Sci Eng Ethics
DOI 10.1007/s11948-010-9225-3

ORIGINAL PAPER

"Ain't No One Here But Us Social Forces": Constructing the Professional Responsibility of Engineers

Michael Davis

Received: 21 June 2010 / Accepted: 22 July 2010
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Abstract There are many ways to avoid responsibility, for example, explaining what happens as the work of the gods, fate, society, or the system. For engineers, "technology" or "the organization" will serve this purpose quite well. We may distinguish at least nine (related) senses of "responsibility", the most important of which are: (a) responsibility-as-causation (the storm is responsible for flooding), (b) responsibility-as-liability (he is the person responsible and will have to pay), (c) responsibility-as-competency (he's a responsible person, that is, he's rational), (d) responsibility-as-office (he's the responsible person, that is, the person in charge), and (e) a responsibility-as-domain-of-tasks (these are her responsibilities, that is, the things she is supposed to do). For all but the causal sense of responsibility, responsibility may be taken (in a relatively straightforward sense)—and generally is. Why then would anyone want to claim that certain technologies make it impossible to attribute responsibility to engineers (or anyone else)? In this paper, I identify seven arguments for that claim and explain why each is fallacious. The most important are: (1) the argument from "many hands", (2) the argument from individual ignorance, and (3) the argument from blind forces. Each of these arguments makes the same fundamental mistake, the assumption that a certain factual situation, being fixed, settles responsibility, that is, that individuals, either individually or by some group decision, cannot take responsibility. I conclude by pointing out the sort of decisions (and consequences) engineers have explicitly taken responsibility for and why taking responsibility for them is rational, all things considered. There is no technological bar to such responsibility.

Keywords Engineer · Responsibility · Liability · Accountability · Causation

M. Davis (✉)
Humanities Department, Center for the Study of Ethics in the Professions,
Illinois Institute of Technology, 5300 S. Shore Drive #57, Chicago, IL 60615, USA
e-mail: davism@iit.edu

Published online: 05 August 2010

> A hobo is in the henhouse stealing eggs when the farmer, having heard the chickens complaining, comes up with a shotgun and asks, "Who's in there?" The hobo responds: "Ain't no one here but us chickens!"—old Vaudeville joke

There are many ways to avoid responsibility. Among them are attributing one's act or its consequences to society, market, culture, God, the devil, or drink. For engineers, "technology" or "the organization" might seem to serve quite well. I mock this response as, "Ain't no one here but us social forces"—recalling the old Vaudeville joke. Of course, the joke depends on someone being there in addition to the chickens, someone who can properly take responsibility but tries to avoid it—by a device too desperate to succeed. The response thus mocked is not a joke. It presupposes that certain facts prevent assignment of responsibility. For example, some have claimed that engineers cannot be responsible for some consequences of their work because the technology is so complex that they cannot reasonably be expected to foresee those consequences.[1] A fact, the impossibility of reasonable foresight, rules out the responsibility in question.

What I propose to do here is argue that any such appeal to mere fact fails. The responsibility in question is something engineers can, and generally do, take on by their own voluntary acts. Engineers construct their responsibility, much of it at least, rather than discover it or have it imposed on them. Taking responsibility is an important but, it seems, overlooked way of becoming responsible. For engineers, the proper question is (primarily): *what responsibility have* we *taken on*? The responsibility of engineers is, in large part, what, as a profession, they make it.

I shall have nothing to say here about whether engineers have taken on too much, too little, or just the right amount of responsibility. My focus is on arguments supposedly defeating responsibility claims.

Preliminary Caveats

Like most important terms in ethics, "responsibility" has too many senses for the term's safe use without distinguishing the more important ones, understanding their relationship, and then trying to keep them straight. We may distinguish the following nine interrelated senses as relevant here (all of which I will eventually need):

1. responsibility-as-simple-causation ("Katrina was responsible for the flooding in New Orleans"),
2. responsibility-as-faulty-causation ("responsible because he acted carelessly"),
3. responsibility-as-good-causation ("She's responsible for our success, give her the credit"),[2]

[1] See for example, Nissenbaum (1996). Though her focus is, as her title suggests, computer scientists, her argument fits engineers as well—and some of her examples include engineers.

[2] Though responsibility-as-good-cause seems the mirror image of responsibility-as-faulty-cause, it is overlooked in most discussions of responsibility—perhaps because there is no obvious credit version of

4. responsibility-as-competency ("a responsible person"—rather than, say, a careless or incompetent one—, responsibility as a disposition or virtue),
5. responsibility-as-power ("your skill gives you a responsibility"),[3]
6. responsibility-as-office ("the person responsible", the one in charge),
7. responsibility-as-domain-of-tasks ("these are her responsibilities", that is, what she is supposed to do),
8. responsibility-as-liability ("you should *pay* because you are responsible for what happened"), and
9. responsibility-as-accountability ("you should *explain* because you are responsible for what happened").[4]

This list has more structure than may be apparent at first. Five of the nine senses are (more or less) factual: the simple-cause, competency, power, office, and task senses. Two, in addition to the simple-cause sense, are entirely historical (or "backward looking"): the faulty-cause and the good-cause senses. When we are talking about responsibility in any of the three historical senses, we should (and generally do) use the past tense: "She *was* responsible for that." The remaining two (the liability and accountability senses) seem to be about the future, that is, they point to what should be done. In this respect, they resemble the power, office, and task senses. The responsibility that comes with power, office, or task is a responsibility to do something (to benefit humanity, to oversee this project, or to perform these tasks). The responsibility that comes with liability (whatever explains the liability) is also something to do, for example, accept blame, apologize, make compensation, or perform as promised. The responsibility that comes with accountability is to give an account of something, for example, offer a justification, excuse, or explanation, or answer pertinent questions. The standard way to talk about responsibility in one of these five future-oriented senses (power, office, task, liability, or accountability) is in the present tense: "She *is* responsible for that."

This difference in tense is only a general index. It is easy to find causal uses in the present tense (when there is a continuing or continual causing) as in, "He is responsible for all my troubles [that is, the cause of them all]." It is also easy to find uses of the future-oriented senses in the past tense (when the power has been lost, the office vacated, the task completed, the liability satisfied, or the account given) as

Footnote 2 continued
responsibility-as-liability or responsibility-as-accountability. The term for this missing sort of responsibility might be "responsibility-as-reward" (or perhaps "creditability").

[3] Responsibility-as-power often appears in discussions of professional ethics. See for example, Alpern (1983), for an early example applied to engineering.

[4] Hart (1968, 210–223) seems to have been the first to distinguish four of these senses: responsibility-as-role (which I have divided into "office" and "task"), responsibility-as-simple-cause, responsibility-as-liability, and responsibility-as-competency ("capacity"). Ladd (1982, esp. 64–65) seems to have been the first to distinguish accountability (which, unfortunately, he treats as a merely organizational notion—as if a perfect stranger cannot "call me to account" for something untoward I did as a mere individual). Kuflik (1999, esp. 174–175) offers six senses—some significantly different from mine. For example, he distinguishes responsibility-as-simple-cause (using a hurricane example) from responsibility-as-function ("the heart is responsible for pumping blood"). Though a useful distinction for some purposes, it would only complicate discussion here. Nevertheless, that distinction is a reminder that my list is neither exhaustive nor canonical.

in, "He *was* responsible for paying the damages [but paid them long ago]." Nonetheless, I think it important to stress the future-oriented aspect of all five senses, though each typically presupposes something in the past (the act assigning office or tasks, the event imposing liability or imparting power, and so on).[5] What is important about the future-oriented senses of responsibility is precisely that they have something to say about the future, something not true of competency or any of the three historical senses.

Neither technology nor organization seems to threaten responsibility in any of the five factual senses (cause, competency, power, office, task). Whatever technology or organization becomes, engineers who help to design, build, maintain, or dispose of technology will remain causal agents, responsible in the first (simple-cause) sense of responsibility for whatever they bring about (whether anyone can trace their individual contributions or not). They may also remain responsible persons (agents to be trusted), experts (with the power that comes from knowledge, skill, or judgment), persons responsible (agents in charge), and persons with responsibilities (tasks to do). When technology or organization seems to threaten "responsibility", it is responsibility-as-liability or responsibility-as-accountability that is threatened. In particular, it might be (and sometimes is) argued that technology may allow engineers to do great harm without fault. We cannot (it is said) hold engineers liable or even accountable for the harm they do without fault because fault is a logical precondition of responsibility in the liability or accountability sense. What engineers do without fault is not their responsibility.[6]

Though strong, the relation between fault and liability (or accountability) is, I think, not that of *logical* precondition. The law is quite capable of holding persons responsible for outcomes when they were not personally at fault—without any incoherence. Among terms covering this sort of responsibility are "strict liability" (liability when there is causal agency but no fault), "vicarious liability" (liability when the fault is in some person other than the one held liable, such as an agent or employee), and "surety liability" (when liability depends on contract rather than fault, causal agency, or relation of agent to principal).[7]

[5] Those who distinguish between "backward-looking liability" and "forward-looking liability" seem to me to have confused responsibility-as-liability with responsibility-as-simple-cause or responsibility-as-faulty-cause. The reason for that confusion seems to be that blame is (generally) backward-looking. We generally blame people for what they have done, not for what they will do, and liability (it is thought) must work in the same way. The mistake is to assume that other blame-related concepts must be just as backward-looking as blame itself. While it may be true that blaming someone for doing such-and-such is to say of her that she *did* something she should not have (or failed to do something she should have), that is, to refer to the past, to say of someone that they *deserve* blame (or that they are blamable) is not only another way to blame them; saying that also sets out a set of tasks (blame them in various ways until the reason for blaming is gone), that is, says something about the future (as blaming does not). Deserving blame differs from responsibility-as-liability only in not assigning the tasks to anyone, though it gives each of us a reason and a right to do the tasks.

[6] There should be a corresponding problem about engineers and good causation, but no one seems to want to deny engineers credit for their good works even though the same arguments that undermine liability and accountability would seem to undermine credit. Where there can be no blame, there can be no praise (or so we generally think).

[7] Indeed, holding *persons* responsible without fault is not the limit of what the law can do. The law can also hold non-humans responsible. For example, in 1595, in Leiden, Provetie, an ordinary dog, was tried

Our question, though, is not what the law can do with responsibility-as-liability (much less with responsibility-as-accountability). Our question is in part what the law *should* do with responsibility—and, in part, what we should do with it outside the law, for example, when attributing professional responsibility. This "should" depends on both moral justification and rational justification.[8] There is a weak, intermediate, and strong sense both of "moral justification" and "rational justification". I can, for example, morally justify my conduct by showing (a) that morality does not forbid it (a weak justification), (b) by showing that morality recommends it (an intermediate justification), or (c) by showing that morality requires it (a strong justification). We need not worry about this detail here. Weak moral justification is all we need for the arguments in question. Only at the end of this paper will I have to say anything about rational justification.

While our question is (primarily) about moral responsibility rather than legal, these examples of legal responsibility-as-liability are worth keeping in mind. Since they seem not to stretch the concept of responsibility to the breaking point, or indeed to stretch it much at all, they demonstrate the range of that concept. Any claim that *moral* responsibility is not as flexible as legal responsibility will have to rely on moral arguments, not on appeal to the "logic of responsibility" (much less to "what 'responsibility' means"). I therefore reject John Ladd's claim that moral responsibility is separate from the nine senses just distinguished. Ladd defines moral responsibility as (roughly) "the concern of people for people".[9] Insofar as this concern constitutes responsibility at all, it seems to me to define a domain of (morally required or recommended) tasks (say, taking people into account when acting) which we also find in law. While I do not think moral responsibility and legal responsibility *necessarily* mirror each other, I see no reason to suppose that the term "responsibility" in morality has a special meaning that cannot be incorporated into law—or that "responsibility" in law has a special meaning not to be found in morality. The difference has certainly not been established.

There are certain factors commonly put forward as conditions *necessary* for the assignment of *moral* responsibility-as-liability—and of moral responsibility-

Footnote 7 continued
for the murder of a child whose death it caused. The dog nipped the child's hand while taking meat from it, the wound became infected, and the child died as a result. All this having been proved, Provetie was found guilty and publicly hanged. There was no claim that Provetie intended to harm the child, that it foresaw the harm, or that it even should have foreseen the harm. It was enough to hold the dog responsible for the death that it did what it should not have, nipped the child's hand, however innocently, and the child died as a result. (Arthur and Shaw 2006, 245–246).

[8] So, for example, morality is silent concerning the legal punishment of dogs. Since reason no longer seems to recommend such punishment, we may wonder why it ever did (if it did). One answer at least is obvious: Going through the forms of criminal trial may have been the simplest way to deal with an unusual case. There is some evidence that this obvious answer may also be the right one. The official summary of the case includes language probably standard at the time but wholly inappropriate to this particular case, for example, "all of which appears from the prisoner's own confession, made by him without torture or being put in irons." Arthur and Shaw, 246. How could the dog "confess"?

[9] Ladd (1982), 67. Note that Ladd explicitly connects moral responsibility with power (my fifth sense of responsibility), for example: "one of the principal factors that creates moral responsibilities for one person rather than another is a difference of *power*, which usually consists of superior knowledge and ability to affect outcomes."

as-accountability when distinguished. The four most common are: (1) cause (or causal factor), (2) rationality (or competency), (3) choice (or freedom), and (4) knowledge (or foresight). (See for example, Swierstra and Jelsma 2006, esp. 312–313.) A person who does not cause an event cannot (it is said) be morally responsible for it, nor can a person who is not a "responsible agent", nor can a person who had no alternative or who did not know what would happen (or at least what she risked). Part of what makes this collection of factors attractive is that each connects responsibility-as-liability with another sense of responsibility. Thus, the first explains why we might use "responsibility" for both liability and cause (any liability presupposes cause); the second, our use of "responsible person" for someone who can be held liable (a competent agent); the third and fourth, with fault, since fault requires both choice (an exercise of deliberative power) and something the agent knew or should have known (an exercise of cognitive power).[10] Indeed, this way of thinking about responsibility puts liability at the concept's center, with the other senses of responsibility derivable by subtracting one or more conditions of liability.[11]

However satisfying this structuring of the concept is, it should not be accepted. All the claims on which it relies seem to be false or, at least, no more than roughly true. Consider the requirement of cause: it seems not to fit some *failures* to rescue. We sometimes hold a person morally responsible for the death of another (in the liability or accountability sense) when she could have, but knowingly did not, come to the aid of the other, for example, a drowning child she could have saved with little risk, cost, or trouble to herself and no breach of duty to another. We blame her for the death though it would have occurred even if she had not been there to help, indeed, even if she had died a decade before. Her inaction, though certainly an event, indeed, a conscious act, is no more a cause of the child's death (whether "cause" means the most important factor or just a necessary one) than the non-presence of the billions of other people who might have saved the child had they been there.[12] Her non-rescue of the child has no causal significance (no special role in the actual process leading to death). Only her rescue of the child would have had causal significance—and that did not occur. We nonetheless hold her morally (and, in some jurisdictions, legally) responsible for the child's death (in the liability or accountability sense). If responsibility-as-simple-cause matters here (as I think it does), it is not as cause in this world but as part of an explanation invoking possible worlds. The cause in question exists only in at least one counterfactual world (one reasonably close to the actual one). Such a counterfactual cause cannot be the actual

[10] Those who are not competent (in the appropriate respect) cannot (it is assumed) be at fault (with respect to that). Neither can those who could not have foreseen the harm they caused be at fault in that respect. Competence and knowledge (of the appropriate sort) are (it is assumed) at least preconditions of fault.

[11] For those who think that I should have included "control" among the list of necessary conditions, I recommend Sher (2006). As will be plain, nothing important turns on this omission.

[12] Her inaction is, in this respect, quite different from the inaction of a lifeguard assigned to watch a stretch of beach. His inaction is a causal factor in any drowning death he might have prevented precisely because another lifeguard would have been there had he not been. The beach would not (we may suppose) be open for swimming if a lifeguard were not present.

cause of the child's death. What is important to the responsibility of the bystander who did not help is that she *could* have saved the child but did not, that is, not faulty-cause in this world (since she caused nothing) but good-cause in another.[13]

Rationality is also said to be a necessary condition for moral responsibility. That is why (it is said) we do not hold the insane, the very young, or dumb animals morally responsible or, at least, why we do not *properly* hold them morally responsible. Of course, sometimes we do hold them morally responsible. For example, we may criticize even a young child for breaking a promise (saying something like, "You should have kept your promise"). Why we do that is open to discussion. My point now is merely that we do criticize the very young in this way, criticizing them in this way is blaming them (as criticizing a dog is not), blaming someone for breaking a promise is (normally) moral blame, and imposing moral blame on the very young at least seems to be holding them morally responsible (in the responsibility-as-liability sense). Certainly, when my son was four and broke a promise, I spoke to him as I would to someone who was morally responsible—and he responded accordingly, for example, by offering an excuse, justification, or otherwise accounting for his conduct, or by offering an apology or suggesting some other way to satisfy the liability incurred. Though I held him responsible in this way, I did not regard him as a competent adult (a responsible person). At four, he was far from that. On matters of safety, especially, I had more faith in our dog (who was ten). If we in fact sometimes treat even the very young as morally responsible in this way without supposing them to meet the rationality condition (as I believe we do), the hard question is whether doing so is morally proper (and, if it is, why). I need not answer that question here (though it seems proper enough to me). My purpose is to raise doubts about these four supposedly necessary conditions for responsibility-as-liability (and accountability). I have, I think, now said enough to raise doubts about this second one. We seem to act contrary to that condition without any feeling of doing something odd. Whatever this second condition is, it is not common sense. We can go to the third, choice.

We cannot (it is said) have any moral responsibility for an outcome when we had no choice but to bring it about. Consider, then, a minor traffic accident. A cat runs out from between parked cars just as I am passing. I slam on the brakes as quickly as I can—but too late. I have not been drinking, missed sleep, or otherwise done anything to impair my reactions. I was not speeding, using a cell phone, or otherwise failing to exercise reasonable care. The accident was, we might say, just one of those things—quite beyond my control—and therefore "definitely not my fault". Should I then drive on as if I were in no way responsible for the cat's death? I should not. I should stop, check to see if there is anything I can do for the cat, and perhaps call the police. I should do all that not to be a nice guy, a Good Samaritan, but because I am responsible (in some sense) for the cat's death. If I do not feel that

[13] Lawyers like to interpret "cause" as necessary condition ("but for"). The problems with so interpreting "cause" are well-known (for example, an inability to make sense of redundant causes or to limit the number of causes). We need not concern ourselves with those problems here. The objection made here stands even if those problems can be solved. For recent work on omissions as causes (more or less consistent with what I say here), see: McGrath (2005), Dowe 2004), Boniolo and De Anna (2006), Pundik (2007), and Baumgartner (2008).

responsibility, an obligation to respond in certain ways, I am a morally worse person than one who does.[14] I seem to owe the cat, or its owner, something for what I have done.[15] What I owe seems like responsibility-as-liability. Of course, I do not owe what I would have if the cat's death had been my fault (say, the result of negligence). But I still owe something. I shall offer no defense of this leap from responsibility-as-simple-cause to responsibility-as-liability here. I merely point it out as a fact of moral life, one that at least seems to undercut the claim that choice is *required* for moral responsibility.[16]

The cat also provides a good example of the fourth condition for moral responsibility (knowledge) not being met. I could not know that the cat was there, between the two cars, much less that it would run out just as I was driving by. Of course, I did know, or at least should have known, that such accidents are possible. Cars are big, fast, and hard to stop; cats, not always as careful of traffic as they should be. Yet, the risk I ran, however knowingly, merely by driving, does not seem to be enough for moral fault. Such general knowledge of unlikely events may help to explain strict liability in law, but it is not the sort of knowledge commonly presented to justify moral responsibility-as-liability (or accountability). More specific knowledge is supposed to be required, at least knowing that there is a reasonable chance that the event will happen if I drive (and the availability of alternatives both reasonable and safer). My knowledge fell well short of that.

I do not claim that these four conditions are irrelevant to responsibility-as-liability (or as-accountability) but only that they are not *necessary* conditions. They seem to me to function more like considerations relevant to rejecting, imposing, or accepting responsibility (mere reasons rather than requirements). The more of those conditions that are met, the stronger the case for moral responsibility, all else equal. But context is important too. In the right context, even one factor, such as simple cause, can be sufficiently strong (more or less by itself) to decide the question (as perhaps it is in the cat case).[17]

[14] Curtis Forbes tells me that this comment may reveal me to be an urbanite. He has noticed that those who grew up in the countryside, as he did, are much less likely to feel this responsibility. He may be right, but even if this sense of responsibility (and the moral judgment of "worse" it supports) is "cultural-centric", it relies on a conception of responsibility independent of choice (and does not appear to be incoherent because it does), which is all I need to make my point.

[15] Now, it might be objected that this example is really about a duty to aid because one is in a position to do so, rather than a duty to aid because one caused the problem. I do not think there is a decisive way to disprove this objection. But I do think there are good reasons to dismiss it. The most important is that the duty to aid usually involves serious danger to another—not, as in this case, merely cleaning up a mess. The only people who are likely to see much force to this duty to aid, apart from the causal connection, are act utilitarians, supposing I have no better way to use my time than looking after the dead cat.

[16] I am not the only one to notice this sort of responsibility. See for example, Kutz (2002), p. 558: "Sometimes an agent's mere causal linkage with harm may warrant a response….agents can reproach themselves for faultless conduct that causes a harm, even when their victims, and onlookers, do not reproach them." The first half of Kutz (2002) is worth reading for the way his "Strawsonian" interpretation of responsibility tends to reach the same conclusions I do in this section.

[17] To see how important context is, suppose the cat had been a rat or other non-pet. Would we feel the same obligation to stop? Should we feel any? Then suppose the cat had been a child or youth. Would we not feel an even stronger obligation to stop and help?

We should keep all this in mind as we evaluate arguments for the claim that technology or organization is undermining the responsibility of engineers for much they do. In particular, we should be charitable in our interpretation of these arguments. We should interpret them, if at all possible, as relying on a less questionable claim than that any of these four conditions is necessary for responsibility (though many do in fact seem to rely on that questionable claim). They fail even when they receive more charity than they deserve.

Arguments Against Holding Engineers Responsible for What They Do

There are at least seven arguments used to defend the claim that technology or organization is making, has made, or might someday make it impossible for engineers to be morally responsible for (at least some of) what they do. We may call them the argument from: (1) many hands, (2) many causes, (3) replaceability, (4) institutional constraint, (5) individual helplessness (lack of coordination), (6) individual ignorance, and (7) neutrality of technology. Each of these arguments suffers from one or more flaws. The responsibility in question is liability, accountability, or both.

Many Hands

We seem to owe the name of the first argument, if not the argument itself, to Dennis Thompson. His summary of it is worth quoting as much for what it does not say as for what it does say: "Because many different officials contribute in many different ways to decisions and policies of government, it is difficult even in principle to identify who is morally responsible for political outcomes" (Thompson 1987, 41). For Thompson, the argument from many hands is primarily about large organizations ("governments"), not about technology. It is an epistemic argument, one about a problem more information might clear up, not a metaphysical argument (one relying on the nature of things). In addition, the problem the argument relies on makes identifying those morally responsible for an outcome "difficult", not impossible—and no newer than determining whether Henry II was responsible for the murder of Thomas Becket. Indeed, Thompson devotes the chapter that this quotation opens to assigning responsibility to politicians and government officials who appeal to one version or another of the argument to avoid it. Thompson is not afraid to look into the henhouse.

For Thompson, as for most who discuss the argument from many hands, a crucial assumption is that responsibility is primarily about holding *others* responsible.[18]

[18] There is, I think, a close analogy between this view of responsibility as primarily imposed and what is called "the external" perspective on law. The external perspective on law misses essential features of law that the internal perspective includes, especially its authority. See especially, Hart (1961), pp. 101–102. From the outside, responsibility may seem to be primarily about having to answer to others for what one does (what Kant would call "heteronomy"). From the inside, responsibility may seem to be primarily about being trustworthy, someone capable of answering for what he does, a certain (virtuous) disposition (what is recognizably Kant's "autonomy").

So, for example, Helen Nissenbaum (whose subject *is* primarily technology) notes, "Boards of directors, task forces, or committees issue joint decisions, and on the occasions where these decisions are not universally approved by all their members but are the result of majority vote, we are left with the further puzzle of how to attribute responsibility."[19] Of course, "we" are left with the puzzle because "we" are not party to the "joint decisions" in question. "We" are trying to impose responsibility on others, not to decide our own responsibility. Were "we" among the decision-makers, we would at least know our part in the decisions, for example, whether we voted for or against the measure in question. The problem of many hands (so stated) does not seem to be much of a problem for holding *oneself* responsible.[20] In any case, it is no problem for someone who takes on the responsibility in question. I can take responsibility for what happened even if I have no idea how I contributed to the ultimate decision (as, for example, President Truman did when he said, "The buck stops here").

Many Causes

For decision-makers themselves, the problem is (in part at least) many *causes* rather than many *hands*. There are two versions of the resulting argument against responsibility. One relies on the complexity of the causal story; the other, on the problem of identifying "the cause" (or "the chief causes") even when the causal story is relatively simple. Like the problem of many hands, the problem of complexity is epistemic, but the problem of identifying "the cause" is metaphysical (a problem about what is to count as "cause").

Nissenbaum's discussion of the THERAC-25 disaster (three patients dead and three more seriously burned by what should have been a relatively safe means of irradiating cancer cells) provides a good example of the complexity version of the argument from many causes:

> After many months of study and trial-and-error testing, the origin of the malfunction was traced not to a single source, but to numerous faults, which included at least two significant software coding errors ("bugs") and a faulty microswitch. The impact of these faults was exacerbated by the absence of hardware interlocks, obscure error messages, inadequate testing and quality assurance, exaggerated claims about the reliability of the system in AECL's safety analysis and, in at least two cases, negligence on the parts of the hospitals where treatment was administered.[21]

[19] Nissenbaum (1996, 29).

[20] I am inclined to think that discussions of responsibility suffer from supposing, however implicitly, too close an analogy between moral and legal responsibility. While legal responsibility is primarily about holding others responsible, moral responsibility is at least as much about holding ourselves responsible as holding others responsible. The structure of moral responsibility may (despite many overlaps with legal responsibility) have far less to do with punishment, compensation, or even blame than legal responsibility has. For more on this, see Cane (2002).

[21] Nissenbaum, 30, has therefore confused the problem of many hands with the problem of many causes. She is not the only one. See for example, Bovens (1998, esp. 45–50), a section titled "Accountability: the

In its complexity, the THERAC-25 disaster differs little from most engineering disasters. Because engineers try to design considerable redundancy into their systems, a disaster typically requires several independent failures. Nothing is *the* cause, but several factors together constitute "the chief causes". Responsibility-as-faulty-cause must then be divided among these—and, insofar as each factor is the work of a different agent, among several agents. But the resulting responsibility-as-liability (or as-accountability) is not like weight, a burden *necessarily* lessened when so divided. Some parts of responsibility are lessened by being divided, especially financial liability, but the rest, such as the blame deserved or the obligation to explain one's own part, may not be.

Nonetheless, the THERAC-25 seems to illustrate the argument that many causes can undercut responsibility. After all, how could an engineer involved in the disaster honestly take any responsibility for the disaster (such as blame or the obligation to explain) until a post-disaster analysis identified the chief causes—and, if the causal story is too complex to identify any engineer's part, how could an engineer take any responsibility at all?

This question is not rhetorical. If it seems rhetorical, that is (in part at least) because we are not being careful enough about the sense of "responsibility" in question. If "responsibility" means responsibility-as-simple-cause or faulty-cause, then we cannot honestly take responsibility (that is, accept a description in which we are the cause) until we know the causal story and how our faulty conduct, if any, fits into it. The same seems true if we are to be called to account for the accident in question or held liable for it. How can an agent give an account or be held liable (even by himself) without knowing who was at fault?

The question is not rhetorical because both responsibility-as-liability and responsibility-as-accountability include more than responsibility for faulty conduct. Remember the moral responsibility arising simply from having caused the cat's death. We can see something like that in the THERAC-25 story. Confronted with the three deaths and three serious injuries, AECL (the manufacturer) investigated the THERAC-25's malfunction, eventually issuing a detailed post-disaster analysis. Undertaking that investigation meant accepting no more than that the THERAC-25 at least *seemed* to be a causal factor in the disaster. Undertaking such an investigation is something AECL's engineers should have urged. For engineers, even such a weak connection—being involved in the disaster as a possible causal factor—entails an obligation to prepare an accurate account of what happened. Preparing such an account is already taking (some) responsibility—and taking that responsibility (responsibility-as-accountability) is possible before anyone knows who was at fault—or even who caused the deaths and injuries.

This may seem like a small point, especially to engineers. What else would we do when there has been a disaster and we, or our organization, may be involved in it? Again, this is not a rhetorical question. For many in management or politics, the answer seems to be: *Call in the* "*spin doctors*". Even among professionals, there

Footnote 21 continued
problem of many hands" and beginning with the Thompson quotation used above, but consisting of several interesting examples all of which illustrate the problem of many causes rather than many hands.

seem to be answers other than the one engineers take for granted. Lawyers, for example, generally do not undertake anything like AECL's post-disaster analysis when they lose a major case. They "move on", each lawyer taking whatever lesson she may from the experience.[22]

Whatever is true of other professionals, engineers consider it their responsibility to study any disaster that seems to arise from what they did—and to report what they find. To commit a certain mistake once, even a serious one, is something engineers tolerate as part of advancing technology (provided the engineer in question exercised reasonable care). What engineers do not tolerate is that an engineer, any engineer, should make the same mistake. Once a mistake has been identified, the state of the art advances and what was once tolerable becomes intolerable (a kind of incompetence). Because keeping good records is part of accountability, engineers have routines for recording what they do.[23] Indeed, anyone who watches engineers work will be surprised at how much of what they do is "documentation". Engineering is unusual among professions in recognizing an obligation to "acknowledge their errors."[24] (NSPE 2010, III.1.a.)

So, one response engineers have to the problem of many causes is to take responsibility for enough investigation to assign further responsibility (both for past errors and for future tasks). They seek to pierce the fog of technology rather than viewing it as a cover under which they can escape responsibility. The argument from many causes overlooks the possibility of that response—indeed, of that sort of responsibility-as-liability (liability as a duty to investigate and report).

But once engineers have investigated, they will often—perhaps always—have at least three candidates for *the* cause (or the chief causes) of the same event: operator error (running the THERAC-25 contrary to instructions), organizational failure (inadequate training or supervision, inadequate quality assurance, or the like), and design flaw (faulty micro-switch or software bugs). There is a nice joke to illustrate how fundamental this trinity of candidate causes is:

> God says, "I told you not to eat from that tree. You have no one to blame but yourselves for your fall from grace."
> "But," Eve responds, "you should have explained better. You should have been more explicit about the consequences."
> "And," Adam adds, "just what was that tree doing in the Garden, anyway? Would it not have been safer to plant it where we could not go?"

[22] The failure to take account of such differences between professions is one reason why Bovens' treatment of professional responsibility (Bovens 1998, 161–163) is—like that of most social scientists and the philosophers who follow their lead—decidedly misleading.

[23] The obligation to keep good records, though helpful to accountability (should giving an account become necessary), is not itself accountability but a liability (an obligation to do something other than give an account).

[24] Some other engineering codes have similar provisions. See for example, IEEE (2006): "7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others". (I cite codes of engineering ethics in this paper to demonstrate that I am not making up what I claim to be facts about engineering. The codes constitute evidence, though not decisive evidence, of what responsibilities engineers have taken on.)

God is trying to treat operator error as *the* cause of the disaster. He accepts no responsibility for what happened. He has a point, of course: Adam and Eve did what they knew they should not do. Had they done otherwise, there would have been no problem. They are, in a sense, plainly the cause of their own fall from grace. But Eve also has a point. Had God been more explicit about the consequences, she might have been better able to resist the serpent's enticements. God certainly could have done a better job of training (and supervising) his subordinates. The organization (God and his angels) failed to do all they reasonably could to prevent the disaster. But for that failure, Adam and Eve might still be in the Garden. And Adam also has a point. Had God designed the Garden differently, Eve could not have reached the tree. Why did God put the tree in the Garden? (And why, we might add, did God not fence the serpent out?) The Garden was a disaster waiting to happen—and God was responsible for that.

Generally, when something goes wrong with technology, there will be this trinity of candidate causes. That fact yields a version of the argument from many causes independent of ordinary complexity. This version relies instead on a fundamental problem in all talk of causes, that is, distinguishing mere causal factors, always many, from the cause or chief causes. What is a causal factor is (more or less) a simple matter of fact (or metaphysics).[25] What is *the* cause, or one of the *chief* causes, is not. As Joel Feinberg noted almost a half century ago, which causal factor we cite as cause depends on practical considerations, especially on the reason we are looking for a cause, what Feinberg called a "pragmatic criterion". Feinberg (1970) distinguished three such criteria (calling them): *explanation*, *engineering*, and *blame*. If our purpose is explanation, we look for the causal factor that helps us to understand why the event in question occurred. The serpent's presence in the Garden, and its cunning, may well be the best explanation of why Eve ate the apple. Without the serpent, the story would have been different. Adam and Eve might have lived in the Garden many happy years before they did anything wrong. They might be there still. The serpent was (in this respect) the cause of the fall from grace. Yet, if our purpose is "engineering" (in Feinberg's sense), then both Eve's organizational criticism and Adam's design criticism seem to pick out true causes. Both point to ways to prevent similar disasters. Eliminating the serpent would only eliminate "the immediate cause" (a particular tempter), not the "underlying" or "real" cause (as we might say), which is temping fruit, something better design or training might eliminate. If, however, our purpose is simply to assign blame, then, and only then, does God seem to have a point. Adam and Eve have no one but themselves to blame for their fall from grace. The serpent was not free in the way they were; the Garden did not eat the fruit, they did; and they knew better.

The practical criterion most appropriate to engineering as such is neither explanation (which seems to belong to history or science) nor blame (which seems more appropriate to law or ordinary moral life), but to what Feinberg actually called

[25] Well, relatively simple. There are conceptual problems about how to treat redundant causes, alternate causes, and the like (as noted already)—and these affect (and are affected by) how we conceptualize cause itself. See especially, Hart and Honoré (1973).

"engineering".[26] The primary concern of engineers who have identified an engineering problem, whether or not of their own making, is—all else equal—to fix it if they can.[27] This is a corollary of the purpose of engineering (roughly, to improve the material conditions of humankind). It is certainly the engineer's responsibility-as-domain-of-tasks. So, for example, though fools are to blame for much they suffer, a routine part of engineering is to make designs "fool proof", that is, to protect against foreseeable misuse (at least insofar as that is possible at reasonable cost).[28]

For engineers, then, the second version of the problem of many causes has a simple solution. Because the engineering criterion distinguishes cause from mere causal factor in a specific way, it forecloses the argument from many causes (in its second version). Indeed, engineers have constructed their profession to foreclose that argument. They make it their responsibility to solve certain problems, engineering problems. Among those problems is avoiding certain disasters (whether by design of the thing itself or by design of its organizational context). Solving such problems is something engineers are "liable to do" because they are engineers, not because they caused the problem. Here is a good example of (moral) responsibility-as-liability without responsibility-as-simple-cause.

This response to the argument from many causes may seem to dismiss the question of blame. It does not. Instead, it points out that engineers can, and often do, take responsibility where blame cannot be assigned. This response does, however, pose a question for those who find it unsatisfactory because it says nothing about blame. Why is blame so important here? Is it not more important to fix the problem, say, the malfunction in the THERAC-25, and to avoid similar failures in the future, than to assign blame for the original failure? (Perhaps engineers and the public will answer this question one way; lawyers and their clients, another.)

Replaceability

We turn now to the third argument against responsibility, the argument from replaceability. Like the first two arguments, this one does not depend on technology or any special feature of modern organizations. The argument is often used in some such form as this: "If I don't do this, someone else will, and since it makes no difference whether I do it or not, there's nothing wrong with me doing it." (Glover 1975; Scott-Taggart 1975; and Bayles 1979).Though that is the common form of the argument, both its strength and weaknesses will be clearer if we state the argument more formally:

1. To be the cause, or a chief cause, a causal factor must be necessary to the event caused.

[26] Of course, engineers do blame one another sometimes, but there is nothing especially interesting about that. Their blaming will have much the same structure as ordinary blaming—though it will take into account the special responsibilities engineers have taken on.

[27] Feinberg (1970), 205, eventually calls the engineering criterion "the handle criterion", having in view the expression "to get a handle on it".

[28] Whether this is a good idea is a separate question. Compare Bucciarelli (2002).

2. If I do not bring X about, someone else will.
3. If X will occur whether I bring it about or not, I cannot be necessary for X.
4. If I am not necessary for X, I cannot be the cause of X or even a chief cause.
5. No one is responsible for what he did not cause.

Therefore: I am not responsible for X (whether I bring X about or not).

There are at least three flaws in this argument—at least as applied to engineers.[29]

The first flaw concerns premise 5. It claims that no one is responsible for what he did not cause. We have just seen that that is not true, that engineers can—and do—take responsibility for problems they did not cause (and are therefore responsible for them—in both accountability and liability senses).

The second flaw is factual. The claim that someone else will do X if I do not (premise 2) is true only if the agent in question can in fact be replaced by someone who will do X. Having long ago identified replaceability as a problem, engineers have adopted standards of practice, including a code of ethics, to prevent employers from being able to make the replaceability argument to engineers in a wide range of circumstances. Within that range, the engineer can simply say, "If you want to replace me with an unethical engineer, go ahead. There may be a few out there. But no ethical engineer will do what you are asking. Do you really want an unethical engineer working for you?" Engineers have in this way largely foreclosed the argument from replaceability. Normally, the argument will be unsound. Except in extraordinary circumstances, there will be no one out there both able and willing to violate the engineering standard in question. And, in those extraordinary circumstances, the employer has a reason not to hire the person—that person being either an "unethical engineer" or no engineer at all.

The third flaw in the argument is logical. The argument assumes that there is only one criterion for cause when, as we have seen, there are at least three. Even if the engineer can be replaced, either with another engineer or with some other sort of technologist, the argument from replaceability carries weight only when we are considering what to fix. (If any operator would do X, the problem of X-ing is not solved by replacing this operator.) But to consider only what to fix is to rely on (a narrow version of) the *engineering* criterion of cause. We might, instead (or in addition), be concerned with finding the cause because we are seeking to avoid deserved blame, damages, or punishment, or having to give an account. We would then appeal to a different criterion of cause. We might, for example, say that X, an act such as approving a flawed design, is wrong even if the approval would be given by a few other engineers if the engineer in question did not give it. Whoever does X is at fault and that individual's fault is the cause of any harm that actually follows. The possibility of alternate causal chains does not change the actual causal chain or

[29] There is a fourth flaw which raises deeper questions about causation. Premise 1 also seems to be false because redundant causes can be causes. Suppose two hunters shoot the same bystander at the same moment (because he has come between them and a duck they are both aiming at), that both their bullets enter his body at the same time, and that either bullet would be sufficient to cause death. Neither hunter is necessary for the bystander to die. The death is "over-determined". Yet, it would seem odd to let both off because neither was the cause, or even a cause, of the bystander's death. I ignore this flaw (and several related ones) here because I promised charity on the subject of necessary conditions for responsibility.

make the cause in question less faulty. (The only question is whose fault it will be, X's or someone else's, assuming it is someone's.) Premise 3 seems to equivocate between a first-person version (my doing y caused X) and an impersonal version (someone's doing y caused X). The argument can block responsibility for what "I" in fact do only by adopting an interpretation of premise 3 in which "I" disappears from the causal chain. The argument from replaceability thus begs the question—whether *I* should contribute to the causal chain in question.[30]

Institutional Constraint

The argument from institutional constraint, though another argument (more or less) independent of technology, is not independent of organization. The argument seeks to undercut the claim that engineers have a choice. Lynch and Kline state it nicely:

> Most engineers operate in an environment where their capacity to make decisions is constrained by the corporate or organizational culture in which they work. Engineers are rarely free to design technologies apart from cost and schedule pressures imposed by a corporate hierarchy, a government agency concerned with its image, or market pressures. (Lynch and Kline 2000, 210)

Lynch and Kline are certainly right that most engineers do (and always have) worked in large organizations. Except for those engineers high in the organization, working in such an organization means working within a framework that others have constructed, one that necessarily drastically limits what an individual engineer can do. Of course, the other side of working within a large organization is that one's choices, while limited by cost, market, organizational politics, and the like, can have much larger effects than the same sort of choice outside the organization. To design a small plane in one's own little company is unlikely to affect many people. To design just the riveting for the wing of the Boeing 737 is likely to have a much larger effect. For engineers, working for a large organization is a Faustian bargain—except that Mephistopheles, if present at all, is largely in the details.

Can an engineer have responsibility for what her employer does—or just for what she does within the narrow bounds where she is free? I see no reason why the engineer cannot take responsibility for what her employer does, however large the employer. She has voluntarily accepted employment with that employer, and can break off that association at any time just by giving notice. Certainly, engineers have long recognized that they should take responsibility for what their employers do—even when what the employer does is beyond the individual engineer's control. Among the provisions of one of the earliest codes of engineering ethics is this: "If after becoming associated with an enterprise he finds it to be of questionable character, he should sever his connection with it as soon as practicable." (American Institute of Electrical Engineers 1912, A.2.) Many contemporary codes contain a similar provision. At a minimum, an engineer should be willing to give an account of an employer's conduct and to accept some blame for what it does when what it does deserves blame (just as she might accept credit if the employer does something

[30] For a more detailed discussion of this argument, see the exchange: Davis (1986a, b) and Bayles (1986).

creditable). An engineer who declines to accept that minimum responsibility but continues to benefit from the employment will seem much like that great but greatly flawed engineer in Tom Lehrer's song:

> "Once the rockets are up, who cares where they come down?
> That's not my department," says Wernher von Braun.

While engineers work *in* departments, they work *for* an organization. If the organization's name is on the rocket, they may have something to answer for when it comes down—even if their department has nothing to do with rockets.

That, however, is not the end of the argument from institutional constraint. The main point of the argument is to free engineers from responsibility for what *is* "their department", that is, for what they in fact help to bring about. The engineers are causal factors but (the argument runs) the organization so hems them in that they are not free enough to be *faulty* causes. The engineer who prepares a plan for a project is not responsible for it because she could have prepared no other. She had "no choice".

This version of the argument from institutional constraint has at least three flaws (beside the one already discussed). Each flaw is serious in itself. One is logical. The engineer always has at least one other choice, that is, not to prepare the plan. That other option may be suicidal, but—as a matter of logic—it always exists. Morally, there is an important difference between "no choice" and "no attractive choice".

The second flaw is conceptual. Engineers are hired to exercise engineering judgment on behalf of their employer. Where judgment is necessary, there must be at least two options, aside from preparing no plan. If there is only one option, a technician can prepare the plan. Even if engineers do not make the final decision, they must make the initial decisions on almost any project they undertake. That decision-making power, that freedom to choose, is what, as a conceptual matter, distinguishes an engineer from a mere technician. The argument from institutional constraint is not a reason why engineers cannot be responsible for how they exercise that decision-making power—in the faulty-cause, accountability, or liability sense of responsibility. They have the necessary freedom to choose.

The third flaw is empirical. Those of us who have watched engineers at work have noticed that many of the decisions engineers make are *in fact* final. Superiors review them but, unless something is clearly wrong, the superior will not enquire deeply into the decision. Going along with engineering decisions is generally more efficient than getting a second opinion or overruling the engineer "on principle". As a matter of fact, *most* engineers in large organizations have considerable decision-making power. Whenever that is true, the argument from institutional constraint simply does not apply.[31]

Individual Helplessness

But, it may be said, the problem is not so much freedom as the need to cooperate with others to accomplish the task in question. One engineer cannot, for example, do

[31] Swierstra and Jelsma (2006) draw this conclusion from their study of European engineers. I came to the same conclusion from a study in the US. See Davis (1997).

anything to help her company adopt sustainable practices that would raise the price of the product in question. The market blocks the way. The individual engineer is helpless. Hence, even though the engineer's code may, as the American Society of Mechanical Engineers or American Society of Civil Engineers code of ethics does, require engineers to "strive to comply with the principles of sustainable development in the performance of their professional duties", an individual engineer can in fact do nothing. Lacking any power to follow the code in this respect, the engineer can have no responsibility to do so. See for example, Miller (2005).

So long as we think of engineers as individuals without the power to coordinate their conduct, this argument from helplessness is sound—at least for a large number of engineering decisions. The flaw in the argument is that engineers, as members of a profession, are never mere individuals. They are always, in addition, members of the profession. The profession may adopt standards of practice which, applying across all employers in a market, would eliminate market pressures that might otherwise block adoption of the practice. Where the market still resists adoption of the standards, the engineers may, through professional organizations, appeal to insurance companies, other private entities, or the government to enforce the standards. (Which entity should be appealed to will, of course, depend on who would benefit from the standard's adoption.) American engineering societies have been developing technical standards of this sort for more than a century. There is a more recent history of similar standard-setting by international bodies, such as the IEEE or International Organization for Standardization (ISO).[32]

Individual Ignorance

But, it may be said, the problem is not so much freedom or power as knowledge. The complexities of any large project make it hard for most engineers to know the whole. On many large projects, engineers literally do not know what they are doing. And, because they do not, they cannot be responsible in either the liability or accountability sense for what happens. That is the sixth argument against responsibility, the argument from individual ignorance.[33] It has at least two flaws.

The first flaw should be obvious from what we have already said. Engineers generally try to understand how what they are working on fits into the world. That is part of good engineering. An engineer who literally does not know what she is doing has a lot to account for. There may, it is true, be some environments where engineers are kept ignorant of the big picture. Some military work is said to be organized to keep most participants in the dark about the ultimate purpose. And

[32] So, for example, a claim like the following seems to me clearly mistaken: "As an engineer, I think we take ourselves too seriously if we think we are ever going to influence what society decides to do by looking at the problem of ethics within the context of technology itself." Wiseman (1980), p. 166. This argument has an extension to society as a whole not relevant here. See for example, Winner (1995).

[33] See for example, Florman (1978), 323: "An engineer designing a rapid transit cannot become expert in acoustics, urban planning, and the habits of woodland birds, and at the same time be an expert in the design of monorails. Nor can he do his best work if he is excessively apprehensive about the consequences of his every move."

some projects, especially those with large software components, are unusually hard to understand. Like the THERAC-25, they end up behaving in ways that no one foresaw—some, perhaps, in ways no one could foresee given the state of the art at the time. But even such unusual environments leave engineers with a responsibility to try to find out what they do not know but need to know to do a good job; it does not excuse them from trying to do a good job. The argument treats the elimination of some responsibility-as-liability as the elimination of all liability.

Ignorance of outcome is, however, rare—and, in any case, only frees engineers from blame. That is the second flaw in the argument. Whatever force the argument from ignorance has, the engineers will still owe an accounting for what happened. And, if anything went wrong, they will also have a responsibility (a liability) to figure out how to prevent it from happening again. The argument from ignorance only defends against one sort of responsibility-as-liability, the sort engineers as such are least interested in (blame).[34]

Neutrality

That brings me to the last of my seven arguments, the argument from technology's neutrality. While it is true that engineers produce technology, they cannot, it is said, control what is done with it. Any piece of technology, even something as innocuous as a scissors, can as easily be put to a bad use (stabbing an innocent person) as a good one. Engineers should not be held responsible for what is done with their work.[35]

This argument does not, it should be noted, deprive engineers of all responsibility, for example, responsibility for flaws in design or manufacture over which they actually have control or, indeed, responsibility for uses for which the technology was designed. All it can deprive engineers of is responsibility for *misuses* of their work *beyond their control*. And, depending on the kind of liability or accountability in question, it may not be able to do even that. Consider the THERAC-25 disaster again. While engineers are certainly not to blame for what they could not control, their response to the disaster was not to crow about how they were not to blame. Instead, they viewed themselves as having a professional responsibility to prevent similar disasters now that they knew what in particular had gone wrong with the machine. For engineers, what they create should not be neutral. It should be designed, built, maintained, and even disposed of in a way at least consistent with the public health, safety, and welfare. Technology as such may, or may not, embody certain values. That is a deep question for the philosophy of

[34] Of course, engineers are interested in avoiding blame, just as they are interested in avoiding legal liability. All I claim is that, as engineers, that is (and should be) what they are *least* concerned about—just as lawyers, as such, are (or at least should be) most concerned with legal liability. As individuals, avoiding blame may be their chief concern.

[35] See for example, Schnädelbach (1980), 28: "'We dealt only with the technical problems and had no influence on the determination of goals'—this is a type of excuse frequently advanced in order to separate technical from ethical responsibility after political and moral catastrophes." While Schnädelbach does a good job of stating the argument from neutrality, he in fact rejects it—even for applied science. I am still looking for a contemporary thinker who endorses it.

technology.[36] *Engineered* technology, in contrast, necessarily embodies (or at least should embody) certain values. An engineer who produces a product that, however clever, fails to benefit humankind has failed—as an engineer. Engineers have been making that point about engineering at least since civil engineering separated from military engineering early in the nineteenth century. (Davis 1998, pp. 12–15). The argument from neutral technology simply overlooks the distinction between technology as such and engineered technology. For that reason, as much as because of government regulation, today's scissors generally lack the sharp tips they once all had. Part of good engineering is designing to prevent foreseeable misuse. Another part of good engineering is seeking to add to the misuses that can be foreseen, for example, by tracking products in use to discover how they have been misused.

The Rationality of Taking Responsibility

I have canvassed seven arguments seeking to relieve engineers of moral responsibility for what they do (or fail to do). These seven are, I believe, all the arguments now in the literature. I have dealt with them in different ways. Some I disposed of by detailed analysis of the key concepts (such as "cause") or by pointing to logical mistakes. Some I could dismiss because they relied on a claim for which there was substantial adverse evidence. But, for most, one step was to point out how engineers have taken on the responsibility in question (liability or accountability). The responsibility in question arises from their own voluntary acts (whether as individuals or as the engineering profession). Though people are generally thought to shy away from responsibility-as-liability or as-accountability, engineers do not seem to. Instead, they seem to claim certain responsibilities most of us, even technically trained managers and other technologists, try to avoid.[37] Some might well wonder whether I have described a mass pathology rather than explained why engineers can have such moral responsibilities. Why take on responsibilities others do not want?

That question, one concerned with rational justification, is one I must now answer. It is, I think, a question easily answered in a way preserving the moral responsibilities in question: engineers, as a group, gain more by taking on the responsibilities in question than they lose. Consider a joke engineers like to tell:

> A priest, a lawyer, and an engineer are about to be guillotined in one of the great squares of Paris during the Reign of Terror. The condemned must lie on a bench with his head set in braces under the huge angled blade. The priest is first. Asked whether he would like to lie face up or face down, he chooses face up—adding, "I want to look where I hope to go." He says a prayer and lies down. The blade drops—but just as it reaches his throat, it stops. The

[36] For a good survey of this debate, see Sundström (1998). By "technology", I simply mean all those systems of people and things that constitute the world humans have made, everything from bridges, computer programs, and dictionaries to hybrid corn, hot dogs, and Labrador retrievers.

[37] Think, for example, of programmers who claim to be "artists rather than engineers"—or scientists who rely on the neutrality argument discussed in the last section.

executioner declares "divine intervention", unties the priest, and lets him go. The lawyer is next and, given the same choice, chooses to "follow precedent—and hope for the best." Again the blade stops just short. The lawyer is also let go, but this time the executioner checks the machine before proceeding. He finds nothing amiss. The engineer is brought forward. He too chooses to lie face up. Just as the blade is about to drop, he shouts "*Stop*! I think I see the problem!"

This is a good joke and, like most good jokes, has several uses. I first heard it from an engineer making the point that not every engineering problem should be solved. I have also heard it used to make the point that engineers see problems others do not. Here, however, I tell it to illustrate how and why engineers might take on responsibilities not otherwise theirs. The engineer under the blade was not (as far as we know) even a causal factor in the production, installation, or maintenance of the guillotine, or under contract or otherwise obliged to take on its repair or even to investigate its malfunction. He might have kept silent without blame—and thereby saved his neck. Fixing the guillotine definitely was not "his department".

Yet, whatever we think of this engineer's prudence, we recognize in him someone we can trust with the world's machinery, someone quite unlike the hobo in the henhouse. Avoiding responsibility has many advantages, but winning the trust of others is not one of them. What engineers gain by taking on responsibilities others avoid are several tasks or offices which, as a matter of fact, have become a relatively lucrative occupation. Creating a lucrative occupation is rational enough to justify accepting the moral responsibility (both accountability and liability) making it possible (provided the tasks accepted are also morally permissible—as they seem to be). The very barriers to moral responsibility that technology and organization throw up are opportunities for a profession willing to make overcoming them their responsibility.[38]

Acknowledgments I should like to thank Ibo van de Poel and Vivian Weil for many helpful comments on earlier one or another drafts of this paper.

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[38] Compare Ladd (1982), 66: "responsibilities are not incurred or acquired like obligations. Rather one finds oneself responsible for something or other as a result of being in a certain position, e.g. of power." The responsibility the engineer took here is (Ladd notwithstanding) incurred like an obligation, not by having the power to help but by a specific voluntary act, claiming to "see the problem". Had the engineer remained silent, he would have had no responsibility to fix the guillotine.

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