Chapter 8

Ethics in Matters Small, Large, and Engineering

8.1 IS ENGINEERING ETHICS NECESSARILY A DREADFUL BORE?

Engineering ethics is a topic that can cause an engineer's eyes to glaze over, and for good reason. What I remember of the few ethics lectures I was forced to attend in engineering school consists of platitudes, wordy, abstract codes, and hypothetical cases concocted to stimulate our thinking. Unfortunately, my fellow engineering students and I weren't very stimulated back then, and the lack of success of the usual approach to engineering or business ethics is now reflected in headline after headline decrying one ethical or moral failure after another. Student cheating is up, CEO fiduciary responsibility is down, and major technology failures occur because engineers stretch the technical truth with modest amounts of pressure from some managerial higher up.

Of course, there are no guarantees that *any* approach to teaching and learning engineering or ethics will fix a particular set of ethical lapses, but the view taken here is that the probability of taking the lessons of engineering ethics to heart increase in proportion to how down to earth the study is. This volume has been a down-to-earth affair, and our approach to ethics will stay that course.

One way to combat ethics fatigue is to start with familiar matters, so we start our investigation of ethics by considering two flavors of golden rule: positive and negative golden rules. Golden rules ask us to behave consistently or charitably depending on the flavor, but other types of ethical reasoning have been studied over the years and a number of these must be discussed. Interestingly, from an engineering point of view, different modes of ethical thought can be viewed in almost dynamic systems terms, and we should make some effort to do so. Oftentimes, human beings have ethical mishaps, not because they didn't know the right thing to do, but because they couldn't bring themselves to do it. Our own self-interest, obedience to authority, and conformity to the group are three obstacles to doing the right thing, and we need to understand how powerful each of these influences can be.

The Entrepreneurial Engineer, by David E. Goldberg

Having said this, ethical practice on the small stuff can leave us in good stead when it comes time to do right on something big. This inductive approach, working from the small details outward, helps us move from personal ethics to engineering ethics. In tackling engineering ethics, we start by studying the notion of a *profession* and find that having a code of ethics is considered by many a *sine qua non* of professional existence. We study two very different engineering codes of ethics and consider why they might be so different. This leads us to define and sketch out the notion of a *conflict of interest,* which leads us to consider the consequences and some alternatives to whistleblowing.

8.2 ETHICS: SYSTEMATIC STUDY OF RIGHT AND WRONG

Ethics is a highfalutin word, but at root ethics is the study of right and wrong. The modern study of ethics is a convoluted one, but the twists and turns of sophisticated intellectual debate obscure a much simpler truth. Human parents since time immemorial have taught their children right conduct and have tried to teach them to avoid wrong conduct, and over much of human history increasingly larger social structures (families, tribes, congregations, communities, etc.) have been the focal point for capturing and codifying rules of right and wrong for continued cultural transmission of these important snippets of wisdom. Interestingly the details of what has been considered right and wrong have varied in time and space, but these early practitioners of ethical behavior were largely in agreement about the key ideas, and most of the planet's early and great cultures arrived at one of the forms of a *golden rule.*

8.2.1 Golden Rules: Positive and Negative

Many of the great religions and cultures of the world have arrived at some form of the golden rule (Table 8.1).

Search the Web for the term "golden rule" and you'll quickly find many more. Although the wordings are different, the meanings are virtually the same. Note, however, there are two different types of golden rule (Hazlitt, 1964).

Negative Golden Rules

Negative golden rules are in many ways the more practical of the two as their dictates are easier to fulfill. Consider, for example, the Confucian golden rule, a negative golden rule:

> Do not do to others what you would not like yourself.

The rule urges us to consider what we would *not* like to have done to us and then *not* do those things to others. Thus, the rule seeks to *inhibit* behavior that is likely to be hurtful to others. Note that the default action under a negative golden rule is to avoid acts toward others: to leave others alone. This makes common

Table 8.1 Some of the World's Great Golden Rules

Religion	Golden Rule
Buddhism	Hurt not others in ways that you yourself would find hurtful. (Udana-Varga 5:18)
Christianity	All things whatsoever ye would that men should do to you, do ye so to them; for this is the law and the prophets. (Matthew 7:12)
Confucianism	Do not do to others what you would not like yourself. Then there will be no resentment against you, either in the family or in the state. (Analects 12:2)
Hinduism	This is the sum of the Dharma [duty]: do naught onto others what would cause pain if done unto you. (Mahabharata 5:1517)
Islam	None of you truly believes until you wish for your brother what you wish for yourself. (Sunnah)
Judaism	Thou shalt love thy neighbor as thyself. (Leviticus 19:18) What is hateful to you, do not do to your neighbor. This is the whole Torah; all the rest is commentary. (Talmud, Shabbat 31a)

sense as most of us have just wondered why others don't just "leave us alone," and negative golden rules encourage us to that end.

While negative rules are useful rough-and-ready guides to avoiding bad conduct, they are less helpful in a philosophically rigorous analysis. The primary criticism of negative golden rules is that they leave the determination of wrong conduct in the hands of a single individual: you. That is, each individual is to judge whether or not an action is improper by his or her own belief system. In a homogeneous population with a widely shared set of beliefs, the widespread following of a negative golden rule can result in the diminution or absence of large-scale social disharmony. Where beliefs vary a good bit—in culturally or ethnically diverse populations, for example—following a negative golden rule may not be sufficient to avoid conflict. Individuals will differ too much on what constitutes right and wrong.

Positive Golden Rules

Positive rules go a step beyond negative golden rules, requiring *right conduct,* even *exemplary,* conduct toward all. Consider, for example, the Christian golden rule, a positive golden rule:

> All things whatsoever ye would that men would do to you, do ye so to them.

The rule urges us to consider what we would like to have done to us and then *do* those things to others. Since positive golden rules focus on *doing* versus *not doing*, they are more activist in nature, and the requirement to do good is limitless in magnitude and without end. For example, I would very much like my publisher to increase my royalty for writing these words to $1,000,000 (in small unmarked bills) per book. Does my unreasonable desire require that I myself should offer to pay my barber a similarly outrageous sum for my next haircut? The infinite ways in which we can be generous to our fellow human beings make it certain that we will not do so at every possible opportunity.

Clearly, then, taken to their limits, positive golden rules are impractical on their face, but this misses their point. The intent of positive golden rules is to set up an *ideal* for good or even righteous conduct toward our fellow human beings. Positive golden rules hold us to a higher standard than negative golden rules, asking us not only to avoid doing harm toward others, but to do good deeds widely and often. In other words, they ask us not only to avoid doing bad things, but to treat others kindly and well.

Exploration Exercise

Consider an incident in your life where you consciously applied a golden rule. Write a short paragraph describing the incident, whether the golden rule was a positive or negative rule, and the ways in which your behavior was different than what you might have otherwise done. If you cannot think of such an incident, describe an event where you believe someone else was acting according to a golden rule.

8.2.2 Whence Right and Wrong?

The almost universal nature of golden rules makes them almost irresistible as a centerpiece of moral theory, but moral philosophers have long recognized their Achilles heel. Since golden rules—whether positive or negative—are defined in terms of individual-centered notions of right and wrong, they depend on widely shared notions of right and wrong conduct as *input*. This places a premium on knowing where individuals get a sense of right and wrong in the first place. Moral philosophy since ancient times has jumped through a variety of intellectual hoops trying to find a satisfactory answer to this question. As with other branches of philosophy, moral philosophy returns with not a single answer but a number of answers, each with its own set of merits and defects. Here we consider a number of broad categories of answer to the title question of the section as follows:

1. Right and wrong come from culturally or religiously determined norms of conduct.
2. Right and wrong come from an innate moral sense.
3. Right and wrong come from maximizing human happiness or utility.
4. Right and wrong come from consistency in reasoning.

5. Right and wrong are not sensible topics of conversation for rigorous philosophers or other human beings.

Each of these points of view represents a major strain of philosophical thought, and to discuss them at length is beyond the scope of this treatment, but we do briefly consider their main points.

From a Religious or Cultural Set of Norms

Almost all of us were introduced to right and wrong at home, and many of us had views expressed at home supplemented by that of a clergyman as part of some organized religion. Outside the home, culturally acceptable norms of behavior are taught and enforced as we go to school, work, and start our own families. As a practical matter, religious and cultural norms of right and wrong are the dominant influence in our lives. The tendency in the last century by philosophers was to question these traditional influences and even question the validity of notions of right and wrong, but culture and religion remain highly influential.

Although modern philosophy has not always been particularly friendly toward ethics or other sets of beliefs that are at least, in part, socially transmitted, one element of modern philosophy relevant to understanding the propagation of belief systems is Searle's theory of the *construction of social reality* (Searle, 1995). Searle examines the philosophical basis of *social facts*, such as chess and money. Chess is not chess because of the shape of the pieces or materials of the board, but it is chess because we agree that it is a game played on an 8×8 board with 16 pieces per side where each piece follows a particular set of rules of movement. Likewise, money is not money because of the paper or metal of bills or coins. It is money because people assign it value and agree to exchange valuable things for it. Chess and money are strange objects in this way, but Searle argues that they are objectively real in this special social sense (and if you doubt this, please feel free to send all the currency in your wallet—or your nicest chess set—to my university address).

In moral matters, the Searlean view might be that ethical codes are ethical codes (and effective) because we and others believe in them. Moral rules (such as golden rules) work when the subject population shares similar ideas of right and wrong and practices those ideas with regularity. Returning to the example of money, a currency is widely accepted as strong when its supply is kept in check, when counterfeit money is minimized, and when a large market or markets accept it in exchange for goods and services. Although there is no counterpart to money as a medium of ethical exchange, the myriad deals we make, promises we keep, and courtesies we extend to one another form a kind of marketplace of ethical conduct. When large numbers of people start to make promises that they don't keep or when discourtesy is the rule, our currency of moral conduct is inflated or devalued in much the same way that money becomes worth less in difficult financial times. While such reasoning certainly helps us understand some of the common failure modes for ethical reasoning, it offers few fundamental principles to help society get back to more widely shared ethical behavior and beliefs.

From a Moral Sense

Once a set of moral rules exists in society, the rules can take on a life of their own, but the adoption of a set of rules at all is itself something of a puzzle. In some ways, the key question in ethics is not that murder, mayhem, and ethical mishap occur regularly and are reported in the daily newspaper. The real issue is that they are *news*; in other words, they are fairly *rare* occurrences. Instead of being surprised by mayhem, how did it become so rare? In prehistoric times, how was it that early humans developed moral rules? Why didn't they just bop one another over the head and take one another's lives and possessions. Doing so would have been perfectly rational from a posture of pure self-interest. But over time, humans have developed to the point where they take special steps to avoid conflict and generally do not interfere with one another. Given the difficulty of evolution of cooperation, it is puzzling that human ethical reasoning has come as far as it has.

One longstanding and influential line of thought that helps explain this conundrum is so-called *ethical naturalism* that asserts that human nature is imbued with a certain tendency to do right. The 18th-century philosopher Adam Smith (Smith, 1759/1984), building on the work of David Hume, is remembered for the assertion that human beings are to some extent moved by *sympathy* for others. Smith did not assert that morals are predetermined in a mechanistic way, but he saw the need to assume the existence of a moral sense to propel and sustain ethical behavior. More recently, James Q. Wilson (1993) has revived this strain of thought and has added modern results from social science and evolutionary theory to bolster the argument.

From Maximizing Utility

Adam Smith is better remembered for laying the foundations of modern economics (Smith, 1776/1937), and it is interesting that his moral philosophy took a naturalistic turn. Given the strains of intellectual thought at the time, one might have guessed that the father of economic thought would have been more of a *utilitarian.* Utilitarianism is the idea that right conduct comes from maximizing *human happiness.* In other words, right action is that which maximizes human happiness. Jeremy Bentham articulated a key utilitarian idea when he said:

> *It is the greatest good to the greatest number which is the measure of right and wrong.*

And J. S. Mill followed with a stout defense of utilitarianism in his volume by the same name (Mill, 1861/1993).

To engineers, there is a quantitative logic about utilitarian thought that has great appeal, and commonplace engineering procedures are utilitarian by their nature. For example, when an environmental engineer does a cost–benefit analysis, he or she is attempting to follow a utilitarian approach to right conduct.

As with most philosophical ideas, however, utilitarianism raises as many questions as it answers:

1. What is happiness?
2. Whose happiness do we maximize?
3. Can we calculate happiness accurately?
4. Are we maximizing happiness now or later?

Each of these is briefly discussed in what follows.

The question "what is happiness?" has challenged philosophers since time immemorial. Early utilitarians went back to the hedonists of ancient Greece and argued that *sensory pleasure* is human happiness, but others have rejected such a view as too simple. Mill argued that pleasure in a larger sense could be taken synonymously with happiness and many have joined in the debate. More recently, research in human happiness by modern psychologists has coined the term *flow* to describe happiness as a kind of intricate interwoven complexity that results in long-term and profound engagement with one's life activities and partners (Csikszentmihalyi, 1990). In many ways, these views harken back to Aristotle and the Greek notion of happiness called *eudaimonia,* or literally "having a good guardian spirit."

Even if we can agree upon what we mean by happiness, another issue quickly appears. Whose happiness should we maximize: yours, mine, or all of ours? Like Bentham, most utilitarians believe in some sort of the greatest good for the greatest number, and they therefore argue for calculation of utility at a level above that of a single individual. Certainly it is easy to imagine self-interested beings maximizing their own utility, but if we are to maximize the utility of society, does this suggest that the naturalists were right, that we have some intrinsic, perhaps evolutionary, tendency to do right by others?

Moreover, the suggestion that we calculate happiness leads to a question whether human beings are even capable of doing so with any accuracy. Are we able as individuals to calculate the utility of our own prospective actions on ourselves and on others? It is difficult enough to know one's own mind, let alone to have knowledge of the motivations, needs, and objectives of others. How can we calculate accurately about the aggregate utility of some large social group on any given action even if we wanted to? A famous economic argument by Hayek (1945) suggests that markets and prices are necessary because they reveal exactly the kind of information necessary to do something akin to utilitarian computation, but that the right information is only revealed if the individual actors pursue their own self-interest in a competitive market. Individuals signal their preferences through sequences of self-interested exchanges in the marketplace, and the resulting prices are used by others for all kinds of calculations. Utilitarians need to reason about the utility of their actions in relation to how they affect others, but markets reveal the utility values of others through a series of *self-interested exchanges* in the market. Without these exchanges, there is no price mechanism and no way of revealing the value attached to different actions. Hayek's argument leads to a more individualistic view on the grounds of knowledge gain, but even

if the calculus of aggregate utilitarianism were possible, we might argue that the calculation of utility act by act is simply impractical.

Some argue, as a result, that *act utilitarianism*, utility theory applied to the evaluation of individual acts is flawed and argue for so-called *rule utilitarianism*. That is, we cannot calculate right and wrong from one act to the next or from moment to moment, so instead we are left with devising sets of useful *rules* that practically help guide our choice of right conduct on average. Certainly the kinds of rules of ethics that have evolved in engineering and other professions are evaluated along these lines.

Finally, all of the discussion to this point has neglected time almost entirely. Even if we agree upon what should be maximized, who it should be maximized for, and that we maximize it in practice, the issue arises whether we perform the maximization for the present moment or in the longer run. Many simplistic objections to utilitarianism assume that the utility calculator will only consider the short run and ignore the long run, but maximizing utility into the future is itself a tricky business. Our ability to predict future events is severely limited, and the question also arises regarding the *period of optimization.* Should we maximize utility for our own generation, our children's generation, our grandchildren's generation, or all generations to come. Although thinking about time helps overcome simple objections to utilitarianism based on myopia, considering the ramifications of one's decision for all time complicates the utilitarian computation along many of the dimensions just discussed.

From Consistency

Immanuel Kant did not react well to the arguments of the utilitarians and believed that right and wrong were too important to be left to what amounted to the balancing of a moral checkbook. His formulation depended on a different sort of calculation—a logical calculation of consistency—to determine right conduct. Starting from the assumption of *good will* to do one's *duty*, Kant formulated his *categorical imperative* which sounds to modern ears like a golden rule on steroids:

> *I am never to act otherwise than so that I could also will that my maxim should become universal law.*

In other words, only those actions that can be universally generalized to all humanity should be undertaken.

In one sense, the generality of Kant's formulation does go beyond the local ethics of simple golden rules, but in so doing it leaves us with the possibility that we may have either insufficient guidance to right conduct (because the requirement for universal generality is too difficult) or incorrect guidance (because we have incorrectly generalized that which is not universal). Despite these concerns, Kant's advice is important to us here because it highlights a key concept that guides common moral reasoning.

Kant's formulation asks us above all to be logically *consistent.* All of us have had the experience of someone giving an order or creating a rule and then watching that same person violate the order or break the rule him- or herself. This is so commonplace that we give it a special name—*hypocrisy*—and Kant may be regarded as the premier philosophical guardian against hypocrisy.

Consistency is generally regarded as laudable, but interesting consequences follow when we value it above all else. For example, Kantian reasoning usual leads to a rejection of lying under any circumstances, but one of Kant's earliest critics asked if it is therefore necessary to tell a murderer the truth about the location of his prey. Such discussions have led to various modifications of Kant's theories, but these modifications continue to value consistency and universality fairly highly.

Not a Sensible Topic of Conversation

Greek philosophy and philosophy of the enlightenment and the 19th century deal with philosophical subjects directly. In other words, the terms of philosophical discourse (terms such as "right" and "wrong") are assumed to have meaning, and the job of the philosopher is to seek their intellectual basis. For much of the 20th and current centuries, philosophers have turned to *metalevel* analysis of philosophical discourse itself. In doing so, a number of philosophers have found the language of moral philosophy to be an empty vessel.

Some, such as Ayer (1946) have argued that ethical or moral propositions are nothing more than "ejaculations" (p. 103):

> *The propositions which describe the phenomena of moral experience, and their causes, must be assigned to the science of psychology, or sociology. The exhortations to moral virtue are not propositions at all, but ejaculations or commands which are designed to provoke the reader to action of a certain sort. Accordingly, they do not belong to any branch of philosophy or science.*

Whether on religious, consistency, utilitarian, or other grounds, most common people would be taken aback by such a stance, but ideas such as these have diffused into many areas of intellectual life, oftentimes under the terms *postmodernism* or *critical theory.* No longer are books *great books*; they are merely *texts* to be analyzed and abstracted. One view is as good as another, and nonacademics are surprised to learn that intellectual life has become what appears from the outside to be merely a game of words. And once one gets the hang of the "theory" game, there is a simplicity and internal consistency about it that is no doubt the source of its attraction. But, when one examines this line of philosophical attack on its own terms—analyzing its "terms" and "texts," such reasoning may be viewed largely as tool for overturning widely shared views on almost any topic. In the limiting case, nothing is true and nothing can be known, except on an individual by individual basis.

As practical people, engineers will find such a state of intellectual affairs—so-called *solipsism*—largely revolting. Engineering is a social enterprise that depends on both an individual and a shared sense of right and wrong. Engineers commit themselves to building products, services, and organizations that *work.* They commit themselves to codes of professional conduct whether they work for an employer or directly for a paying client. To take ethics or right conduct off the table is not an option for the practicing engineer or the larger public served by his or her deeds. Academics may find such word play attractive, but if engineers themselves find it acceptable to dismiss engineering ethics as "mere ejaculations" people will die in the ensuing cesspool of shoddy work, lack of accountability, and failure. This unacceptable state of affairs takes us back to a position where we must find a way for a large group of individuals to share notions of right and wrong if we are to act together in some reasonably organized manner. This begs us to synthesize the key notions discussed above into a more integrated whole.

8.2.3 An Engineer's Synthesis of Ethical Theory

Moral theory, like much of philosophy, is a competition of ideas pursued to their logical ends. The way to make a name in philosophy is to concoct a plausible theory and pursue its logical consequences wherever they lead. It is much rarer to see philosophers *integrate* disparate theories into a consistent whole.

Engineers, by contrast, are constantly faced with physical theories that apply at different length and time scales, and they must make sense of them and know when to apply which theory to what situation. Perhaps the situation in philosophy should be viewed similarly. That is, perhaps different forms of philosophical argument should be applied in different circumstances. In particular, perhaps ethical theory should be viewed in dynamic systems terms, and different modes of philosophical thought should be considered in terms of *when* they came to be applied and how that mode of thought interacted with other beliefs about ethical matters.

Consider the following major categories of ethical thought:

1. Moral sense
2. Shared belief
3. Utilitarianism
4. Kantian consistency
5. Moral skepticism

A schematic of the plausible dynamic interactions of these five modes is presented in Figure 8.1. Starting from the naturalistic tradition, we assume the existence of a moral sense in humans, and from that seed, shared beliefs result in reductions in violence through loyalty among related groups of humans. This permits effective small-scale social organization; the benefits of such cooperation on a small scale lead to the recognition that social rules of conduct convey benefits to all. The utility of such rules drives their wider spread, and quite

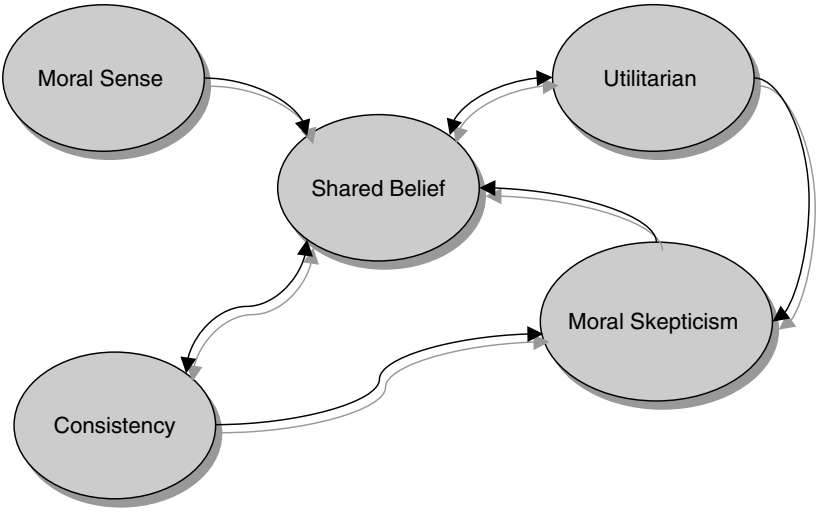

Figure 8.1 Schematic of the dynamic interactions of different modes of ethical thought.

naturally concern arises to whether those rules are consistent and universal. Over time, we grow too clever by half, elevate ethical reasoning to abstract word play, and start to question the validity of the rules that have served us so well. The resulting degradation of society leads to a reevaluation of the rising skeptical trend (largely on utilitarian and consistency grounds) and virtuous behavior rises again. It might be an interesting exercise to attempt to write equations for the evolution of the different strands of thought along evolutionary lines; however, our purpose here was merely to offer a systems-level view of the interaction of different strands of thought in one plausible manner. The more important issue for us is to get from ethical theory to ethical practice.

8.3 FROM ETHICAL THEORY TO PRACTICE

Ethical theory is one thing, ethical practice is another, and what makes the practice side of things so difficult? Simply stated, staying on the ethical straight and narrow, whether personally or professionally, requires knowing when a moral crossroads has been reached, determining the right thing to do, and doing it. Upon rare occasion, we come to a difficult ethical dilemma that requires careful thought before action, and in those few cases, the knowing-we-have-a-problem and knowing-what-to-do part of things is hard; however, the more usual case is that we are faced with a situation where there is no dilemma, not a single question, and yet we fail to do the right thing. In these *failures of responsibility* (Harris, Pritchard, & Rabins, 1995) we knew what we should have done, and yet we didn't do it. How does this happen? There are, of course, many ways to avoid

doing the right thing—and most of us are well practiced in most of them—but here we consider the big three:

1. Self-interest
2. Obedience to authority
3. Conformity to the group

Each of these needs to be considered further.

8.3.1 Self-Interest

As the comic strip character Pogo once said, "Yup son, we have met the enemy and he is us." When we know what the right thing to do is and we don't do it, one of the most likely culprits is our own self-interest. Oftentimes, moral dilemmas present us with a choice between a behavior that is attractive (and not right) and one that is difficult (and the morally correct course of action). In those cases when the attractive and incorrect behavior wins out, we often find a way of *rationalizing* our choice. We argue that the behavior we chose wasn't really wrong, didn't really hurt anyone, or that the correct course of action was too difficult or impossible. Such choices are always difficult, but learning to listen to and then ignore the little internal voice of rationalization can help us do the right thing on a more regular basis.

8.3.2 Obedience to Authority

We are often ethically defeated by ourselves, but *obedience to authority* is another important source of difficulty. In 1963, Stanley Milgram performed an important set of psychological experiments at Yale University. In these experiments, subjects were told that they would participate in an experiment on learning. The subject was asked to administer a set of shocks as a punishment for incorrect learning of a memory task, increasing in severity from 15 to 450 volts, to another "subject" who in fact was Stanley Milgram's assistant, an actor in his 50s. Although there was no real electric shock administered, the subject believed it to be real because a real, albeit small, demonstration shock was given to the subject prior to starting the "learning experiment."

During the tests, the actor playing the learner would start to complain verbally about the pain at 150 volts, complain about his bad heart at 250 volts, and kick the wall and go silent at 300 volts. During the tests, an "experimenter" in a white lab coat would stand by and calmly encourage the subject to continue the experiment. In all, 40 subjects were tested in this manner, and 26 of 40 went all the way to maximum shock level and all of the subjects went to at least 300 volts.

The level of obedience surprised even Milgram, and these experiments are often cited to explain atrocities in war and elsewhere. In an engineering context, the consequences of obedience to authority are usually less directly and obviously harmful, but the social setting is similar. Encouragement to do something

unprofessional or unethical can often come from someone in authority, and the Milgram experiments show fairly conclusively that saying no to authority can require unusual courage.

8.3.3 Conformity to the Group

Blindly obeying authority can lead us astray, but so can conforming to a group. In 1951, Solomon Asch asked subjects to participate in a study of visual perception judging the relative lengths of lines. They were shown cards such as that in Figure 8.2 and asked to choose which of the three lines on the right is the same length as the line on the left. Of course, the task is obvious and individually subjects chose the right answer. Then Asch asked the subjects to do the same task in groups of 8 to 10, where the other "subjects" were confederates of the experimenter and were instructed to answer incorrectly (and unanimously) in 12 of 18 of the trials. Asch arranged for the real subject to be the next-to-last person to answer in the group. Asch thought that most people would resist the group and answer correctly.

To Asch's surprise, 37 of the 50 subjects conformed wrongly to the majority at least once, and 14 subjects conformed on half or more of the 12 incorrect trials. Other experiments have confirmed the conformity result, but people go along with the group for one of two reasons: They want to be liked by the group or because they believe the group is better informed.

Regardless of the reasons behind the conformity, the ramifications for an engineering context are important. Ethical dilemmas arise for engineers almost

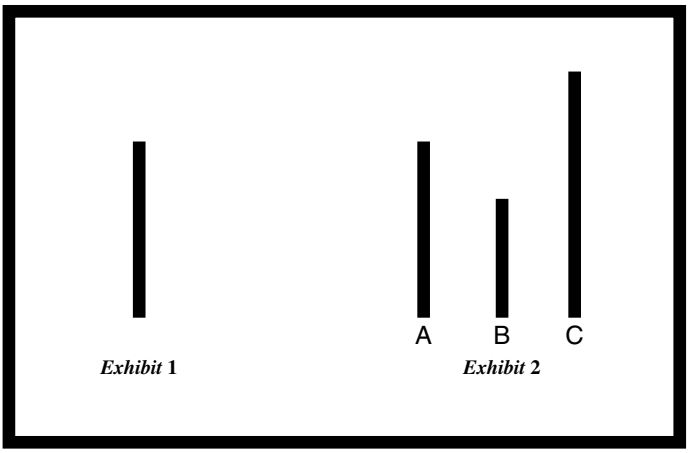

Figure 8.2 In Asch's 1951 experiments to test conformity to a group, subjects were shown a series of cards and asked to match the line on the left with the line of nearest size on the right. When performed by an individual, the task is performed correctly. When confederates intentionally give a wrong answer prior to the subject's answer, subjects often conform and give the wrong answer.

always in a group context. If there is any tendency for a group to take the ethically easy way out of a difficult situation, this will make it harder for an individual to come forward and do the right thing. Moreover, the social dynamic of the group may be compounded by having to go up against one or more authority figures at the same time. Seen in this way, it is a wonder that whistles are ever blown in hierarchical organizations of any size.

Exploration Exercise

Consider a particular business or engineering scandal in the media and analyze whether the wrongdoing was intentional or not, and whether it involved self-interest, obedience to authority, or conformity to the group. Being as specific as possible, write a short essay identifying the key parties to the scandal, their roles in perpetrating the scandal, whether or not their actions appeared conscious or unintended, and the role of self-interest, obedience, or conformity to the sequence of events.

8.3.4 Practice Makes Perfect

With self-interest, obedience to authority, and conformity to the group lurking to distort our moral compasses at many turns, doing the right thing is hard. In many engineering ethics courses, the usual approach is to work from the top down by studying the big stuff first. Read case studies of the *Challenger* or the Bhopal disasters. And indeed, we want to discuss some of these larger matters, but these larger situations are not representative of the garden variety of ethical matter that will face the usual engineering graduate. Ethics with a capital E is misleading in that the situations are enormously complex, relatively infrequent, and the individual engineer's role in the mishap is usually submerged. Exercising ethical judgment is like other complex skills—it requires plenty of practice—but if we spend our time thinking mainly about hitting the ethical homerun, we're going to swing and miss during everyday batting practice. Therefore, when we are discussing ethical issues, perhaps it is best to start a little closer to home.

If we are studying ethical issues in school, perhaps it would be better to start with discussions of cheating on homework and examinations, the purchasing of term papers, plagiarism, and more garden-variety types of ethical missteps. If we are discussing ethics on the Web, perhaps we should discuss downloading and sharing of music or software files without permission. If we are already in the business world, perhaps it would be best to discuss the padding of expense accounts, the theft of office supplies from an employer, not giving a full day's work for a full day's pay, the presentation of another's idea as your own, and the like.

If we confront these everyday matters and develop an ethical approach toward them, when bigger issues arise, we will have practice doing right when the stakes were smaller and fewer people were watching. That practice doesn't guarantee we will do the right thing when the stakes are high, but exercising our moral

muscles will help us in tight spots when our self-interest, obedience to authority, and conformity to the group are conspiring to get us to go against the actions we know are right.

As with other complex disciplines, the way to improve is through practice in matters small and large. More generally, in approaching ethical questions in engineering design, in manufacturing, in business, or in life, it is better to think of flesh-and-blood human beings. Rather than thinking about anonymous customers, we should think about clients with names, voices, and faces; or we should think about our families and our neighbors—real spouses and real kids.

Exploration Exercise

For one or two days, keep an ethics-courtesy log where you record your activities along with a brief analysis of the ethical implications of those activities. Many ordinary activities have an ethical component. Do you reflexively tell the truth, or do you make up little stories? Do you use registered software, music, and other intellectual property, or do you download or use copies without cost? Are you courteous to others by saying "please" and "thank you," or do you order people around, issuing commands when you want something? Write a short essay reflecting on your logging experience and the content of this section.

8.4 FROM PERSONAL TO ENGINEERING ETHICS

An underlying theme of the present approach is that engineering ethics should be viewed as largely an extension of personal ethics. In that view, it is important to understand key points of ethical theory and practice in everyday life before adding the complexities of the engineer's world to the mix. As engineers are professionals who combine an unholy mix of business and science/technology in practice, it is not surprising that engineering ethics is itself an unholy mix of business and professional ethics together with the ethics of science and technology thrown in for good measure.

To better understand this mixture, we should start by understanding the notion of a professional, consider a number of engineering codes of ethics, examine the notion of a conflict of interest, and think about whistleblowing and its consequences.

8.4.1 What Is a Profession?

It is often stated that engineers are members of a learned profession, and a number of authors have tried to characterize the attributes of a profession. Many of these use Greenwood's 1957 five attributes of a profession as a starting point (Greenwood, 1957):

1. A systematic body of knowledge
2. Professional authority and credibility

3. Regulation and control of members
4. A professional code of ethics
5. A culture of values, norms, and symbols

In terms of these attributes, engineering appears to measure up on items 1, 2, and 5, and engineering codes of ethics require our further study; however, the regulation and control of members is a weak link, especially if we compare engineering to other professions such as medicine and law. In those other professions, the very terms "physician" and "lawyer" are controlled by licensing and professional organizations, whereas in engineering, the term "engineer" can be used to describe locomotive drivers and custodians as well as those of us who design and build technological artifacts.

The tug-of-war between professionalism and public service on the one hand and serving the interests of large-scale business interests has shaped the social history of engineering in important ways (Layton, 1990), and it is likely to continue doing so for the foreseeable future. As one examines different codes of ethics, we will see different emphases depending on whether a particular professional society is weighted toward a business or a professional model of engineering practice.

8.4.2 A Tale of Two Codes

Engineering is a divided profession, and different codes of ethics govern different engineers. Here we compare two very different codes of ethics:

1. National Society for Professional Engineering (NSPE)
2. Institute for Electrical and Electronics Engineers (IEEE)

A comparison of the NSPE (2003) and IEEE codes is a study of extremes. Where the NSPE code is lengthy, precise, and detailed, the IEEE is terse, vague, and general. Of course, the NSPE code is designed to govern the practice of engineers who work as professionals, and the IEEE code is aimed at an audience that is largely unregistered and employed by corporations.

NSPE Code of Ethics for Engineers
Reprinted by permission of the National Society of Professional Engineers (NSPE) www.nspe.org.

Preamble

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must

perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.

I. Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

II. Rules of Practice

1. Engineers shall hold paramount the safety, health, and welfare of the public.
   - **a.** If engineers' judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.
   - **b.** Engineers shall approve only those engineering documents that are in conformity with applicable standards.
   - **c.** Engineers shall not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or this Code.
   - **d.** Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe are engaged in fraudulent or dishonest enterprise.
   - **e.** Engineers shall not aid or abet the unlawful practice of engineering by a person or firm.
   - **f.** Engineers having knowledge of any alleged violation of this Code shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required.
2. Engineers shall perform services only in the areas of their competence.
   - **a.** Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved.
   - **b.** Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control.
   - **c.** Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project, provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment.
3. Engineers shall issue public statements only in an objective and truthful manner.
   - **a.** Engineers shall be objective and truthful in professional reports, statements,

or testimony. They shall include all relevant and pertinent information in such reports, statements, or testimony, which should bear the date indicating when it was current.

b. Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter.

c. Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties on whose behalf they are speaking, and by revealing the existence of any interest the engineers may have in the matters.

4. Engineers shall act for each employer or client as faithful agents or trustees.

a. Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services.

b. Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.

c. Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

d. Engineers in public service as members, advisors, or employees of a governmental or quasi-governmental body or department shall not participate in decisions with respect to services solicited or provided by them or their organizations in private or public engineering practice.

e. Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member.

5. Engineers shall avoid deceptive acts.

a. Engineers shall not falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint venturers, or past accomplishments.

b. Engineers shall not offer, give, solicit or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect of intent to influencing the awarding of a contract. They shall not offer any gift or other valuable consideration in order to secure work. They shall not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

III. Professional Obligations

1. Engineers shall be guided in all their relations by the highest standards of honesty and integrity.

- **a.** Engineers shall acknowledge their errors and shall not distort or alter the facts.
- **b.** Engineers shall advise their clients or employers when they believe a project will not be successful.
- **c.** Engineers shall not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment they will notify their employers.
- **d.** Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses.
- **e.** Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

2. Engineers shall at all times strive to serve the public interest.

- **a.** Engineers shall seek opportunities to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community.
- **b.** Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.
- **c.** Engineers shall endeavor to extend public knowledge and appreciation of engineering and its achievements.

3. Engineers shall avoid all conduct or practice that deceives the public.

- **a.** Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact.
- **b.** Consistent with the foregoing, engineers may advertise for recruitment of personnel.
- **c.** Consistent with the foregoing, engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others.

4. Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve.

- **a.** Engineers shall not, without the consent of all interested parties, promote or arrange for new employment or practice in connection with a specific project for which the engineer has gained particular and specialized knowledge.
- **b.** Engineers shall not, without the consent of all interested parties, participate in or represent an adversary interest in connection with a specific project or proceeding in which the engineer has gained particular specialized knowledge on behalf of a former client or employer.

5. Engineers shall not be influenced in their professional duties by conflicting interests.

- **a.** Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment suppliers for specifying their products.

b. Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the engineer in connection with work for which the engineer is responsible.

6. Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods.

a. Engineers shall not request, propose, or accept a commission on a contingent basis under circumstances in which their judgment may be compromised.

b. Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical considerations.

c. Engineers shall not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice.

7. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.

a. Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.

b. Engineers in governmental, industrial, or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties.

c. Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of other suppliers.

8. Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the engineer's interests cannot otherwise be protected.

a. Engineers shall conform with state registration laws in the practice of engineering.

b. Engineers shall not use association with a nonengineer, a corporation, or partnership as a "cloak" for unethical acts.

9. Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.

a. Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments.

b. Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the engineer for others without express permission.

c. Engineers, before undertaking work for others in connection with which the engineer may make improvements, plans, designs, inventions, or other records that may justify copyrights or patents, should enter into a positive agreement regarding ownership.

d. Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property. The employer should indemnify the engineer for use of the information for any purpose other than the original purpose.

e. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminars.

— As Revised January 2006

"Engineers shall strive to adhere to the principles of sustainable development[1] in order to protect the environment for future generation."

Statement by NSPE Executive Committee

In order to correct misunderstandings which have been indicated in some instances since the issuance of the Supreme Court decision and the entry of the Final Judgment, it is noted that in its decision of April 25, 1978, the Supreme Court of the United States declared: "The Sherman Act does not require competitive bidding."

It is further noted that as made clear in the Supreme Court decision:

1. Engineers and firms may individually refuse to bid for engineering services.

2. Clients are not required to seek bids for engineering services.

3. Federal, state, and local laws governing procedures to procure engineering services are not affected, and remain in full force and effect.

4. State societies and local chapters are free to actively and aggressively seek legislation for professional selection and negotiation procedures by public agencies.

5. State registration board rules of professional conduct, including rules prohibiting competitive bidding for engineering services, are not affected and remain in full force and effect. State registration boards with authority to adopt rules of professional conduct may adopt rules governing procedures to obtain engineering services.

6. As noted by the Supreme Court, "nothing in the judgment prevents NSPE and its members from attempting to influence governmental action. . ."

NOTE: In regard to the question of application of the Code to corporations vis-à-vis real persons, business form or type should not negate nor influence conformance of individuals to the Code. The Code deals with professional services, which services must be performed by real persons. Real persons in turn establish and implement policies within business structures. The Code is clearly written to apply to the Engineer and items incumbent on members of NSPE to endeavor to live up to its provisions. This applies to all pertinent sections of the Code.

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[1] *Sustainable development* is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

The NSPE code is detailed to the point where it offers practicing professionals practical guidance in creating an ethical engineering practice. The NSPE as an organization takes ethical matters seriously and regularly reviews ethics cases with its Board of Ethical Review (BER). Studying NSPE cases and their review can be a useful way to see how the code applies in practice. Cases are available at www.nspe.org or at a number of other online engineering ethics sites.

The IEEE code (1990) is a study in contrasts. It is as brief as the NSPE code is long. It is general where the NSPE code is specific. Of course, most of the IEEE's members are not in private practice, but instead work for large corporations.

IEEE Code of Ethics
(Reprinted by permission of the IEEE)

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

1. to accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
3. to be honest and realistic in stating claims or estimates based on available data;
4. to reject bribery in all its forms;
5. to improve the understanding of technology, its appropriate application, and potential consequences;
6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
8. to treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;
9. to avoid injuring others, their property, reputation, or employment by false or malicious action;
10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Approved by the IEEE Board of Directors
August 1990

Exploration Exercise

Compare and contrast the IEEE and NSPE codes of ethics in a short essay. In what ways are the two codes similar and in what ways are they different. Consider the nature of the two organizations and hypothesize as to the nature of the differences.

8.4.3 Conflicts of Interest

Almost all codes of ethics warn against conflict of interest, but there is a substantial amount of confusion over what constitutes a conflict of interest, and many codes, interestingly enough, do not define them directly. For example item 2 of the IEEE code has the following to say:

> *2. avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;*

Apparently conflicts are something to be avoided, but the IEEE code is not helpful in defining them. The NSPE code addresses conflicts of interest under the rubric of "faithful agency" it gives several examples in item 4:

> *4. Engineers shall act for each employer or client as faithful agents or trustees.*
>
> **a.** *Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services.*
>
> **b.** *Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.*
>
> **c.** *Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.*
>
> **d.** *Engineers in public service as members, advisors, or employees of a governmental or quasi-governmental body or department shall not participate in decisions with respect to services solicited or provided by them or their organizations in private or public engineering practice.*
>
> **e.** *Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member.*

Item a mentions the term "conflicts of interest" and b to e are examples of classical conflicts of interest, but the NSPE code is little help in defining what we mean by a conflict of interest.

In fact, there is a good deal of confusion over conflicts of interest, and we must be much clearer about what one isn't and is. The first point to make is that a conflict of interest is not any ordinary ethical lapse. If you are dishonest,

betray a confidence, intentionally do substandard work, work outside your area of confidence, or otherwise behave in a typically unprofessional manner, you may have acted unethically, but you have not done so in the face of or as a result of a conflict of interest.

No, conflicts of interest do not (cannot) arise in simple two-sided relationships where one party plays a single role with respect to another. Conflicts of interest arise when a party plays multiple roles between two or more parties, and may be defined concisely as follows:

> *A* **conflict of interest** *arises when a party may be forced to choose between the obligations of two or more roles in a manner where the interests of one party may be elevated over the interests of another.*

Each of these terms deserves brief comment followed by a diagram and some discussion of the canonical conflict of interest that faces all practicing engineers.

The term *party* here is meant to represent an individual, organization, or aggregate of individuals, and this might be an engineer, a company, a client, or some other party to an ethical transaction. The term *role* indicates what relationship a party has with another; for example, an engineer may be an employee or a consultant to a company. Roles carry certain "obligations" of satisfactory performance. Engineering employees and consultants, for example, are expected to create effective designs for those who employ them, and in this way we see that the obligations of various roles are related to the interests of the related party.

Of course, all this sound fairly confusing, but it really is quite simple, as we can see in Figure 8.3. In this figure, what we call a *party–role* (PR) *diagram,* we see the canonical parties and roles in a typical engineer's life. The PR diagram is drawn with respect to the conflicted party, and the roles are shown as directed arrows away from the conflicted (or potentially conflicted) party. In the particular drawing, we see how engineers typically work as *consultants* for *clients* or

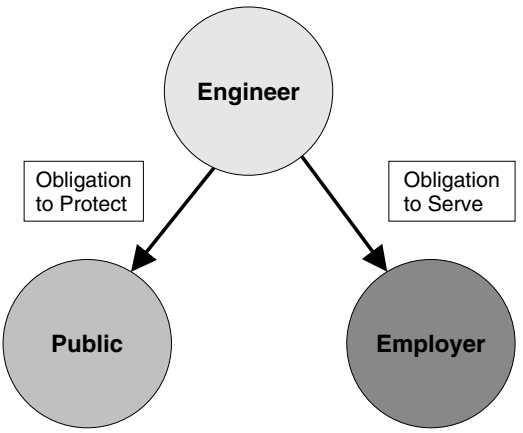

Figure 8.3 Schematic of an engineer working for an employer who also has an obligation to the public. Such party–role diagrams are helpful in understanding and visualizing conflicts of interest.

employees for *companies*. In addition, engineers—by virtue of their professional status—have an obligation to serve the general good of *society* or the *public* as a *guardian* or *protector*. The very nature of these relationships opens the door that the obligations of the two roles may sometimes collide.

For example, if your boss gives you an order to pour a carcinogenic solvent down a sanitary sewage drain, you are being asked to make a choice between the obligation you have in your role as employee and keep your obligation to follow the directions of your boss and the obligation you have to protect the public from illegal dumping of restricted substances. Of course, in this example, the right thing to do is clear, but understanding conflict of interest more generally, the different roles you play, and the different obligations you face may help you understand difficult ethical decisions more thoroughly.

Exploration Exercise

You work for ABC Consultants as a project engineer and you have a choice of buying a ticket to Atlanta, Georgia, using company funds for $500 on AAA Airlines or $250 on FlyCheap Airways. You have a frequent flyer plan with AAA but not FlyCheap. In a short paragraph, consider the conflict of interest you have in this setting. Describe what you believe to be the ethical course of action and why. Draw a PR diagram sketching the basic conflict of interest, labeling the parties and roles clearly. Detail the obligations of the different roles in words besides the sketch. Suppose that ABC Consultants requires all frequent flier miles collected in the course of company business to be turned over to the company. Draw the resulting PR diagram and explain how this change in rules affects the conflict of interest.

8.4.4 Whistleblowing Is Not a First Resort

Whistleblowing gets a lot of attention in the press, but going public with objections to your employer's policies, plans, or products may get you fired. Whistleblowing laws exist in some states, but much employment in the United States remains governed by the doctrine of "at-will employment," meaning that an employee can be terminated at any time for any reason. Your best protection against ever having to face a choice between going along with an unethical policy or decision or losing your job is to seek employment with organizations (a) known for products and services in line with your values and (b) who have reputations for ethical conduct. If you thought you joined such a company, but repeatedly find yourself in ethically uncomfortable situations, this may be an important signal to look for a new job.

Having said this, what can you do if, as part of your work, you are confronted with something you believe is very wrong? The first thing to do is to make sure that you believe the matter of concern *is* very serious. If you do, you must then bring it to the attention of others above you in the hierarchy. Most often this

would require you to approach your immediate supervisor, but there may be circumstances where that may not be wise. Perhaps there are co-workers who agree and who will stand by you. Perhaps there are other managers who understand the problem and are willing to argue your position. If your organization has an ethics hotline or ombudsman charged with looking into ethical concerns, it may be appropriate to use those channels.

If after going through channels inside the organization the matter is not resolved, you may be forced to go to the press or to an appropriate governmental agency. This is not a step to be taken lightly, and even with the best of whistleblower laws, whistleblowers pay a heavy personal price to set the ethical record straight.

SUMMARY

We started the chapter by examining how engineering ethics is often perceived by engineering students as a fairly boring and unimportant topic. The importance of the subject is underlined by widespread ethical lapses in business and public life, and the profession of engineering, too, is subject to these difficulties. As we discovered, the subject needn't be boring if (a) we approach it with an engineer's eye for modeling and (b) work from the bottom up to hone our professional ethical reflexes on top of the personal ethical notions we learned at home, in church, at school, or in our communities at large.

Most of us gain entryway into the realm of moral reasoning from one or more golden rules, and here we examined a number of golden rules from a number of the world's great religions and cultures. We found that the rules come in two flavors, positive and negative golden rules. Negative golden rules ask us to behave consistently, not doing unto others what we would not have done to ourselves. Positive golden rules ask us to behave charitably, holding us up to an ideal of good deeds and works.

Although golden rules are a useful entry point for discussion of morality, they are not the end of the story because golden rules are silent on what constitutes wrong or right conduct. This has led philosophers over the centuries to contemplate different theories of ethics, and here we very briefly considered five of them, but one of the key points was to understand their relationship, one to the other, and how ethical understanding is something of a patchquilt of different modes of reasoning, in much the same way that engineering model building often uses different models in different circumstances.

Theorizing is one thing, but engineers' interest in theory is putting it to practice. In that vein, we recognized that oftentimes engineers know the right thing to do, but sometimes they choose not to do it. Three obstacles to responsible behavior, self-interest, obedience to authority, and conformity to the group, have been discussed, and relevant results from social psychology experiments have been discussed. Understanding these results helps us recognize that doing the right thing, especially in an organizational setting, can be a terrifically difficult matter. A key response to this realization has been to advocate practicing ethical behavior in the small things everyday. In this way, when a larger ethical issue arises, the engineer will be better prepared to do the right thing when the stakes are higher, many are watching, and the pressure to do wrong is at its worst.

Finally, this led us to consider how engineering ethics necessarily goes beyond personal ethics, because of the complexity of engineering social interaction, the dictates of professional practice, and the existence of explicit engineering codes of ethics. After reviewing two engineering codes of ethics, we considered how conflicts of interest arise between

the obligations of different roles between two or more parties. Thereafter, we considered how engineers sometimes may be called on to stand up within their organization and do the right thing, despite resistance from their co-workers and supervisors. In the extreme case, whistleblowing, going public to the press or government with details of wrongdoing may be necessary, but whistleblowing is an extreme step, and it should only be used as a last resort, after other methods of influencing the organization have been exhausted.

EXERCISES

1. Read about a major corporate scandal or engineering disaster. In a short paragraph, identify key parties to the mishap and identify ways in which ethical wrongdoing led to trouble.
2. Make a list of 10 things that depend in part for their existence on social agreement.
3. Write a short essay on the sources of or influences on your own sense of right or wrong. Did this come from your parents, peers, religious training, or where? How do you personally determine right from wrong?
4. Current surveys suggest that large numbers of college students cheat on examinations. Is cheating ethically acceptable or unacceptable? Write a short paragraph explaining why or why not.
5. Current surveys suggest that many students download music they did not purchase from the Web. Is such downloading ethically acceptable? Write a short paragraph explaining why or why not?
6. Imagine you are a talented rock musician with a number of popular CDs. Reconsider your response to Exercise 5. Did your response change depending upon your point of view?
7. Lawrence Kohlberg articulated a theory of moral development with three levels of development and two stages within each level. Using the web, investigate the levels and stages of Kohlberg's ladder, and write a short paragraph whether there is a connection between any of the stages and the major modes of moral thinking discussed herein.
8. Look up the Association for Computing Machinery (ACM) code of ethics at www.acm.org. Compare and contrast the ACM code with that of the IEEE in a short essay.
9. Consider a company in the news because of ethical missteps. Investigate whether that company has a code of ethics, and determine which elements of the company's code were violated in the mishap.
10. Consider a company you admire that also has a code of ethics. In a short essay discuss the code of ethics and the ways in which it reflects or does not reflect what you know about the company.
11. Scientific organizations sometimes have codes of ethics. Look up the code of ethics of a scientific organization and compare and contrast that code to the NSPE code of ethics in the text.
12. Some items in engineering codes of ethics have less to do with ethical matters and more to do with regulating engineering commerce and trade. Examine the NSPE code of ethics and determine which items are of this nature. In a short paragraph discuss whether you view these as ethical issues or not.

13. NSPE case studies are available on the Web (www.nspe.org). Read a case study involving conflict of interest and draw a clear PR diagram labeling parties and roles. In words, write the obligations of the roles that were at issue in the conflict.

14. M. W. Thring's book, *The Engineer's Conscience* (London: Northgate, 1980), contains six propositions that he says are "necessary conditions for the survival of civilization." They are as follows:

- There is only one humane way of leveling off the world's population, and this is to provide a fully adequate standard of living and education to all people.
- The enormous differences in standard of living and use of resources between groups of people must be essentially eliminated within one generation if we are to eliminate the tensions leading to World War III.
- No pollutant must be emitted to the atmosphere, to water, or to land until it has been proved conclusively that the level of pollution has no long-term harmful cumulative effect on people, animals, or plants.
- It is a necessary condition for a stable civilization in the next century that the rich countries gradually eliminate their nonproductive activities, such as advertising, weapons manufacture, and fashion and built-in obsolescence, and replace these with genuine attempts to help the poor countries to build up the equipment and knowledge to become full self-supporting at a good standard of living.
- We have to bring about a fundamental change in the ethos of our society if it is to have any chance of moving into a stable 21st-century world.

Write an essay debating the merits of any one of Thring's "propositions."