Problem Solving: Engineers as Leaders
The Art of Leadership from the Perspective of an Engineer

by Steven B. Sample

I am an engineer by education and a leader by experience. Both are problem-solving professions that have dissimilar roots. Engineering employs the application of well-defined and long-lasting mathematical, scientific, and technical principles, while leadership is remarkably fluid, situational, and contingent. Unlike the specificity of math and science, leadership has no set rules. This elusive quality of leadership makes it an art, not a science. Thus it is more like music, painting, and poetry than it is routine endeavors. Nonetheless, aspiring leaders can be taught to develop their own potential for leadership by studying what’s worked for others.

As part of my own study of leadership, management expert Warren Bennis and I co-teach a course for juniors and seniors each spring called “The Art and Adventure of Leadership.” It is now the most sought-after course at the University of Southern California, attracting more than 300 applications for just 40 slots.

Although most of the students in this leadership class aren’t engineering majors, I often tell them how the study of engineering has made me a better leader. It’s a way to remind them that leaders come from all types of disciplines and backgrounds. In other words, the path to political leadership is not necessarily through law school, nor is business school the only route to becoming a company president.

In fact, 30 or 40 years ago, the doors were closed to engineers who wanted to be presidents of comprehensive universities. Today, among the 62 members of the Association of American Universities (which comprises America’s leading research universities), 10 are led by engineers (including USC).

What lessons can be learned in engineering that can contribute to a person’s effectiveness as a leader? At the top of the list would be analytical thinking and judgment—key attributes of the engineering profession. These qualities can help leaders examine problems from various angles and assess situations through qualitative and quantitative means.

The downside of engineering as preparation for leadership occurs when engineers become so entrenched in a particular technology or methodology that they stop exploring new ideas. They lapse into rigid thinking that can stifle their own creativity and that of others. In addition, engineers—whose work directly affects people—sometimes gloss over the importance of moral considerations in the design and creation of new products or processes.

What I love most about engineering is that it cultivates skillful judgment and analysis—key ingredients in problem solving. Real engineers make judgments based on inadequate information and imperfect designs. They operate under constraints such as time, cost, size, reliability, customer appeal, and what the competition is doing. Sometimes an engineer’s judgments are based as much or more on gut feeling than on precise analysis.

One does not need to crank out closed-form analyses of problems to lend themselves to precise solutions to be a professional engineer; such work can be done by computers and technicians. Rather, the exquisite part of engineering involves deciding to move ahead with a solution based on reasonable professional judgment and analysis when you know that that solution is not as good as the one you might develop if you were to keep working on the problem.

In exploring possible solutions to a problem, engineers—just like leaders—must be careful not to fall into the proverbial rut of rigid and narrow thinking.
Often the most important inventions in a particular field are made by people who are new to that field—people who are too naïve to know why something can't be done. These neophytes, unburdened by hidebound perspectives and internal naysaying, are able to think more freely about seemingly intractable problems. They're willing to explore radically new ideas and technologies.

Unfortunately, some engineers feel threatened by new inventions. When I was a practicing engineer, I quickly found out that many of my colleagues, after just a few years in practice at one company and in one technology, become psychologically and emotionally welded to that technology.

Just consider this: At one time, the leading vacuum tube manufacturer was RCA. Then the transistor was invented. One would think that RCA, as the dominating force in the electronics business, would have latched onto the transistor as a new technology that could take their business to greater heights of success. However, the engineers at RCA hated the concept of the transistor. So Texas Instruments became the rising star of the transistor business. And although an engineer at Texas Instruments later invented the integrated circuit, most of the engineers at TI had spent their whole lives with transistors and didn't want to have anything to do with integrated circuits. Another firm—Intel—became dominant in that field.

Although hidebound thinking can be stultifying, moral laxity can be downright dangerous. Leaders must develop a strong moral compass if they are to be effective leaders. Even the perception that a leader is dishonest, unfair, or unconcerned about the rights of other people can adversely affect the success of a company or organization.

As engineers, many of us would like to think that engineering is somehow morally neutral. But engineering is all about empowering people to manipulate and exploit the natural world for their own purposes. Thus, engineering is inevitably involved in moral as well as technological issues.

Sometimes the outcomes of our work as engineers are morally repugnant. For example, engineers are frequently asked to develop better methods for killing and maiming people.

However, engineers also have developed ways to make people safer, communication faster, infrastructures stronger, and computer systems more secure. Engineers are at the forefront of developing new and better robots, biomedical devices, nanotechnology devices, and multimedia tools that enhance the health, education, and well-being of people around the world.

As an engineer, I'm especially pleased that top research universities such as USC are in the vanguard of pursuing solutions to societal problems. Most of society's major challenges are global in scope. They include sustainability, disease prevention, environmental quality, and fossil-fuel alternatives—all areas in which engineers can and do make important contributions to improving people's lives.

**Conclusion**

In conclusion, the best advice I can give to those people studying engineering or leadership is to cultivate their natural creativity, intellectual independence, and moral integrity. These are the best tools for guarding against the rigid thinking and moral ambivalence that can drag down or prostitute new ideas.

The goal of my work as an engineer—and as a leader in higher education—has been to expand human potential. I encourage engineers who are inclined toward leadership to exploit the fact that their talents and predilections as engineers will serve them well as leaders.

For more on this topic, visit [www.hkn.org/bridge](http://www.hkn.org/bridge)

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An electrical engineer, inventor, and author of the best-selling book *The Contrarian's Guide to Leadership*, Sample has been president of the University of Southern California since 1991. A recent publication of the Harvard Business School listed his book as one of six "must-reads" for leaders. In February 1998, he was elected to the National Academy of Engineering for his contributions to consumer electronics and leadership in interdisciplinary research and education. He was named an Eminent Member of Eta Kappa Nu in October 2005.