What Counts as a Design Problem?

Aristotle said of being ethical that “going wrong is easy, and going right difficult; it is easy to miss the bull’s eye and difficult to hit it.”¹ He could just as well have said this of solving design problems. Of course, a design problem usually has more than one solution. So there is more than one way for an engineer to hit a bull’s eye, but there are so many variables that need to be taken into account that it is all too easy to miss the target and fail to get things right.

We saw one way of failing when examining the software flaw responsible for the crash that killed 159 people. The engineers failed to think through how what they designed would work in practice. This is not the only way in which engineers can fail to understand what counts as a design problem, but it is a far more common problem than it may seem. Each of the following examples illustrates that point.

1. **Cadillac trunk** -- In some older Cadillacs, you are to lower the trunk lid to within a foot or so of the latch and then let go. A motor takes over and gently closes the lid. If you push the trunk down to latch it, you break the mechanism. Once the mechanism is broken, the trunk will not latch at all. Repair is costly because it requires taking out part of the trunk compartment to get to the mechanism. So you end up with a cascading set of harmful effects -- the trunk latch broken, a trunk you are unable to latch, and a costly repair, all because you or someone else tried to latch the trunk the way we normally do.

   The self-closing mechanism creates a problem waiting to happen. We all know that sometime, someone, even with a warning not to close the trunk by hand, will break the mechanism. The trunk opens just the way normal trunks do, with no sign on or in the trunk indicating it is to be treated any differently than any other trunk. So someone fixing a tire or putting in groceries will get no warning that the trunk should not be closed the way trunks are normally closed. A single visit to a hotel with a doorman who takes your luggage and slams the trunk will suffice to do in your trunk and your wallet.²

   The problem with the trunk of these Cadillacs is not at all unusual. We have in part a user problem. Those who are most concerned that the trunk be closed properly, and best positioned to know how to close it properly because they can read the instruction manual that comes with the car, are not the only ones who will close the trunk, and even they will have to guard against letting old habits take charge. But there are others who will use the trunk -- an auto mechanic getting a tire, that hotel doorman -- and so there is a risk of harm.

   We also have in part a legacy problem. People are used to trunks operating in a certain way. Change the way trunks operate, and some people are going to continue to try to operate them the old way, just by force of habit. That is the problem we saw with the

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² I had this problem with my father-in-law’s Cadillac. He prevented me from breaking the trunk by jumping out of the car to warn me. This problem was also brought to my attention by a student, Zak Kulage.
toaster where the lever to lower the bread would irreparably be damaged if it were also used to raise the toast. So an engineer suggesting a new design needs to consider how things might go wrong because of past habits that will need to be changed. Engineering progress requires pushing the envelope of design and so forcing new habits upon us, but those old habits can cause significant harm.

In this case the harm is primarily financial -- the costs of the time lost, of the repair, of not having the car available. The engineers responsible for this trunk-closing mechanism failed to do anything to prevent those old habits from causing harm -- no warning signs, no mechanism to prevent someone with those old habits from slamming it shut when it seems to catch for no good reason.

Vehicles are a wonderful source of examples of error-provocative designs. “But,” one may well wonder, “do these constitute moral problems?” The test is whether there is significant enough harm that could have been avoided, and the determination of harm is not limited to loss of life, for instance, but extends to any setback to an interest we have. Our interest in regard to the Cadillac is to have a functioning car, without unnecessary expense or time spent without the car while it is being repaired. Closing the trunk lid as we normally do in Cadillacs with a self-closing mechanism produces a cascading set of harmful effects. Engineers should try to avoid all those harms if they can design such a mechanism without those attendant harms.

Because engineers should try to avoid all those harms, we need not get hung up on trying to find a line between morally significant and morally insignificant harms. It is a question that has stymied philosophers, and engineers do not need to get caught up in that query in order to identify the harms that would be produced by a design solution or consider alternative solutions that avoid those harms. What matters for engineers are only two questions: Is there harm, and is it necessary? If there is harm that can be avoided, it ought to be avoided.

In the following example, there is no doubt that the harm ought to have been avoided.

2. X-ray machine --X-ray technicians always go behind a lead shield so that they will not suffer the consequences of too many X-rays. One large machine was built so that the patient lay on a table, and the X-ray was in a heavy arm extending over the table. The arm could be turned so that the X-ray could be focused on a particular spot on a patient, and all these movements were controlled by an X-ray technician at a console in a room separated from the machine. Software controlled the relations between the knobs on the console and the movements of the X-ray arm. At the end of the day the arm was always lowered to a very small height above the X-ray table. An engineer wrote the software to do what it was required to do, but what occurred was perfectly predictable.

After finishing up with the last patient of the day, a technician called out to tell the patient he could leave. The technician then shut down the machine. When the technician went out to leave work, the nurse asked where the patient was. “I told him he could leave.” “Well, he didn’t come through here.” They found him face down on the table, flattened by the heavy arm of the X-ray.

The technician had been behind a lead shield, in a separate room, and so was not in a position to see whether a patient had gotten off the X-ray table. Nothing about the

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software required that the technician check to see if the X-ray table was clear before lowering the X-ray arm. The patient had not heard the technician, and, face down, he could not see the machine coming down to crush him as it was lowered to the table top.

A little thought about how such software would be used in practice would have revealed the problem. Software engineers need to think through how software will work in situ. How does it work with pre-existing software? This is a problem not unlike that physicians need to consider when prescribing medication that may not interact well with other medication the patient is taking. Does the software give clear directions to those operating it? This is a problem like that of anyone trying to communicate information and avoid ambiguity. There are so many variables that need to be examined in designing software that it is understandable how a software engineer may fail to think through those effects that are likely to occur when the software is put to use in practice. The situation here is the same as the situation regarding the autopilot software. The software engineers failed to think through what was likely to happen when the software was being used by those it was designed for -- a pilot, an X-ray technician.

Some may think it is difficult enough learning to think like an engineer, and here we are demanding that engineers put themselves in the shoes of those who use the artifacts they have created -- to think like a pilot, or an X-ray technician. But that is not a demanding challenge. They do not have to be pilots, only think through what it would be like to be faced with two different defaults when trying to land. They do not have to be X-ray technicians, only think through what it would be like to operate the X-ray machine with that software, including closing up the X-ray machine without having any way of ensuring that no one is on the X-ray table. To ensure that their design solutions do not cause unnecessary harm, engineers do not need to stretch their thoughts very far -- as the next example illustrates.

3. Defibrillator -- Joshua Oukrop was 21 when he died. He was on a biking trip with his girl friend when he called out from ahead, “Hold on. I need to…”, and tumbled over backwards, his defibrillator having failed to work when needed. He had a genetic heart disease and a defibrillator that was to “emit an electrical jolt to restore [normal] rhythm to a chaotically beating heart.” Mr. Oukrop’s defibrillator shorted out.

The defibrillator failed because of the deterioration of the polymide coating on electrical wires “in a component that sits atop the sealed part of a heart device. The component, called the header, is essentially a junction box connecting a unit’s computer and power supply with cables, or leads, that carry electrical impulses to the heart.” But “body fluids can slowly seep into the header, which is not hermetically sealed, and cause

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5 A recent example concerns Plavix, an anti-clotting drug given to those who have had a heart attack, and an anti-ulcer drug, Prilosec or Aciphex, generally given because Plavix can irritate the stomach. Those taking both drugs have a 25% higher risk of another heart attack (Joaanne Silberner, “Study: Common Heart Drug Combo Raises Risk,” All Things Considered, March 3, 2009, at http://www.npr.org/templates/story/story.php?storyId=101386673). Physicians have been routinely prescribing anti-ulcer drugs when, as it turns out, the drug somehow interferes with the anti-clotting Plavix, reducing its effectiveness significantly.

polymide to deteriorate,...”\(^7\) The deterioration means that the defibrillator will short out when it tries to send a life-saving jolt to restore the heart’s normal rhythm.

The manufacturer, Guidant, discovered the flaw in 2002, three years before Mr. Oukrop died. It fixed the problem, but did not inform those who had had the flawed defibrillator implanted or inform their physicians. It announced the flaw only in 2005 when it discovered that the New York Times was publishing an article about it.

Guidant did not inform the patients with the defibrillators or their physicians because, it said, it judged “the risks, like infections, associated with surgical replacements outweighed the risks posed by the device.”\(^8\) It may have been right about its assessment of risks, but that paternalistic response prevented patients from making their own judgments and precluded physicians from taking part in judgments about the health of their patients. Neither physicians nor patients gave informed consent that the flawed defibrillators not be replaced.

Guidant may have made that decision because it continued to sell the old model until, apparently, its inventory was gone. After the New York Times article, Guidant appointed an independent panel to investigate, and among its findings was the following:

> During a period of approximately one year after the corrective action was taken in response to the observation of arcing, more than 4,000 of the pre-mitigated devices continued to be implanted, approximately 1,300 of which were shipped from CRM’s in-house inventory and the remainder in the possession of the sales force and in hospital inventories.\(^9\)

As an attorney for someone suing the company might put it, with great sarcasm, mimicking their reasoning, “Replacing a flawed defibrillator with an equally flawed defibrillator is surely not worth the risk of an operation.”

Guidant made at least two unconscionable decisions:

a. not to inform patients and their physicians of the flawed defibrillators that had already been implanted, and

b. to continue to sell the flawed defibrillators, knowing full well that they were flawed, that physicians and patients could not know they were flawed, and that the devices would put those new patients at risk when implanted.

It is more than a little disingenuous for Guidant to continue to sell the flawed defibrillator while claiming that it was riskier to replace the flawed device was greater than to leave it in place. If the risk of replacing the flawed devices was greater than the risk of leaving it in place, surely the risk created by operating to implant a flawed device must be higher still.


\(^8\) Meier, October 20, 2005.

since the risky operation creates a new risk for the patient because of the flaw in the device. So why would Guidant sell what it knew was a flawed device?

It is difficult not to think that Guidant was moved not to inform patients and their physicians because they wanted to sell the flawed defibrillators. That is, it did not inform the patients or physicians so they could make up their own minds about whether to replace the flawed device because if it had informed them, it would have had to inform them that the replacement devices were equally flawed. They would not likely sell any and would presumably have to write off 4000 flawed devices at $25,000 apiece.

By the time Guidant announced the defect, two people were known to have died and over forty defibrillators had failed.\(^{10}\) Over 29,000 were at risk of their defibrillator failing just when it was needed and thus faced a terrible choice: keep what is there and hope it works when it is needed, or have yet another operation to replace the defibrillator for another that may or may not work properly.\(^{11}\)

Guidant’s morally unconscionable behavior has had another effect, that is -- the loss of trust that Guidant is concerned about the health of patients in need of a defibrillator and a subsequent wonder about the industry in general. Guidant was willing to write off the health of patients in need of a defibrillator in place of writing off its flawed devices, and if Guidant was willing to do that, what assurance do patients and physicians have regarding any defibrillator or, indeed, any other medical device?

The engineers who designed the defibrillator were equally at fault for failing to think through how it was to be used and failing to ask themselves a simple question, “Will the parts withstand implantation?” If you are designing something that is to be used in a hostile environment -- clothing for use by those fighting fires, for instance -- it is irresponsible not to test it in that environment to be sure that it can perform its task. Selling clothing for fire fighters that ignites upon contact with fire would be as unconscionable as knowingly selling flawed defibrillators.

The possible harm from the flawed device is significant -- death from a heart attack. It is particularly galling that the source of the harm is the very device that is supposed to save your life. What Guidant continued to sell was a false sense of security.

Without the details about any of the internal workings of the company, we cannot know exactly what kind of moral problem we have here. For all we know, this may be a situation where competent engineers wanted to test the device, but were prevented from doing so by management. That is not an implausible hypothesis given Guidant’s moral climate. But whatever the details, we do know that the device should have been tested in situ and that the engineers should have refused to sign off on the device if they had tested it in situ, found it wanting, but were overruled by management.

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\(^{10}\) It is difficult to assess the risk because we do not know how many have died because of a failure of their defibrillator. The number of deaths that we know occurred because of a failure with a defibrillator is probably significantly smaller than the number of deaths actually caused by failures. The defibrillators are mostly implanted in older people, and when they die, the cause is attributed to heart failure, and no autopsy is done to determine if the defibrillator failed. So we do not know even roughly how many have died because of the flawed device. Without that knowledge, we have no way of assessing the risk of keeping a flawed defibrillator versus getting a new one. No one can answer the question, “What is the chance that my defibrillator will fail?” So Guidant was in no position to claim, as it did, that the risk of replacing the device outweighed the risk posed by the defective device. We simply do not know what the latter risk was.

This is an important lesson. A “new way of connecting defibrillators to the wires” has been developed, and it was not tested for how it will work in humans.\textsuperscript{12} The Food and Drug Administration said that no testing was necessary because “the new wiring connectors are simply a design modification and not a new technology.” The history of failures suggests otherwise. We now know about one of Guidant’s flawed defibrillators.\textsuperscript{13} Medtronic, another maker of defibrillators, introduced a new thin wire connector in 2004 that “began to fracture and fail at an unexpectedly high rate. By the time they were recalled, they had been implanted in some 235,000 patients,” putting all at risk.\textsuperscript{14} That number makes the 29,000 put at risk by Guidant seem like only a minor catastrophe.\textsuperscript{15}

The Cadillac trunk, the X-ray machine, and the defibrillator are examples in which something is wrong with the design solution the engineers adopted. It is not that the artifacts will not work. Anyone testing them will find that they work just fine. The trunk will close as it is supposed to close; the X-ray machine will close down to the table as it is supposed to; and the defibrillator will send the charge it is supposed to send when activated. That is part of the problem. Isolated from the situations in which they will be used, these artifacts seem perfectly fine. Put into the situations in which they will be used, enough will fail to work as they were designed to work to cause unnecessary harm, including death.

The problem is that the design problem for these artifacts was not fully articulated. The engineers needed to develop a defibrillator that could withstand implantation and still work, software that would require that the X-ray table be empty before it could close down, and a trunk mechanism that would not be so likely to break if the trunks are closed as we are all so used to closing trunks.

At a moral minimum, engineers are responsible for ensuring that their designs do not themselves cause unnecessary harm, and yet that is just what these artifacts do when they are put to use.

\textsuperscript{12} It would perhaps be more accurate to say that the new method of connecting wires is being tested by being implanted in patients and then waiting to see what happens.

\textsuperscript{13} We have been looking at the problem with only one model by Guidant, its Ventak Prizm 2 DR Model 1861. But others of its models also had problems. Two had similar problems of short-circuiting, and Guidant ended up recalling at least seven models (Williams, June 17, 2005).


Quaid Case

In a 60 Minutes Report on March 16, 2008, Dennis Quaid and his wife Kimberly reported on the near death of their newly born twins. The twins had been taken to the hospital a few days after coming home because they showed signs of a staph infection. Part of the standard treatment in such cases, apparently, is the use of a blood thinner to prevent clotting. But the twins were given a blood thinner that turned their blood to the consistency of water. It was pouring out of them, leaking out everywhere it could -- their belly buttons, their noses, their toes.

Kimberly Quaid had a premonition that something had gone wrong, and so Dennis Quaid called the hospital at 9 p.m. to ask if the twins were O.K. He was told that they were, but, in fact, they were not. When the Quaids came to the hospital the morning after the disaster, they were met by their pediatrician, the head nurse, and a lawyer from “risk management,...the liability division of the hospital.” The Quaids had not been called about the problem.

The twins should have been given Hep-Lock, a blood thinner for infants. They were given the adult version, Heparin. They should have gotten 10 units; they got 10,000 -- a thousand times more than prescribed, and they got it at least twice. The President of the hospital where this occurred said of the infants’ near-death experience:

It was the result of human error.

The spokesperson for Baxter, the manufacturer of the two blood thinners, said it was not their fault:

The errors that the hospital has acknowledged were preventable and due to failures in their system.

Both these statements blame the operators, three in this case according to the hospital: the individuals who put Heparin in the drug cabinets for the nurses to use, the person or persons who took the drugs from the cabinet to give to the nurses, the nurse or nurses who administered the drug.

The spokesperson for Baxter said that the way to prevent such errors is to read the label, but the containers for Heparin and Hep-Lock are very similar and are thus easy to confuse. They are the same shape and the same size, with labels differing only because one is darker blue than the other with a different name, but all in the same font. The previous year, six infants in Indianapolis were also given Heparin instead of Hep-Lock. Three died, and as a result, Baxter sent out a warning and redesigned the container for Hep-Lock so that it was visually different from the container for Heparin and required the removal of a

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plastic cover. What Baxter did not do was recall any of the old stock, and the Heparin that caused the near death of the Quaid twins came from old stock.\textsuperscript{17}

It would be naive to accept the statements of Baxter and the hospital President at face value. Neither can be read straight, as statements of fact. Both are attempts at risk management, Baxter explicitly saying that it was not their fault and both saying that it was a preventable human error -- “not our fault,” that is, but “operator error,” the fault of those careless nurses and others in the hospital.

It would also be a mistake, however, to dismiss the claims. They purport to be truth-carriers, and so we should do what we need to do to determine whether they are true. To determine that, we would have to investigate in some detail, as the 60 Minutes Report did, exactly how it came to be that the drug was administered to the infants. We would need answers to the three questions we must ask regarding any accident:

What about the operators? Intelligent, well-trained, fully engaged in what they were doing? Were the nurses and others involved capable?

What about the situation? Unusual, different enough to cause problems even for the most well-trained, intelligent, and fully engaged operator? Did the problems occur at the end of a particularly hectic day? At the end of a shift?

What about the object at issue? So well designed that it would ensure that no operator error could cause something untoward?

Only after answering all three questions will we be in a position to determine the truth, or falsity, of the claims being made. In the case of the Quaid twins, it seems both that some in the hospital made mistakes and that there is a reason for their making mistakes, the objects at issue -- the containers for the drugs -- making it more likely than not that even the most intelligent, well-trained and fully engaged individual would mistake one for the other of the two medications at some time or other. The design produced an accident that had been waiting to happen. Only with more detailed information will we be able to provide a properly nuanced judgment.

Yet some moral judgments are easy to make:

- Baxter should have recalled all its former stock so that the kind of accident that occurred in Indianapolis could not occur again because of any failure on Baxter’s part to ensure that the drug containers were clearly distinguishable.
- The President of the hospital had no right to accuse anyone of human error without a full investigation.
- Baxter was in no position to accuse the hospital of “failures in their system” because it made those judgments without doing a proper analysis of the problem to see if it was in any way responsible.
- Those in the hospital responsible for the twins were wrong not to inform the Quaids when they called that there was a problem with the twins.

\textsuperscript{17} Ibid.
And it was impolitic in the extreme to have a hospital lawyer at the door to the twins’ room when the Quaids arrived: it sent the signal that those in the hospital were far more concerned to limit the hospital’s liability than to help solve the problem and save the twins.

These moral judgments are judgments about particular acts and omissions by Baxter and by those in the hospital, and none require any significant analysis -- though each is tentative, of course, refutable by additional evidence or good reasons for what all the world look to be unethical acts and omissions.

These moral judgments are easy to make in part because of the relations we take up with others once we occupy a particular role. In taking on the Quaid twins as patients, the physicians and nurses at the hospital took on moral responsibilities to the twins and to the Quaids, responsibilities the administrators in the hospital have an obligation to support and encourage. Those in the hospital breached those responsibilities when they failed to inform the Quaids of the problem when they called. These are responsibilities that are functions of the hospital having taken on patients. But the manner in which those in the hospital responded to the problem the improper medication caused puts into doubt the integrity of those who responded and those responsible for those responses, and it puts at risk the integrity of everyone else in the hospital. Any potential patient would have to wonder whether the problems the Quaids had was a fluke, uncharacteristic of care at that hospital, or the uncovering of a systemic problem -- a feature of the hospital’s character, as it were.

Why did those responsible not inform the Quaids when they called? It is difficult not to believe that they hoped to take care of the problem without the Quaids ever finding out. Why did those responsible have a lawyer by the door waiting to receive the Quaids the next morning? It is difficult not to believe that those responsible had a paramount interest in limiting their liability. This is not the sort of behavior we expect from someone of good character, and it is equally not the sort of behavior we expect from those in a hospital -- an organization whose stated purpose is to provide care for the sick and whose employees are supposed to act to further that stated purpose. Through their actions, those responsible are like a physician’s saying in such a situation, “I do not tell the truth when it might cause me harm” and “I am also more concerned about being sued than about helping my patients.” We would think such a physician had a character flaw.

Something more is wrong, that is, than just a single unethical act or omission. Consider Baxter’s response. Baxter is a pharmaceutical company. It makes drugs which it then sells so that patients can get proper medication. Patients and medical care professionals cannot know, and have no easy way of finding out, whether those drugs are properly made, whether they are what they claim to be, whether Baxter has taken due care in manufacturing them so that they are always have the same amount of ingredients, with their ingredients thoroughly mixed, in containers properly marked with the right ingredients of the right size. In short, we must trust that those in charge at Baxter have done what its selling drugs obligates them to do. They failed to do that when they did not
recall the former stock. They put children at risk and did so knowingly, aware that the problem of packaging had caused three deaths already. It is difficult not to believe that those in charge at Baxter put profit over the potential harm that it knew its packaging could cause, that they did just what those at Guidant did when they discovered that their implant could short-circuit: they traded the company’s reputation for money.

Those in charge at Baxter and Guidant and the hospital did not just make a moral mistake. The way in which all responded to the criticism they received indicates a deeper moral problem. Each pointed the finger of blame at others, trying to deflect criticism from themselves rather than trying to determine what went wrong and fixing the problem so that such harm could not happen again. Because of that sort of response, we have another sort of moral problem: those at these companies and the hospital have lost their moral compass. Would you trust a Baxter representative who told you, after yet another “accident,” that it was not Baxter’s fault? Guidant? The hospital? We all make mistakes, and we can excuse even the most grievous of errors if those making it respond appropriately. But these three responded in a way that puts their corporate character in question. They responded the way a restaurant I was patronizing responded to a complaint about a fly in a friend’s rice -- “fied rice,” as another friend called it -- by blaming the waiter rather than apologizing and saying they would work to ensure it did not happen again.

What is even more morally appalling -- and the reason these examples have been chosen -- is that those at Baxter, Guidant, and the hospital all have taken on special obligations to help by being in the businesses they are in. Baxter manufactures and sells drugs that are to help the sick; Guidant designs, manufactures, and sells heart implants to those whose lives depend upon electrical circuits firing to restart their faulty hearts; the hospital is licensed to care for its patients. All three betrayed that obligation to help when they responded by blaming others rather than by investigating what went wrong and fixing it so that others would not be harmed, but helped. We want to say, “These companies and that hospital have lost their way.”

This is not a moral judgment about any particular act or omission, but about the nature of these companies -- their corporate character. Marriage counselors say that a marriage has moved significantly closer to disintegration when one spouse criticizes the other, not for some particular act or omission, but for being a particular kind of person -- from “You forgot to take out the garbage” to “You are a lazy SOB.” The judgment of a person’s character signals a change in the way we are looking at a person -- not as someone who just made a mistake, but as someone who makes mistakes, not as someone who failed to do something, but as the kind of person who fails to do what needs to be

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18 It does not help Baxter that other drug companies have had, and are continuing to have, serious problems ensuring that their products meet acceptable standards. Johnson & Johnson has had problems with patients “developing temporary gastrointestinal trouble, including nausea and vomiting, after taking [some of its] medicines” (see Scott Hensley, “Johnson & Johnson Recalls Tylenol, Rolaids, and Motrin Over Bad Odors,” NPR, January 15, 2010, available at [http://www.npr.org/blogs/health/2010/01/johnson_johnson_recalls_more_m_1.html](http://www.npr.org/blogs/health/2010/01/johnson_johnson_recalls_more_m_1.html), accessed 6.3.10). In addition, the company’s unit McNeil Consumer Healthcare has had to recall “36 million bottles of liquid pediatric Tylenol, Motrin, Benadryl and Zyrtec because they may have contained too much of the active ingredient of the drug, metal specks or inactive ingredients that failed testing requirements” (Natasha Singer, “F.D.A. Weighs Penalties in Drug Recall,” *New York Times* (May 27, 2010)). The problems concern quality control and are apparently a pervasive difficulty for the company, having a long history.
done, not as someone who lied, but as a liar. Once that move is made and a person’s character is put into question, everything the person does is open to question. Where we once presumed a good character, we now presume a bad one, and where we once assumed a problem was a mistake, out of character for the person, we now assume it is exactly what that sort of person would do.

The judgment of character is a judgment about the internal morality of the person, about the kind of person they are, and that is the sort of judgment we are making about Baxter, Guidant, and the hospital: they did not just make a mistake, but responded in a way that illustrated their true corporate character. They were more concerned about maximizing their profits than about doing what they are obligated to do because of the sorts of companies they are. They are like toy companies that purvey toys contaminated by lead and seem unable to ensure that their toys are lead-free. Parents have no way of determining before purchasing a toy whether it contains lead or not, and after purchase, it would be an undue burden on them to have a toy tested for lead before giving it to a child. We rightly expect toy companies to bear that burden and ensure that the toys they sell are safe. Just so, we rightly expect companies like Baxter to do what they can to ensure that their products are safe and are safely dispensed -- especially when they have the sort of warning Baxter received from the deaths of three children in Indianapolis. Its failure to answer that wake-up call should create doubt on the part of consumers about the company’s commitment to their well-being.

The lesson for engineers, and, indeed, for any professional, is that they display their professional character, the inner morality of the position they have come to occupy in being a professional of a certain sort, in a variety of ways -- in what problems they choose, by how they solve those problems, and by how they respond to the inevitable mistakes they make and the failures that occur. We are not interested in their personal morality, to emphasize -- what they think about abortion, for instance, or war and peace -- but in the inner morality they have as engineers, the way of looking at the world and of solving problems they come to learn as they learn to be engineers.

Engineers whose design solutions have high failure rates under the stress of ordinary use will display their professional character, good or bad, in their responses. Figuring out why the failure rate is so high and redesigning the artifact to reduce the rate to an acceptable level is what engineers are to do -- not what great engineers are to do, or even good engineers, but just engineers. It is part of the job description of an engineer, that is, that an engineer does not leave failures alone, but goes back to fix them. We would laud praise upon the engineer were the problem solved with a minimum of fuss and expense. We would give extra credit for elegant solutions. We would be reluctant to use an engineer on another project who said, “People must be using it wrong. That’s not my problem.” If a design provokes errors, it is a problem for the engineer -- as well as for those who have been provoked into a mistake because of the error-provocative design.