GRAD ED: CHALLENGES & CONNECTIONS

Are there experts in engineering ethics?

Karl D. Stephan

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As a student, every class day you listen to lectures by experts: people who know more than you do about technical topics. While you may never become as qualified an expert in Fourier transforms or microelectromechanical systems as some of your professors, you attend lectures because you want to join the ranks of a larger class of experts known to the public as engineers. So expertise is an inseparable part of engineering education.

When you graduate, your engineering expertise gives you special powers and abilities that less-qualified people do not possess. With such a privilege comes the responsibility of using your talents wisely and ethically. But ethical training, at least in terms of credit hours, seems to take a back seat to technical training in engineering schools. Back in 1999, I published a survey of 254 U.S. engineering schools that showed that fewer than a third of the schools surveyed required all their

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undergraduate students to take a course in which engineering ethics was mentioned in the catalog description. And only about 17% required a stand-alone ethics course for all students. While some progress has been made since then in incorporating ethics into the curricula of many engineering schools due to a change in accreditation requirements that occurred around 2000, it is likely that most engineering students still do not take a stand-alone course devoted exclusively to engineering ethics.

Is this a problem? Shouldn't engineering students, the people who will soon be developing the latest high-tech engineered products and services, also get the benefit of the very latest and best in ethical training too? If ethics is so important to engineering, where are all the ethics experts to teach the latest in ethics advances?

This question used to bother me a lot. From the time I learned there was such a thing as engineering ethics, I had the impression that while some ethical problems could be solved by your average engineer, there were others that were simply beyond the abilities of most people, and somewhere there were specially trained ethics consultants, maybe, that you would call in for the hard cases. In fact, I simply extended the expertise model I was familiar with in the technical aspects of engineering, to the realm of ethics. But I have since learned that this was a mistake.

As you progress through a typical modern engineering program, you are trained to think scientifically. By "science" we mean knowledge that is based on observations and experiments and that can be objectively verified by more observations and experiments. This is good as far as it goes, but it is easy to fall into the trap of thinking that *all* knowledge is, or should be, scientific in the same sense. The engineer who decides on which person to date by developing a spreadsheet with weighting factors for all candidates based on appearance, talents, and so on is clearly taking this scientific approach too far. (At least it's clear to me—but maybe you think it's a great idea!) The point is that there are areas of our lives—matters of human relationships, trust, faith, and other issues of the heart—in which the scientific method is not the best way to find out what you need to know.

Ethics, it turns out, is one of those areas. In the third century B.C. there were no engineers in the modern sense

"There is no single place where you can find the rules to follow in engineering ethics," Stephan says.

of the word. People built some amazing things back then—bridges, temples, aqueducts—but science as we know it played no part in their technical knowledge, which was based mainly on tradition or trial and error. Around 360 B.C. a man named Aristotle wrote a book on ethics that ethics experts (otherwise known as moral philosophers) still read, comment on, and teach from today. Does that mean that unlike technology, which continually builds on new scientific knowledge as well as advances in technology itself, the field of ethics has seen no progress for over 2,000 years?

Most students need to be taught that an engineering organization in which everyone individually has the best of intentions and makes what looks like the right decisions on a personal level, nevertheless can do great harm.

Yes and no. Yes, because the questions answered by ethics have to do with human beings and human nature, and human nature has not changed fundamentally in all that time. The ethical dilemmas, the temptations to do wrong, and the habits of character that Aristotle discussed are the same basic kinds that you deal with every day of your life. But the subject of ethics has progressed in the last 2,300 years in the sense that the world we inhabit is radically different from Aristotle's Athens. It is much more interconnected, physically and intellectually. It moves faster, and engineering mistakes that in Aristotle's time might result only in a few people getting crushed by a collapsing balcony, can now result in the deaths of thousands in widely separated parts of the world.

For the first hundred years in the history of modern engineering (which dates back only to 1830 or so), there were essentially no classes, textbooks, or experts in engineering ethics. Yet during that time millions of people benefited from engineered products that, by and large, were made and sold ethically (though with notable exceptions). This happened because most people who have the self-discipline and intelligence to master an engineering field and do things right technically also have the moral qualities it takes to do the right thing ethically. I believe engineering ethics arose as a separate discipline in the 1960s mainly as a response to the increasing complexity of the engineered world. Most students need to be taught that, for example, an engineering organization in which everyone individually has the best of intentions and makes what looks like the right decisions on a personal level nevertheless can do great harm.

An ethical point of view

For the past few years I have written a weekly engineering ethics blog (http://engineeringethicsblog.blogspot.com/). Does this make me an engineering ethics expert? I have never taken a philosophy or theology course for credit. I won't go so far as to say that anybody can become an expert in this field, but anyone with an engineering degree can take the trouble to look at a problem from an ethical point of view. You can ask questions such as: Who is affected by what I'm doing? What are their interests? How could they be hurt or helped by this engineering activity? What are my responsibilities and those of my organization? Simply asking these questions and trying to find answers takes you a long way down the road to truly ethical engineering.

Engineers like rules, and you may ask what the rules are in engineering ethics. There is no single place where you can find the rules to follow in engineering ethics, just as you will find that for a sufficiently complex engineering problem, there is no such thing as the unique "best"

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design. However, just as there are systematic ways of approaching engineering design problems, there are step-by-step procedures you can learn that will enable you to approach ethical problems intelligently. Many people (including myself) rely on their respective faith traditions for ethical guidance. Despite the fact that the different great religions teach radically different things about the unseen world, it turns out that what they say about how we should act in the present world is pretty much the same in its essentials. Even people without a religious faith commitment generally have a conscience—an inner voice that helps them know right from wrong—and they know when they are doing wrong. The challenge for all of us, believers or otherwise, lies in whether we listen to that voice, and what we do about what it tells us.

So don't worry if you missed out on the advanced engineering ethics class—although if you have a chance to take an ethics course, by all means do so. I missed out, but that didn't stop me from writing about the subject every week. And it shouldn't stop you from being as ethical as you can be in your chosen engineering career.

Further reading

Aristotle's *Nichomachean Ethics* is available in a number of good translations in English and other languages. For a good short treatment of how the world's religions basically agree with regard to fundamental moral principles, see *The Abolition of Man* by C.S. Lewis. My survey on ethics education appeared in the October 1999 issue of the *ASEE Journal of Engineering Education* (vol. 88, pp. 459–464, with erratum vol. 89, p. 1, Jan. 2000).

About the author

Karl D. Stephan (kdstephan@txstate.edu) obtained a B.S.E.E. from Caltech, an M.Eng. from Cornell, and a Ph.D. in microwave engineering from the University of Texas at Austin. After 16 years at the University of Massachusetts, Amherst, he joined Texas State University-San Marcos in 2000, where he is now a professor at the Ingram School of Engineering. He has published over 80 journal and conference papers in the fields of microwave engineering, atmospheric physics, the history of technology, and engineering ethics.

For information on the IEEE Code of Ethics, visit http://www.ieee.org/about/corporate/governance/p7–8.html