty from diverse disciplines, small group and individual coaching by industry professionals, and summer internships with mentoring and guided reflection. The UPOP approach depends on active involvement of an enthusiastic community of employers willing to hire and mentor interns, former students available to share their recent experiences, and MIT alums and other professionals who volunteer to help deliver the educational content and enable the immersive design of the experiential learning exercises.

Networking is an important professional skill and the third most common method for MIT students securing employment upon graduation—after on-campus recruiting by employers, and summer internships that convert to regular positions. UPOP sophomores learn tools and techniques for networking, and practice them by making personal connections with engineering leaders in the UPOP community. The MIT alums who serve as mentor-instructors in January, often remain in contact with their students throughout the spring semester and beyond.

In this mutually beneficial model, the UPOP student's education is enriched by contact with alums, employers gain visibility on campus, and MIT alums value the chance to re-connect with the Institute, citing several motivations for their decisions to volunteer:

- **Giving back:** alums attribute their own success to their MIT education and see helping MIT students as a great way to contribute to MIT and to society at large.
- **Direct Recruiting:** the UPOP sophomores they hire as interns may be suitable candidates for regular hire two years later.
- **Indirect Recruiting:** participation with UPOP sophomores raises company name recognition among juniors, seniors and even graduate students.
- **Networking:** alums enjoy meeting other successful professionals and getting to know each other well over the course of the seven-day team teaching experience
- **Learning:** mentors report learning new material through the UPOP curriculum.
- **Intensity:** alums enjoy the intensity of the MIT environment and are inspired by their interactions with the students.

**PRELIMINARY FINDINGS**

To date, UPOP has undergone only formative evaluations to better understand student needs and guide immediate changes in program design. Rigorous summative evaluation to demonstrate program efficacy will require:

- (1) **Dependent Variable:** A definition of superior outcomes, with measurable values of career satisfaction, professionalism or leadership success, five or ten years after graduation.
- (2) **Independent Variable:** Evidence that, relative to those measures, UPOP students outperform other MIT students who do not take UPOP.
- (3) **Population Representation:** Indicators that the students who choose to take UPOP are representative of all MIT students, rather than somehow predisposed to succeed against the defined criteria for superior outcomes.
- (4) **Control of Confounding Factors:** As emerging adults, sophomore students will continue to undergo cognitive development and they will benefit from parallel experiences in the MIT classroom and research labs, as well as clubs, athletic teams, student government and independent living groups.

A study of program results meeting the above requirements will be undertaken in the future. This paper reports only anecdotal evidence in the form of participation numbers and testimonials from students, employers and volunteers.

**Participation Numbers**

UPOP has grown steadily since its first implementation in AY01-02 from 73 students in the school of engineering to over five hundred students representing all departments and majors. (See Figure 1 and 2.) Reflecting the student population at MIT, a majority of UPOP students come from the school of engineering (78%) and the program is consistently even in gender distribution. The program has weathered economic fluctuations, surges in interest from one industry or another, and growing rivals for the students' scarcest resource: discretionary time. UPOP's database of employers has grown from a handful of tentative partners willing to take a risk on sophomores, to hundreds of employers eager to recruit UPOP interns. Finally, the community of dedicated supporters has grown to over one hundred MIT alums and other seasoned professionals who volunteer their time each year to help coach and mentor UPOP students.

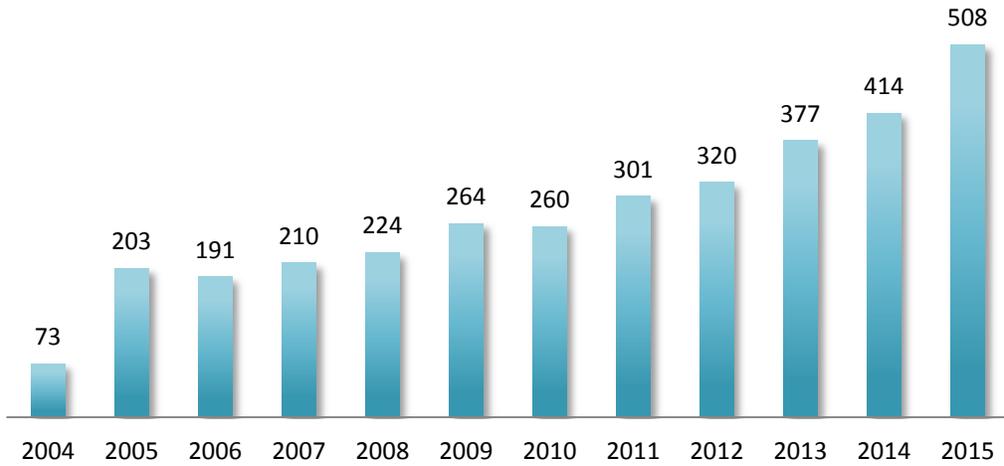


Figure 1: Sophomore Applications by Graduation Year.

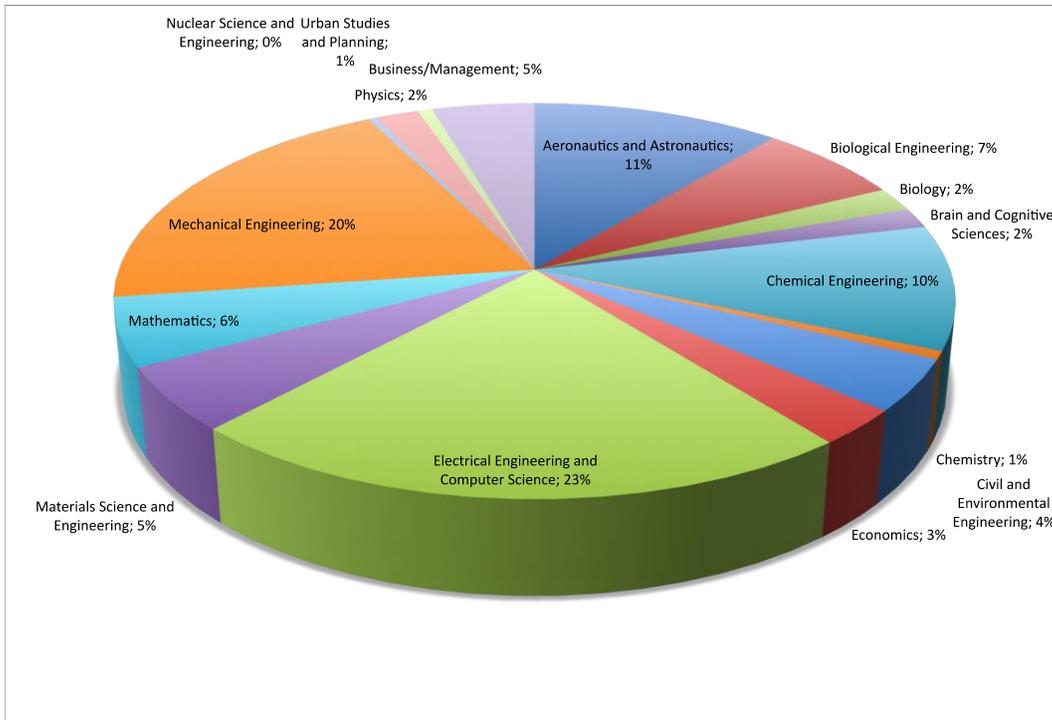


Figure 2: Distribution of Student Majors.

#### Feedback from Students, Employers and MIT Alums

Former students are a key factor in student recruitment with approximately 80% of current students reporting recommendations by former UPOP students as their reason for applying. Well-known MIT graduates enhance this viral marketing effect with testimonials such as the following from the current “rock star” of MIT alums:

*“...UPOP for me was kind of the beginning of a pretty amazing adventure of learning about the business side of the house. So why does it matter? I wish someone had explained this to me. ... no matter how smart you are, there’s a ceiling to how much you can do with your own hands, ... Sooner or later you have to get other people involved.” – Drew Houston, CEO and founder of Dropbox.*

Mounting anecdotal evidence is available from UPOP employers who assign high marks to individual UPOP students and their work, as well as to the UPOP curriculum with its emphasis on professionalism and effective communication. According to NACE’s Job Outlook 2009, communication skills, strong work ethic, ability to work in a team, and initiative are among the qualities employers value most. The Polk-Lepson Research Group at the Center for Professional Excellence (2012) reports a decrease in professionalism among young workers.

According to surveyed employers, UPOP students out-perform their non-UPOP peers when functioning on multi-disciplinary teams and in making oral presentations. Additional program evaluation data show advantage for UPOP students in the following areas:

- Asking for more challenging assignments
- Managing and organizing workload
- Addressing personal conflicts
- Addressing team conflicts
- Tailoring presentations to fit audiences’ interests
- Appreciating the role of ethics in engineering

After a full year of training and a summer internship, UPOP students themselves often reflect on their significant progress. “The UPOP program taught me what’s expected of me in the work place, and how I can make the most of a career in engineering through effective communication and active leadership,” said one member of the Class of 2009.

### CONCLUSIONS

The need for programs like UPOP may be especially acute at universities like MIT where the campus culture emphasizes research and the student workload leaves little time for mentoring, networking and connections to industry. Classroom instruction and opportunities to practice research with MIT faculty give students a strong grounding in engineering science, technical knowledge and analytic skills. MIT was ranked first by *US News and World Report* in its 2013 ranking of undergraduate engineering programs among colleges with doctoral programs in engineering. Nevertheless, MIT graduates, like others trained in top quality engineering science programs, are often oblivious to the unwritten rules of organizations and can get left to execute engineering decisions made by their less technical colleagues.

**FUTURE WORK**

UPOP is a work in progress and much improvement is needed to continually update and refine the curriculum design and delivery methods to better meet the evolving needs of students. The goals being pursued in the coming two academic years include reducing the cost per student and recruiting even greater diversity in mentor-instructors, employers and other constituents of the UPOP community who serve as role models for non-engineering students with career destinations in law, medicine, management, research and academia. Finally, summative evaluations are being designed to assess efficacy for isolated components of the curriculum.

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**AUTHOR INFORMATION**

Susann Luperfoy spent twenty years straddling the cultural chasm that divides university study from the world of work, an excellent preparation for teaching street smarts to MIT undergraduates. Her work experience in academia, government, and industry spans diverse organizations, from early stage start-ups to mature public corporations and research labs, supervising tenured professors, artists, and military veterans. She acquired “firm skills” by making mistakes, observing mistakes of others, and occasionally getting things right by accident.