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Professional Responsibility for Harmful Actions

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Professional Responsibility for Harmful Actions

This essay explores the grounds on which professionals should be held responsible for the harms caused by their actions. Many of the examples used concern engineers, designers and architects involved in real-life cases from tort law. The essay is divided into three parts. Part I provides a general analysis of the concepts of responsibility and negligence through an examination of some legal cases. Though these cases are primarily concerned with legal liability, the aim is to provide the reader with some useful concepts and distinctions for making judgments about moral responsibility. Obviously the concepts of legal liability and moral responsibility are not the same: for example, one is not legally liable for everything that one is morally responsible for. Nonetheless, legal terminology and distinctions, themselves refined from common sense and moral intuition, are helpful in ascribing moral responsibility for harm. Thus, even though legal concepts are used in analyzing these cases, the reader should keep in mind that the primary goal is not to illustrate the law, but to draw moral conclusions. Part II proposes two models of professional responsibility, the Malpractice Model and the Reasonable Care Model. These models are used to analyze and make judgments about two detailed case studies: the Turkish Airlines DC-10 crash in Paris, 1974, and the American Airlines DC-10 crash in Chicago, 1979. Part III addresses one important problem that arises out of these case studies, namely, how to ascribe responsibility for harm to individual professionals when they are employed by large corporations.

I

Assigning responsibility for harm is an important problem in both morality and law. To say that someone is responsible for a harm means that he or she can be blamed, punished or required to pay compensation. In moral contexts (though not in all legal ones), a person is responsible for a harm only if it is a causal consequence of something that person actually did or omitted to do. Legal exceptions to this general rule include corporations which are held liable for the harms caused by their employees and parents who are held responsible for their children. The responsibility in these exceptional cases might be thought of as a convenient fiction and justified on grounds of wise social policy rather than morality.

Having caused or causally contributed to a harm is only necessary, not sufficient, for being responsible for that harm. Again there is a legal exception, namely, the doctrine of strict liability. According to this doctrine a person is held responsible for *all* instances of harm that he or she causes. Justified though this extreme view may be in areas such as product liability, workmen's compensation and the manufacture and transportation of hazardous substances, it is grossly inadequate as a model of *individual* responsibility for actions which cause harm. Strict liability fails to recognize the crucial requirement that a person must, in the relevant sense, be *at fault* before we can reasonably blame him or her for the harm which this person causes. To be at fault one's conduct must have violated a moral or legal standard, thus making one's action or omission "wrongful." The three main types of fault which establish legal responsibility for harm are intentional wrongdoing, recklessness and negligence.

The simplest type of fault establishing responsibility arises from violations of the moral and legal duty not to cause harm *intentionally*. In a case recently decided by the U.S. Supreme Court, we find a clear instance of intentional wrongdoing by several members of the American Society of Mechanical Engineers (ASME). These engineers served on one of the subcommittees of ASME's Boiler and Pressure Vessel Committee responsible for interpreting Section IV of the Society's Boiler and Pressure Vessel Code governing low-water fuel cutoffs. The court found that these engineers conspired to misinterpret the Society's Code so that a new product, competing with McDonnell and Miller's fuel cutoff, could be declared unsafe. This resulted in a dramatic decline in the sales of the manufacturer of the new device, Hydrolevel Corporation, and a corresponding increase in the sales of McDonnell and Miller, Inc.

In this case, at least two engineers on the Section IV Subcommittee, one of whom was employed by McDonnell and Miller, acted intentionally to inflict monetary damage on that company's competitor.[1] Their wrongful actions caused harm; they were aware that this harm was likely to result, and, in fact, they deliberately acted wrongly so as to bring this harm about. Obviously they

are responsible for the harmful consequences of their actions and they should be blamed or punished for the harm they caused. Indeed in such cases of intentional wrongdoing the defendants may be required to pay punitive damages in addition to compensation to the plaintiff.

One of the striking features of the ASME case is the clear respect in which the engineers were at fault in deliberately misinterpreting the boiler safety code. Sometimes, though, the element of fault and hence the ascription of responsibility is not so clear. Imagine, for example, that the members of the ASME committee thought they had *correctly* interpreted the boiler safety code in finding Hydrolevel's new product unsafe. In this case, an *unintentional* misinterpretation, rather than an intentional one, would have been the cause of the unfavorable safety ruling and the ensuing financial losses of Hydrolevel. Would we still hold the members of the subcommittee accountable for Hydrolevel's losses? While it is true that the engineers caused the harm, it is no longer clear that they were at fault. After all, everyone makes mistakes and if those mistakes are unavoidable or inadvertent why blame anyone? The point is that not all of one's mistakes are one's fault and in engineering endeavors it is sometimes difficult to decide whether or not a mistake is faulty. If an engineer is at fault in these cases of unintentional error it is because he or she has been either reckless or negligent.

An action is negligent, and the party who performed the action held accountable for the ensuing harm, if the party has not acted with "due care" to minimize the harmful consequences of his or her conduct. Recklessness (often misleadingly called "willful and wanton" conduct) resembles negligence in that the harm caused is unintended but differs from mere negligence in both degree and kind: the risk of harm is greater or more probable; the reckless agent is consciously aware of the risk (or is presumed to be) but acts or fails to act despite this awareness. Some statutes (for example, "Good Samaritan" laws) require at least recklessness, not mere negligence, for legal liability.

DISCUSSION: Why do you think the law requires recklessness, beyond mere negligence, for liability in cases where, say, a physician gives emergency treatment to a road accident victim?

Each of us has a legal duty of due care to avoid harming others or risking their harm. Most moral theories recognize a strict moral duty to avoid causing harm and many also insist that we have a positive duty to act in ways that minimize the risk of harm. This insistence stems from a fundamental moral principle that we should treat others as we would want others to treat us. Only in rare cases, under special conditions, would we want others to harm us or to put us at risk of harm. Legal and moral theory reflect this principle by recognizing a duty of due care toward others as a binding requirement on each of us. Failure to exercise this duty of care in our conduct renders us subject to moral blame as well as to legal sanction.

In general, we are held responsible not only for the harmful consequences of our actions but also for the harmful consequences of our omissions if the actions which we omit to perform are ones that could be reasonably expected of us. Assigning professional responsibility for harm in negligence cases often crucially depends on what it is *reasonable* to expect from members of a given profession. Reasonableness is a concept which embodies the notions of what it is proper and rationally prudent for a person to do in a given set of circumstances. In tort law, which concerns itself with civil responsibility for harmful actions and failures to act, it is considered reasonable to expect professionals to live up to the minimal standards recognized and accepted by their profession. It is also thought that the professional should conform to what *any* prudent person would deem reasonable. Thus, if the standard operating procedures of an entire profession are deemed unreasonable in the light of common prudence, then merely living up to those standards is no defense against a charge of negligence. For example, in the 1930's a court ruled that because radios reduce the probability of collisions, it was negligent of captains not to have them on their ocean-going tugs. Merely conforming to professional standards did not guarantee that these captains had discharged their duty of due care. In general, the duty of due care is not automatically met simply by following professional norms (Prosser 1964, p. 170).

DISCUSSION: What are the general relations that hold between law and morality? Can you think of convincing examples of (i) immoral actions that should not be made illegal, (ii) illegal actions that are not immoral?

In order to analyze the concept of negligence more fully, consider two cases of mistakes made by soil engineers.[2] In both cases an engineer certifies that the soil will not settle to such an extent that cracks will form in a foundation. In the first case the engineer bases his report on data he knows to be incomplete. In the second case the soil engineer reaches the same conclusion but based on data she believes to be complete, or at least sufficient. It turns out that both are mistaken and the foundation cracks some months later. The decision of the first engineer is a faulty mistake, but the second engineer may not be at fault if she did not know that the mistake was likely to occur. The first engineer is at fault because he *knowingly* risked making a mistake which could cause harm. But is the second engineer entirely blameless? We need to know more about the case. If the second engineer employed a soil testing method which she believed to be reliable then her mistake might be thought morally blameless. But what if the test was known by most soil engineers to be much less reliable than its alternatives? Shouldn't the second engineer also have known this? The second engineer would probably be judged to be at fault even though she neither intended nor foresaw any harm since, as a professional engineer, she should have foreseen that her conduct created an unreasonable

risk of harm to others. Soil engineers are expected to know about the reliability of the tests they use.

The crucial issue in deciding the legal fault of negligence is the person's *conduct,* not her mental state, psychological peculiarities or character traits (for instance, being absentminded or intimidated by an unscrupulous administrator). Moreover, as long as one's *conduct* creates no unreasonable risk of harm, then, as far as the law is concerned, one is not negligent, regardless of whether one has the slightest concern for the safety of others. This is one obvious respect in which the moral concept of blame differs from the legal concept of liability. If no harm actually results from the defendant's conduct, then in tort law the plaintiff has no cause of action.

Should professional engineers be held responsible for *all* the harmful consequences of their faulty actions? Imagine an elaborate chain of events as in a Rube Goldberg drawing: a woman rocks in a chair in her neighbor's parlor; the rocker pinches a cat's tail; the cat shrieks, frightening a little boy in the next room; he spills his glass of milk which runs over the edge of the table on to a sleeping dog; the dog jumps up and dashes from the room, knocking over the neighbor's priceless vase. Is the woman who rocked responsible for breaking the priceless vase? Her act of rocking started a causal chain which culminated in the vase breaking. Because of this, the broken vase was a consequence of her action since it would not have occurred without it. But, as in the case of the second soil engineer, her causal role was inadvertent since she neither foresaw nor intended the harmful consequences of her action. Also in this case it is hard to imagine that the woman was at fault in performing the initial act of rocking. Even if the woman had been at fault, (perhaps because she ignored her neighbor's request to refrain from rocking since the chair was a fragile heirloom), is she responsible for the rather remote harmful consequence of her action?

A real life "Rube Goldberg" case occurred in the early part of the twentieth century in America. In the case of *Palsgraf v. Long Island Railroad Company* (1928), a passenger carrying a package was running to catch one of the company's trains. Two railroad employees helped the passenger aboard but did so carelessly, causing the package to slip from his arms. Unbeknownst to the railroad employees, the package contained fireworks which detonated violently on hitting the rail. The force of the explosion overturned some scales several feet down the platform which struck and injured the plaintiff, Mrs. Palsgraf. Was the railroad company responsible for her injuries? Students and scholars have argued about this case for years. At the time, the New York Court of Appeals ruled by a vote of 4 to 3 that Mrs. Palsgraf had suffered a harm which could not have been foreseen by the railroad. Thus even though the railroad company's employees acted negligently in dislodging the package they had not thereby violated any duty of due care owed to Mrs. Palsgraf standing some distance away. Things would have been different had she been standing nearby and the package hit her foot. As things were, however, the harmful consequence of the faulty action could not have been foreseen nor would it have been foreseen by a reasonable person in that situation. Hence the railroad was not found responsible for the injuries it caused to Mrs. Palsgraf.

DISCUSSION: Do you agree with the majority opinion in Palsgraf? Wasn't the railroad company at fault for not securely fastening the scales? (Airlines, railroads and buses are legally required to exercise "great care," that is, the high degree of care that a very prudent and cautious person would undertake for the safety of others.)

A different case (*Inman v. Binghampton Housing Authority,* 1957) involving the same issue of assigning responsibility for remote harmful consequences concerned a faulty architectural design. The city of Binghampton, New York, contracted to have a housing complex constructed within its city limits. Following the plans and designs of an architect named Lacey, Smith's Construction Company completed the buildings in 1948. In 1954 a two year-old child was injured at the housing complex by falling off the stoop of his parents' house. The stoop was a single step but it was the height of two normal steps along part of its length with no railing around it. The step leading from the stoop to the sidewalk was in the center of the porch and did not extend along its entire length. Furthermore the rear door opened outward in such a way as to require the person using it to step back dangerously close to the edge of the porch. The parents of the injured child, the Inmans, contended that the injury resulted from a design defect. The architect should have known that children would use the stoop and should have made it a two step stoop or at least put a railing around it. Clearly the harmful consequence is remote from the actions of the architect, but is it so remote that the architect is relieved of responsibility for the child's injury? The court ruled that the harmful consequence was not too far removed but it also judged that the architect should not be blamed for the poor design since the defect was not hidden and could easily be discovered. Even though the harm should have been foreseen by the architect, the fact that it could also easily be foreseen by the parents absolved the architect from responsibility. Harmful consequences must be foreseeable by the professional (or, better, by a reasonable professional) but also *un*-foreseeable by the injured party in order for the responsibility to be ascribed to the professional.

Related to this standard is one concerning the operation of intervening forces and agents in limiting the scope of responsibility. In the case just mentioned it might be held that the parents' own negligence in leaving their child unattended played a role in causing the injury. Since this occurred after the architect's negligence, it might relieve the professional from blame. Normally, if the intervention is unexpected by the first party, the person who so intervenes assumes the responsibility, even if both act negligently. If I throw a match on the ground and just before it goes out you pour gasoline next to it causing an injurious explosion, then our acts jointly caused the harm. But since it was unreasonable to expect me to predict your intervention, without which the explosion would not have occurred, I am not held responsible for the explosion despite my causal contribution to its occurrence.

Most manufactured articles have uses for which they are unsuitable and dangerous. That an item may be faultily designed with respect to its intended and reasonably foreseeable uses and misuses does not establish the designer's responsibility for harms caused by its unintended and unforeseeable uses. Thus in the (apocryphal) case of the householder who tried to dry the family cat in the microwave oven, even if the oven was faultily designed, the manufacturer is not liable for the harmful consequences of its improper and unforeseeable misuse.

A good illustration of these doctrines is provided by the following case (Thorpe 1979, p. 34). A farmer was using a forged-head carpenter's hammer to drive a pin into a clevis to connect a manure spreader to his tractor. A piece of metal chipped off the hammer and caused the farmer to lose an eye. It was established that there were no metallurgical flaws in the hammer when it left the manufacturer but the tool had become work-hardened with use thus making it more likely to break off in chips when striking an object harder than itself. The defense lawyer objected that the farmer had not used the hammer as the manufacturer intended and that he should have employed a ball-peen hammer for this type of job. But it was well-known that this type of hammer, which the farmer had bought at the local hardware store, was used for all sorts of tasks and metallurgists were familiar with the effects of work-hardening. Furthermore, several chipped hammers had been returned to the manufacturer for replacement. The court found the manufacturer responsible for the accident on the grounds that he should have foreseen the kind of use to which the farmer was likely to put the hammer.

DISCUSSION: Compare this case with the Inman case. Why is the farmer not negligent? If he is, how would this affect your opinion? In deciding liability in cases where harm has resulted from the unforeseeable misuse of a defective product it is also crucial whether the injury is caused by the defect or whether the misuse *alone* was responsible for the injury. Thus consider the following three cases (Noel 1982, p. 640): (1) The plaintiff purchases a hairdryer from the defendant. The hairdryer contains an electrical defect introduced during the manufacturing process. The plaintiff for some reason uses the hairdryer as a "hammer" and attempts to drive a nail into a piece of wood. The plaintiff is injured when a piece of the dryer is chipped off by the nail and strikes the plaintiff's eye. (2) The plaintiff uses the hairdryer as a hammer but is injured by the electrical defect in the hairdryer rather than the chipped piece of the dryer. (3) The plaintiff again uses the hairdryer as a hammer but this time the misuse of the product and the electrical defect combine to cause the injury. In which of these cases is the defendant responsible for the plaintiff's injury?

These cases illustrate the guiding legal standard for deciding which consequences of our actions we are responsible for. Generally speaking, we are only held responsible for those consequences which it is reasonable to expect might result. It is not reasonable to expect that violent explosions will occur near the scales causing them to tip. It is not reasonable to expect that parents will let their children play in areas that are clearly unsafe for unattended infants. It is not reasonable to expect that gasoline will be poured next to a dropped match. In legal theory one is not held responsible for all harmful consequences of one's actions, but only for those that it is reasonable to expect one to foresee. In order to decide which consequences it is reasonable to expect people to foresee, the law turns to the common sense and moral judgment of a jury.

II

We now present two cases of putative negligence by professional engineers in an attempt to investigate more closely the scope and limits of responsibility in engineering practice. In these cases we invite you to judge what it is reasonable to expect of the engineers involved. We will appeal to your considered moral intuitions and judgments while recognizing that you may not always agree with us. Morality, like legality, is subject to differences of opinion, especially in difficult cases. Underlying these disagreements, though, there is often a common core of shared judgments about fundamental issues and it is on these that we try to rely. The key issue in many of these cases is deciding what constitutes negligent fault. In order to facilitate our analysis we propose the following simplified account of professional responsibility embodying a rather crude model of negligence.

The Malpractice Model of Professional Responsibility: A professional, S, is negligent and hence responsible for the harm he or she causes, if his or her behavior fits the following pattern:

(1) as a member of his or her profession, S has a duty to conform to the standard operating procedures of his or her profession;
(2) at time t, action X conforms to the standard operating procedures of S's profession;
(3) S omits to perform X at time t;
(4) harm is caused to some person, P, as a result of S's failure to do X—that is, if S had done X, then the harm to P would not have occurred.

As we have already indicated, such a model of professional negligence leaves out several important factors. But before trying to improve this simple malpractice model we shall apply it to the first of two cases involving design defects in an aircraft. These two cases both concern crashes of DC-10's and are the main focus of our investigation of responsibility for harm in professional engineering.

Since both of the following cases involve the DC-10, some background information may be helpful. There are four wide-bodied or so-called "jumbo" jets now used by commercial airlines around the world: the Boeing 747 (used mainly for transatlantic and long distance flights), the Lockheed Tristar (the L-1011), the McDonnell Douglas DC-10 and the European Airbus (the A300). The DC-10 was built after one of the most intense marketing wars in American aviation history. In the 1960's Boeing had established a supremacy in the long haul market with its revolutionary 747. This left Lockheed and Douglas to compete for the medium haul market by designing a three-engined wide-bodied plane employing the same kind of big fan-jet engines that had proved so successful in the 747. Initially Lockheed had a commanding lead. Because of the large number of tri-jets that would have to be sold to turn a profit (about 500), it was not expected that Douglas would continue with its own plans. But in 1967, after Douglas was taken over by the military aircraft builders McDonnell, the new McDonnell Douglas Corporation announced its determination to catch up with Lockheed. The DC-10 was then produced with remarkable speed. Some critics of the aircraft have attributed purported design flaws partly to the rush with which the plane was built and partly to the failure of adequate communication between the two widely separated locations of the new corporation, St. Louis (McDonnell) and Long Beach, California (Douglas). As we shall see, both the 747 and the Tristar possess safety features that were lacking in the DC-10. Aggressive marketing (such as substantial discounts and earlier delivery dates) enabled the DC-10 to outsell its competitor. By June 1979, there were 274 DC-10's in service around the world compared to 163 Tristars. Many airlines such as Lufthansa and Swissair had invested so heavily in the DC-10 that they could not operate economically without it. In 1979, Laker Airlines' entire transatlantic fleet consisted of six DC-10's.

Case I: The Turkish Airlines DC-10 Crash in Paris, 1974.

On March 3rd, 1974, there occurred the worst single plane disaster in aviation history. A Turkish Airlines DC-10 bound for London crashed in the Forest of Ermenonville about thirty miles northeast of Paris, France soon after taking off from Orly International Airport. All 346 passengers and crew were killed. Identifying the victims was difficult since most of the bodies had been reduced to scraps of charred flesh by the force of the 500 mph impact. Six of the bodies that were found relatively intact had been ejected from the aircraft nine miles behind the crash site.

Despite early conjectures of sabotage, there was no evidence of an explosion. A reliable eyewitness reported seeing no smoke or fire during the plane's rapid descent and there was no trace of explosives on the six bodies that had been ejected from the aircraft before it crashed. Recovery of the flight recorder allowed a precise reconstruction of the accident.

The immediate cause of the DC-10 crash in Paris was the blowing out of the rear cargo door at 13,000 feet some twelve minutes after takeoff. The rapid decompression of the cargo bay caused the cabin floor to collapse severing the flight control cables that run through the floor to the cockpit. With the complete loss of these controls it was impossible to fly the aircraft. The cargo door blew out because it had not been securely locked. While Sanford Douglas, the president of McDonnell Douglas, initially tried to shift the blame on to the baggage handler who had closed the door in Paris, both McDonnell Douglas and the Federal Aviation Administration (FAA) were aware that the DC-10 had a record of such failures. There had been a closely similar accident over Windsor, Ontario two years previously. On June 12, 1972, American Airlines Flight 96 from Detroit to Buffalo lost its cargo door at 12,000 feet. Again, the explosive decompression caused the cabin floor to collapse severing most but not all of the control cables. Luckily, none of the passengers was sucked out of the aircraft because the collapsed floor blocked the hatch opening. In a remarkable display of flying skill, Captain Bryce McCormick managed to land the plane safely at Detroit Metropolitan Airport.

A National Transportation Safety Board (NTSB) investigation of the Detroit accident revealed that the fault lay in the design of the locking mechanism of the DC-10's cargo doors. Even though the baggage handler had positioned the external handle in the "door locked" position, the locking pins were not fully engaged. No warning lights had indicated this fault to the flight crew. When the pressure imbalance between the inside and outside of the cargo bay reached a critical value, the hatch would be torn off, causing sudden decompression and probable collapse of the cabin floor.

In the light of its investigation into the Windsor accident, the Safety Board recommended modifications in the cargo door locking system and the immediate installation of pressure relief vents to counteract the catastrophic effects of sudden decompression on the cabin floor. Under the Congressional Act of

1958 establishing the FAA, the Federal Aviation Administration has wide discretionary powers to reject or modify the recommendations submitted to it by the Safety Board. The administrator of the FAA, John Shaffer, decided not to issue an airworthiness directive which would have required these repairs to be made immediately. Instead he reached what has been called a "gentleman's agreement" with McDonnell Douglas. The company would modify the aircraft on a voluntary basis and issue a service bulletin to all airlines recommending new procedures for ensuring the safety of the doors. These recommendations had no binding force and amounted to little more than advising the flight crew to check the latch before takeoff.

By McDonnell Douglas's own admission, it was dilatory in carrying out the modifications recommended by the FAA. Eugene Dubil, a senior vice-president of the Douglas Aircraft Company and chief of the DC-10 design team, has said that he "takes responsibility for the cargo doors not getting fixed up fast enough after the Windsor incident" (Newhouse 1982, p. 85). One year later, eighteen domestic DC-10's had not been repaired and at least one left the factory without any cargo door modification. In July, 1972, three inspectors at the Long Beach Plant of McDonnell Douglas certified that Ship 29 of the DC-10 line had been modified in compliance with the FAA guidelines. In fact none of the changes to the cargo doors had been made. Two years later, Ship 29, owned and operated by Turkish Airlines, crashed near Paris killing everyone on board.

Commentary on Case 1:

There is convincing evidence that some of the engineers who designed and tested the DC-10 were negligent. For some of these engineers this negligence borders on recklessness.

McDonnell Douglas had contracted with the Convair division of General Dynamics to build and test the cargo door locking mechanism because Convair had an excellent reputation for structural design. From the beginning, engineers at Convair doubted the safety of the proposed latching mechanism. In August, 1969, Convair engineers drafted a Failure Mode and Effects Analysis for the lower cargo door system of the DC-10, warning that there were four possible failure sequences in flight that could jeopardize those on board through sudden decompression. These were described in the report as "Class IV hazards" since they involved a danger to human life. In November, 1970, H. B. Riggs, working for the McDonnell Douglas design team (and on loan from Convair) wrote an internal memo, "Approaches to Eliminate Possibility of Cabin Pressurization with Door Unsafe" (Eddy 1976, p. 181). Yet none of this information was forwarded to the FAA and none of it caused either the engineers or the management of McDonnell Douglas to call for changes in the DC-10 prototypes. After the Windsor accident in 1972, F. D. Applegate, Director of Product Engineering for Convair, wrote a scathing memo of which the following are excerpts:

> 27 June 1972
> Subject: DC-10 Future Accident Liability*
>
> The potential for long-term Convair liability on the DC-10 has caused me increasing concern for several reasons.
> 1. The fundamental safety of the cargo door latching system has been progressively degraded since the program began in 1968.
> 2. The airplane demonstrated an inherent susceptibility to catastrophic failure when exposed to explosive decompression of the cargo compartment in 1970 ground tests.
> 3. Douglas has taken an increasingly "hard line" with regards to the relative division of design responsibility between Douglas and Convair during change cost negotiations.
> 4. The growing "consumerism" environment indicates increasing Convair exposure to accident liability claims in the years ahead. . . .
>
> We informally studied and discussed with Douglas alternative corrective actions including blow out panels in the cabin floor which would provide a predictable cabin floor failure mode which would accommodate the "explosive" loss of cargo compartment pressure without loss of tail surface and aft center engine control. It seemed to us then prudent that such a change was indicated since "Murphy's Law" being what it is, cargo doors will come open sometime during the twenty years of use ahead for the DC-10. . . .
>
> My . . . criticism of Douglas . . . is that once this inherent weakness was demonstrated by the July 1970 test failure, they did not take immediate steps to correct it. It seems to me inevitable that, in the twenty years ahead of us, DC-10 cargo doors will come open and I would expect this to usually result in the loss of the airplane.[3]

The designers of the Lockheed Tristar and the Boeing 747 had installed a cargo door latching mechanism different from that in the DC-10 and had increased from three to four the number of independent control systems. These decisions were made because it was thought prudent to add an extra margin of safety in a plane carrying so many passengers. According to the Applegate memo, McDonnell Douglas was well aware of the defects in its own design.

Several features unique to the DC-10 cargo door compromised its safety. First, unlike its competitors, it used over-center latches. These work on the same basic mechanical principle as the ordinary electric light switch. Once home, these latches are perfectly secure. Unlike the C-latches used on the Boeing, they cannot "creep." The possibility of "creeping" on the 747 and the Tristar actually makes them safer. If these doors are not securely locked, air will leak out as the plane gains altitude, pressurization will gradually fall, and the problem will be easily detected. With the DC-10, however, if the latching

*Eddy et al: *Destination Disaster,* 1976. Reprinted with permission by Times Books, pp. 183–184 and p. 185.

mechanism does not travel past the center point, the latches will hold until the pressure difference forcing the door outwards causes a sudden, violent failure. Thus it is crucial that the DC-10 have a detection system which would reliably indicate when the latches are not all the way home. The biggest design flaw was in this detection system. The usual way to tell whether the door is securely fastened is to pass a rod (the locking-pin bar) through the latching mechanism so that it will slide forward only when the latches are in their proper positions. This rod is connected to a handle on the outside of the door. The handle is normally operated by the baggage handler. In the original design of the DC-10, the mechanism attached to the external handle was woefully inadequate. Quite modest pressure on the handle could push it into the position indicating "locked" even when the latches were not all the way home. It is noteworthy that in both the Detroit accident and the Paris disaster, the first response of McDonnell Douglas was to blame the baggage handlers. The real fault, revealed in the ensuing investigations, lay in the design of the door.[4]

These last considerations make this a clear case of a management and engineering decision falling under the malpractice model of responsibility. The McDonnell Douglas design team chose a cargo door latching device that was known to be less safe than the other latching mechanisms used in the aircraft industry for wide-bodied jets. Furthermore the designers remained committed to the inferior latching system even after there was clear evidence that it posed a serious threat to human life. As we have already indicated, one of the chief components in establishing negligence is the foreseeability of the harm resulting from one's actions. The Paris crash of 1974 is one of the clearest cases on record of a major disaster that was completely foreseeable by the engineers and corporate managers involved. The authors of the documentary study, *Destination Disaster,* have concluded that "to some of its designers, the faults of the DC-10 had been obvious long before [1972]. And to judge by their written prophecies, neither Windsor nor the later tragedy outside Paris could have come as much of a surprise" (Eddy 1976, p. 165). Thus it is reasonable to expect the appropriate engineers and management of McDonnell Douglas to have anticipated the cargo door failure on the DC-10 and to have promptly modified this aspect of the aircraft's design. When one also considers that the standards in other parts of the aircraft industry dictated safer latching mechanisms, one sees why the primary responsibility for 346 deaths and the loss of the Turkish Airlines DC-10 can be attributed to the malpractice of the professionals employed by McDonnell Douglas.

As well as illustrating the malpractice model of negligence this case also reveals some of its limitations. It appears to have been standard operating procedure for the engineers involved in design and testing at McDonnell Douglas and Convair to defer to upper management. Even supervisory engineers such as Applegate did not voice their fears until after an accident had occurred. Given this practice it might appear that the individual engineers

involved in the design and testing of the DC-10 had *not* acted negligently. This would be true, on the malpractice model outlined earlier, if the engineering profession does not recognize a professional duty to try to prevent management from proceeding with the manufacture of an unsafe aircraft or a duty to warn the public about the unsafe aircraft once it reaches the airlines. Some of the engineers involved in the DC-10 case argued that they had warned management about the problem and that it was then management's responsibility, not their own, if these warnings were ignored.

One obvious defect of the malpractice model suggested by this discussion and by tort cases in common law is that merely conforming to the standards of one's profession is not always a legitimate excuse for avoiding responsibility for harm. This leads us to propose a reasonable care model of negligence which falls somewhere between the malpractice model and the doctrine of strict liability. As indicated earlier, strict liability eliminates the fault criterion entirely and stipulates that anyone who causes or causally contributes to a harm is responsible for that harm regardless of foreseeability, reasonableness or fault. The middle ground we propose is not a standard of strict liability but it recognizes a standard that may be higher than that required by one's profession. This model superimposes a standard of reasonableness as seen by a normal, prudent nonprofessional over that of the reasonable professional. Thus where the nonprofessional would exercise more care than the average professional, then the extra care is required of the professional. But, if the average person would not act as carefully as the professional, (perhaps due to ignorance), then the standard of due care is determined by the behavior of the average professional. Thus, we would amend the earlier malpractice model as follows.

The Reasonable Care Model of Professional Responsibility: A person, S, is responsible for the harm he or she causes when his or her conduct fits the following pattern:

(1) as a member of a profession, S has a duty to conform to the standard operating procedures of his or her profession, unless those standards are lower than those that a nonprofessional would adopt in a given situation, in which case S has a duty to conform to the higher standard;

(2) at time t, action X conforms to the standard of reasonable care defined in (1);

(3) S omits to perform X at time t,

(4) harm is caused to some person, P, as a result of S's failure to do X.

The following case illustrates the importance of this amended model of professional responsibility.

Case II. The American Airlines DC-10 Crash in Chicago, 1979.

The worst air disaster in U.S. history occurred on May 25, 1979, when American Airlines Flight 191, a DC-10 bound for Los Angeles, crashed thirty-one seconds after taking off from Chicago's O'Hare International Airport. Just before liftoff, the left engine ripped loose from its mounting, pivoted up and over the front of the wing, and went skidding down the runway. Though the DC-10 is designed so that it can take off and fly with only two engines, the aircraft developed a yaw to the left which eventually rolled the wings through the vertical position. Flight 191 crashed in an open field near a trailer park less than a mile from the runway killing all 274 people on board.

Simulator reconstructions of the accident revealed that the pilot, Captain Lux, had not been at fault for failing to regain control of his aircraft. Because of multiple systems failures, Lux was deprived of the information needed to correct the pitch to the left and to prevent the stalling out of the right engine as airspeed declined. When the left, number one engine tore loose it severed a number of hydraulic control and power lines that, in the DC-10, as in most earlier jet aircraft, are located in the leading edge of the wing. (The 747 and the Tristar route these lines along the trailing edge where they are less exposed.) With the loss of the hydraulic lines and fluid, the slats on the leading edge of the left wing began to retract under wind pressure. The slats on the right wing, controlled by one of the two hydraulic systems which remained undamaged, stayed extended. This produced an extreme imbalance of aerodynamic lift which rolled the aircraft to the left. In the DC-10, the engines and wings are not visible from the cockpit. Normally the flight crew would be warned whenever the slats disagree and when an engine is likely to stall. Both systems were disabled on Flight 191 by the loss of the generator which powers them. (The Tristar has an auxiliary stall-warning and slat-disagreement warning system; such a back-up system is also available as an option on the 747.) One factor that definitely might have saved Flight 191 from disaster was a mechanical device to prevent slat retraction. Unlike the DC-10, both the 747 and the Tristar have such systems to lock the slats and prevent retraction if the hydraulic system fails. All these design features of the DC-10 were consistent with FAA regulations at the time of the Chicago accident and even after the accident the FAA did not insist that McDonnell Douglas install a slat-locking device, agreeing with this aircraft's manufacturers that it was unnecessary. In its report on the Chicago accident, the Safety Board admitted that "at the time of DC-10 certification, the structural separation of an engine pylon was not considered. Thus, multiple failures of other systems resulting from this single event were not considered" (Newhouse 1982, p. 89).

There were three problems which contributed to the Chicago accident: (1) a crack in the flange of the engine pylon, (2) the unintended retraction of the slats which caused the plane to yaw, and (3) the failure of the systems warning

the pilot of the imbalance in the slats and likelihood of stalling the engines. The first problem resulted mainly from the negligence of the maintenance crew which serviced the engines but, as discussed below, it might also have been due, at least in part, to a design defect. The second and third problems were due to design specifications; but it would be incorrect to call them flaws unless it were reasonable to foresee these problems and the risk were sufficiently great. McDonnell Douglas maintains that the likelihood of all three factors occurring simultaneously was calculated by them to be so remote (less than one-in-a-billion), that it is unreasonable to attribute the crash to design error. The FAA concurred in this judgment by exonerating the company and its design team in its report on the accident.

The immediate cause of the Chicago crash was a ten and one half inch crack in the rear bulkhead of the pylon which attaches the engine to the wing. Similar cracks were found in the pylons of other DC-10's. When cracks were found in two planes which had been inspected and declared safe just a few days before, the head of the FAA, Langhorne Bond, withdrew the plane's airworthiness certificate. The entire domestic fleet of 138 DC-10's was grounded for a month. Pilots were advised to fly the empty planes to their maintenance centers over sparsely populated areas. Sixty-eight of the planes were found to have problems serious enough to require repair.

The cracks in the pylons of the DC-10's were attributed by the FAA to the improper maintenance procedures of the American Airlines and Continental Airlines maintenance crews. During inspections, the crews had been removing and reinstalling the engines and pylons as a unit instead of separating them as recommended by the plane's manufacturer, McDonnell Douglas. In remounting the heavy assemblies it was easy to misalign and crack the flange of the rear bulkhead. Both carriers denied any wrongdoing and paid their fines to the FAA (American, $500,000; Continental, $100,000) under protest. During the FAA investigation, 31 DC-10's belonging to United Airlines were discovered to have more or less serious structural flaws in their wing pylons. These flaws were traced to defective quality control by the manufacturer for which the FAA fined McDonnell Douglas $300,000.

Two months before the Chicago accident, the DC-10 involved in that crash had undergone routine maintenance at the Tulsa facility of American Airlines. The engine and pylon had been removed and remounted as a single unit using a forklift truck.

Commentary on Case II:

Unlike the previous case of the Turkish Airlines crash, it is not at all clear that the design engineers at McDonnell Douglas were responsible for the disaster in Chicago. Though the Safety Board criticized several design features of the DC-10 (principally the absence of a slat-locking mechanism and the aircraft's lower degree of fail safe back-up systems as compared with the 747 and the Tristar), the primary responsibility was said to rest with the improper maintenance procedures of the airlines that owned and operated the plane which crashed. Admittedly, McDonnell Douglas was found guilty of lapses in quality control that led to defective pylons in the planes purchased by United Airlines. But these particular defects, while serious in themselves, were not causally relevant to the crash of the American Airlines plane in Chicago. Judged by the standards widely accepted in the aircraft industry prior to the 747 and the Tristar, the DC-10 was an adequate and safe design (leaving aside the cargo door locking mechanism). Judged by the standards *created* by the 747 and the Tristar, the DC-10 was inferior with regard to safety in extreme and improbable situations. But with the larger numbers of passengers carried by a single flight of a wide-bodied jet, even relatively small margins of risk become unacceptable.

As we have seen, both the 747 and the Tristar possess safety features lacking in the DC-10 which, had the engineers at McDonnell Douglas incorporated them into their own design, might have saved Flight 191 from disaster.[5] Some commentators have suggested that the inferior design of the DC-10 from the point of view of safety resulted from its overly hasty construction and that this was a clear case of corporate irresponsibility. We will assess this claim and, for us, the more interesting contention that in Case II as in Case I, the design engineers were responsible for the harms caused by their (supposed) professional negligence.

The main difference between Cases I and II is that, in the first but not in the second, the engineers and management involved clearly violated the norms of professional conduct in the aircraft manufacturing industry when they deliberately went ahead with the cargo door latching mechanism that they should have known (and almost certainly did know) was potentially dangerous. But in Case II, there were no such striking violations of professional standards. The FAA, for example, did not consider the DC-10 control systems to be significantly less safe than those of the 747 and the Tristar. But is this sufficient to relieve the designers of the DC-10 of all responsibility for the Chicago crash? The judgment depends on what is considered reasonable risk in the aircraft industry. The FAA, like most governmental regulatory agencies, sets only *minimal* standards of safety. We believe that reasonable risk is not the same as minimally acceptable risk, especially in industries where there is a great potential for harm. Of crucial relevance to our assessment is that McDonnell Douglas had had one of its DC-10's crash near Paris five years before. We hold that when a hazardous design defect has been found in one of the products of a company, that company then has a duty to make sure that that product is safe, *not just in respect of the known defect,* before the product is allowed back into the public sector. In one way at least, Cases I and II are quite similar: Boeing and Lockheed had opted for safer designs than had McDonnell Douglas. After the Paris crash, it was no longer possible for McDonnell Douglas to say that while the design of the DC-10 was different from that of its competitors, it was nevertheless within the limits of *reasonable* design risk.

DISCUSSION: One might try to absolve McDonnell Douglas of all responsibility for the Chicago crash as far as the plane's design is concerned. The company contends that a perfectly safe plane either cannot be built or is not economically feasible and that a one-in-a-billion chance of risk is not too great given the value of the service that the DC-10 provides to the public. Is it reasonable to expect McDonnell Douglas's design team to have predicted that the maintenance crews would be negligent in servicing the DC-10 engines? Should the design team have constructed the flanges of the engine pylons to be able to withstand greater stress during maintenance? McDonnell Douglas maintains that while this particular problem was predicted, it was legitimately dismissed when it was also realized that this would only cause a safety hazard when combined with several other extremely unlikely events. How cautious should we expect design teams to be and what is too great a risk in this kind of case?

A second difference between Cases I and II is that in the second, but not in the first, the negligence of the airline maintenance crews was a contributing cause of the accident. As mentioned earlier, in legal theory the negligent acts of another which are subsequent to the original acts relieve the first actor of responsibility, if the harm would not have occurred without the second intervention and *if those subsequent acts of negligence could not reasonably have been anticipated by the first actor.* Was it reasonably foreseeable that the airline maintenance crews would omit to disassemble the pylon from the engine while servicing it? We believe it was.

It has been estimated that it would have taken an extra 200 man-hours per engine to service them in the manner recommended by McDonnell Douglas. More importantly, McDonnell Douglas knew that maintenance crews were using the less time-consuming and more hazardous procedure. Continental Airlines and American Airlines were both using forklift trucks to remove the entire engine and pylon assembly as a unit. In December, 1978, and again in February, 1979 (several months prior to the Chicago crash), cracked flanges were discovered in planes belonging to Continental that had been serviced in this way. The Safety Board concluded: "Neither the air carrier (Continental) nor the manufacturer (McDonnell Douglas) interpreted the (FAA) regulation to require that it further investigate or report the damage to the FAA" (Newhouse 1982, p. 87). Once the McDonnell Doulgas engineers saw that the risk of cracks in the flange was no longer so remote, they should have taken action to reduce the chances of a serious accident. While it is undeniable that the members of the maintenance staff acted wrongly and were thus responsible for the cracks in the pylons, McDonnell Doulgas must assume part of the blame as well.

DISCUSSION: Is the moral and legal principle implicit in the judgment of the last paragraph the same as the one involved in the earlier case of the farmer who was blinded by a fragment from the hammer that he was (improperly) using? Should an explicit warning absolve a manufacturer from responsibility for this kind of harm?

A third difference between the two cases is that in the first, but not in the second, there is substantial evidence that individual engineers within McDonnell Doulgas had recognized the safety problems involved (the cargo door latching mechanism; the inadequate provision for mitigating the effects of sudden decompression) and were convinced that they constituted an unacceptable risk. As a result these engineers must share some of the responsibility for the ensuing harm since they clearly foresaw what might happen and they were in a position to try to prevent these hazards from endangering the public. The model of individual responsibility within a corporation presupposed by this judgment is defended below. Suffice it to say that only on the second model of negligence, the reasonable care model, is it true that the engineers involved could be held responsible for the Paris crash because they failed to prevent the DC-10 from reaching the market in its unsafe condition.

The reasonable care model imposes a stronger duty of care on professional engineers than does the malpractice model. In Case II the design team's initial decision not to make the flange stronger was reasonable given the extremely remote chance of harm resulting. But after the cracks in the flange were reported, and after it became clear that the reduced maintenance crews at American and Continental were not maintaining the engines and pylons properly, then, on the reasonable care model, it became the duty of individual engineers who knew of this to try to prevent the harm that was now far more likely to occur. This is one of the consequences of superimposing the reasonable care standard on the malpractice model.

One advantage of the reasonable care model is that it discourages engineers from believing that their professional responsibility is diminished by upper management decisions within their corporations. Aside from working to preserve professional integrity, this places the responsibility for eliminating or reducing hazards on those best able to anticipate them. Many upper management personnel are not engineers and even when they are, competing pressures, such as the desire to increase profits or protect the company, may compromise their professional judgment. For them reasonable risk will always be defined, at least partially, in terms of increased cost to the company. While the pursuit of profit is a legitimate motive in any business, it should not play so large a role when potentially disastrous consequences might result from cost-cutting. In *MacPherson v. Buick Motor Company* (1916), the New York Court of Appeals recognized that products were too complicated to be understood by the average consumer. Thus, it was argued, the manufacturer has a duty to insure that its products are manufactured safely. For the same reasons,

we contend that professional engineers should get actively involved when manufacturing companies put profits ahead of concern for public safety. The engineer is most likely to know the hazards that the unsuspecting public will encounter with products such as aircraft. Thus the engineer is the one who should take responsibility for their careful design.

III

What have we learned from Cases I and II about the concept of professional responsibility? Perhaps the most important thing is the difficulty of ascribing responsibility for harm to individual engineers when they are employed by large corporations. It is much easier to assign such responsibility to doctors and lawyers, because these professionals, unlike engineers, are not usually corporate employees as well. Professional engineers in corporations rarely have complete control over decisions about how much risk to take with the safety and well-being of others since they are influenced by supervisory management. Peter Faulkner, a systems application engineer for Nuclear Services Corporation, stated the problem well:

> Just as I was beginning to doubt the adequacy of the industry's safety controls, I also came to realize that both employer and client expected me to keep these doubts to myself, despite documentary evidence. . . . I spoke to many of my fellow engineers. . . The general feeling was that the industry eventually would solve most of these problems and that line engineers should leave complex management and policy problems to executives and experts. It began to appear that I was working with people who had long since accepted their roles as narrow specialists; this perception allowed them to shrug off any responsibility for nuclear industry management problems, even though they saw more clearly than most the hazards posed by inadequate design and testing (Westin 1981, pp. 41 and 42).

Professional responsibility is easy to recognize and appreciate if one is one's own boss. What could be more reasonable than to be held potentially liable for the harms that one causes as a free and responsible professional? But if one is employed by someone else and if one no longer has complete control over the decisions which fall within the sphere of one's competence then one's professional integrity may be compromised. In such situations, it is tempting to believe that one is not fully responsible or, perhaps, not responsible at all for the harms that one causes either by act or omission. This is especially true when one merely acquiesces in a state of affairs in which one has not taken any personal initiative. This is why so many engineers might readily agree about cases involving other people but still fail to act in what they themselves would regard as a fully responsible manner in their own jobs. We shall now consider the general question: What is the responsibility of professional engineers for harms which result from decisions taken within the corporations of which these engineers are employees?

Peter Faulkner's statement provides us with a good starting point. He contends that line engineers see "more clearly than most the hazards posed by inadequate design and testing." This suggests that line engineers are more likely to meet the foreseeability requirement for negligence. Frank Camps, who was principal design engineer for the Ford Motor Company in the early 1970's when the first Ford Pinto prototype was being tested, also attests to the

important role that the engineer can play in preventing harm because of his or her special knowledge. Camps confesses:

> I was instructed to inform the federal government only of our successful test crashes—and not the many failures. . . . I became part of the Ford scheme. I was expected to be loyal to the company's policies and to ignore my own uneasiness about the safety of the cars we were approving (Westin 1981, pp. 119 and 121).

Camps later found out that if he had not gone along with the management cover-up, he could have prevented Ford from making unsafe Pintos. Perhaps Camps's experience is unusual given his part engineering, part supervisory role at Ford. But it illustrates the general rule that the more control an engineer has over management decisions, the more responsible he or she is for the company's actions.

A common way of talking about corporations and companies encourages the mistaken view that these collectivities, not individual human beings, are responsible for the harms caused by corporate decisions. We say, for example, that Ford Motor Company produced an unsafe Pinto and that Ford is responsible for the resulting harmful consequences. But "Ford Motor Company" cannot act harmfully since it cannot, properly speaking, "act" at all. It is merely a fictitious "person," recognized as having a certain status at law, but incapable of performing actions for itself.

The corporation or company only truly acts through its members or employees. This is called *vicarious* acting or agency and should be distinguished from the individual action or agency of the members or employees of such collectivities. In an important sense, the corporation is dependent on its members and employees, for the corporation cannot act without at least one of its employees or members acting *for it.* If none of these human beings chose to act, then the corporation could not act either. Thus the members of the corporation must share individually in the corporation's responsibility (May 1983).

How should this responsibility be distributed? Surely it is unreasonable to hold any single member or employee solely responsible for consequences which require collective action or endorsement. Even though a single supervisory or line engineer could have prevented a harm, it is generally true that a number of other corporate members or employees could have done so too. One could try to base the degree of individual responsibility on a member's salary relative to that of other corporate members on the grounds that one's responsibility is a cost which should reflect the financial benefits of corporate membership. But this principle has nothing to do with fault, causation or negligence and hence could be applied, if at all, only in a narrowly legalistic way that does not reflect morality.

Alternatively, one could base the degree of individual responsibility on the individual's degree of authority in the organization. This seems to be what Frank Camps and his fellow engineers were doing implicitly. Since most engineers do not have much authority over corporate decisions, their degree of responsibility should be correspondingly small. On such a view engineers would, in practical terms, become mere employees and relinquish all pretensions to professional status. They would, just like other employees, merely be following orders from a higher authority with no responsibility for their subsequent effects. This is something of a paradox for professional engineers. They want to be seen as independent professionals like lawyers and physicians, yet most of them are employees of large corporations. Moreover, unlike corporate lawyers, they are dispersed throughout the whole corporate structure. They do not even have their own corporate niche with authority over their own departments.

DISCUSSION: There has been much discussion and disagreement about what makes someone a "professional." What more needs to be added to a person's knowledge and skill before it becomes a professional expertise? Does the person need to subscribe to an explicit code of professional ethics? Must there be an organization of a special kind to which the person belongs? Must the members of the organization have the authority and independence to reach decisions for themselves and to execute those decisions? How does the professional maintain this independence when he or she is a member of another organization such as a corporation which may limit one's autonomy?

What can be done to enable corporate engineers to become independent of management to the extent necessary for their integrity as professionals?[6] First and foremost, engineers must regard themselves as fully responsible for the results of their actions and omissions. This means that where there are risks of harm, engineers must strive assiduously to minimize negligence, both for themselves and for others within the corporation. When all else fails this might involve blowing the whistle on other members of the corporation. Such action need not be interpreted as disloyalty to the company. After exposing defects in the design of the Pinto windshield, Camps commented:

> My attempt to bring the dangers of the Pinto vehicle to the attention of the public was not a disloyal act, but rather one designed to avoid tragedy—an act in the public interest. I did not turn away from Ford but in my own way I rose to its defense. . . . the truly loyal employee is the one who helps keep the company on the right track—producing a good product that is safe for the consumer to use (Westin 1981, p. 129).

Richard De George has recently taken a position opposed to ours. He contends that: "Engineers in large firms have an ethical responsibility to do their jobs as best they can, to report their observations about safety and improvement of safety to management. But they do not have the obligation to insist that their perceptions or their standards be accepted. They are not paid to do that, and they have no ethical or moral obligation to do that" (De George 1981, p. 5).

De George has two arguments for this view. First, he says that it is too much to expect of engineers to demand that they risk their jobs for the public. Second, he argues that since engineers are not paid to make *ultimate* safety decisions, (this being the job of upper management), their contractual obligation does not require them to do anything more than to inform their supervisors about safety problems. Both of these arguments are initially appealing given our insistence that the demands of morality require only what it is reasonable to expect of engineers.

We acknowledge the force of De George's first argument. It is unreasonable to expect engineers to speak out about safety problems if they are not protected from retaliation by their employers. But as De George concedes, the judgment that engineers are not morally required to jeopardize their jobs to safeguard the public depends on the situation. If the danger is great and if it is probable that nothing will be done unless the engineer speaks out, then clearly the engineer is morally required to inform the public, especially if the project is one in which he or she is personally involved. Certainly, when engineers are protected from retaliation by their employers, they have a strong moral duty to inform the public of dangers to its safety.

We find De George's second argument unsound. Specific contractual obligations constitute only a very small part of our obligations and duties. Teachers, lawyers, nurses and architects are expected and required, as a matter of common morality and as a matter of professional ethics, to do many things in the practice of their profession which they are not specifically enjoined to do by any contract. Why should things be any different for engineers in large corporations? Since the responsibilities of the rest of us, whether or not we are professionals, go far beyond our contractual duties, then it seems reasonable to expect the same to hold true of engineers.

The sociologists Perrucci and Gerstl have found that engineering "lacks the one characteristic traditionally deemed the essence of professionalism—a community of shared values" (Perrucci and Gerstl 1969, p. 176). Perhaps the most important shared value that engineers as a group could easily attain would be to hold each engineer personally responsible for harms which result from his or her own actions (or omissions) even if that act or omission was not sufficient to cause the harm by itself. Committing themselves to this value would mean that engineers working in large corporations would no longer be able to pass the buck when it comes to assigning blame in the way that Camps's colleagues did. More importantly, engineers would require protection from management retaliation when they refuse to act negligently themselves or when they refuse to condone negligence in others.

At a recent conference on the professional responsibility of engineers, the most commonly voiced concern was the problem of engineers maintaining their professional integrity in large corporations. A number of people suggested increasing the strength of professional engineering associations or turning them into full-fledged unions which could demand increased independence for their members and fight management attempts to retaliate against whistleblowers. This is an appropriate response, though not itself a complete solution, to a difficult problem. Unless engineers present a united front and show that they are not afraid to take full responsibility for their actions, corporate managers will continue to coerce them to act negligently. Taking full responsibility for one's actions is the hallmark of the true professional.

In this essay we have given a philosophical analysis of the responsibility of professionals for their harmful actions. The detailed study of two airline disasters, as well as several other cases of negligence and recklessness, illustrate the complex problems faced by today's professionals. We have argued that it is not enough that professionals merely conform to the accepted standards of their professions. They should aspire to a standard of reasonable care whenever this conflicts with the professional norm. We have also argued that professionals should not be held to too strict a standard of responsibility until they are protected from retaliation by their supervisors and employers. Professionals should not be expected to be saints, but neither can they avoid moral responsibility by hiding behind professional codes or the corporate veil. We are all better off when each one of us takes full responsibility for his or her actions. Any changes in social and economic institutions that help bring this about will improve the moral environment for each of us.

Notes

1. The decision in the case of *American Society of Mechanical Engineers Inc. v. Hydrolevel Corporation,* was handed down on May 18, 1982. The Supreme Court not only found that these engineers had acted wrongly but also held their association responsible for the harm caused to Hydrolevel. The full citation for this and the other legal cases mentioned in this essay can be found following the Bibliography. See also the analysis in May (1982).
2. For a concise statement of the law on this subject see Section 21.08, "Actions Against Soil Testers," in Sweet (1977, pp. 387–389).
3. At a Convair management meeting (which included Applegate) it was decided not to send this memo to the McDonnell Douglas design team. This was decided on the grounds that sending the memo would increase the likelihood that Convair would also be held liable, along with McDonnell Douglas, in the event of an accident. Besides which, the Convair team reasoned that there was nothing in the Applegate memo that was not already known to the engineers at McDonnell Douglas. See Eddy (1976, p. 187). Kipnis argues that Applegate must share in the blame for the crash of the Turkish Airlines DC-10. He reaches this judgment on the basis of the following principle: "Engineers shall not participate in projects that degrade ambient levels of public safety unless information concerning those degradations is made generally available" (Kipnis 1981).
4. There were other, more subtle flaws in the design of the DC-10 cargo door. For a clear explanation and comparison of the latching mechanisms on the DC-10, the 747, and the Tristar, see Eddy (1976, Chapter 8 and Appendix B).
5. Some of these additional safety features were considered by the engineers on the McDonnell Douglas design team. For example, in explaining why they did not choose the slat-locking mechanism used by Boeing and Lockheed, Ray Bates, director of commercial programs and senior vice-president of McDonnell Douglas said: "If you have a mechanical locking device, you run the risk of the slats locking when you don't want them to" (Newhouse 1982, p. 88). Senior officials at Lockheed dispute whether this is a real danger and point to the safety record of their own planes in this respect.
6. Because of their status as professionals, engineers and other professionals incur special moral obligations and duties towards their clients, their employers and employees, and towards the public at large. In something like an exchange or contract, professionals take on special obligations in return for the respect of society in their area of expertise. In this way, professionals establish their autonomy and integrity as professionals.

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A collection of essays on the problems and responsibilities of those who publicly disclose safety problems within their organizations.

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248 N.Y. 339, 162 N.E. 99 (1928).

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