CHEATING AMONG ENGINEERING STUDENTS

Reasons for Concern

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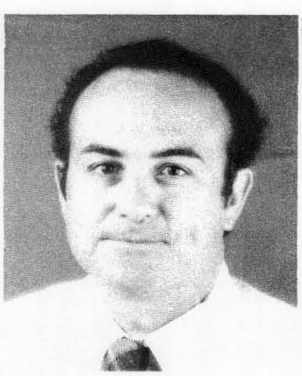
IN RECENT DECADES, our society has become increasingly dependent upon engineers. As it becomes more technologically complex, engineers will be called upon to make decisions of ever greater importance to society. Recent events, however, cast serious doubt upon the capability of some engineers to make appropriate ethical decisions in their work.

There are several recent and catastrophic examples of unethical behavior among some engineers. Included among these is the decision of Ford Motor Company to market the Pinto automobile, even though testimony indicates that at least one high-ranking engineer considered the design unsafe [1]. Another example concerns the B. F. Goodrich contract to develop a 4-rotor brake. When tested, the brake failed to meet specifications, but regardless of the contradictory test data, the engineers involved were instructed to draft a positive qualification report. In order to do this, the engineers had to use falsified data. One of them consulted an attorney and was advised to inform the FBI, eventually exposing the fraud, but only after—not before—his complicity in the fraud.



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A third example of unethical behavior concerns the 1974 Paris crash of a DC-10 airplane. One engineer thought that the cargo door and passenger supports should be redesigned, yet his supervisor decided against modifications for fear that their firm would have to pay for the redesign costs. Although they now know that should have been the proper course of action, they both admitted that at the time it posed "an interesting legal and moral problem." Apparently not interesting enough.

Of course, only a small percentage of engineers engage in such behavior, and even those who do are seldom responsible for consequences as serious as those described above. Nonetheless, only a few such occurrences are enough to make us consider how to better help engineers avoid such situations.

To begin with, one might examine the extent and quality of ethics instruction received by most engineering students. Two observations are pertinent. First, one notes that there are few, if any, courses in engineering ethics offered in most engineering programs. Second, and perhaps more problematic, is the inadequate action taken by most engineering faculty and departments to prevent or respond to academic dishonesty. Academic dishonesty is a serious problem: if students learn to cheat with impunity in the classroom, they might continue to cheat when gainfully employed.

Inasmuch as cheating appears to be pervasive, on the increase, and perceived by many students as legitimate, there is need to be concerned about its impact. One study, conducted by the Arizona State University College of Engineering and Applied Sciences, found that 56% of 364 students polled had

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cheated [5]. Sisson and Todd-Mancillas found that 56% of the entire graduating class of engineers (287) had in one way or another cheated [6].

Instructor complacency, pressure to win, and student ignorance appear to be the main reasons why cheating is widespread and increasing. Also, some research has been done which helps us to better understand how cheaters justify their behavior [8]. Dienstbier's findings lead him to conclude that students are most likely to cheat when they feel subjected to intense and seemingly unjustified pressure. He further concludes that eventually cheaters learn to perceive their academic dishonesty not as morally unjustified or even as questionable, but rather as a necessary and rational way of coping with the pressure to get good grades. Having developed a perspective justifying and promoting academic dishonesty, it is probable that the cheater goes on to apply this self-serving perspective to a variety of other circumstances, which, like stressful academic environments, pose no assurance of success, yet great pressure to succeed.

Thus, upon graduation and finding oneself in the midst of a highly competitive work environment, an engineer (one who formerly developed the ability to rationalize academically dishonest behaviors) may cheat on the job as well. This cheating may be manifested in defrauding documents, such as those forged by B. F. Goodrich engineers discussed earlier. Just as students cheat in school as a means of coping with academic pressure, these engineers cheated as a means of coping with the professional demands of the marketplace. Regretfully, these engineers will now have to suffer the long-term psychic and financial cost of their involvement in the fraud. There is, then, reason to be concerned about the long-range consequences of cheating on cheaters themselves. But what of the consequences to other students? The non-cheating student suffers at least as much as the cheating student does. Statistically, even a small percentage of cheating students will create distorted grades, putting an honest student at severe disadvantage. Furthermore, this distortion is exacerbated in engineering courses where partial credit and curving are common grading practices. For instance, by merely glancing at another's paper, a dishonest student may learn how to set up a problem. Later, that student may claim, "At least I set up the problem correctly, and that should be worth at least 60 percent."

While dishonesty in the classroom puts honest students at a disadvantage, at least insofar as achieving high grades is concerned, two other consequences are even more serious. First, dishonest students obtain an unfair advantage when seeking employment, as employers prefer to hire applicants with better academic records. Second, the dishonest student has an unfair advantage when applying for scholarships and admission to graduate school.

Presume, for instance, that a company hires an engineering graduate of University X who had dishonestly obtained a high G.P.A. Subsequently, the company discovers that the engineer's job performance is far below what had been anticipated, given the engineer's impressive undergraduate record. In the future, that company may be less likely to rely on the academic records of other students graduating from University X, or perhaps the company's experience with this particular engineer will be so disappointing that they will recruit from other universities in the future. A similar predicament may occur when a student is admitted to graduate school on the basis of a dishonestly obtained (inflated) G.P.A. Conceivably, the student might be unable to perform at the level of competence expected of him, resulting in failure to complete the program. Disappointment in this student's performance may cause this graduate program to excercise greater caution when selecting future applicants from University X. This would be unfair to future applicants whose competencies may be very real, but whose grade point averages are lower than the one obtained dishonestly by the previously admitted student.

Despite the serious nature of the possible consequences of academic dishonesty, too few instructors implement measures for prevention, controlling, or detecting the problem. Reasons for this may be a lack of departmental or university support in prosecuting offenders, an attitude that teachers ought not act as police officers, a disregard for either the high frequency of cheating or its serious short- and long-term consequences, or simple ignorance of how to prevent and control cheating in engineering courses. Some of the reasons listed above seem to account for inaction, and it was for this reason that a detailed consideration of the consequences of cheating has been presented in

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along with the boundary conditions

$$H(z{=}0) = W/2, \qquad H(z{=}L) = H_f, \qquad (dH/dz)_{z=L} = 0$$

The solution is

$$H(z) = \left(\frac{W - 2H_f}{L^2}\right)\left(\frac{z^2}{2} - zL\right) + \frac{W}{2} \tag{A15}$$

which is a parabolic film thickness.

<u>3. Finite surface tension (0 < Ca < k)</u>

Eq. (A11) is cast in the form

$$H^3\left(\frac{d^3H}{dz^3} - \frac{St\,Ca}{H_f^2}\right) + 3Ca\left(H - H_f\right) = 0 \tag{A16}$$

with no apparent analytic solution. For a special case of horizontal coating (St = 0), and since usually $H_f / W << 1$, the transformation

$$H^* = \frac{H}{W}, \qquad z^* = \frac{z}{W} \tag{A17}$$

reduces Eq. (A16) to

$$H^{*3}\frac{d^3H^*}{dz^{*3}} + 3Ca\left(H^* - \frac{H_f}{W}\right) = 0 \tag{A18}$$

which predicts that near the inlet, where $H^* \approx 1$, the film decays with rate depending on the Ca. Near the other end, where $H^* \approx 2H_f/W$, the film becomes flat, surface tension becomes unimportant, and therefore the slope is zero. Eq. (A18) can be solved asymptotically by perturbation techniques. ❒

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this paper. Perhaps these considerations will motivate us to develop innovative ethics curricula and to improve monitoring of course activities, so that our disciplines may be able to better safeguard (and perhaps even increase) their already high levels of excellence.

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