

WHY ENGINEERS SHOULD SUPPORT THEIR PROFESSION'S CODE

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The title of my talk, "Why Engineers Should Support Their Profession's Code", implies that all engineers share a single code of ethics. Unfortunately, they don't. Members of the IEEE are subject to one code. Members of the NSPE are subject to another. Civil, chemical, and mechanical engineers are subject others. A few of you may be subject to two of these codes, or even three. Which are you to support? I shall not try to answer that question here. The primary difference between these codes is in format and detail. The codes are enough alike in substance that obeying one is generally consistent with obeying the others. So, let's just pretend there is only one (the one I'm handing out); and let's get on with explaining why you should support "it". And because ethics is a practical matter, let's begin with a practical problem.

The Challenger Disaster

On the night of January 25, 1986, Robert Lund was worried. The Space Center was counting down for a shuttle launch the next morning. Lund, vice-president for engineering at Morton Thiokol, had earlier presided at a meeting of engineers that unanimously recommended against the launch. He had concurred and informed his boss, Jerald Mason. Mason informed the Space Center. Lund had expected the flight to be postponed. The Center's safety record was good. It was good because the Center would not allow a launch unless the technical people approved.

Lund had not approved. He had not approved because the temperature at the launch site would be close to freezing at lift-off. The Space Center was worried about the ice already forming here and there on the boosters, but Lund's

worry was the "O-rings" that sealed the booster's segments. They had been a great idea, permitting Thiokol to build the huge rocket in Utah and ship it in pieces to the Space Center two thousand miles away. Building in Utah was so much more efficient than building on-site that Thiokol had been able to underbid the competition. The shuttle contract had earned Thiokol \$150 million in profits.

But the O-rings were not perfect. Data from previous flights indicated that the rings tended to erode in flight, with the worst erosion occurring on the coldest preceding lift-off. Experimental evidence was sketchy but ominous. Erosion seemed to increase as the rings lost their resiliency and resiliency decreased with temperature. At some temperature, the rings could lose so much resiliency that one would fail to seal properly. If a ring failed in flight, the shuttle could explode.

Unfortunately, almost no testing had been done below 40°F. The engineers had had to extrapolate. But, with the lives of seven astronauts at stake, the decision seemed clear enough: Safety first.

Well, it had seemed clear earlier that day. Now Lund was not so sure. The Space Center had been "surprised" and "appalled" by the evidence on which the no-launch recommendation had been based. They wanted to launch. But they would not launch without Thiokol's approval. They urged Mason to reconsider. He had re-examined the evidence and decided the rings should hold at the expected temperature. Joseph Kilminster, Thiokol's vice president for shuttle programs, was ready to sign a launch approval, but only if Lund approved.

Lund's first response was to repeat his objections. But then Mason had said something that made him think again. Mason had asked him to think like a manager rather than an engineer. (The exact words were "take off your engineering hat and put on your management hat".) Lund did

and changed his mind. The next morning the shuttle exploded during lift-off, killing all aboard. An O-ring had failed.

Should Lund have reversed himself and approved the launch? In retrospect, of course, it seems obvious that reversing himself was wrong. But most problems concerning what we should do would hardly be problems at all if we could foresee all the consequences of what we do. Fairness to Lund requires us to ask whether he should have approved the launch given only the information actually available. And since Lund seems to have reversed himself and approved the launch because he began to think like a manager rather than an engineer, we need to consider whether Lund, an engineer, should have thought like a manager rather than an engineer. But, before we can consider that, we need to know what the difference is between thinking like a manager and thinking like an engineer.

One explanation of the difference would stress technical knowledge. Managers are trained to handle people. Engineers are trained to handle things. To think like a manager rather than an engineer is to focus on people rather than on things. According to this explanation, Lund was asked to concern himself primarily with how best to handle his boss, the Space Center, and his own engineers. He was to draw upon his knowledge of engineering only as he might his knowledge of a foreign language, for example, to help him understand what his engineers were saying. He was to act much as he would have had he never earned a degree in engineering.

If that explanation of what Mason was asking of Lund seems implausible (as I think it does), what is the alternative? If Mason did not mean that Lund should make his knowledge of engineering peripheral (as it seems Mason, himself an engineer, did not when he earlier personally re-examined the evidence), what was he asking Lund to do? What is it to think like an engineer if not simply to use

one's technical knowledge of engineering? That is a question engineers have been asking for almost a century. Answers have often been expressed in a formal code of ethics.

That may seem odd. What business (you may ask) do engineers have promulgating codes of ethics? What could they be thinking? Isn't ethics a matter of private conscience, not majority vote? There are (you might add) no experts in ethics. And, if there were, wouldn't the experts be philosophers or clergy rather than engineers? Such questions make any connection between engineering and ethics look rather dubious. So, before we can say much more about what Lund should do, we shall have to dispose of these questions.

The Connection Between Professions and Codes of Ethics

A code of ethics generally appears when an occupation organizes itself into a profession. Why this connection between codes of ethics and organized professions? A number of explanations have been offered over the years. But, for our purposes, the most helpful is that a code of ethics is primarily a contract between professionals. According to this explanation, a profession is a group of persons who want to cooperate in serving the same ideal better than they could if they did not cooperate. Engineers, for example, might be thought to serve the ideal of efficient design, construction, and maintenance of safe and useful objects. A code of ethics would then prescribe how professionals are to pursue their common ideal so that each may do the best he can at minimum cost to himself (and to the public--if looking after the public is part of the ideal). The code is to protect each from certain pressures (for example, the pressure to cut corners to save money) by making it reasonably likely that most other members of the profession

will not take advantage of his good conduct. A code protects members of a profession from certain consequences of competition.

According to this explanation, an occupation does not need society's recognition to be a profession. It needs only a practice among its members of cooperating to serve a certain ideal. Once an occupation has become a profession, society has a reason to give it special privileges (for example, the sole right to do certain kinds of work) if, but only if, society wants to support serving the ideal in question in the way the profession has chosen to serve it. Otherwise, it may leave the profession unrecognized.

Understanding a code of ethics as a contract between professionals, we can explain why engineers should not depend on mere private conscience when choosing how to practice their profession, why they should take into account what an organization of engineers has to say about what engineers should do.

What others expect of us is part of what we should take into account in choosing what to do, especially if the expectation is reasonable. A code provides a guide to what engineers may reasonably expect of one another, what (more or less) "the rules of the game" are. Just as we must know the rules of baseball to know what to do with the ball, so we must know engineering ethics to know, for example, whether, as engineers, we should merely weigh safety against the wishes of our employer or instead give safety preference over those wishes.

A code of ethics should also provide a guide to what we may expect other members of our profession to help us do. If, for example, part of being an engineer is putting safety first, then Lund's engineers had a right to expect his support. When Lund's boss asked him to think like a manager rather than an engineer, he should, as an engineer, have responded, "Sorry, if you wanted a vice president who would

think like a manager rather than an engineer, you should not have hired an engineer."

If Lund had so responded, he would have responded as the "rules of the engineering game" require. But would he have done the right thing, not simply according to those rules but really? This is not an empty question. Even games can be irrational or immoral. (Think, for example, of a game in which you score points by cutting off your fingers or by shooting people who happen to pass in the street below.) People are not merely members of this or that profession. They are also persons with responsibilities beyond their profession, persons who cannot escape pangs of conscience, criticism, blame, or punishment just by showing that they did what they did because their profession told them to. While we have now explained why an engineer should, as engineer, take account of her profession's code of ethics, we have not explained why anyone should be an engineer in the relevant sense.

I should put this point more dramatically. Suppose Lund's boss had responded in this way to what we just imagined Lund to have said to him: "Yes, we hired an engineer, but--we supposed--an engineer with common sense, one who understood just how much weight a rational person gives a code of ethics in decisions of this kind. Be reasonable. Your job and mine are on the line. The future of Thiokol is also on the line. Safety counts a lot. But other things do too. If we block this launch, the Space Center will start looking for someone more agreeable to supply boosters."

If doing as one's professional code says is really justified, we should be able to explain to Lund (and his boss) why, as a rational person, Lund should support his profession's code as a guide for all engineers and why, under the circumstances, he could not rationally expect others to treat him as an exception.

Why Obey Your Profession's Code?

We might begin our answer by dismissing two alternatives some people find plausible. One is that Lund should do as his profession requires because he "promised", for example, by joining an engineering society having a code of ethics. We must dismiss this answer because it is at least possible that Lund never did anything we could plausibly characterize as promising to follow a code. Lund could, for example, have refused to joined any professional association having a code. Yet, it seems such a refusal would not excuse him from conducting himself as an engineer should. The obligations of an engineer do not seem to rest on anything so contingent as a promise, oath, or vow. So, the "contract" between professionals of which we spoke cannot literally be a contract. It seems more like what lawyers call a "quasi-contract", that is, an obligation resting not on actual agreement but on what it is fair to require of someone given that he has benefited in a certain way by some action of his (for example, by claiming to be an engineer).

Another plausible answer we may quickly dismiss is that Lund should do as his profession requires because "society" says he should. We may dismiss this answer in part because it is not clear that society does say that. One way society has of saying things is through law. No law binds all engineers to abide by their profession's code of ethics (as the law does bind all lawyers). Of course, society has other ways of saying things than by law, for example, by public opinion. But it seems doubtful that the public knows enough about engineering ethics to have an opinion on the question we are considering. More important, it is not clear why public opinion or law should decide what it is rational or moral to do. Certainly there have been both irrational laws (for example, those requiring use of

outmoded techniques) and immoral laws (for example, those recognizing slavery). The public opinion supporting those laws could not have been much less irrational or immoral than the laws themselves.

The two answers we have now dismissed share one notable feature. Either would, if defensible, provide a reason to do as one's profession says that is independent of what in particular the profession happens to say. The answers do not take account of the contents of the code of ethics. They are "formal." The answer we shall now consider is not formal. It is that supporting a code of ethics with a certain content is rational because supporting any code with a content of that sort is rational.

Consider the model code prepared by the Accreditation Board for Engineering and Technology (handout). The Code is divided into "fundamental principles" and "fundamental canons." The fundamental principles simply describe in general terms an ideal of service. Engineers "uphold and advance the integrity, honor and dignity of the engineering profession by: I. using their knowledge and skill for the enhancement of human welfare, II. being honest and impartial, and serving with fidelity the public, their employers and clients [and so on]". What rational person could object to other people with her skills trying to achieve that ideal? (Or at least, what rational person could object so long as their doing so did not interfere with what she was doing?) Surely every engineer, indeed, every member of society, is likely to be better off overall if engineers uphold and advance the integrity, honor, and dignity of engineering in that way.

Below the fundamental principles are the fundamental canons. The canons lay down general duties. For example, engineers are required to "hold paramount the safety, health and welfare of the public," to "issue public statements only in an objective and truthful manner," to "act in

professional matters for each employer or client as faithful agents and trustees," and to "avoid all conflicts of interest." Each engineer stands to benefit from these requirements both as ordinary person and as engineer. How? The benefits for engineers as ordinary persons are, I think, obvious. As an ordinary person, an engineer is likely to be safer, healthier, and otherwise better off if engineers hold paramount the public safety, only make truthful public statements, and so on. How engineers stand to benefit as engineers may not be so obvious. So, let's begin with a thought experiment.

Imagine what engineering would be like if engineers did not generally act as the canons require. If, for example, engineers did not generally hold paramount the safety, health, and welfare of the public, what would it be like to be an engineer? The day-to-day work would, of course, be much the same. But every now and then an engineer might be asked to do something which, though profitable to his employer or client, would put other people at risk, some perhaps about whom he cared a great deal. Without a professional code, an engineer could not object as an engineer. An engineer could, of course, still object "personally" and refuse to do the job. But, if he did, he would risk being replaced by an engineer who would not object. An employer or client might rightly treat an engineer's personal qualms as a disability much like a tendency to make errors. The engineer would be under tremendous pressure to keep "personal opinions" to himself and get on with the job. His interests as an engineer would conflict with his interests as a person; his conscience, with his self-interest.

The only way--apart from law--to prevent such conflicts is to make it part of being an engineer that the public safety, health, and welfare come first. Preventing such conflicts is, it seems, sufficient reason for any engineer,

including Lund, to want engineers generally to adhere to (something like) the ABET Code. But why should an engineer adhere to it himself when, as in Lund's case, it seems he stands to benefit by departing from it? The answer should now be obvious. Lund would have to justify his departure from the Code by appeal to such considerations as the welfare of Thiokol and his own self-interest. Appeal to such considerations is just what Lund could not incorporate into a code of ethics for engineers or generally allow other engineers in defense of what they did. Lund could not let such an exception be incorporated into a code because its incorporation would defeat the purpose of the code. A code of ethics is necessary in large part because, without it, the self-interest of individual engineers would lead them to do what would harm everyone overall. Lund could not allow other engineers to defend what they did by appeal to their own interests or that of their employer for much the same reason. To allow such appeals would be to contribute to the breakdown of a practice Lund has good reason to support.

We are, of course, assuming that engineers do in fact generally act in accordance with the ABET Code (whether or not they know it exists). If that assumption were mistaken, Lund would have no professional reason to do as the Code says. The Code would be a dead letter, not a living practice. It would have much the same status as a "model statute" no government ever adopted, or the rules of a cooperative game no one was playing. Lund would have to rely on private judgment. But relying on private judgment is not necessary here. Lund's engineers seem to have recommended as they did because they thought the safety of the public, including the astronauts, paramount. They did what (according to the ABET Code) engineers are supposed to do. Their recommendation is itself evidence that the Code corresponds to a living practice.

So, when Lund's boss asked him to think like a manager rather than an engineer, what he was in effect asking Lund to do is to think in a way that Lund must consider unjustified for engineers generally and for which Lund can provide no rationally defensible principle making himself an exception. When Lund did as his boss asked (supposing he did), he in effect let down all those engineers who helped to build the practice that today allows engineers to say "no" in such circumstances with reasonable hope a) that their client or employer will defer to "professional judgment" and b) that other members of their profession will aid them if the client or employer does not defer.

Lund could, of course, still explain how his action served his own interests and those of Thiokol (or, rather, how they seemed to at the time). He could also just thumb his nose at all talk of engineering ethics (though that may lead to the government barring him from work on any project it funds, to fellow engineers refusing to have anything to do with him, and to his employer coming to view him as an embarrassment). What he cannot do is show that what he did was right, all things considered.

Using a Code of Ethics

So far we have assumed that Lund did as his boss asked, that is, that he thought like a manager rather than an engineer. Assuming that allowed us to provide a relatively clear explanation of what was wrong with what Lund did. What was wrong was that Lund acted like a manager when he was an engineer and should have acted like one.

We must, however, now put that assumption aside and consider whether engineering ethics actually forbids Lund to do what it seems he did, that is, weigh his own interests, his employers, and his clients against the safety of the seven astronauts. Ordinary morality seems to allow such

weighing. For example, no one would think you did something morally wrong if you drove your child to school, rather than letting him take the bus, even though your being on the road increased somewhat the risk that someone would be killed in a traffic accident. Morality allows us to give special weight to the interests of those close to us. If engineering ethics allows it too, then--whatever Lund may have thought he was doing--he would not actually have acted unprofessionally. Let us imagine Lund reading the ABET Code. What could he infer?

Of the seven fundamental canons of the current ABET Code, only two seem relevant: 1) "[holding] paramount the safety, health and welfare of the public" and 4) "[acting] in professional matters for each employer or client as faithful agents or trustees." What do these provisions tell Lund to do? The answer is not obvious. Does "public" include the seven astronauts? They are, after all, employees of Thiokol's client, the Space Center, not part of the public as, say, those ordinary citizens are who watch launches from the beach opposite the Space Center. And what is it to be a "faithful agent or trustee" of one's client or employer? Is it to do as instructed or to do what is in the client's or employer's interests? And how exactly is one to determine those interests? After all, the actual result of Lund's decision was a disaster for both employer and client--but a disaster Lund, his employer, and his client thought themselves justified in risking. And what is Lund to do if the public welfare requires what no faithful agent or trustee could do? Does "hold[ing] paramount" the public welfare include sometimes acting as a faithful agent or trustee would not act?

These questions will be surprisingly easy to answer if we keep in mind the connection between professions and codes of ethics, remembering especially that a code is the work of engineers, not a stone tablet inscribed with divine wisdom,

a set of rules that is supposed to win the support of engineers because the rules help engineers do what they want to do.

The language of any document, codes included, must be interpreted in light of what it is reasonable to suppose its authors to intend. For example, if "bachelor" appears undefined in a marriage statute, we interpret it as referring to single males, but if the same word appears undefined in directions for a college's graduation ceremony, we instead interpret it as referring to all students getting their baccalaureate, whether male or female, single or married. That is the reasonable interpretation because we know that marriages usually involve single males (as well as single females) rather than people with bacclaureates while just the reverse is true of graduation ceremonies. So, once we figure out what it is reasonable to suppose engineers to intend by declaring the "public" safety, health, and welfare "paramount," we should be able to decide whether interpreting "public" so that it includes "employees" is what engineers intend (or, at least, what, as rational persons, they should intend) and also whether they intend the paramountcy requirement to take precedence over the duty to act as a faithful agent or trustee.

The "authors" of a code of engineering ethics (both those who originally drafted or approved it and those who now give it their support) are all more or less rational persons. They differ from most other rational persons only in knowing what engineers must know to be engineers and in performing duties they could not perform (or could not perform as well) but for that knowledge. It is therefore reasonable to suppose that their code of ethics would not require engineers to risk their own safety, health, or welfare, or that of anyone for whom they care, except for some substantial good (for example, high pay, easy application of the Code, or service to some ideal to which

they are committed). It also seems reasonable to suppose no code they "authored" would include anything people generally consider immoral. Whatever a rational engineer might do in private, she could not expect an immoral provision to win much public support from other engineers.

That, I think, explains why a code of engineering ethics would make holding-the-public-safety-paramount a duty taking precedence over all others, including the duty to act as a faithful agent or trustee. Rational engineers would want to avoid situations in which only their private qualms stood between them and a use of professional knowledge they considered wrong or otherwise undesirable. Each would (as we saw) want to be reasonably sure the knowledge of other engineers would serve the public even when the interests of the public conflicted with those of employer or client. Given this purpose, what must "public" mean?

We might interpret "public" as equivalent to "everyone" (in the society, locale, or whatever). On this interpretation, the "public safety" would mean the safety of everyone more or less equally. A danger that struck only children, or only those with bad lungs, or the like, would not endanger "the public." This interpretation must be rejected. Since few dangers are likely to fall upon everyone more or less equally, interpreting "public" to mean "everyone" would yield a duty to the public too weak to protect most engineers from having to do things that would make life for them (and those for whom they care) worse than it would otherwise be.

We might also interpret "public" as referring to "anyone" (in the society, locale, or whatever). On this interpretation, the "public safety" would be equivalent to the safety of some or all. Holding the public safety paramount would mean never putting anyone in danger. If our first interpretation of "public" made provisions protecting the public too weak, this second would make such provisions

too strong. For example, it is hard to imagine how we could have automobile, mountain tunnels, or chemical plants without some risk to someone. No rational engineer could endorse a code of ethics that virtually made engineering impossible.

We seem, then, to need an interpretation of "public" invoking some relevant feature of people (rather than, as we have so far, just their number). We might, for example, think that what makes people a public is their relative "innocence," "helplessness," or "passivity." On this interpretation (which I believe to be the right one), "public" would refer to those persons whose lack of information, technical knowledge, or time for deliberation renders them more or less vulnerable to the powers an engineer wields on behalf of his client or employer. An engineer should hold paramount the public safety, health, and welfare to assure that engineers will not be forced to give less regard to the welfare of these "innocents" than simple decency requires.

On this third interpretation, someone might be part of the public in one respect but not in another. For example, the astronauts would be part of the public in respect of the O-rings because, not knowing of the danger, they were in no position to abort the launch because of it. The astronauts would, in contrast, not be part of the public in respect of the ice forming on the booster because, having been fully informed of that danger, they were in a position to abort the launch if they were unwilling to take that risk. This third interpretation of "public" thus seems to be free of the difficulties that discredited the preceding two. We now seem to have a sense of "holding the public safety paramount" we may reasonably suppose rational engineers to endorse.

On this interpretation, the engineer's code of ethics would require Lund either to refuse to authorize the launch

or to insist instead that the astronauts be briefed to get their informed consent to the risk. Refusing authorization would protect the "public" by holding the safety of the astronauts paramount. Insisting that the astronauts be briefed and decide for themselves would hold the safety of the "public" paramount by transferring the astronauts from the category of member of the public to that of informed participant in the decision. Either way, Lund would not, under the circumstances, have had to treat his own interests, those of his employer Thiokol, or those of his client the Space Center, as comparable to those of the public.

Is this the right answer? It is if we have taken every relevant consideration into account. Have we? How are we to know that we have? We can, of course, go through a check list. But how are we to know that the check is complete? Past experience is an indication, but now and then something unprecedented occurs. So, what are we to do? In engineering ethics, as in the rest of engineering, it is often easier to demonstrate the fault of alternatives than to demonstrate that one answer must be right. This is such a case. While we cannot demonstrate that our third interpretation is the right one, we can demonstrate that the obvious remaining alternative is wrong.

The remaining alternative to our third interpretation is that "public" refers to all "innocents" except employees of the client or employer in question. Employees are to be excluded because (it might be said) they are paid to take the risks associated with their line of work. On this interpretation, Lund would not have to hold the safety of the astronauts paramount. They would not be part of the public.

What is wrong with this fourth alternative? We understood "innocents" to refer to people whose lack of information, training, or time for deliberation renders them

vulnerable to the powers an engineer wields on behalf of his client or employer. An employee who takes a job knowing the risks (and being able to avoid them) might be able to insist on being paid enough to compensate for them. She could then truly be said to be paid to take those risks. She would not be an "innocent". And so, on our third interpretation (as well as on the fourth), she also not be part of the public to which an engineer owed a paramount duty. She would have given informed consent to the risk in question. So, the two interpretations do not differ in respect to such informed employees.

On the other hand, if the employee in question lacked the information to evaluate the risk, she would be in no position to insist on adequate compensation. She could not be said to be paid to take those risks. She would, in other words, be as innocent of, as vulnerable to, and as unpaid for, the risks in question as anyone else in the public. Since nothing prevents an engineer, or someone for whom an engineer cares, from being the employee unknowingly at risk, rational engineers have as much reason to want to protect such employees as to protect the public in general. "Public" should then be interpreted according to our third interpretation, not according to the fourth. "Public" can include employees.

Conclusion

You support your profession's code of ethics: a) by acting as it requires, b) by encouraging others to do the same, and c) by criticizing, ostracizing, or otherwise calling to account those who do not. Why then should you support your profession's code? We can now give at least three reasons: First, you should support your profession's code because supporting it will help protect you and those for whom you care from being injured by what

other engineers do. Second, supporting the code will also help to assure you a working environment in which it will be easier than it would otherwise be for you to resist pressure to do what you should not do. And third, you should support your profession's code because supporting it helps make your profession an occupation you can be proud to be associated with.

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