

Rules can't cover all contingencies, but ethical systems can help engineers make decisions that ultimately hinge on their sense of values. What of all this can be taught?

RULES, ETHICS and MORALS

In Engineering Education

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In professional engineering practice, as in everyday life, we are constantly required to make decisions. Sometimes these decisions are fairly simple, such as what flavor of ice cream to eat, or what value to use for the overflow rate in designing a clarifier. Sometimes, however, they can be difficult, such as whether to lie to your children if you know the lie is to their benefit, or to look the other way at payoffs between vendor and consulting engineer. Such decisions are based on our knowledge of law and rules of professional conduct, our selected ethical system for decision-making, and our sense of moral values.

Although engineers are constantly making value-laden decisions, they seldom recognize the underlying bases for such decision-making, nor are they taught in universities or during their careers the principles of ethical thinking. My objective in this article is to propose functional definitions for three commonly used words in value-laden decision-making—rules, ethics, and morals—and discuss how these concepts enter into engineering practice as well as the role of education in helping engineers make value-laden decisions.

Rules

The strictest rules in engineering involve mathematics, physics, chemistry, and the other sciences. Rules from science are a means of organizing our thinking, and their validity is seldom questioned. The rules discussed here do not refer to such laws

of nature, but to two other kinds of rules.

One type of rule involves sound engineering practice, rules either dictated by regulatory agencies or codified in technical manuals, handbooks, and standards. In structural engineering, for example, the AISC Manual of Steel Construction specifies design criteria. Good engineering practice dictates that such standards be followed unless given satisfactory reasons to design on some other basis.

The other type of rule relates to ethical concerns in engineering practice. Every profession has, whether explicit or implicit, a set of rules for professional conduct. By belonging to a profession one accepts its standards and constraints. By calling oneself a professional engineer, one agrees to abide by the set of professional ethics articulated by the National Society of Professional Engineers. NSPE's Code of Ethics contains many rules relating to professional practice, such as:

► [The] engineer shall not solicit or accept financial or other valuable consideration, directly or indirectly, from contractors, their agents, or other parties in connection with work for employees or clients for which they are responsible.

The intent of such rules, which leave little room for maneuver, is to provide a path to the "correct" decision if an engineer is faced with an ethical question. For example (using an actual case), if the principals in a firm ask an engineer to suppress a report that raises serious environmental concerns about a project, but

which also happens to be critical of one of their major clients, the NSPE code clearly states:

► Engineers shall at all times recognize that their obligation is to protect the safety, health, property and welfare of the public. If their professional judgment is overruled under circumstances where the safety, health, property or welfare of the public are endangered, they shall notify their employer or client and such other authority as may be appropriate.

In other words, the engineer is obligated to blow the whistle. Even though whistle-blowing is at best a difficult act which can permanently scar one's professional career [see the article that follows], the *rules* say that this is the proper course of action. Rules can thus be defined as *explicit commandments which dictate proper conduct*.

A picture of the rule model of decision-making is shown in figure 1. The dilemma is represented by the block labeled "problem requiring solution"; it is necessary to choose one course of action that will lead to one result. The Code of Ethics is intended to be a set of rules which define the "correct" path leading to the "correct" decision as dictated by the collective wisdom of a professional society. The engineer need only be familiar with the code to select the proper path using the "rule filter" shown in figure 1.

But suppose the dilemma confronting the engineer is not covered by the rules—or worse, covered by several contradictory rules. Suppose an engineer working on a major public-works water resources project rec-

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ognizes that although the project is technically sound, the economics have been falsified to make the project palatable to Congress. The code says:

►Engineers shall advise their clients or employers when they believe a project will not be successful.

But what is meant by successful? Is the waste of public money sufficient to classify a project as unsuccessful?

Suppose an engineer called on to study the control of industrial waste finds that a process employed by the client may create a serious pollution problem. Turning to the code, the engineer finds:

►Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties;

and, reading further,

►[The] engineer shall not disclose confidential information concerning the business affairs or technical processes of any present or former client or employer without his consent.

Clearly the code does not provide the proper rules with which to address the problem. If the engineer truly holds public safety paramount, then he or she must report the danger to the authorities. This action, however, clearly contravenes the responsibility not to disclose proprietary technical information. The engineer cannot do both; and is thus faced with a moral dilemma.

This problem can be conceptualized as shown in figure 2. The rule filter may provide two equally acceptable (by the code) results, or it may provide *no* options, since the problem was either never anticipated by the rulemakers, or they anticipated the problem but could not arrive at a satisfactory resolution.

Some codes are internally classified into *fundamental canons* and *rules of practice*. But the canons are often nothing more than rules in disguise. For example, one fundamental canon in the NSPE code states:

►[Engineers shall] avoid improper solicitation of professional employment.

There is little that is "fundamental" about such a rule.

The so-called codes of ethics of professional engineering are in fact nothing more than sets of commandments, which can provide valuable guidance in solving moral dilemmas. Often, however, the rules are inadequate and another means of decision-making is needed: the concept of ethics.

Ethics

For an engineer, one of the most frustrating aspects of beginning a study of ethics is that ethicists, who presumably have spent professional lifetimes studying the stuff, are unwilling to agree on a definition.

If ethics cannot be defined, does it exist? This question has been seriously debated. At the turn of the century, ethics ceased being widely taught in American universities because empirical sciences were all the rage and ethics simply didn't measure up. The movement was symbolized by the famous pronouncement that "whatever exists at all, exists in some amount."¹ Since there cannot be an "amount of ethics," how then can ethics exist?

More recently, it has been suggested that since everyone understands what ethics is, why try to define it?² If it is possible to have congressional ethics reviews and codes of ethics, and even professional "ethicists," all lacking an adequate definition of ethics, why beg the question? It is indeed tempting to forget the problem of definition and just get on with *doing* it.

Unfortunately, my training as an engineer demands definitions. I believe that only by establishing a functional definition of ethics (and other terms in the language of values) can useful communication occur. Some philosophers have in fact taken a crack at defining ethics (see box, opposite page).

Despite the varying definitions, there is some consensus. Philosophers will agree that ethics relates not to how people actually treat each other (the domain of social science), but how they *ought* to treat each other. Ethics allows us to *evaluate* actions and study how value-laden decisions ought to be made.

We can further clarify the question by subdividing ethics into components. Meta-ethics, for example, is concerned with the meaning of such words as *good* and *justice*. Normative ethics is concerned with the question of what, all things considered, ought to be done. Since in engineering the question is, of course, what ought to be done in a given situation, this discussion is limited to normative ethics.

At the risk of adding another incomplete and personal definition into the ring, I propose for the purposes of discussion this definition of ethics:

Ethics is the study of systematic methodologies which, when guided by individual moral values, can be useful in making value-laden decisions.

This definition has a clear engineering bias. I suggest that ethics is a *study*, that it is *systematic*, and that it can be *used* for something positive.

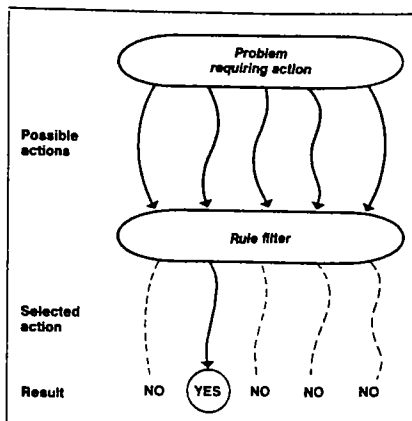


Figure 1. The code of ethics defines the one correct course of action.

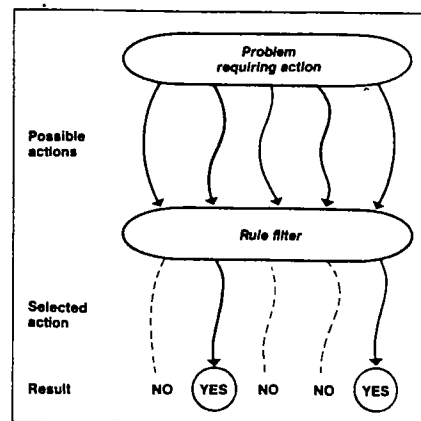


Figure 2. The code may provide two equally acceptable paths.

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Attempts to Define Ethics

Here are some examples of attempts philosophers have made to define ethics:

■ Ethics is the name we give to our concern for good behavior. We feel an obligation to consider not only our personal well-being, but also that of others and of "human society as a whole."³

■ Ethics is a systematic study of human actions from the point of view of their rightness or wrongness as a means of achieving ultimate happiness.⁴

■ Ethics is the science that deals with conduct, insofar that this is considered as right or wrong, good or bad.⁵

■ [Ethics is a] system or code of morals of a particular person, religion or group.⁶

■ Ethics is the science of determining values in human conduct.⁷

It should be clear that philoso-

phers disagree on what ethics is. Is it a science or a concept? Is it a way of thinking or a guide to living? Is it a means of coexisting in society, or a calculation of how best to achieve ultimate happiness? Perhaps it is all of these. Or none. Philosophers can apparently exist comfortably in such a Babel of definitions and even admit as Alasdair MacIntyre does, that

■ Our reply to a request for an account of *the* meaning of "ethical" would have to be: there no longer is such a concept or such a meaning. Instead we are forced into a task of conceptual reconstruction. Any such reconstruction will... itself be morally partisan.⁸

Another philosopher confesses that

■ Both the term "ethics" and the realities to which it purports to refer are highly problematic in our society, subject to seemingly endless disagreement and lack of resolution.⁹

The path from problem to result depends on which system of ethics is used, and hence what type of questions relative to the problem are asked. Suppose one of the systems represents *deontological* ethics. In this system, each act is judged purely on whether the act is "right" or "wrong," regardless of its consequences. Lying might be one act that would be considered wrong; in a deontological decision system, in all instances where a choice has to be made between lying and telling the truth, the latter would always be chosen.

Consider the dilemma of an engineer called to testify on behalf of a community that wants to place sludge on land as a means of ultimate disposal. The engineer is asked at a public hearing if the sludge contains any carcinogens. The engineer knows full well that if one looks hard enough, it is highly likely that some carcinogens, probably at very low concentrations, will be discovered. All the data *he* has seen, however, indicate the absence of carcinogens. Should he answer "No," or "Yes, of course, all sludges contain some

amount of carcinogens," or something in between? A deontological decision would be to tell what he knows, even though the consequences may be that a community is denied an acceptable disposal alternative. If, on the other hand, the engineer used *utilitarian* ethics, in which the end result is important, he would answer "No," confident in having performed the best service for the community. He would have calculated the sum total benefit of his two alternatives and chosen the one that (in his opinion) produced the greatest good.

A special system of ethics, developed only in the past 40 years, is labeled *environmental ethics*.¹⁰ All previous ethical theories concentrate on how people relate to each other. Since the moral agents are exclusively human beings, only people constitute the "moral community." In environmental ethics, this moral community is broadened to include plants, animals and even inanimate objects, and its calculations include environmental concerns as a legitimate moral agent for which we have

responsibility. Accepting environmental ethics as part of a utilitarian calculation requires that values be placed on natural objects and beings other than ourselves. A deontological environmental ethic, on the other hand, would require imperatives based on caring and respect for things natural.¹¹ This extension of classical ethics presents an exciting new challenge for both philosophers and environmental engineers.

My definition of ethics suggests that ethical theory can be reduced to a series of decision trees applicable to problems that require ethical reasoning. Once a decision tree is selected, it can be applied to any value-laden problem. Education in ethics, by this definition, involves the understanding and appreciation of formal ethical thinking. If a system of ethics is suggested that is based on "promoting the greatest good for the greatest number," students should recognize this as a utilitarian calculation. If ethical reasoning is based on the principle of "always treating individuals as ends in themselves and never solely as means," this should be recognized as a classical deontological statement.

Some authors have tried to create a model for engineering decisions in which the engineer has only to insert the variables into the program and turn the crank.¹² Unfortunately, such attempts mask the true meaning of ethical inquiry, since the underlying principles are not understood for the formulation of the procedure. This situation is analogous to trying to teach the concept of alum coagulation without understanding inorganic chemistry. In fact, quite unfortunately, the concept of first explicating and then applying ethical theory without further thought has been derisively called the "engineering model" of ethical practice.¹³

When we are ready to translate the carefully calculated "ought to do" to the "do" of our actions, we have to ask if, all things considered, it *feels* right. I have avoided until now discussing *how* one makes individual decisions. One decision point, for example, may require a decision to lie or to tell the truth. I presume

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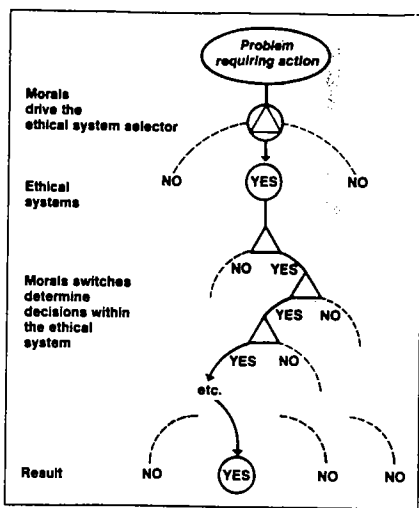


Figure 3. Decision tree shows how various ethical systems lead to different actions.

we all agree that lying is a negative value, and truthfulness is positive. But how does one choose that moral value? What goes into the making of the decisions necessary within the system of paths in resolving value-laden problems? The answers to these questions require a discussion of the concept of moral values.

Morals

Perhaps we can visualize, as shown in figure 3, the moral dilemma of getting from the problem to one of the end results, using any one of a number of pathways that represent the various ethical systems. Morals, I suggest, are what provide the gates at the decision points. I agree with Morrill's definition of moral values:

Moral values are those standards or patterns of choice that guide us toward satisfaction, fulfillment or meaning.¹⁴

Suppose one were to choose a deontological system of ethics, but conclude that lying is acceptable and that truthfulness is not a value to which one should ascribe. If, in other words, a decision is to be made, the question of true/false is irrelevant. A person who does not recognize lying as wrong lies freely and thinks that all people act this way. Such a person could easily use a system of deontological ethics, but simply not plug in the question of truthfulness in the decision-making. In the above-

mentioned sense of ethics, he or she would be perfectly "ethical."

But we would like to think that this person is wrong. We would like to have our fellow travelers respect the inverse golden rule, to "not do unto others what you would not have them do unto you." Put another way, we would hope our friends and colleagues are moral people, that they have a sense of moral values we agree with, and that these are universal values rooted in the common search for happiness.

In a deontological system, one has first to choose to accept lying, cheating, or stealing as wrong actions. In a utilitarian system, one has to accept that the happiness of others is a positive value, a good that goes into the calculation that decides the answer. It is quite possible, for example, to use utilitarian calculus so that the only good calculated is the happiness one collects for oneself. At the other extreme, environmental concerns might be included in the calculation and strongly tilt the response toward an answer that is not in one's short-range self-interest. Caring for other species is a moral value that one either possesses or does not ascribe to.

All these are *morals*, the "value baggage" one carries along that activates the gates in ethical systems. Where did these moral values come from? Why is it that not all people agree on any given set of moral values? Did all of us somehow "catch" morals as we were growing up, or could it be that they were taught?

Teaching Rules, Ethics and Morals

To recap:

- Rules are easily formulated and clearly stated commandments. Many difficult value-laden decisions in professional engineering practice can be made using established rules such as the codes of ethics.

- Rules, unfortunately, cannot cover all possible dilemmas concerning value-laden problems; a system of ethical thinking can be used to organize one's thoughts.

- It becomes necessary to select

an ethical decision-making system, and this selection depends on one's experience and knowledge of ethical thinking. Engineers with no training in choosing ethical alternatives will most likely choose the utilitarian system.

- But each system requires decisions that are value-based. The moral values used in such decisions are the individual values which determine the outcome of specific questions within the ethical decision-making process.

- Finally, the decision maker must be comfortable with the answer thus calculated; it has to feel right.

What rules, ethics, and morals can we as educators realistically be expected to teach?

Teaching rules comes easy to engineering educators and thus rules governing professional conduct can be readily taught. But even this is not common practice in engineering schools. As one observer¹⁵ has pointed out, most faculty members who are asked to include professional ethics in their courses think that reviewing the rules of the code of ethics is the sum total of what is available to be taught; they are totally unaware of the rich lode of classical and modern ethical thinking.

Ethics, as I have defined it here, can also be taught, since ethical theories can be broken down into systematized methods for solving problems, with clear objectives and modes of application. Teaching ethics is *not* teaching right or wrong, or good or bad, but rather methods of making personal decisions about

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these qualities. These methods can be taught and contrasted with each other to demonstrate the wide spectrum of ethical theories. Students can be taught to "think ethically" in the same way they can be taught to "think scientifically."

Young engineers should be taught that ethical decision-making is highly personal, and people may use different systems of ethical thinking to make value-laden decisions. It is the variety and equal validity of the various *processes of making the decisions* that can be taught and that can have a significant beneficial impact on a young engineer.

In contrast, morals cannot be taught. There is no way to *explain* to a person who has just shot a whale that this act is wrong. There is no way to explain to someone who routinely manipulates test data in order to pass state effluent limits that this action is wrong. Try explaining to someone why he or she should not throw an empty beer can out a car window. Teaching morals is simply not possible, since moral values "are the product of strong parental, cultural, and psychological factors and forces. They are not items of knowledge to be learned simply by "taking thought."¹⁴

Teaching morals, in fact, can be construed as negative, since it could be thought of as a form of mind control or indoctrination, a criticism often incorrectly leveled at the teaching of ethics. While teaching ethics is the teaching of skills, teaching morals may be considered at cross-purposes with the aims of higher education. (In some systems, e.g., communist education, however, the teaching of ethical inquiry is discouraged, while instruction in values is at the heart of the system. Closed political systems must indoctrinate.)

I would like to suggest that while we, as educators, cannot and should not teach morals, we in fact influence them tremendously by example. Because educators touch the lives of students at their most formative stages of professional development, we are unavoidably functioning as moral educators. Our students are (this is purely a personal observa-

tion) extremely receptive to our expressed moral values.

The single data point found to support this case is from a longitudinal study¹⁶ of Haverford College graduates that found, contrary to what we think we teach, that our lasting effect on students is in the maturation of their values and ethical sense. The study concluded that "the college's distinctive, most salient, enduring effect was to permanently alter the character, the values, and the motives of many men."¹⁷

All education has a hidden curriculum which, in contrast to the formal curriculum of class instruction, consists of a wide range of learning about life in general. In my opinion, the most important component in the hidden curriculum is the example of the teacher. Our students' antennas are up, and they are searching for the values they will carry with them for the remainder of their careers. We are their role models.

Conclusion

In defining, in the engineering tradition, what I mean by rules, ethics, and morals, I admit to fuzziness, overlap, and even inconsistencies. There is a lot more to this topic than most of us would ever dream of. But this should not prevent us from including in our courses aspects of professional decision-making that relate to personal conduct and moral values. Admittedly, the materials are scarce, as others have lamented¹⁵ and the rewards few. What should be everyone's responsibility too easily becomes no one's, because it is easy to push the "soft" ethical issues out of courses under the guise of attaining more engineering rigor. Few of us have the training to teach a meaningful course in professional ethics.

Our responsibility to students nevertheless dictates that we make the effort to integrate ethics into our teaching. We can teach our students how to be better engineers and better citizens, partly by instructing them in the usefulness of rules and the systematic application of ethical theory—but mostly by being good examples.

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