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Article by John Schwartz

Re-engineering Engineering



Marc Asnin/Redux, for The New York Times

The Hands-On Approach: Building a different breed of engineer at **Olin College**.

WHEN NONENGINEERS THINK ABOUT ENGINEERING, it's usually because something has gone wrong: collapsing levees in New Orleans, the loss of the space shuttle Columbia in 2003. In the follow-up investigations, it comes out that some of the engineers involved knew something was wrong. But too few spoke up or pushed back — and those who did were ignored. This professional deficiency is something the new, tuition-free **Franklin W. Olin College of Engineering** wants to fix. At its tiny campus in Needham, Mass., outside Boston, Olin is trying to design a new kind of engineer. Most engineering schools stress subjects like differential calculus and physics, and their graduates tend to end up narrowly focused and likely to fit the stereotype of a socially awkward clock-puncher. Richard K. Miller, the president of the school, likes to share a professional joke: “How can you tell an extroverted engineer? He’s the one who looks at *your* shoes when he talks to you.” Olin came into being, Miller told me last spring in his office on campus, to make engineers “comfortable as citizens and not just calculating machines.” Olin is stressing creativity, teamwork and entrepreneurship — and, in no small part, courage. “I don’t see how you can

make a positive difference in the world,” he emphasized, “if you’re not motivated to take a tough stand and do the right thing.”



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Beyond Theory: An Olin senior working as part of a consulting team asked to develop a robotic agricultural tractor.

Olin College started with what would amount to institutional suicide. Named for its founder, a munitions manufacturer who died in 1951, the F. W. Olin Foundation had spent nearly six decades giving money to dozens of campuses for buildings, much of it for teaching engineering and science. In 1993, however, the board of the foundation floated the idea of doing something that well-financed organizations rarely do: go out of business. Lawrence W. Milas, the president of the foundation, said he had grown frustrated with a process that helped schools but didn’t change engineering education, which he says he thought was in a rut. He wondered whether it might be a good idea to fold the foundation and devote its assets to the creation of a new college.

A conversation with an executive of the [National Science Foundation](#), Joseph Bordogna, persuaded Milas that his idea was sound. As a major, engineering was slipping in popularity. And the schools and their graduates were suffering from many of the ills of higher education generally. More and more, the schools were demanding specialized courses of study instead of an interdisciplinary approach. Bordogna explained how the National Science Foundation had been lending support to schools that were trying to adopt reforms and foster an undergraduate experience that focused on learning through inquiry and discovery. Yet Milas understood that these programs were competing with a strong institutional inertia. Engineering schools had structured themselves, largely for the convenience of faculty, around a comfortable way of teaching but not the best methods of learning. There was too much note-taking in the classroom and not enough hands-on learning. Institutions stressed research over undergraduate teaching, because that’s where the recognition and grant money come from.

The Bordogna meeting got Milas thinking. “That’s when the light went on,” Milas recalled. “We can start with a blank slate.” He went back to the Olin Foundation and started to push. He recalled that the other members of his small board had reservations, but Milas was certain. “I was a little bit of a terrier on this,” he said. “We went for it.” Eventually, the F. W. Olin Foundation agreed to give more than \$400 million to create a whole new school.

Milas began looking for someone to lead the school, and the president of Harvey Mudd College, in California, suggested that he take a look at Miller, at the time the dean of the college of engineering at the [University of Iowa](#). To Miller, it was an unexpected call, and an unwelcome one. He had just turned down another job offer, “and my family was cheering.” He had a teenage daughter who was hoping to graduate from high school with her friends. But Miller also wanted to see engineering make a change for the better, and he endured years of frustration in trying to put through modest reforms in Iowa and, previously, at the [University of Southern California](#). When the call came from Milas, Miller said, he agreed to fly down to Sarasota, Fla., to meet him in the summer of 1998, “just to have a conversation.”

The conversation went on over two days. Milas told Miller that the endowment would be large enough that the school would charge little or no tuition. “The primary job of the president wasn’t going to be out there raising money,” Miller told me. “It meant that you could spend your time doing the important work of trying to rethink engineering education.” Even more important, Milas told him that he wanted to create a nimble institution that could continually reinvent itself and honor change. “I couldn’t stop thinking about this on the way home,” he said.

Not long after, he became employee No. 1. “My wife sort of thinks of it as my midlife crisis,” he told me.

IT ISN'T EASY TO BUILD a college from scratch, although, to listen to Miller, it’s a lot of fun. Miller recruited a leadership team, and the school invited 30 students (out of more than 600 applicants) to come in 2001 for a “partner year” in which they would help develop and test the curriculum. They helped come up with Olin’s DNA: project-based learning. The first students built projects like golf-ball cannons: they worked with faculty members to master principles of physics, materials science and mathematical modeling on the fly as they planned and built machines that could shoot a golf ball 300 yards. The school officially opened in 2002; it secured agreements with Babson College next door to provide some business and humanities classes; Wellesley and Brandeis nearby also kicked in humanities courses, as well as life-science classes.

The result is a school with no academic departments or tenure, and one that emphasizes entrepreneurship and humanities as well as technical education. Its method of instruction has more in common with a liberal arts college, where the focus is on learning how to learn, than with a standard engineering curriculum. “How can you possibly provide everything they need in their knapsack of education to sustain them in their 40-year career?” Miller asked. “I think those days are over. Learning the skill of how to learn is more important than trying to fill every possible cup of knowledge in every possible discipline.”

Though the school charges no tuition, room and board is about \$12,000 a year, which is in line with the full cost of a year at some state universities. Olin has already garnered an impressive amount of attention in the college guides. A Kaplan/Newsweek “How to Get Into College” guide called Olin one of “the new Ivies.” The Princeton Review says Olin “may well be the most dynamic undergraduate institution in the country.”

And the students are good. Over lunch in the school’s sunny dining hall, one student, Andrew Coats, recalled that in the summer after his freshman year he had an internship, and “we were all given our canned engineering project” to fill up the time. The topic was new to him, he said, but he had already tackled plenty of projects and climbed steep learning curves in just one year at Olin, so he dove in. “I was able to do my summer-long project in two and a half weeks,” he told me with a smile. “Somebody who graduated from [M.I.T.](#) is probably a better formal engineer. They can probably recite better than I could. But I have other experience.”

Alison Lee, a recent graduate now in South Korea on a Fulbright scholarship, said the process of solving seemingly insurmountable problems is an Olin rite of passage, like the project that was given to her and her fellow students: build a robot that can climb a wall. When it worked, she said, “it was the moment of realization that I could do anything.” (In a field where female students are traditionally scarce, more than 40 percent of Olin’s students are women.) The problem-based process is good preparation for the real world, said another student, Meenakshi Vembusubramanian. “You’re not going to go into a job and get a thermodynamics problem set,” she said. “You’re going to have a problem that’s badly defined.”

The notion of taking part in something new is part of the draw for incoming students. Alyssa Levitz could have gone just about anywhere after high school — her grades and scores were great, and her equally accomplished sisters were accepted at the [University of Pennsylvania](#) and Brown. She had visited 15 colleges, and they were starting to blur. But Levitz, who says she is as comfortable with math and science as with historical fiction, and who plays flute, piccolo and piano, found that Olin “just stood out.” She applied, attended candidates’ weekend and says she loved the team project that required her to connect a series of foam slabs to form a kind of aqueduct. More important, she hit it off with an assistant professor of electrical engineering and music, Diana Dabby, who was studying the application of chaos theory to music. She heard a performance of the school’s conductorless orchestra. (“Not even,” goes the campus joke, “a semiconductor.”) These were engineers, yes, but the teachers and students were also artists and musicians and, it seemed, passionate about teaching and learning. It didn’t hurt that Olin charges no tuition, but that wasn’t the point. After she was accepted and feeling the rush that comes with the fat envelope, she

shared the news with friends back in Iowa City. One classmate said, “I always thought you’d go someplace like Brown, one of the Ivy Leagues.” Another said: “That’s the one without accreditation, right? What would be the point in going there?”

OLIN DID RECEIVE ITS INITIAL accreditation last December, after graduating its first class. The school is already causing a stir, even beyond engineering. The [Harvard](#) Macy Institute, a program affiliated with Harvard Medical School, has developed a case study of Olin. “The issues that the Olin case portrayed were very relevant for the kind of problems we’re trying to encourage people to confront” in medicine, said Constance M. Bowe, an emeritus professor at the University of California, Davis, School of Medicine and author of the study. “We need to be teaching them how to learn, as opposed to teaching them a whole lot of facts.” She sees Olin as trying “to create more of a stem cell” — the kind of cell that can become any other kind of cell.

Miller is proud of the Harvard case study, and he showed it to me in his office, a high-ceilinged room decorated with astronomy photographs and attractive stones. Through the large second-floor windows, some of the school’s 300 students could be seen below, crossing the oval formed by the handful of buildings that constitute the campus. Miller helped build the school and teaches in it as well: he created a course in leadership and ethics. He brings in whistle-blowers to talk about the pressures they are under and the importance of taking a stand. One of them was James Ashton, a former executive of [General Dynamics](#) who alerted the government to waste and fraud in the company’s submarine division. Such people, Miller said, describe the accumulation of “seemingly inconsequential decisions along the way” that lead people into ethical crises — something not all schools teach but that students entering the real world need. In traditional academia, he would not be teaching such a course. He has no advanced degrees in philosophy or ethics, only passion for the topic. But, as he put it: “The problem at Enron was probably not the lack of a Ph.D. in a discipline. It was courage.”

That message gets hammered home in the classroom, according to Benjamin Linder, an assistant professor of design and mechanical engineering. His classes have an art-school feel: students, dressed in T-shirts and jeans, shorts or pajama bottoms, are up and down and walking around the room, clustering around their projects and discussing them, cutting blue foam with a hot-wire cutter to make models. Linder told me he pushes his students not to just follow instructions. “Engineering,” he says, “has traditionally been focused on doing it right, but not on what’s the right thing to do.” That means designing products that are environmentally friendly and that respond to the needs of the people using them and not just to what the purchasing department wants. He urges his students to be more than team players. The goal, Linder said with utter earnestness, was to teach fledgling engineers “how to be bold.”

Some within the engineering profession are drawn to this side of Olin. Robert G. Bea, a professor of civil and environmental engineering at the University of California, Berkeley, applauded the efforts of teachers like Linder to encourage questioning and pushing back. Bea, who worked on investigations into the New Orleans disaster and the loss of the Columbia, told me: “We are, as engineers, taught to be servants. We’re trained to do things, not to tell you that we can’t.” Alan Eustace, senior vice president of engineering and research at [Google](#), wondered if the Olin program might produce precisely the kind of students Google is looking for. “I absolutely believe that teamwork and experiential learning and understanding problems and bringing multiple disciplines together to solve problems is fundamental to the way that engineers work” in the real world, he said. “The skills they are trying to develop are very meaningful in environments that we try to build.”

But not every company is Google, and Miller admitted he is concerned that few of the class of 2006 are going on to graduate study in engineering or jobs in the field. Some graduates have told him that they are not happy in their first jobs and feel like cogs in a machine. “I’m hoping to get the message to our kids that a little bit of patience and endurance could pay off in the end,” he said. Still, “this is one of the things that keeps me up now.”

In some companies, he says, the freethinking products of Olin might have trouble fitting in. “Does industry want people like that? I think that’s a very good question, but I think this goes beyond what industry wants,” he said. “This is the right thing to do — this is what industry needs. If the country had more people like this, we’d be in a much better situation.”