mechanical engineering

feature article

engineering management

going soft

Good engineers don't necessarily make good managers. But fear not—You can learn to lead.

by Jean Thilmany,
Associate Editor

No doubt, at some point in your engineering career you've received the e-mail that purports to spell out the difference between engineers and so-called normal people.

When they get together, normal people seek stimulating conversation, social contacts, and a feeling of connectedness. When engineers meet, on the other hand, they want the meeting over as soon as possible. Above all, they want to avoid getting invited.

The old gag about engineers and social skills isn't true, of course, and often seems designed to raise the hackles of the technically gifted.

Brett Lindenfeld managed a team that, in his words, was made up of superstars. In 18 months, the team developed robotic arms for the Mars Exploration Rovers.

Okay, maybe there's just a smidgen of truth. A lack of people skills is understandable and eminently correctable, according to Steven Cerri, who teaches what he calls soft skills to engineers who want to make the transition to management. He heads STCerri International of San Rafael, Calif., and leads workshops that teach communication and interpersonal skills to technical professionals.

The gulf between engineer and manager is huge, though spoken of infrequently, Cerri said. Often, management itself rewards good engineers with promotion, not taking into account that the two jobs require vastly different sets of skills.

As a former engineer who became a manager and—after an initial struggle—found he had an inherent knack for dealing with people, Cerri sympathizes with engineers on the cusp of moving up.

"As engineering students, we're taught that there are right and wrong answers," he said. "It isn't as if in college we're given essay tests where we get to argue. In our world, if the answer is 3.14, it's 3.14.

"But in management, there's no right or wrong," he added. "There are only effective answers. Management deals with ambiguity, with situations where answers don't exist in a right-and-wrong structure. I believe management is a whole new career for engineers, but that people don't treat it as such."

Managing a group of people is an ambiguous job. Not so engineering. There's no one-size-fits-all management style. Those charged with heading a group of employees must use what Cerri calls a contextual leadership strategy. That is, they choose how to lead their teams based on each individual situation.

That continued need to choose might be a nightmare to engineers, who are used to hard numbers, Cerri said.

My Reality, Your Reality

Most of us are drawn to careers that mesh with our inherent likes and dislikes, and with what Cerri calls our internal maps of reality. Those who go into technical professions do so because they're drawn to certain things about that world, such as verifiable results and the sense of solving a problem. Those drawn to other careers —journalism, say—seek different daily rewards: an ever-changing job, for example.

"We pick a technical field because that's the way we want to move through the world," Cerri said. "If we wanted to be involved with people, we would be therapists."

Despite the job-skills differences, engineers on their way up frequently choose to become engineering managers or to open their own consulting businesses. As managers or entrepreneurs, they need to exercise a new set of soft-skills muscles.

Cerri's initial class is for corporate engineers who are thinking about a transition to management. This first class helps those employees look at whether they'd even like to manage people. Cerri kicks off with a questionnaire that evaluates each person's natural tendencies.

"The questions repurpose the technical mind by asking people how they process information," he said. "Technical people need to figure out how far they are from what they need as managers. They need to see what skills they'll need."

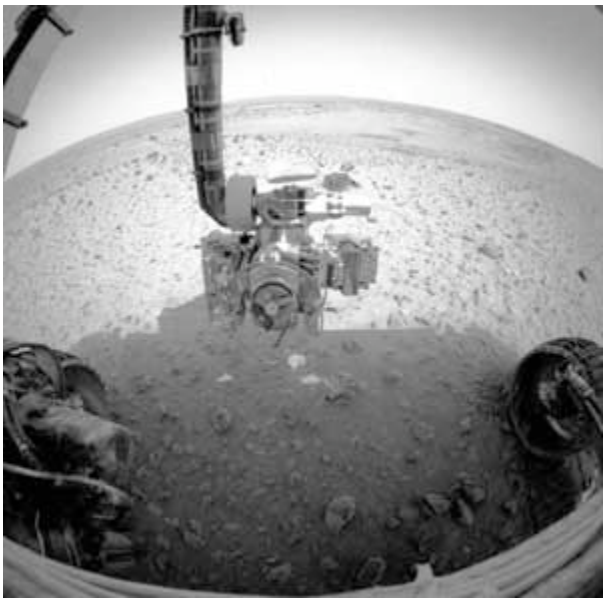
His second class is aimed at engineers who definitely want to manage or who are already leading people. Students include mid-level managers, project managers, and team leaders. For this class, Cerri puts his students into a variety of made-up situations to teach them how to best communicate.

The exercises show engineers how to, as Cerri puts it, step into others' maps of reality.

"You have to enter their world, because they're not coming to yours," he said.

"You have to learn how others process information," he added. "While you're talking to them, there are ways to find out how they do that. Then you can send messages they'll understand. If you send messages from your own reality that they can't get, they'll need to translate. They'll get frustrated, drop information, and you don't want that."

Students learn how to focus their messages to best help engineers receive them. They focus on the nonverbal aspect of communication.



Traditional project management didn't work when building the Mars Rover robotic arm.

For instance, for one exercise Cerri asks his students to program a videocassette recorder. He tells them to do this two separate times, using the exact same wording and instructions each time. There's a hitch, of course. When he gives the first set of instructions, he condescends to students via verbal tone and body language. The second time, he speaks calmly.

Cerri then asks his students what they thought of the exercise. To a person, they usually tell him the first time he told them what to do, they felt uncomfortable. They

second time they didn't. And they were better able to program the VCR.
"I say to them, 'I only changed my tone,' " Cerri explained. "Then they get it. Engineers usually haven't gotten this before."

During a second exercise, he asks students to pick a topic on which they disagree and one on which they agree. The trick is, they discuss the topic on which they agree without building rapport, a skill Cerri teaches. Then, using methods to build rapport, they discuss the topic on which they disagree.

"They realize that even though they agree, without rapport it's uncomfortable," he said. "I say to them, 'With your customers, your colleagues, wouldn't you rather have rapport?' "

He deliberately leads interactive exercises, because students don't need to read about gaining soft skills. They need to practice them and to see them in action, Cerri said.

"Most people think what's important is to know how to do something," he said. "But we all know we should exercise more, and eat right. There's a lot of information on how to do that, but we still don't do it.

"What's important is to change the way you think, the way you perceive situations as you move through the world," he said.

When they're in trouble, managers frequently work harder, using the tried-and-true engineering skills they already possess. They fall back on what they know best, whereas they need to work harder as managers.

"Really, when it comes to working with people, it's about what's going on inside, rather than what's happening outside yourself," he said.

Leading at the College Level

Engineers who plan to be managers or go into business for themselves should learn and nurture leadership skills as early as possible in their careers, preferably in college, according to Steven Nichols, director of the Chair of Free Enterprise in the College of Engineering at the University of Texas in Austin.

Although Nichols is on the mechanical engineering faculty at the school and serves on the ASME Executive Committee on Engineering, Management, and Technology, it is in his role as director of the Chair of Free Enterprise that he encourages a culture of leadership and creativity among students.

"I believe in mantras, in short phrases that sell what you're doing," Nichols said. "And I believe in saying it again and again: technology, innovation, creativity, and leadership. That's what we should be fostering in our students."

The engineering school specifically emphasizes a mix of technical and leadership skills for the well-rounded engineer. Although leadership skills are most often considered only when engineers become managers, they're vitally important for all engineers, Nichols said.

The skills must be encouraged early because a significant number of University of Texas engineering graduates will work for themselves at some point in their careers. They'll be managing their own companies—even if they're companies of one—and dealing with clients and customers, Nichols said.

"We believe creative, entrepreneurial, and leadership skills are something all engineers should have, not just a few engineers," he said. "They're skills we expect from our faculty, so we should expect to develop these same skills in our graduates."

Engineers need to think broadly about what their responsibility is within their organization, he added.

"I fear our tendency is to teach engineers that what they do is equations," Nichols said. "But what they really do is create and innovate. Yes, they have to have technical

excellence, or they're not engineers. That's the heart and soul of the discipline of engineering. But the creative process is what they give to society."

Companies are filled today with engineers and managers who can execute ideas. But it's the corporations staffed with engineering managers who create new ideas that will be around in 50 to 100 years, he argued.

To help promote these skills, Nichols's school sponsors a competition called Idea to Product, which challenges students to create and market something new. The students, with the help of business mentors from the community, develop the product, device, or service from start to finish. They must take advantage of technology to create the product and the product must meet a societal need.

Last year, one group of students developed a technique for rapid prototyping that uses silicon carbide, for example.
In the process of moving from development to marketing, students learn to work with each other, to be creative, and to lead, Nichols maintained.

The Rover arm carries four instruments that collect data about the surface of Mars.

Brett Lindenfeld, director of engineering at Alliance Spacesystems Inc. of Pasadena, Calif., was in charge of a team that had to work fast to create machinery that would play well with others. And, once they let it go, there was

no correcting mistakes.

Last year, Lindenfeld led the Alliance Spacesystems team that built and tested the robotic arms mounted on the front of NASA's two Mars Exploration Rovers, Spirit and Opportunity.

The Jet Propulsion Laboratory in Pasadena, Calif., which built the rovers, initially contacted Lindenfeld's company in November 2000 regarding the rover arms.

Although the one-meter collapsible arm relied on the rover to get to Mars, it is more than a sidekick. The robotic arm—NASA officials call it an instrument deployment device, or IDD—carries all four instruments NASA is using to collect data about Mars's surface.

"The JPL needed the arm to be more advanced than on the previous Mars lander and they needed it to be brand-new, developed from scratch," Lindenfeld said. His team had 18 months to deliver the first arm. Because the JPL was developing the rover itself within the same time period, Lindenfeld's team had no existing sketches or plans to work from.

"The deadlines were insanely quick," Lindenfeld said. His team had approximately four months to create about 300 part drawings. In all, the team designed four arms, including two for use on the rovers, one strictly for testing on Earth, and a spare arm, which wasn't assembled. The arms were made up of more than 1,000 pieces each, 300 of which were unique to each arm.

The end of each arm would hold four instruments, including a microscope and a spectrometer. They were provided by other vendors. Lindenfeld's team needed to provide a way for these instruments to be attached.

Tossing the Traditional

His team comprised five engineers who designed, assembled, and tested the arms, and three additional engineers who prepared testing and assembly methods.

JPL paid just under $10 million for the arms.

Lindenfeld found that traditional project management methods didn't work in such a fast-paced, highly technical design environment where engineers worked without precedent. Instead, he relied heavily on sending electronic drawings to JPL, using e-mail and collaborative software.

His engineers used analysis software to iterate like crazy, in his words. But it was ingenuity and a well-trained, creative team that got him through, he said.

"I'd be lying if I said I had a master plan every step of the way," he said. "I had a team of superstars. They needed direction and guidance, not really management. These are the most driven people you can imagine."

Lindenfeld compared his management duties for the project to constructing a road for marathon runners as they ran, always building just a few meters ahead of them.

"I was the one coordinating with JPL; I was making sure they had all the tools they needed and had no distractions," he said. "There were a zillion things to do, but my team couldn't worry about that.

"I needed to keep building and clearing the road in front of them and to make sure I didn't build it into a brick wall," Lindenfeld said. "I was the one with the big picture of where the road should lead."

Of course, he had the responsibilities of a traditional manager, balancing the project's schedule, cost, and risk. But a tight, highly motivated team helped immeasurably, he said.

Perhaps without realizing it, Lindenfeld showed in the course of helping develop the rover arms that he has what Cerri and Nichols say it takes to be a great engineering manager. And he's modest to boot.

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