ARTICLE

THE LEGAL PROFESSION AS A STANDARD FOR IMPROVING ENGINEERING ETHICS: SHOULD ENGINEERS BEHAVE LIKE LAWYERS?

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I. INTRODUCTION

On March 22, 1993, at 7:00 a.m. under a beautiful blue Cape Canaveral sky, the seven member crew of the space shuttle Columbia strapped in to await the liftoff of their nine-day science mission. At 9:51 a.m. the shuttle liftoff sequence begins...

T-minus 10 . . . 9 . . . 8 . . . 7 .

Columbia's three 12 million horsepower engines begin their thundering ignition. First engine 3, followed by engine 2, and engine 1.

T-minus . . . 6 . . . 5 . . .

Powerplants in Engine 1 and 2 begin to gush the bright orange flame that will lift Columbia into the earth's sky and beyond. As the flight nears liftoff, the bright orange flames hit the cooling pads creating billows of white steam clouds that rise up around the craft. During these final few seconds before liftoff Columbia's computer performs system checks monitoring hundreds of sensors fifty times per second.

T-minus. . . 4 . . . 3. . .

As the computer was performing one of its thousands of checks in the final few seconds before liftoff, it observed an unexpected pressure surge in Engine 3. Sensing a failure, the computer instituted emergency shutdown procedures. As Columbia roared to life, Commander Steve Nagel, sitting in the shuttle's cockpit, watched the red light come on over the main engine gauge, indicating that the engine was shutting down. In a split second, the computer shut down engine 3, followed by engine 2 and engine 1 and suddenly at the moment the astronauts were to blast off, there was an eery silence.[1] *Columbia never left the ground.*

The space shuttle Columbia became the third launch pad engine shutdown in space shuttle history and the first aborted mission since the 1986 explosion of the space shuttle Challenger.[2] Experts defended the National Aeronautics and Space Administration's (NASA) decision to abort the launch. The shuttle's program manager and launch director praised the safety system for detecting the malfunction and halting the liftoff.[3] Other experts noted: "NASA is doing its job right, the absolute top priority is the safety of the crew and equipment. This shuttle was not ready to launch. Even Lufthansa cancels flights when there's a problem."[4] Even young onlookers understood the importance of proper

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1. *See* William Harwood, *Malfunction Halts Shuttle Flight Three Seconds Before Flight*, WASH. POST, Mar. 23, 1993, at A9.

2. *Id.*

3. *See* Paul Hoversten & Robert Davis, *Space Shuttle Safety System Does its Job*, USA TODAY, Mar. 23, 1993, at 3A.

4. Paul Hoversten, *Canceling of Launch Defended*, USA TODAY, Mar. 23, 1993, at 3A (quoting John Logsdon, space policy analyst from George Washington University).

safety precautions; a high school student commented, "it is better they stopped three seconds before than three second later."[5]

Halting the shuttle launch was an admirable safety move for NASA, which was under considerable financial pressure to launch from the new administration.[6] NASA was also under political and financial pressure from the German government, which paid $150 million to charter the shuttle to perform scientific research.[7] Unfortunately, NASA's safety policy has not always performed as admirably in the past. In 1986, the space shuttle Challenger exploded 73 seconds after liftoff, despite the vigorous efforts of engineers involved in the shuttle design to delay the takeoff. The engineers' cries to postpone the launch were ultimately ignored by corporate management, who succumbed to NASA's pressure to launch.[8]

Unfortunately, the Challenger tragedy is not an isolated incident. It reflects a failure in the corporate system as a whole–a system in which management leaves engineers out of the decision making process, and the corporate ethic outweighs both the engineer's professional ethics and public safety concerns. In the existing corporate decision-making system, technical truth is often overshadowed by client demands and the pressure for corporate profits. Although the last-second launch pad shut down of the space shuttle Discovery shows that NASA is increasing its awareness of safety concerns despite the pressures it faces to launch, the corporate world still lags behind.

This Article examines the existing framework for dealing with unethical behavior and the safety concerns of engineers in the corporate world. After finding inadequate mechanisms, training, and guidelines for dealing with the ethical dilemmas that engineers regularly face in practice, this Article will consider ways to improve the channels for dealing with these dilemmas. Specifically, the Article will examine the method the legal profession has developed to deal with ethical dilemmas faced by lawyers in practice and consider the application of similar mechanisms and training to guide engineers in their dilemmas.

This Article suggests that the engineering profession needs to establish mechanisms to guide engineers faced with dilemmas and to

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5. Monica Young, *Joy at Hudson High Grounded by Decision*, BOSTON GLOBE, Mar. 23, 1993, at 6 (quoting Jennifer Howes, a high-school student who was watching the shuttle's failed liftoff).

6. Budget cuts by the Clinton administration threaten future NASA projects. The administration is concerned about the high cost of shuttle flights, which NASA claims cost $530 million per mission, but which experts price at as much as $1.7 billion, as well as by cost overruns on the thirty-one billion dollar space station. *See* Hoversten , *supra* note 4.

7. Hoversten & Davis, *supra* note 3. Germany reportedly was losing $600,000 per week for the delay in the mission. It anxiously pressured NASA to launch. *See* Mark Carreau, *NASA May Launch Discovery on April 6*, HOUSTON CHRON., Mar. 26, 1993, at A15.

8. *See infra* notes 29-31 and accompanying text.

revolutionize the corporate decision making system to incorporate engineering-based technical truth into corporate choices, so that the engineer need not be armed with a whistle in order to assert his professional ethics. Part II details the Challenger tragedy, which is indicative of the engineer's dilemma. Part III discusses the existing framework for dealing with the ethical dilemmas faced by engineers. It examines the existing training and mechanisms for guidance in making ethical choices and the tension between the corporate ethic and the engineer's professional ethic. Part IV considers the existing framework for the lawyer to obtain guidance in dealing with ethical dilemmas. It further examines how the lawyer, like the engineer, deals with the tension between client desires and professional ethical guidelines. Part V argues that comparing the two frameworks offers guidance that may improve the mechanisms for dealing with ethical dilemmas in the engineering profession, and that a system of uniform guidelines would allow engineers to put down their whistles and assert their professional ethics.

II. THE CHALLENGER DISASTER: THE FAILURE OF A SYSTEM, NOT JUST AN O-RING

Seventy three seconds after liftoff at 11:38 a.m. on January 28, 1986 the space shuttle Challenger exploded, bursting into flames, and killing the seven member crew–including school teacher Christa McAuliffe, who would have been the first private citizen to fly in space.[9] All of America mourned the tragic loss of life.[10] Although NASA officials claimed to be baffled by the tragic explosion of the space shuttle,[11] engineers at Morton Thiokol who designed the shuttle's solid rocket motor knew the cause of the shuttle explosion.[12] The design engineers at Morton Thiokol had learned from tests that the O-Ring joints they designed might fail in an usually cold launch temperature, and they communicated this concern to NASA, but their fight to stop the launch was to no avail. The engineers' concerns were ignored when the final decision was made, and the launch received the go-ahead from Morton Thiokol management and NASA.

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9. *See* William J. Broad, *The Shuttle Explodes: 6 in Crew and High-school Teacher are Killed 74 Seconds after Liftoff*, N.Y. TIMES, Jan. 29, 1986, at A1; Michael Hirsley, *Shuttle Tragedy Stuns Nation: Spacecraft and Crew Lost in Mystery Blast*, CHI. TRIB., Jan. 29, 1986, at C1; Peter H. King, *Shuttle Explodes: Crew Killed; Challenger Blows Apart Shortly After Perfect Liftoff*, L.A. TIMES, Jan. 29, 1986, at A1.

10. *See* King, *supra* note 9; Arthur Spiegelman, *Nation Mourns Death in the Family*, Reuters North European Service, Jan. 29, 1986.

11. Hirsley, *supra* note 9. *See also* King, *supra* note 9 (NASA officials claimed to have no idea what triggered the accident).

12. *See generally* Roger M. Boisjoly, *The Challenger Disaster: Moral Responsibility and the Working Engineer*, *in* ETHICAL ISSUES IN ENGINEERING 6-14 (Deborah G. Johnson ed., 1991).

The Presidential Commission created to investigate the accident determined what the Morton Thiokol engineers already knew: the destruction of a rubber sealed O-Ring designed to prevent hot gases from leaking through the joint while the rocket motor propellant burned was the sole cause of the tragedy.[13] The Commission found that the O-Ring design was flawed; it was unacceptably sensitive to temperature.[14] When the O-Ring joint failed, a 5000 degree jet of flame quickly shot through the rocket, causing the explosion which destroyed the craft and killed her crew.[15]

NASA was aware of the O-Ring problem as early as 1979, when it wrote a memo rejecting the O-Ring joint design, but later accepted the design because a safer one would have meant a huge increase in costs[16] at a time when NASA was under government pressure to be cost-effective.[17] NASA got away with the cheaper design until the Challenger flight, but the seals had leaked on nine of the ten flights preceding the Challenger disaster. Morton Thiokol engineer Roger Boisjoly became concerned about the leaking seals after the January 1985 shuttle flight, when he found evidence of a massive blow-by, a near-complete break down of the joint.[18] The company's engineers began testing the O-Rings, and found that low temperature affected their performance. Roger Boisjoly presented this information to Morton Thiokol management and NASA on July 1, 1985.[19] The engineer's concern heightened when no action was taken to correct the dangerous O-Ring problem. Consequently, in July 1985, he wrote a memo to the Vice President of engineering at Morton Thiokol, with copies to NASA officials, alerting them to the seriousness of the problem. The memo stated, "It is my honest and very real fear that if we do not take immediate action to dedicate a team to solve the problem, with the field joint having the number one priority, then we stand in jeopardy of losing a flight along with all the launch pad and facilities."[20] Boisjoly warned of "a catastrophe of the highest order" if the seals leaked.[21] The night before the space shuttle launch, with the seal problem still uncorrected, Morton Thiokol engineers frantically tried to stop the flight.

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13. PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, REPORT TO THE PRESIDENT, Vol. I, at 40 (1986) [hereinafter COMMISSION REPORT].

14. *Id.* at 72.

15. *See* Caroline Click, *Challenger Explosion Provides Ethics Lesson, Engineer Says*, UPI, Apr. 11, 1990, *available in* LEXIS, NEWS Library, ARCNWS file.

16. *See* Tony Chiu, *Whistle-blower*, LIFE, Mar. 1988, at 17, 20.

17. *See infra* text accompanying notes 25-26.

18. *See* Boisjoly, *supra* note 12, at 6; Chiu, *supra* note 15, at 20.

19. *See* Boisjoly, *supra* note 12, at 7.

20. *Id.* at 8.

21. John Nielsen, *Challenger O-Rings*, FORTUNE, Mar. 31, 1986, at 10.

On January 27, 1986, the night before the launch, Morton Thiokol engineers and administrators held a teleconference with NASA officials at Kennedy Flight Center and Marshall Space Flight Center to present their concerns about the O-Ring joints, and to persuade NASA not to launch, given the 18-degree Fahrenheit overnight temperature that had been forecast.[22] Roger Boisjoly gave a presentation explaining the susceptibility of the joints to low temperatures that ended with a recommendation backed by Morton Thiokol Vice President Bob Lund not to launch below 53 degrees.[23] NASA was not pleased with this recommendation.[24] NASA was eager to launch the flight, because it had already been delayed twice from its original launch date in July 1985, and NASA officials were under political and economic pressure to launch.[25]

The pressures on NASA were many. They included the need to secure funding from Congress by meeting an over-ambitious schedule of 24 flights per year by 1990, the pressure to be cost-effective and productive, the necessity of delivering a payload into orbit by a certain critical time in order to avoid delaying future NASA experiments, the media ridicule of NASA's inability to launch according to schedule, the desire to demonstrate technical capabilities, and the intense public interest in the "Teacher in Space" program.[26] NASA succumbed to these pressures, and insisted that the launch take place on schedule.[27]

Even though the recommendation not to launch was technically sound, and fully supported by Thiokol engineers and administrators, it was attacked by NASA officials.[28] Although NASA officials said that they would not launch over Morton Thiokol's objection, they argued that the data used to conclude that the seals would not function properly was inconclusive.[29] At this point, Thiokol officials asked for an off-line caucus to re-evaluate their recommendation.[30] Roger Boisjoly describes what transpired during the caucus:

> . . . as soon as the mute button was pushed our general manager, Jerry Mason, said in a soft voice "We have to make a management decision.' I became furious when I heard this because I knew that an attempt would be made by management to reverse our recommendation not to launch.

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22. *See* Boisjoly, *supra* note 12, at 8.

23. COMMISSION REPORT, *supra* note 13, at 90; Boisjoly, *supra* note 12, at 8.

24. *See* Boisjoly *supra* note 12, at 8.

25. Boyce Rensberger & Kathy Sawyer, *Challenger Disaster Blamed on O-Rings, Pressure to Launch*, WASH. POST, June 10, 1986, at A1.

26. *See* Rensberger & Swyer, *supra* note 25; Arie W. Kruglanski, *Freeze-Think and the Challenger*, PSYCHOL. TODAY, Aug. 1986, at 48; Chiu, *supra* note 16, at 17.

27. *See* Click, *supra* note 15.

28. *See* Boisjoly, *supra* note 12, at 8.

29. *See id.* at 8; Chiu, *supra* note 16, at 17.

30. COMMISSION REPORT, *supra* note 13, at 90.

> Some discussion had started between the managers when Arnie Thompson [a Thiokol engineer who opposed the launch] moved from his position down the table to a position in front of the managers and once again tried to explain our position by sketching the joint and discussing the problem with the seals at low temperatures. Arnie stopped when he saw the unfriendly look in Mason's eyes and also realized that no one was listening to him. I then grabbed the photographic evidence showing the hot gas blow-by and placed it on the table and, somewhat angered, admonished them to look and not ignore what the photos were telling us, namely, that low temperature indeed caused more hot gas blow-by in the joints. I too received the same cold stares as Arnie with looks as if to say "Go away and don't bother us with the facts." At that moment I felt totally helpless and that further argument was fruitless so I, too, stopped pressing my case.
>
> What followed made me both sad and angry. The managers were struggling to make a pro-launch list of supporting data but unfortunately for them the data actually supported a decision not to launch. During the closed manager's [sic] discussion, Jerry Mason asked in a low voice if he was the only one who wanted to fly. The discussion continued, then Mason turned to Bob Lund, the vice president of engineering, and told him to take off his engineering hat and put on his management hat. The decision to launch resulted .from a yes vote of only the four senior executives since the rest of us were excluded from both the final decision and the vote poll. The telecon resumed and Joe Kilminster [a Morton Thiokol vice president] read the launch support rationale from a handwritten list and recommended that the launch proceed. NASA promptly accepted the recommendation to launch without any probing discussion and asked Joe to send a signed copy of the chart.
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> . . . A review of that chart will produce the following conclusions from anyone having normal powers of reason. The chart lists nine separate statements, seven of which are actually reasons against the launch, while one is actually a neutral statement of engineering fact. The remaining statement concerning a factor of three on soil erosion is not even applicable to the discussion which had ensued for over an hour. Therefore, Morton Thiokol senior management reversed a sound technical decision without one shred of supporting data and without any re-evaluation of the data they had promised when they requested the caucus.[31]

Thiokol was under great pressure from NASA to approve the launch. The customer's insistence to launch, and Thiokol's financial dependence on NASA's $400 million per year contract, pressured management to make a decision that contradicted its own experts' technical conclusions.[32] Boisjoly stated, "there was no question in my mind that we were going to have an explosion."[33] The engineer's prediction was correct. Seventy-three seconds after liftoff, 5000 degrees of

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31. Boisjoly, *supra* note 12, at 9.

32. *See* COMMISSION REPORT, *supra* note 13, at 90; Click, *supra* note 15; Kruglanski, *supra* note 26, at 49.

33. Click, *supra* note 15 (quoting Roger Boisjoly).

jet flame caused the Challenger to explode because the low temperature caused a leak in the O-Ring joint.

After the Morton Thiokol engineers testified before the President's Commission as to the events preceding the flight, they were shunned by Thiokol's management and were relegated to lesser positions in the company.[34] Charles Locke, Thiokol's chief executive officer, commented on the testimony the engineers gave at the Presidential Commission: "People are paid to do productive work for our company, not to wander around the country gossiping."[35] Locke's comments reflect the corporate ethic, which "perpetuates itself by selling a product and turning a dollar—a worthy pursuit in a nation whose economic keystone is capitalism . . . ."[36] The corporate ethic places the company's financial performance and the client's interests before public and project safety.

Although the engineers who testified were applauded for their honesty by the Commission and the public, they were condemned by their company and its employees. The engineers were blamed by their peers for the possible demise of the company–as if the company's demise would be a result of the testimony, and not the irresponsible, dangerous decision of Thiokol's management. That decision cost seven people their lives and cost the government a two billion dollar shuttle.[37] "The five of us who testified called ourselves the lepers. There was a tremendous morale breakdown at MTI. We were getting blamed for it, though it was the company itself that pushed the self-destruct button."[38]

The Challenger did not crash because of a poorly designed O-Ring, it crashed because of a poorly designed decision-making system—a system where engineers have little input and no vote.

During his testimony Roger Boisjoly explained this system:

> I must emphasize, I had my say, and I never [would] take [away] any management right to take the input of an engineer and then make a decision based upon that input, and I truly believe that. I have worked at a lot of companies, and that has been done from time to time, and I truly believe that, so there is no point in me doing anything further that I had already attempted to do. . . I left the room feeling badly defeated, but I felt I really did all I could to stop the launch.[39]

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34. *See* Click *supra* note 15; Myron P. Glazer & Penina M. Glazer, *Whistleblowing*, PSYCHOL. TODAY , Aug. 1986, at 36, 37.

35. Carole Patton, *Engineer vs. Boss: Still a Slugfest over Priorities, Ethics*, ELECTRONIC DESIGN, June 12, 1986, at 179.

36. *Id.*

37. *See* Chiu, *supra* note 16, at 20.

38. *Id.* (quoting Roger Boisjoly).

39. COMMISSION REPORT, *supra* note 13, at 93.

Commentators have called this attitude, which is prevalent in the corporate world, 'separatism.'[40] Engineers make valuable suggestions, but are separated from the decision making process, which is left to management.[41] Boisjoly has since stated, "You will never hear me refer to this as an accident. It could have been prevented."[42]

Six months after his testimony, Boisjoly left Morton Thiokol on extended sick leave because of the hostile work environment. He experienced post-traumatic stress syndrome, for which he underwent two years of treatment. After leaving Morton Thiokol, Roger Boisjoly has led a crusade for engineering ethics, speaking at more than fifty universities and before the major engineering societies. He encourages engineering students to assert and uphold their professional ethics in the face of corporate pressure.[43] In 1988, Robert Boisjoly was awarded the prestigious Prize for Scientific Freedom and Responsibility from the American Association for the Advancement of Science for his campaign to promote integrity in industrial decision making.[44] Roger Boisjoly's situation is not unique; practicing engineers face similar dilemmas on a lesser scale everyday.

III. CURRENT MECHANISMS INADEQUATELY PROTECT THE ENGINEER'S PROFESSIONAL ETHICS

The Challenger tragedy is a good starting point for considering the engineer's dilemma and frustration in the corporate world. As the Challenger tragedy shows, the ethical conduct of the engineer and his corporate employer hold great importance for society. If the engineer or his employer acts unethically, bridges collapse, planes crash, cars ignite upon rear impact, space shuttles explode and nuclear power plants leak. All of these effects threaten the safety of the public and all of them depend on the ethical conduct of the product's designer. Despite the importance of ethics in the engineering profession, there are inadequate training programs, mechanisms and organizational frameworks for providing the engineer guidance in dealing with ethical dilemmas. There are no required classes on professional ethics for engineers, licensing is not required for one to work as an engineer, and there is no governing body to look to for guidance when confronted with an ethical dilemma. Moreover, most engineers work for large corporations where the managers alone make decisions, where the corporate ethic and client

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40. *See, e.g.*, Steven Goldberg, *The Space Shuttle Tragedy and The Ethics of Engineering*, 27 JURIMETRICS J. 155, 156-58 (1987).

41. *See id.* at 156-57.

42. Click, *supra* note 15 (quoting Roger Boisjoly).

43. *See* Samuel C. Florman, *Beyond Whistleblowing*, TECH. REV., July 1989, at 20.

44. Chiu, *supra* note 16, at 17.

interests outweighs the engineer's professional ethic, and where there is no mechanism for the engineer to voice objections.

A. Training

The public generally regards engineers as possessing very high professional ethical standards.[45] Yet the budding young engineer is offered no training in professional ethics prior to graduation and employment. Accredited engineering schools are not required to offer courses in engineering ethics, and few of them do.[46] "There is concern that there is no infusion of ethics in the undergraduate engineering curriculum. The curriculum is so crowded now that there is no room for professional practice content."[47]

Massachusetts Institute of Technology (MIT), the top engineering school in the country,[48] with 4500 students in its undergraduate engineering curriculum, only began offering an elective course in engineering ethics to undergraduate students in 1990. The first year the course was offered, only three students registered for the course.[49] In 1992, the number of participants increased to twenty-four, but in 1993 the class size dropped to twelve. MIT is currently considering offering a graduate course in engineering ethics, but at this time, no such course is available. Arthur Schwartz, General Counsel of the National Society of Professional Engineers, comments, "Ethics seems to have a low priority in the educational system."[50] A study of 259 top science graduate schools found that few schools offered courses in engineering ethics:[51]

> In our survey we found that deans [of the 259 science schools consulted] felt it was terribly important for their students to learn

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45. *See* Jay Matley et al., *Engineers and Their Ethics*, CHEMICAL ENGINEERING, Sept. 28, 1987, at 119. (This article relies upon a 1986 report prepared for the National Academy of Engineering in which the public appraised the ethical standards of various professions. The public perceived engineers as having very high ethical standards, only surpassed by clergymen and physicians. The survey was also given to a group of engineers and, like the public, they ranked their ethical standards third only to clergymen and physicians.)

46. *See* ROBERT J. BAUM, ETHICS AND ENGINEERING CURRICULA 21-23 (1980); ALLAN FIRMAGE, MODERN ENGINEERING PRACTICE 33 (1980); Vivian Weil, *Ethics in Engineering Curricula*, 8 RES. IN PHIL. & TECH. 243, 245 (1985).

47. *NSPE Center to Focus on Engineering Ethics*, ENGINEERING NEWS-RECORD, Aug. 25, 1988, at 18 (quoting Herbert Koogle, NSPE's National Institute for Engineering Ethics' first chairman and president of Koogle and Pouls Engineering Inc.).

48. *See* William J. Cook, *America's Best Graduate Schools*, U.S.NEWS & WORLD REP., Mar. 22, 1993, at 68.

49. The author was one of the three students who participated in the engineering ethics course in its first year.

50. *NSPE Center to Focus on Engineering Ethics*, ENGINEERING NEWS-RECORD, Aug. 25, 1988, at 18.

51. *See* Philip J. Hilts, *Panel Urges Independent Body to Set Ethical Standards in Science*, N.Y. TIMES, Mar 28, 1991, at D21.

> about ethical issues, but most said they had no courses that taught the subject and no expectation that they would. There is a major gap between good intentions and practices.[52]

B. Licensing

Most students who graduate from engineering schools take jobs in large industrial or government organizations without being licensed.[53] Although licensing and registration are available in every state, the engineering profession, unlike law or medicine, does not require that all engineers who practice be licensed.[54] It is estimated that less than one-third of the 1.5 million practicing engineers in the United States are registered.[55]

Most states have standardized their licensing procedures and based their requirements on the Model Law suggested by the National Council for Engineering Examiners (NCEE).[56] Licensing and registration procedures are a tool employed by the states to protect public safety and ensure that only qualified practitioners represent themselves as professionals.[57] State licensing procedures are intended "to set minimum standards for entry into a profession" and "to provide means for expelling dishonorable or incompetent practitioners."[58] The licensing of professionals such as lawyers and doctors is a mandatory requirement in all states.[59]

To qualify for a license, the engineer must pass the Professional Engineering (PE) examinations, must have an engineering degree, must work a minimum of four years as an engineer, and must obtain recommendations from at least three other practicing registered engineers.[60] The PE examination consists of a series of exams on engineering fundamentals and another exam on the principles and practices of engineering.[61] It is possible to qualify for a license without a degree in engineering by substituting additional years of experience for

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52. *Id.* (quoting Dr. Judith P. Swazey of the Acadia Institute, which performed the study).

53. *See* BAUM, *supra* note 46, at 15.

54. *See id.* at 5. It is even possible to be employed and licensed in engineering without an engineering degree. A professional working as an engineer may actually be trained in a pure science, holding a degree in physics, mathematics or chemistry. *Id.* at 5-6.

55. Roughly 400,000 are registered. *See* ENGINEERING PROFESSIONALISM AND ETHICS 508 (James H. Schaub & Karl Pavlovic eds., 1986); STEPHEN H. UNGER, CONTROLLING TECHNOLOGY: ETHICS AND THE RESPONSIBLE ENGINEER 110 (1982).

56. *See* UNGER, *supra* note 55, at 110.

57. *See* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 507.

58. UNGER, *supra* note 55, at 110.

59. *See* FIRMAGE, *supra* note 46, at 77; UNGER, *supra* note 55, at 110.

60. *See* UNGER, *supra* note 55, at 110.

61. *Id.*

the degree requirement.[62] A license is only valid in the issuing state, but many states will grant licenses to engineers who have already acquired a license from another state without further qualification.[63]

The field of civil engineering has the highest percentage of registration,[64] because civil engineers are required by the state to be licensed if they are involved in certifying plans for public roads or bridges, or if they oversee the engineering aspects of construction.[65] Since only civil engineers, and only the subset of civil engineers who want to participate in the above-mentioned activities, are generally required to be licensed by the state, the PE exams are geared toward that engineering discipline. Few electrical or chemical engineers even apply for registration because it is not necessary for practice in their field, and the PE exams incorporate little from these disciplines.[66] Commentators have found the PE exams to be an inadequate test of engineering principles.[67] They test for knowledge of obsolete technology, and are not comprehensive enough to encompass all fields.[68]

Licensed engineers are required to be ethical, as well as competent. Section 19 of the Model Law, suggested by the NCEE as a guide for states to use in developing licensing procedures, incorporates the National Society of Professional Engineers' (NSPE) Code of Ethics into its licensing requirements.[69] The first Canon of this Code states: "Engineers, in the fulfillment of their professional duties, shall: Hold paramount the safety, health and welfare of the public in the performance of their professional duties."[70]

Even those engineers who are required by the state to be licensed often escape registration and licensing through one of the many broad exceptions. One such exemption, the government agency exemption, exempts engineers who work for government agencies from registration if they work in the service of the government.[71] Another exemption, the industry exemption, exempts engineers who design and manufacture products that are offered for sale by their company from the registration

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62. *Id.*

63. *See* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 508.

64. *See* FIRMAGE, *supra* note 46, at 78.

65. *See* UNGER, *supra* note 55, at 111.

66. *Id.*

67. *See, e.g.*, UNGER, *supra* note 55, at 111.

68. *Id.*

69. The NSPE is the society of licensed engineers. *See* Donald E. Wilson, *Social Mechanisms for Controlling Engineers Performance, in* ETHICAL ISSUES IN ENGINEERING 360, 354-67 (Deborah G. Johnson ed., 1991); UNGER, *supra* note 55, at 111. For a full listing of the NSPE Code of Ethics, see Appendix.

70. NSPE CODE OF ETHICS FOR ENGINEERS (1987), *reprinted in* Rena A. Gorlin, ed., CODES OF PROFESSIONAL RESPONSIBILITY 69-74 (1990). See Appendix for full listing.

71. *See* FIRMAGE, *supra* note 46, at 79.

and licensing requirement.[72] Finally, an exemption recommended by the Model Code of the NCEE exempts all employees and subordinates of a licensed engineer.[73] As a result of these exemptions, state licensing requirements only apply to a small percentage of practicing engineers.

Although the state registration board is empowered to revoke or suspend licenses for violation of any of the registration laws, this authority is seldom employed.[74] Hence, the current licensing procedures provide no real guarantee that engineers will behave in accordance with ethical standards. In addition, state registration boards have no power to bring disciplinary actions against engineers who are not licensed, regardless of their incompetence or unethical behavior.[75]

C. The American Engineering Association (AEA)

Unlike the practice of law, which is promoted by the American Bar Association (ABA), or the practice of medicine, which is promoted by the American Medical Association (AMA), the engineering profession has no single unified professional organization; there is no AEA. Apart from the specialty-oriented societies, the two leading organizations in engineering are the Engineers' Council for Professional Development (ECPD) and the National Society of Professional Engineers (NSPE). Both of these societies expound a Code of Ethics to guide engineers in their professional responsibilities.[76] The ECPD's Model Code of Ethics has been adopted by thirty other professional societies. But there are over 150 separate engineering societies, and membership in all of them is strictly voluntary.[77] There are engineering societies corresponding to each of the

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72. *See* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 508; Wilson, *supra* note 69, at 358. The industry exemption has stirred debate concerning the efficacy of the registration and licensing laws when the majority of engineers are exempted because they work in industry. *See, e.g.*, G.J. Kettler, *Against the Industry Exemption, in* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 531-34; Milton F. Lunch, *Legislators Play Dealer's Choice with P.E. Registration Laws, in* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 520, 522-23. *But see* M.J. Kolhoff, *For the Industry Exemption, in* ENGINEERING PROFESSIONALISM AND ETHICS *supra* note 55, at 526-30.

73. *See* Wilson, *supra* note 69, at 359 (discussing MODEL CODE OF PROFESSIONAL RESPONSIBILITY 23(c) (1981)).

74. *See* UNGER, *supra* note 55, at 111; Wilson, *supra* note 69, at 360-62. Even though enforcement standards vary by jurisdiction, there are few recorded cases in any jurisdiction disciplining engineers for violation of the licensing laws. The penalty in those few cases which have been brought is restricted to suspension or revocation of the license issued by the state, but this does not prohibit continued practice as an engineer in those capacities which do not require a license, and few practice areas do.

75. The lack of authority over non-licensed engineers means that over a million engineers are not subject to state regulation or discipline. Of course, they are still subject to criminal and civil sanctions for extreme cases of misconduct.

76. See Appendix for the NSPE Code of Ethics.

77. *See* BAUM, *supra* note 46, at 7. Membership in a professional organization is purely voluntary.

various engineering disciplines and specialties,[78] as well as general organizations that extend membership to any engineer who meets their requirements.[79] Most professional societies exist for the advancement of technology more than the professional development of the engineer; their primary functions are holding conferences and publishing journals.[80] Some engineering societies have codes of ethical conduct to which members must adhere, but many do not have any such code.[81] Even those societies with codes have few or no existing mechanisms to enforce their codes.[82]

The American Society of Civil Engineers (ASCE) is the exception to this rule; it has rigorously pursued violations of its code of ethics.[83] But its enforcement mechanisms are limited to expulsion from the organization and the bad publicity that may result from that expulsion.[84] In cases of extreme misconduct, the society can recommend that the state board repeal the engineer's professional license, or, if the engineer has violated civil or criminal laws, the society can release its findings to the state for use in further proceedings.[85] But engineering professional societies seldom resort to these enforcement mechanisms, and engineers rarely lose their licenses.[86]

> Undoubtedly many new engineers enter into the profession each year who have not seen or heard of any rules of conduct applying to their chosen profession. . . . New engineers will quite likely be unknowledgeable of ethical standards of the profession unless they have enrolled in a college course that teaches such [and there are few of these] or unless they join a professional society that has a Code.

FIRMAGE, *supra* note 46, at 33.

78. For example there is the American Society of Civil Engineers (ASCE) (the oldest American engineering society founded in 1852), the American Society of Mechanical Engineers (ASME), the American Institute of Chemical Engineers (AIChE), the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), and the Institute of Electrical and Electronics Engineers (IEEE) (which is the largest of any of the engineering societies). *See* BAUM, *supra* note 46, at 7.

79. For example there is the National Society of Professional Engineers (NSPE) (open to all registered engineers), the Engineers Council for Professional Development (ECPD), the American Association of Engineers (AAE), and the United Engineering Society (UES).

80. *See* BAUM, *supra* note 46, at 7.

81. The ASCE promulgated the first Code of Ethics for engineers in the United States in 1914. *See* FIRMAGE, *supra* note 46, at 35.

82. *See* BAUM, *supra* note 46, at 7.

83. *See* FIRMAGE, *supra* note 46, at 39-40.

84. Although this penalty may seem lenient, engineers will go to great lengths to retain their memberships and maintain a good professional reputation. *See* FIRMAGE, *supra* note 46, at 40-41.

85. *See id.* at 40.

86. Even if the engineer should be expelled from the society or lose his license, he does not lose the right to practice his profession, and can still be gainfully employed in engineering.

Even so, the primary goal of a code of ethics is guidance, not punishment.

> [T]he main purpose of a Code of Ethics of a professional society is not to serve as a means of removal from membership those who do not conform. The main purpose [of a Code of Ethics] is to serve as a guide and an emblem of moral standards for which the profession subscribes. It is an 'ethic' for the education of students and members just entering the profession.[87]

If this goal is to be met, engineers must be educated about ethical codes, and must subscribe to an organization that promulgates a code. As set forth above, there are three impediments to meeting this goal. First, engineers are not required to take courses teaching the ethical standards of the profession. Second, engineers are not required to join a professional society. Finally, engineers are not bound by any professional code of ethics as a condition of practicing their profession.

D. Conflict of Interest: Corporate Ethic vs. Professional Ethic

Detailing the Challenger tragedy elucidates some of the flaws and inadequacies in the corporate framework; it provides no guidance to engineers such as Roger Boisjoly when they are caught in ethical dilemmas, and no mechanism through which such engineers can voice their concerns. Management frequently makes decisions in which corporate cost or client interest outweighs public safety—often over the objections of its own technical experts. For the engineer, there is a "conflict between employer imperatives on the one hand and professional, moral or legal norms with respect to the public welfare, on the other."[88] This dilemma was played out in the Challenger incident, where Morton Thiokol engineers' sound technical decision to stop the launch in the interests of public safety was overruled by a management group responding to client pressure. The opposing engineers stated that, beyond presenting their conclusions to management, they did not believe there was anything they could do to stop the launch.[89] Is this attitude consistent with the NSPE's Professional Code of Ethics?

The first Canon of this Code states: "Engineers, in the fulfillment of their professional duties, shall: Hold paramount the safety, health and welfare of the public in the performance of their professional duties." Rule 1(a) of the Code requires that engineers "at all times recognize that their primary obligation is to protect the safety, health, property and welfare of the public. If their professional judgment is overruled under circumstances where the safety, health, property or welfare of the public

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87. FIRMAGE, *supra* note 46, at 41.
88. Weil, *supra* note 46, at 248-49.
89. *See supra* notes 39-40 and accompanying text.

are endangered, they shall notify their employer or client and such authority as may be appropriate."[90]

In the Challenger case, the engineers disclosed their concerns to their employer, Morton Thiokol, and to their client, NASA.[91] This case illustrates the failure of the decision making system; the engineers fulfilled their duty by informing all concerned, yet the tragedy still occurred.[92] After the disaster, Thiokol engineers testified to the events preceding the launch before the President's Commission. But they were punished for their testimony; both corporate management and fellow employees shunned the engineers who testified, afraid that the testimony might endanger corporate profits. The Morton Thiokol engineers' situation is not unique; practicing engineers face similar dilemmas every day.[93]

Most engineering students graduate from college to take jobs in large industrial or government organizations.[94] In large bureaucratic organizations, managers–not engineers–make the decisions. Managers are more likely to make decisions based on costs or client pressure than

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90. *See* Appendix.

91. It may be argued that they should have been required to notify an appropriate authority. However, this is problematic because the client *was* an agency of the federal government, making it unclear who would be the appropriate authority.

92. The engineers did not inform the astronauts themselves; it would be unreasonable for the engineer to be expected to call each of the products perspective users who may be injured. But, it may not be unreasonable to expect them to go to the press, as a last resort when their company's choice endangers the public. Of course, this should only be attempted after the engineer has exhausted all other avenues and should be at the engineer's discretion, not a requirement of the ethical codes, since it would almost certainly result in the loss of employment. There is little protection from retribution by the employer for the engineer's whistle blowing.

93. The DC-10 crash case is another such recorded instance. The fuselage of the DC-10 jumbo jet was designed by Conair and the plane was marketed by McDonnell-Douglas. In 1972, Conair's senior engineer directing the design project wrote a memo to a company vice-president detailing the dangers of the present design. He explicitly detailed how the design could cause the cargo doors to burst open during flight, causing the depressurization of the passenger cabin, the collapse of the floor of the passenger cabin, and the loss of control of the plane, resulting in the crash of the aircraft. He stated that it was inevitable that the defective design would cause crashes. Company management did not dispute the technical facts or the predictions by his memo, they simply made a decision not to inform McDonnell-Douglas because of the possible financial liabilities to the company. The engineer's prediction was correct. In 1974, a fully loaded DC-10 crashed as a result of the cargo doors opening during flight, killing 346. *See* MIKE W. MARTIN & ROLAND SCHINZINGER, ETHICS IN ENGINEERING 43-44 (2nd ed. 1989); Fay Sawyier, *The Case of the DC-10 and Discussion*, *in* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 388-401. The engineer who wrote the memo was confronted by a moral dilemma when the company overruled his safety concerns because of corporate costs. If he were bound by the NSPE's Code of Ethics he would have been required to inform McDonnell-Douglas, the client, about his concerns when he realized his employer was not going to act upon them.

94. *See* BAUM, *supra* note 46, at 15; FIRMAGE, *supra* note 46, at 72.

safety.[95] "Companies thrive or die by their economic performance, so the instinct or temptation to base corporate actions on purely economic grounds is hardly surprising. Hence the frequent anguish of individual engineers in situations where profitability clashes with other values."[96] An engineer's professional ethics are vulnerable to subversion to the corporate ethic because engineers are not generally self-employed and are normally economically dependent on their company.[97] Disagreeing with a management decision can mean personal disaster.

> Though engineers are members of a profession that holds public safety paramount, we cannot reasonably expect engineers to be willing to sacrifice their jobs each day for principle and to have a whistle ever by their sides ready to blow if their firm strays from what they perceive to be the morally right course of action.[98]

Engineers with ethical concerns should be able to get a fair hearing without endangering their jobs or blowing the whistle.[99]

> In addition to asking how an engineer should respond to moral quandaries and dilemma, and rather than asking how to educate or train engineers to be moral heroes, those in engineering ethics should ask how large organizations can be changed so that they do not squeeze engineers in moral dilemmas, place them in the position of moral quandaries, and make them feel that they must blow the whistle. . . . The ethical responsibilities of the engineer in a large organization have as much to do with the organization as with the engineer. . . . We not only need moral people. Even more importantly we need moral structures and organizations.[100]

Companies can begin by opening the channels of communication between engineers and management. This can be achieved by hiring an ombudsman whose primary responsibility would be to confidentially investigate and respond to any ethical concerns or complaints. The ombudsman should be a high-ranking company official, and should report directly to the company's chief executive officer or board of directors.[101] Two hundred major companies have already hired such an

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95. *See* Veronica Fowler, *Engineering and Ethics*, Gannet News Service, Feb. 14, 1989, *available in* LEXIS, NEWS Library, ARCNWS file. *See also* Grimshaw v. Ford Motor Co., 174 Cal. Rptr. 348 (Cal. App. 1981) (discussing the Ford Pinto case, in which punitive damages were awarded because Ford management, aware of the dangerously designed rear-end fuel system, nevertheless marketed the product because it was not cost-effective to install $12 worth of parts per car to make the vehicle safe).

96. *Engineers, Employers, Ethics*, CHEMICAL ENGINEERING, Mar. 2, 1987, at 5.

97. *Id.*

98. Richard T. DeGeorge, *Ethical Responsibilities of Engineers in Large Organizations: The Pinto Case*, 1 BUS. & PROF. ETHICS J. 1 (1981).

99. *Id.* at 11.

100. *Id.* at 12.

101. *See* UNGER, *supra* note 55, at 123.

ombudsman., and instituted a formal procedure to make this ombudsman available to employees.[102]

In the light of public scrutiny that followed the Challenger tragedy, NASA created a new position, the Associate Administrator for Safety. This administrator reports directly to the NASA administrator who has the authority to stop a shuttle launch that may be unsafe. The agency has also increased its safety and quality staff, and all staffers have been trained to be more receptive and responsive to safety concerns[103]

IV. ETHICS IN THE LAW

Like engineers, lawyers face a dilemma when they must weigh their professional ethics against their duty to their clients. But unlike the engineering profession, the legal profession has established a detailed mechanism to guide the lawyer confronted with an ethical problem. This Article argues that the engineering profession should follow the legal framework for establishing ethical standards and dealing with ethical concerns.

Unlike the engineer, the lawyer is well trained in the ethical responsibilities of his profession. His competency is established through mandatory licensing. He is governed by a single professional society that establishes professional rules of conduct. He is bound to follow a detailed procedure when confronted with a situation in which his corporate ethic (client interest and financial concerns) is pitted against his professional ethic (duty to the court and profession).

A. Training

States have always monitored and regulated the training required to enter the legal profession. Prior to the 1900's, membership in the legal profession was granted upon successful completion of an apprenticeship, the length being determined by each individual state.[104] Training by apprenticeship was eventually replaced by academic training.

> By 1890 nearly one half, by 1920 about three fourths, and by 1940 all states required some professional study preparatory to admission [to the legal profession]. The spread of this requirement was gradually attended by a lengthening of the period of professional preparation, up to the three-year requirement which by 1940 was fixed in forty states.[105]

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102. *See* Florman, *supra* note 43, at 22.

103. *Id.*

104. *See* James E. Moliterno, *An Analysis of Ethics Teaching in Law Schools: Replacing Lost Benefits of the Apprentice System in the Academic Atmosphere*, 60 U. CIN. L. REV. 83, 85 (1991).

105. JAMES W. HURST, THE GROWTH OF AMERICAN LAW: THE LAW MAKERS 280 (1950).

At the beginning of the twentieth century, the legal profession recognized the importance of training practitioners in the profession's standards of ethical conduct. By 1915, fifty-seven of the eighty-one law schools in the country offered a course on legal ethics.[106] Today, the American Bar Association (ABA) only offers accreditation to law schools that meet all of its requirements[107]–one of which is a mandatory course in professional ethics for all law students.[108] This course must teach students about the duties and responsibilities of the legal profession, as well as the ABA Code of Professional Responsibility.

B. Licensing

As early as the Civil War, admission to the legal profession was regulated by the states.[109] Initially, admission to the bar to practice law required only an apprenticeship. In the early 1900's, training in professional schools followed by a standardized exam replaced apprenticeship as the primary method of earning admission to the bar.[110] Passing the bar examination is required for admission to nearly every state's bar, and required to practice law in each state.[111] Each state sets its own standards for passing the bar.

From the early twentieth century, the legal profession recognized the importance of professional responsibility.[112]

> Even when admissions standards sank to their lowest point, eligibility was conditioned on the 'good moral character' of the applicant. Though the states continuously insisted on this factor, up to the mid-twentieth century they had not found adequate means to test 'character'. In their nature the bar exams were not adapted to this end.[113]

The formal written examinations are now standardized within each state to assure the public that all practitioners meet a minimum level competency and are adequately trained to practice. In addition to examinations that test the candidate's knowledge of substantive law, a

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106. *See* Moliterno, *supra* note 104, at 86.

107. *See* FIRMAGE, *supra* note 46, at 22-23.

108. *See* Robert F. Drinan, *Moral Architects or Selfish Schemers?*, 79 GEO. L.J. 389, 396 (1990); Moliterno, *supra* note 104, at 83. The ABA requirement that all law schools offer a mandatory course in legal ethics and professional responsibility to qualify for accreditation is found in STANDARDS FOR APPROVAL OF LAW SCHOOLS AND INTERPRETATIONS, Standard 302(a)(iv) (1992).

109. HURST, *supra* note 105, at 277.

110. *See* GEOFFREY C. HAZARD, JR. & DEBORAH L. RHODE, THE LEGAL PROFESSION: RESPONSIBILITY AND REGULATION 466 (2nd ed. 1988).

111. *See* David M. White, *The Definition of Legal Competence: Will the Circle Be Unbroken?*, 18 SANTA CLARA L. REV. 641, 644 (1978).

112. In 1908 the ABA promulgated its Canons of Legal Ethics. *See infra* note 116 and accompanying text.

113. *Id.* at 290.

majority of states now require the Multi-State Professional Responsibility Exam (MPRE).[114] The MPRE is a two-hour, fifty-question exam that tests the applicant on the ethical standards established by the legal profession.[115]

C. American Bar Association (ABA)

In 1908, the ABA adopted its Canons of Professional Ethics, and in 1970 it promulgated a Code of Professional Responsibility. The Code was adopted by every state except California and Illinois, each of which passed its own Codes of Ethical Conduct.[116] The Preamble to the ABA Code of Professional Responsibility states:

> Lawyers, as guardians of the law, play a vital role in the preservation of society. The fulfillment of this role requires an understanding by lawyers of their relationship with and function in our legal system. A consequent obligation of lawyers is to maintain the highest standards of ethical conduct.[117]

The ABA Model Code is comprised of canons, ethical considerations, and disciplinary rules.[118]

In 1983, in response to criticism of the Code from the courts and commentators, the ABA promulgated a second set of standards, the Model Rules of Professional Conduct[119] The ABA intended for all states to adopt the Model Rules, so that there would be one uniform code of ethical conduct.[120] The majority of states have adopted the Model Rules,(some with modifications), but fourteen states have continued using the Model Code.[121]

The Preamble to the Model Rules states:

> A lawyer is a representative of clients, an officer of the legal system and a public citizen having a special responsibility for the quality of justice. . . .
>
> In the nature of law practice, however, conflicting responsibilities are encountered. Virtually all difficult ethical problems arise from conflict between a lawyer's responsibilities to clients, to the legal system and to the lawyer's own interest in remaining an upright person while earning a satisfactory living. The

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114. *See* Drinan, *supra* note 108, at 396. In 1991, thirty-seven states required applicants to pass the MPRE for admission to their Bar. *See* Serena Stier, *Legal Ethics: The Integrity Thesis*, 52 Ohio St. L.J. 551, 592 n.167 (1991).

115. *See* Jeffrey M. Duban, *The Bar Exam as a Test of Competence: The Idea Whose Time Never Came*, 63 N.Y. ST. B.J. 34, 40 n.22 (1991).

116. *See* HAZARD & RHODE, *supra* note 110, at 100.

117. MODEL CODE OF PROFESSIONAL RESPONSIBILITY pmbl. (1981).

118. *See* FIRMAGE, *supra* note 46, at 20-22.

119. *See* HAZARD & RHODE, *supra* note 110, at 100.

120. *See* Ralph G. Elliot, *With Whom May I Talk and What May I Say? Current Issues in Legal Ethics*, 65 CONN. B.J. 81, 82 (1991).

121. *See* HAZARD & RHODE, *supra* note 110, at 100.

> Rules of Professional Conduct prescribe terms for resolving such conflicts. Within the framework of these Rules many difficult issues of professional discretion can arise. Such issues must be resolved through the exercise of sensitive professional and moral judgement guided by the basic principles underlying the Rules.[122]

The lawyer is subject to and governed by whichever set of rules his state chooses to adopt. Either the Code or the Rules apply to every member of the legal profession.[123] Disciplinary action is not pursued by the ABA, but by each state bar association in accordance with its ethical canons and oath of admission.[124]

D. Conflict of Interest: Corporate Ethic vs. Professional Ethic

The Preamble to the Model Rules aptly describes the lawyer's dilemma when it states:

> In the nature of law practice, however, conflicting responsibilities are encountered. Virtually all difficult ethical problems arise from conflict between a lawyer's responsibilities to clients, to the legal system and to the lawyer's own interest in remaining an upright person while earning a satisfactory living.[125]

The lawyer, who has a duty to his client and a duty to the court, is often confronted with a dilemma when the two obligations conflict.

> At the heart of the attorney-client relationship is the principle that the lawyer must maintain confidentiality of information relating to the representation. . . . [This guarantee of confidentiality is important] to promote full and frank disclosure by the client to the attorney; to assure that counseling is effective and based upon complete understanding of all facts and circumstances.[126]

This requirement of confidentiality is codified in Model Rule 1.6(a).[127] It prohibits the attorney from revealing any information that relates to the representation of his client without the client's consent.[128] In

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122. MODEL RULES OF PROFESSIONAL CONDUCT pmbl. (1983).

123. For the purposes of analyzing the existing legal framework for guiding attorneys who face ethical dilemmas, this paper will refer to the Model Rules of Professional Conduct but acknowledges that some states may have modified the Rules or may still use the Model Code.

124. *See* William H. Wisely, *The Influence of Engineering Societies on Professionalism and Ethics, in* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 30, 28-37.

125. MODEL RULES OF PROFESSIONAL CONDUCT pmbl. (1983).

126. Robert J. Jossen, *Client Perjury, Fraud and Misconduct*, 403 PLI/Lit 579 (1990).

127. MODEL RULES OF PROFESSIONAL CONDUCT Rule1.6(a) (1983). The Model Code also recognized the duty to keep all attorney-client communications confidential. Under the Model Code the lawyer's duty to the client is paramount. *See* MODEL CODE OF PROFESSIONAL RESPONSIBILITY DR-4-101 (1980).

128. MODEL RULES OF PROFESSIONAL CONDUCT Rule 1.6(a) (1983).

addition, the lawyer, as an advocate of his client, has a duty to zealously represent the client.[129]

If the lawyer's only duty were to his client, no dilemma would exist, but the lawyer also has a duty to the court. The attorney, as an officer of the court, has a duty "to preserve the effective administration of justice."[130] As an officer of the court, the lawyer has a duty of "candor toward the tribunal," reflected in Model Rule 3.3.[131] Under Rule 3.3, the lawyer cannot knowingly make any false statement, offer false evidence, or fail to disclose a material fact if non-disclosure would constitute assisting the client in a criminal or fraudulent act.[132] In addition, lawyers are prohibited from assisting a client in any criminal or fraudulent conduct.[133] Under the Model Rules of Professional Conduct, the lawyer's ethical duty to the court outweighs his duty to his client.[134] When the two obligations conflict, the Rules specifically detail the procedure the lawyer should take for acting in accordance with his duty to the court and his profession.[135]

A second analogy is the dilemma in-house counsel faces when confronted with possible wrongdoing by corporate officers. A recent Securities and Exchange Commission (SEC) case, *Salomon Brothers*,[136] highlights the tension between the lawyer's duty to the corporation and his professional and ethical responsibilities. In *Salomon Brothers*, the general counsel became aware of a criminal act committed by the firm. The firm had submitted a fraudulent bid in the government securities market.[137] The general counsel advised the corporation's senior management that the law required that the fraudulent bid be reported.[138] Despite their assurances that they would report the fraud, the top

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129. *See* Don D. Skypeck, *Professional Ethics of Criminal Defense Lawyers: Is There a Single Solution to the Issues Raised by Perjuring Clients?*, 16 MEM. ST. U. L. REV. 531, 535 (1986); Charles F. Thompson, *The Attorney's Ethical Obligations when Faced with Client Perjury*, 42 S. C. L. REV. 973, 974 (1991).

130. Skypeck, *supra* note 129, at 534.

131. MODEL RULES OF PROFESSIONAL CONDUCT Rule 3.3 (1983).

132. *See id.* Rule 3.3(a).

133. *See id.* Rule 1.2(d).

134. *See id.* Rule 3.3(b). This Rule states that the lawyer's duty of candor and honesty to the court applies even if the information the lawyer must disclose is confidential and even if this information would otherwise be protected from disclosure by Rule 1.6(a). See also MODEL RULES OF PROFESSIONAL CONDUCT Rule 1.6(b) (1983), which states that the lawyer may reveal the otherwise privileged confidential communication from his client if the lawyer reasonably believes it must be revealed in order "to prevent the client from committing a criminal act that the lawyer believes is likely to result in imminent death or substantial bodily harm." *Id.*

135. *See id.* Rule 3.3 cmt.

136. *Matter of Gutfreund*, Exchange Act Release No. 34-31554 [1992 Transfer Binder] Fed. Sec. L. Rep. (CCH) ¶ 85,067 (Dec. 3, 1992).

137. *Id.* at 83,599.

138. *Id.* at 83,601.

executives took no such action.[139] This inaction left the general counsel in a dilemma. Was he required to report the fraudulent bid himself, violating client confidences and risking his job in the process, or to remain quiet and allow the crime to go unreported? The SEC stated that when in-house counsel knows that management is not implementing his advice he has three alternatives: (1) go to the board of directors; (2) resign; or, (3) disclose the wrongdoing to the appropriate authority.[140]

The general counsel in *Salomon Brothers* would have had an easier choice had the senior management simply refused to follow his advice outright. In such a situation, the attorney would be bound by the explicit provisions of Model Rule 1.13. Under Model Rule 1.13, if the attorney knows that officers or employees of the corporation intend to act in a manner that is likely to cause substantial injury to the organization, the lawyer can: (1) ask the officer to reconsider the matter; (2) advise the corporation to seek a separate legal opinion on the matter; or, (3) refer the matter to a higher authority in the organization.[141] If the corporate officers refuse to act in accordance with the law and the corporation is likely to suffer substantial injury, the in-house counsel may resign.[142] But even if the in-house counsel's advice is rejected outright, he may not have any legal duty to report the trading violation.[143] In fact, reporting the improper bid might violate the duty of confidentiality that he owes to his client under Model Rule 1.6, unless the lawyer is aware that the client plans to continue making improper bids. In this case, the lawyer may have a duty to disclose or possibly resign.[144] Although there may still be some gray areas where the lawyer's duty is unclear, the Model Rules guide attorneys who struggle with ethical dilemmas to reach a solution that is consistent with the goals and duties of the profession.

All fifty states require bar applicants to take an oath that they will not purposely mislead the bench, and that they will adhere to the Rules of Professional Responsibility adopted by that state.[145] The Rules provide a framework of ethical conduct to which the lawyer must adhere in order to practice in the legal profession. The integrity of the profession is maintained through rigorous enforcement of these professional conduct rules. The attorney commits professional misconduct if she violates any of the rules set forth in the Rules of Professional Conduct as adopted by

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139. *Id.* at 83,602.

140. *Id.* at 83,609. For a more detailed discussion of the Salomon Brothers case, see C. Evan Stewart, *Corporate Counsel as Whistleblower*, N.Y.L.J., July 1, 1993, at 5.

141. MODEL RULES OF PROFESSIONAL CONDUCT Rule 1.13(b) (1983).

142. *See id.* Rule 1.13(c).

143. *See* Michael Orey, *Salomon's Hot Seat*, AMERICAN LAWYER, Mar. 1993, at 5.

144. *See* MODEL RULES OF PROFESSIONAL CONDUCT Rule 1.2(d) cmt. (1983).

145. Skypeck, *supra* note 129, at 534.

their licensing state.[146] Under many circumstances, the lawyer also has a duty to report the professional misconduct of any colleague, lawyer or judge who violates the rules of professional conduct.[147] This obligation ensures that the profession, through self-regulation, will maintain high ethical standards.

V. COMPARING LAW AND ENGINEERING

Those involved in the engineering profession could benefit by considering the framework that the legal profession has developed to assist the attorney in resolving ethical dilemmas. In order to function as a profession, the engineering field needs to develop a more structured framework to uniformly impart ethical standards to the profession's members, and to assure the public that all those who call themselves engineers meet minimum standards of competency and have requisite training in dealing with ethical dilemmas that arise in the practice of their field.[148] The engineer would not be confronted with the frustration and

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146. *See* MODEL RULES OF PROFESSIONAL CONDUCT Rule 8.4 (1983). This rule defines professional misconduct for a lawyer to include violating or assisting another in violating the rules of professional conduct, committing any criminal act, or engaging in any conduct that reflects adversely on the lawyer's fitness to practice, honesty, integrity, or trustworthiness.

147. *See* MODEL RULES OF PROFESSIONAL CONDUCT Rule 8.3 (1983).

148. Even though the legal profession has well established and effective mechanisms for the training and guidance of its practitioners, the public appraises the ethical standards of lawyers lower than those of engineers. *See* Matley et al., *supra* note 45, at 119. This article relies upon a 1986 report prepared for the National Academy of Engineering. In this article, the author details the explanations given by the study's participants for their perceptions. Respondents believed that since engineers deal with facts and figures and reach their conclusions through the application of mathematical calculations, there was little room for misconduct. People feel that engineers can be relied upon to report their findings and recommendations because they are reporting the results of calculations or experiments, unlike lawyers who give opinions, where there is more room for unethical conduct. The survey participants, like the public were generally mystified by engineering, they had little understanding of what engineers actually do. Since lay people (non-scientists) are often intimidated by science and mathematics, they seldom feel qualified to question the engineer's conduct or standards. On the other hand, the public often believes that they know as much as the lawyer does. This results in resentment of lawyers who don't appear to be building anything or performing any service that the client couldn't do themselves. Since lawyers are in the business of dispensing opinions, judgements, and advice, (something that every person feels qualified to do) people often question their conduct. The public's perception of engineers as maintaining higher ethical standards than lawyers could also be based upon the notion that law is subjective and lawyers are always finding ways around laws. While engineers on the other hand, are bound by a law which forces engineering decisions to be made objectively and never exceeding the bounds of the laws of nature and its physical properties. This author tends to agree with public perception of engineers as highly ethical, yet this is not inconsistent with the premise that the engineering profession is in desperate need of improving their framework for training and guiding engineers confronted with dilemmas, and that the engineering profession can benefit by modeling their ethical framework after the one established by the legal profession.

feeling of helplessness experienced by Roger Boisjoly, who was caught in the conflict between corporate ethics and professional ethics.

Ethically conscious engineers bound by a professional code would promote consumer health and welfare by increasing awareness of safety concerns. Our tort system, which provides deterrents against the manufacture of unreasonably dangerous products, could be enhanced if engineers, bound by a code of professional ethics, had a stronger role in corporate decision making. Engineers obliged to "hold paramount the safety, health and welfare of the public in the performance of their professional duties"[149] would be bound by the obligations of their profession to voice their safety concerns. Moreover, if the engineering profession required that its practitioners be licensed, engineers would be more accountable for their work.[150] Their professional livelihood would be threatened by the design of an unsafe product.[151]

This section argues that the engineering profession needs to revolutionize its training and licensing procedures, modeling them after those developed by the legal profession.

A. Training

Commentators agree that a course in ethics in the engineering curriculum is necessary to train the engineer in the standards of ethical conduct established by the profession.[152] The engineering curriculum should be expanded to include such a course. Like lawyers, engineers should be required to take a course in professional responsibility that teaches the duties and responsibilities of the profession and familiarizes them with a code of professional responsibility. In order to add another requirement to the already overcrowded list of mandatory engineering courses, universities may need to expand the engineering program from four to five years.

> Engineering, . . . differs from such well-established professions as law and medicine. Whereas the established professions developed a graduate curriculum on a base of undergraduate liberal or pre-

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149. NSPE CODE OF ETHICS Canon 1. *See* Appendix.

150. *See infra* note 155 and accompanying text.

151. The possibility of product liability litigation arising from marketing an unsafe product only influences management when the costs of injuries the product may cause exceed the costs of making the product safer. At that point the fear of tort litigation will deter the company from the production of an unsafe product. Increasing the ethical awareness of engineers and holding them accountable would get engineers more involved in the decision making process because their professional reputations (as well as the company pocketbook) will be on the line; the result will be more concern for product safety.

152. *See, e.g.*, BAUM, *supra* note 46, at 17-20; FIRMAGE, *supra* note 46, at 41; Heinz C. Luegenbiehl, *Codes of Ethics and the Moral Education of Engineers*, 2 BUS. & PROF. ETHICS J. 41, 57 (1983); Weil, *supra* note 46, at 249-50.

> professional courses, engineering education has, since its beginnings in the nineteenth century, offered professional training at the undergraduate level in a period of four years. This has placed considerable strain on the content of engineering curricula, which attempt to cover basic and applied science, mathematics, engineering design and tool courses, and liberal studies in a relatively short period of time. The result is a curriculum of great density, few electives, and only scant attention (less than a year) to courses in the humanities and social sciences.[153]

As an alternative, engineers could be required to attend a fifth year of training for an engineering Masters that would include a required course in engineering ethics. Commentators have argued in favor of such a professional engineering program.[154] If the Engineering Masters were created, engineering, like law and medicine, would require a student to complete independent training beyond the Bachelor's degree to achieve professional status.

B. Licensing

Licensing and registration procedures are tools employed by the states to protect the public safety and ensure that only qualified practitioners represent themselves as professionals.[155] There is no justification for allowing the majority of practicing engineers to go unlicensed. State licensing procedures are intended "to set minimum standards for entry into a profession" and "to provide means for expelling dishonorable or incompetent practitioners."[156] These goals can not be met if more than two-thirds of the practitioners are exempted from required licensing. Therefore, commentators have argued that there should be mandatory licensing for all engineers.[157]

> It has been argued that the status of the engineering profession would be enhanced and the public interest better served if all engineers were required to be licensed. Gains would result, according to this thesis, from the fact that relatively uniform standards of knowledge, experience, and character would have to be met by everyone entitled to be called an engineer. On the one hand, engineers would be more accountable, in a legal sense, for the results of their work, and on the other hand, being more competent and more respected, they would have more leverage in disputes with managers attempting to ignore or overrule their professional

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153. Richard L. Schott, *Professions and Government: Engineering as a Case in Point*, *in* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 93, 91-102.

154. *See, e.g.*, BAUM, *supra* note 46.

155. ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 507.

156. UNGER, *supra* note 55, at 110.

157. *See* Morton Fine, *Registration Viewed as Bond to Practice of Learned Profession*, *in* ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 55, at 511, 512-13; UNGER, *supra* note 55, at 112; Wilson, *supra* note 69, at 358-64, 366.

> judgements. In addition, the argument continues, courts might look with considerably more disfavor on employers who discharge engineers who acted in consonance with their legally defined responsibilities.[158]

Licensing is the hallmark of professionalism.[159] Licensing is the public's guarantee that only qualified, competent and ethical practitioners will achieve professional status. If all engineers are licensed, then disciplinary actions and penalties can be useful tools to enforce the standards of the profession, rather than the ineffective exercises that they are today.

Mandatory adherence to a code of ethics in order to retain one's license to practice as an engineer would benefit not only the public, but the engineers themselves. Engineers like Roger Boisjoly would not have to face the disdain of their peers and superiors when they try to adhere to professional standards.

As in the legal profession, where (with a very minor exception in California) only those who have earned a degree from an accredited law school can attain professional status, a person should only be granted a license to practice as an engineer if he has graduated from an accredited engineering school. The PE exams need to be updated and broadened to cover all major engineering disciplines. Moreover, they should include an examination on the ethical standards of the profession, including the Engineer's Code of Ethics.[160] At present, there are no questions on engineering ethics on the PE exams.[161]

The ethical standards of the engineering profession could be revolutionized if states would do away with the many exemptions that allow the majority of engineers to escape licensing. If licensing were required of all engineers, and a prerequisite to such licensing included passing an examination on a Code of Professional Responsibility for engineers, engineering schools would be forced to incorporate such an ethics course into their curricula.

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158. UNGER, *supra* note 55, at 112.

159. There are corresponding requirements in medicine and law which require all practitioner's to be licensed in order to practice the profession. *See supra* notes 111-112 and accompanying text.

160. This requires that engineers uniformly adopt a single code of ethics, since there are currently too many different codes to expect a student to be aware of the details of all of them. This is similar to the legal profession where law graduates must pass a bar which tests their substantive knowledge of the law of the state in which they wish to practice as well as a professional responsibility bar which tests them on the Model Code of Professional Responsibility.

161. *See* FIRMAGE, *supra* note 46, at 33.

C. The American Engineering Association (AEA)

If engineering is to be a true profession, it needs to require membership in a single umbrella organization that would cross over engineering specialty lines.[162] Such an organization is the best way to regulate the ethical conduct of the profession as a whole. It would serve to establish, review, and enforce ethical standards:

> In medicine, law, and architecture the existence of but one major professional society for each 'learned art' has greatly simplified the establishment, administration, and enforcement of ethical standards, as well as related education functions within and outside these professions. In each case the standards are under constant review, and are amended as necessary to meet changing conditions. Standing committees or similar bodies are maintained to provide official interpretation of standards as needed, and to monitor current problems. Procedures for handling ethical violations have been developed through many years of experience, and enforcement has been diligently pursued regardless of cost and occasional legal counteraction.[163]

There is at least some support for such an organization in the profession.

> There have been continuing efforts during all of the more than one hundred-year history of the professional engineering societies to establish a single organization that would represent and serve the interest of all engineers, but none of these efforts has been successful to date.[164]

The engineering profession could accomplish this goal if all the specialty societies would agree to be governed by an umbrella organization, such as the ECPD or the NSPE,[165] which would address itself to the advancement of the profession in a broad sense. The specialty societies could retain their autonomy for purpose of furthering the technology that is particular to their disciplines, while the general AEA could concentrate on broader issues concerning the licensing standards and standards for professional conduct for the entire profession. The AEA could promulgate a single Code of Ethics for the profession, which states could adopt in their licensing requirements, thereby assuring the continued ethical conduct of the engineers. Uniformity is essential. The engineering profession needs to have a single code so that engineers are not confused about which set of standards apply to them.

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162. A basic attribute of a profession is the concern for the professional motivation and ethical conduct of the profession's members. If this is a condition precedent to earning the distinction as a professional, the engineering profession has not yet met the standard.

163. Wisely, *supra* note 124, at 35.

164. BAUM, *supra* note 46, at 7.

165. The EPCD already represents sixteen major engineering societies. Thirty engineering societies have adopted the ECPD's Code of Ethics for Engineers. *See* BAUM, *supra* note 46, at 7.

D. Conflict of Interest: Corporate Ethic vs. Professional Ethic

Current mechanisms are inadequate to provide the engineer with guidance when confronted with an ethical dilemma. The Challenger tragedy illustrates just such a dilemma. A second and perhaps more typical example of an ethical dilemma that the corporate engineer confronts is when her company accepts her technical evaluations, including a calculated risk to human life, and decides to go forward despite the risk because management finds the degree of risk acceptable. In such a case, a strict construction of Rule 1(a) would force the engineer to notify the proper authority. Rule 1(a) applies when the engineer believes that the public is endangered by the decision, but management has overruled his professional judgment. But the construction of the rule is less clear when the dilemma arises because management and technical experts simply disagree on how much harm is too much. In such a case, the engineer may pursue a course of action dictated by his personal ethics that may include leaving the company, informing the proper authorities, or perhaps even informing the public. Because this is a value judgment, as opposed to a technical judgment of the sort in the Challenger case, engineers may have difficulty persuading management to concur in their judgments.

To begin the process of revolutionizing the corporate decision making system, the engineering profession needs to develop more detailed procedures for the engineer to follow when confronted with the Challenger type dilemmas. The legal counterpart of the Challenger tragedy is the dilemma of the perjurious client.[166] Although both the engineer and the lawyer are dependent on their clients for economic survival, the lawyer is not free to ignore ethical considerations in the practice of his profession. The Model Rules explicitly detail the procedures for a lawyer to follow when he discovers that his client intends to commit perjury. He is required to attempt to dissuade the client from this course of action, and to inform the client of the consequences of this action–including the lawyer's own duty to disclose this fraud to the court.[167] If the lawyer believes this attempt has been

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166. Another illustration of a lawyer's dilemma for which the Model Rules offer detailed assistance is the lawyer's duty to prevent the client from committing a criminal act that the lawyer believes will result in imminent death or substantial bodily harm. In this circumstance, the lawyer's duty to his client is subordinate to his professional responsibility. Model Rule 1.6 allows but does not require that the lawyer reveal the client's confidences to whatever extent necessary to prevent the crime. But, the lawyer is required to withdraw from representation, if the lawyer's services would further the criminal conduct. MODEL RULES OF PROFESSIONAL CONDUCT Rule 1.16 (1983).

167. *See* MODEL RULE OF PROFESSIONAL CONDUCT Rule 3.3(a) (1983); ABA Comm. on Ethics and Professional Responsibility, Formal Op. 87-353 (1987).

unsuccessful, he must attempt to withdraw from representation.[168] If the court orders the attorney to proceed, as is often the case, he has no choice but to obey.[169] If the lawyer cannot effectively withdraw from the proceeding, he must either attempt to limit the client's testimony to the issues on which he will testify truthfully, or refuse to allow the client to testify.[170] If neither of these options are possible, the lawyer *must* disclose to the court the client's intent to commit perjury.[171] This clear guidance in the face of an ethical dilemma is the framework that the engineering profession desperately needs to copy.

Rule 1(a) of the NSPE's Code of Ethics is a good example of the procedures that are needed, but the profession needs more specific guidance. Rule 1(a) requires that the engineer confront his company management and inform the client and appropriate authorities when management overrules his technical recommendation, endangering the public.[172]

The engineer's code must relieve peer pressure on practicing engineers by defining professional misconduct in terms of knowingly allowing the public to be endangered. It could do so by enacting requirements like Model Rule 8.3, which demands that the professional report the misconduct of his peers.[173] Mandatory compliance with this new code, which would be achieved through licensing and rigorous enforcement, would work to solve the engineer's dilemma, ensure the public's safety, and prevent another space shuttle from exploding.

VI. CONCLUSION

The last second launch pad shut down of the space shuttle Discovery shows that NASA has increased its awareness of safety concerns. It is encouraging that these concerns outweighed NASA's many pressures to launch. But it was NASA's computer, not its personnel, that actually stopped the launch. Would NASA officials have acted the same way?

Unlike the engineering profession, which largely chooses to ignore the ethical dilemma the engineer faces when client or corporate interests conflict with professional responsibility, the legal profession recognizes that the lawyer may be placed in a moral dilemma when his client's interests conflict with his professional responsibilities. In the legal profession, established guidelines are available to assist the attorney to

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168. *Id.*
169. *See* Thompson, *supra* note 129, at 979-80.
170. *See* ABA Formal Op. 87-353, *supra* note 167.
171. *Id.*
172. *See* Appendix.
173. *See* MODEL RULES OF PROFESSIONAL CONDUCT Rule 8.3 (1983).

resolve this conflict. The engineering profession should look to the legal profession for guidance in developing a more extensive framework to assist the practitioner confronted with conflicting obligations.

In order to alleviate the engineer's ethical dilemma, the engineering profession must require stricter licensing of its members. To effectively protect the public from incompetent, unethical engineers, states must repeal the exemptions which currently allow engineers to escape licensing. States must also make licensing contingent upon passing an examination on the ethical standards of the profession, like the lawyer's MPRE. Once this professional responsibility requirement is established, engineering schools will be forced to integrate a course in engineering ethics into their curriculum. Engineering, as a profession, must also adopt a single code of ethics and create a single governing body (AEA) to address the advancement of the profession in a broad sense. The AEA can co-exist with existing specialty societies, as long as they adopt the general Code of Ethics.

The Engineer's Code of Ethics needs to recognize and address itself to the dilemmas that engineers face in practice, much as the Model Rules have done in the legal profession. The code must state when the engineer's duty to the public and his profession outweighs his duty to his employer and client. It needs to detail mandatory procedures for the engineer to follow if she believes that her company management has endangered the public by overruling or ignoring her technical recommendation, much as the Model Rules detail the procedures for the attorney to follow when he believes his client intends to commit perjury.

All engineers must not only be bound by the code, but have a duty to uphold it. This code will be useless unless enforced; states will need to evaluate engineers' conduct and discipline those who violate the code. This enforcement will act as a deterrent, preventing other engineers from similar misconduct.

Perhaps the greatest benefit to be derived from stricter licensing of engineers would be that engineers would command more respect and have more leverage in disputes with company management. Detailed procedures for informing the authorities when management endangers the public would discourage companies from making decisions that might otherwise elevate corporate ethics over professional ethics. These procedures will be especially effective when management is comprised of engineers who could lose their licenses to practice if they violate the rules of professional conduct.

The engineering profession must implement changes to assist its practitioners in dealing with ethical dilemmas. Until it does, we are only waiting for the next disaster. Until it does, engineering schools should hand their graduates not only diplomas, but whistles.

APPENDIX

National Society of Professional Engineers (NSPE) Code of Ethics.

PREAMBLE

Engineering is an important and learned profession. The members of the profession recognize that their work has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety and welfare. In the practice of their profession, engineers must perform under a standard of professional behavior which requires adherence to the highest principles of ethical conduct on behalf of the public, clients, employers and the profession.

I. FUNDAMENTAL CANONS

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

1. Hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Perform services only in the areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act in professional matters for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts in the solicitation of professional employment.

II. RULES OF PRACTICE

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
   a. Engineers shall at all times recognize that their primary obligation is to protect the safety, health, property and welfare of the public. If their professional judgment is overruled under circumstances where the safety, health, property or welfare of the public are endangered, they shall notify their employer or client and such authority as may be appropriate.
   b. Engineers shall approve only those engineering documents which are safe for public health, property and welfare in conformity with accepted standards.
   c. Engineers shall not reveal facts, data or information obtained in a professional capacity without the prior consent of the client or employer except as authorized or required by law or this Code.
   d. Engineers shall not permit the use of their name or firm name nor associate in business ventures with any person or firm which

they have reason to believe is engaging in fraudulent or dishonest business or professional practices.

e. Engineers having knowledge of any alleged violation of this Code shall cooperate with the proper authorities in furnishing such information or assistance as may be required.

2. Engineers shall perform services only in the areas of their competence:
   a. Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved;
   b. Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control;
   c. Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project, provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment.
3. Engineers shall issue public statements only in an objective and truthful manner.
   a. Engineers shall be objective and truthful in professional reports, statements or testimony. They shall include all relevant and pertinent information in such reports, statements or testimony.
   b. Engineers may express publicly a professional opinion on technical subjects only when that opinion is founded upon adequate knowledge of the facts and competence in the subject matter.
   c. Engineers shall issue no statements, criticisms or arguments on technical matters which are inspired or paid for by interested parties, unless they have prefaced the comments by explicitly identifying the interested parties on whose behalf they are speaking, and by revealing the existence of any interest the engineers may have in the matters.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees.
   a. Engineers shall disclose all known or potential conflicts of interest to their employers or clients by promptly informing them of any business association, interest, or other circumstances which could influence or appear to influence their judgment or the quality of their services.
   b. Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed to, and agreed to by, all interested parties.

c. Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from contractors, their agents, or other parties in connection with work for employers or clients for which they are responsible.
d. Engineers in public service as members, advisors or employees of a governmental body or department shall not participate in decisions with respect to professional services solicited or provided by them or their organization in private or public engineering practice.
e. Engineers shall not solicit or accept a professional contract from a governmental body on which a principal or officer of their organization serves as a member.

5. Engineers shall avoid deceptive acts in the solicitation of professional employment.
   a. Engineers shall not falsify or permit misrepresentation of their, or their associates', academic of professional qualifications. They shall not misrepresent or exaggerate their degree of responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint ventures or past accomplishments with the intent and purpose of enhancing their qualifications and their work.
   b. Engineers shall not offer, give, solicit or receive, either directly or indirectly, any political contribution in an amount intended to influence the award of a contract by public authority, or which may reasonably construed by the public of having the effect or intent to influence the award of a contract. They shall not offer any gift, or other valuable consideration in order to secure work. They shall not pay a commission, percentage or brokerage fee in order to secure work except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

III. PROFESSIONAL OBLIGATIONS

1. Engineers shall be guided in all their professional relations by the highest standards of integrity.
   a. Engineers shall admit and accept their own errors when proven wrong and refrain from distorting or altering the facts in an attempt to justify their decisions.
   b. Engineers shall advise their clients or employers when they believe a project will not be successful.
   c. Engineers shall not accept outside employment to the detriment of their regular work or interest. Before accepting any outside employment, they will notify their employers.

d. Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses.
e. Engineers shall not actively participate in strikes, picket lines, or other collective coercive action.
f. Engineers shall avoid any act tending to promote their own interest at the expense of the dignity and integrity of the profession.

2. Engineers shall at all times strive to serve the public interest.
   a. Engineers shall seek opportunities to be of constructive service in civic affairs and work for the advancement of safety, health and well-being of their community.
   b. Engineers shall not complete, sign, or seal plans and/or specifications that are not of a design safe to the public safety, health and welfare and in conformity with accepted engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.
   c. Engineers shall endeavor to extend public knowledge and appreciation of engineering and its achievements and to protect the engineering profession from misrepresentation and misunderstanding.
3. Engineers shall avoid all conduct or practice which is likely to discredit the profession or deceive the public.
   a. Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact necessary to keep statements from being misleading or intended or likely to create an unjustified expectation; statements containing prediction of future success; statements containing an opinion as to the quality of the Engineers' services; or statements intended or likely to attract clients by use of showmanship, puffery, or self-laudation, including the use of slogans, jingles, or sensational language or format.
   b. Consistent with the foregoing, Engineers may advertise for recruitment of personnel.
   c. Consistent with the foregoing, Engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others.
4. Engineers shall not disclose confidential information concerning the business affairs or technical processes of any present or former client or employer without his consent.
   a. Engineers in the employ of others shall not without the consent of all interested parties enter promotional efforts or negotiations for work or make arrangements for other employment as a principal or to practice in connection with a specific project for

which the Engineer has gained particular and specialized knowledge.

b. Engineers shall not, without the consent of all interested parties, participate in or represent an adversary interest in connection with a specific project or proceeding in which the Engineer has gained particular specialized knowledge on behalf of a former client or employer.

5. Engineers shall not be influenced in their professional duties by conflicting interests.
   a. Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment suppliers for specifying their product.
   b. Engineers shall not accept commissions of allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the Engineer in connection with work for which the Engineer is responsible.
6. Engineers shall uphold the principle of appropriate and adequate compensation for those engaged in engineering work.
   a. Engineers shall not accept remuneration from either an employee or employment agency for giving employment.
   b. Engineers, when employing other engineers, shall offer a salary according to professional qualifications.
7. Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods.
   a. Engineers shall not request, propose, or accept a professional commission on a contingent basis under circumstances in which their professional judgment may be compromised.
   b. Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical consideration.
   c. Engineers shall not use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice without consent.
8. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice or employment of other engineers, nor untruthfully criticize other engineers' work. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.
   a. Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.

b. Engineers in governmental, industrial or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties.
c. Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of other suppliers.

9. Engineers shall accept responsibility for their professional activities; provided, however, that Engineers may seek indemnification for professional services arising out of their practice for other than gross negligence, where the Engineer's interest cannot otherwise be protected.
   a. Engineers shall conform with state registration laws in the practice of engineering.
   b. Engineers shall not use association with a non-engineer, a corporation, or partnership, as a "cloak" for unethical acts, but must accept personal responsibility for all professional acts.
10. Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.
   a. Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments.
   b. Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the Engineer for others without express permission.
   c. Engineers, before undertaking work for others in connection with which the Engineer may make improvements, plans, designs, inventions, or other records which may justify copyrights or patents, should enter into a positive agreement regarding ownership.
   d. Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property.
11. Engineers shall cooperate in extending the effectiveness of the profession by interchanging information and experience with other engineers and students, and will endeavor to provide opportunity for the professional development and advancement of engineers under their supervision.
   a. Engineers shall encourage engineering employees' efforts to improve their education.
   b. Engineers shall encourage engineering employees to attend and present papers at professional and technical society meetings.
   c. Engineers shall urge engineering employees to become registered at the earliest possible date.

d. Engineers shall assign a professional engineer duties of a nature to utilize full training and experience, insofar as possible, and delegate lesser functions to subprofessionals or to technicians.
e. Engineers shall provide a prospective engineering employee with complete information on working conditions and proposed status of employment, and after employment will keep employees informed of changes.