# Ethics and Professionalism
# Engineering Problem Solving

## Ethics

- *A code of conduct,* arbitrarily and subjectively created by society, religion, conscience...
- Often not as clean as Black and White
- What does ethics have to do with engineering?

## Examples: Kickbacks

A County Engineer in Virginia demanded a 25% kickback in secret payments for highway work contracts he issued. In 1967 he made such an offer to Allan, a 32 year old civil engineer who was vice president of a young and struggling consulting firm greatly in need of the work. Allan discussed the offer with others in the firm, and was told it was his decision to make. Finally Allan agreed to the deal, citing as a main reason his concern for getting sufficient work to retain his current employees. (Martin and Schinzinger, pg 14)

## Example: Waste Dumping

"On a midnight shift, a botched solution of sodium cyanide, a reactant in an organic synthesis, is temporarily stored in drums for reprocessing. Two weeks later, the day shift foreman cannot find the drums. Roy, the plant manager, finds out that the batch had been illegally dumped into the sanitary sewer. He severely disciplines the night shift foreman. Upon making discrete inquiries, he finds out that no apparent harm has resulted from the dumping." (Martin and Schinzinger, pg 32)

Should Roy inform government authorities, as is required by law in this kind of situation?

## Example: Fight is also risky

Ralph Sims had worked for the US Government for many years as an engineer, rising to a fairly high managerial position. On retirement, he accepted an executive position with SuperCom, a company producing electronic equipment for the military.

Shortly after coming on board, Ralph was informed by a subordinate that, for a long time, a key test on an important product was not being made in the manner specified by the contract. This had been going on for several years and the subordinate felt very uncomfortable about it. Ralph, who had considerable expertise in the technology involved, looked into the matter carefully. It turned out that, in his previous career, he had acquired some knowledge about the specified test.

He found that a shorter, and hence less costly, test had indeed been substituted for the required one. But, after some study, he concluded that SuperCom's test was actually as effective as the specified test.

Nevertheless, by this unauthorized substitution, SuperCom was violating the contract and exposing itself both to criminal and to civil prosecution. He took his findings to upper management and urged them to apply to the contracting agency for a contract change authorizing the simpler test. Ralph felt confident that such a change would be accepted.

But his arguments were not accepted and SuperCom continued on their previous course. The apparent reason was the company president's reluctance to confess that the company had been deceiving the government for years. Ralph did not see why he should get into an unpleasant battle with the SuperCom's leaders over this, since there were no safety issues and even the quality of the product was not actually at stake. Nevertheless, he did not wish to be involved in a dishonest and probably illegal operation. Therefore, he chose the course of quietly resigning, without "turning in" the company.

About three years later, a SuperCom employee reported the deception to the government, and a criminal investigation was launched. When he resigned, Ralph had signed a non-disclosure agreement as a condition for receiving some severance pay. Nevertheless, when called upon by the prosecutor's office to give information about the situation, he cooperated fully.

To his dismay, when the indictments came down, he was one of the people charged with complicity in the fraud. This necessitated his hiring an attorney and undergoing both the expenses and anguish of being a defendant in a criminal case. Fortunately for him, after many months, a new prosecutor was assigned to the case. Shortly afterward, the charges against Ralph were dropped. But, meanwhile, the affair had cost him months of anguish, embarrassment, and a damaged reputation due to publicity whose effects can never be fully repaired.

The trial took three months. All five of the company's employees were acquitted. There was a hung jury in the case against the president. The company was fined $800,000 and its estimated legal expenses were estimated at close to a million dollars. Furthermore it is no longer permitted to work on government contracts involving testing. (Examples of Real World Engineering Ethics Problems by SH Unger, Science and Engineering Ethics, Volume 6, Issue 3, 2000)

## An in-class discussion: DC10 Cargo Door

- On June 12, 1972 A DC-10 left Detroit with 67 passengers, after reaching 12,000 ft, the cargo door blew off, collapsing floor and disrupting all hydraulic controls to tail section. Only the pilot's skill and the light load prevented a disaster.
- June 27, 1972 Daniel Applegate, Director of Product Engineering for Convair, the fuselage contractor, wrote a memo to his supervisors detailing potential problems of cargo door. The problem was first recognized in Aug 1969. The same thing had also happened in a ground test in 1970.
- Recognized design flaws - floor, latch
- After the Detroit near-disaster, NTSB (National Transportation Safety Board) investigation revealed several problems and recommended immediate design changes. FAA did not follow NTSB recommendations. FAA director John Shaffer and Douglas President Jackson McGowan reached a gentleman's agreement to voluntarily fix problem, but no further official action was taken.
- In July 1972, Three inspectors at Long Beach plant certified that Ship 29 had been modified (but it was not). Two years later, after leaving Paris, its cargo door blew off at 13,000 feet, killing 346 people.

## An in-class discussion: Why did this accident happen?

- McDonnel Douglas was in precarious financial condition - trying to beat Lockheed L1011 to market
- Convair did not push too hard, since by contract, they may have been held liable for the costs of all design changes
- Engineers pressed the matter through normal channels to the highest levels within both companies, but did not take it any further, Standard operating procedure at McDonnell Douglas and Convair was for engineers to defer to upper management, even though they were aware of serious design flaws

In-class exercise: (hand in during the class)

Were the engineers negligent and why?