# Engineering Ethics

Lec-6: The Concept of Safety

# Safety

- One approach to define safety would be by defining it in terms of whatever risks a person judges to be acceptable.

- Such a definition was given by William W. Lowrance: ***"A thing is safe if its risks are judged to be acceptable."***

# Safety Level for Engineers

- To ensure a comfortable safety level, engineers are obligated to:

1. Anticipate or predict all the failure modes that can lead to an accident, both at the design and the operational stages.

2. Take into account operational experience and past human and design errors, and incorporate them into their design in view of avoiding catastrophes.

# Ethical Principles of Leaders

- For many leaders, providing a safe workplace lays the foundation for organizational excellence and integrity in strategic, financial and operational performance.

- These leaders are driven by a deep sense of commitment to ethical principles that include:

- ***Value for human life*** – The belief that preservation and protection of human life supersedes other goods.

- ***Integrity*** – That the commitment to telling the truth and keeping promises, plus applying the best of one's abilities, promise worker loyalty and commitment.

- ***Justice*** – That a strong sense of fair dealing with employees establishes trust between leaders and their reports.

- ***The good of the many*** – That excellence stems from a concern for the achievement of the common good (as opposed to what is good just for the individual person or company).

- ***Excellence*** – The belief that whatever degree of safety or integrity we have achieved, we always have the opportunity to improve.

# A Principle-Driven Culture

- Our work with organizations has led us to identify five key cultural factors predictive of desired ethical and safety outcomes:

- ***Procedural justice*** – If leaders seem to be making decisions in fair ways, workers assume they can follow instructions without fear of mistreatment.

- ***Open and candid upward communications*** – In an environment where supervisors and other leaders respond well to communications from lower down in the organization – even to bad news – ethical issues are more likely to surface before they become a crisis.

- ***Inclination of workers to approach peers on sensitive issues*** – A leader can foster a culture where it is acceptable and expected that employees approach each other about difficult issues surrounding safety, ethics and other critical areas.

- ***Perceived organizational support for espoused values*** –When employees see their leaders demonstrate a commitment to stated values, they are more likely to respond in kind.

- ***Management credibility*** – Employees who see their managers as credible are more likely to take personal responsibility for their performance and support new initiatives.

# *Leading With Safety*

- A culture that truly values ethical (and safe) behavior must be led by men and women committed to principle for its own sake, not solely for the purpose of compliance.

- This foundation in principle perhaps is the greatest strength that safety offers to organizations interested in ethics.

- Safety appeals to the ethical ideals that motivate the company's best leaders at every level of responsibility.

- Finally, as a performance metric with outcomes consequential to the lives and livelihoods of employees and their families, safety provides tangible proof that doing the right thing always merits an organization’s best efforts.

# Safe Exits

- It is almost impossible to build a completely safe product or one that will never fail.
- The best one can do is to assure that when a product fails:

(1) it will fail safely,

(2) the product can be abandoned safely, or—at least

(3) the user can safely escape the product.

# Safe Exits (Examples)

- Ships need lifeboats with enough spaces for all passengers and crew members.
- Buildings need usable fire escapes.
- Backup systems for computer-based data banks, air traffic control systems, automated medical treatment systems.
- Sources of water for fire fighting.

# Engineering of safety-critical system

- The engineering of safety-critical systems is a constant process of ethical decision making.
- Some of these decisions are subtle, such as balancing cost, performance and reliability in the selection of a component, or choosing the right wording for a customer memo.
- Other decisions are explicit and life-changing, such as deciding whether to continue in a dysfunctional organization in the hope of eventually making a positive difference.

- An engineer applies scientific and technical knowledge to address problems within their domain of expertise.

- As members of a professional discipline, they are required to take account of ethical considerations in their work.

# Honesty & Dishonesty

# Honesty

- The concern with truth telling extends far beyond the boundaries of the engineering profession. Religious and secular literature contain many injunctions to tell the truth.
- For example, one of the Ten Commandments forbids bearing false witness against one’s neighbor.

- In light of the long emphasis on honesty in our moral tradition, it is not surprising that engineering codes contain many references to honesty.

- The third canon of the code of ethics of the Institute of Electrical and Electronics Engineers (IEEE) encourages all members “to be honest and realistic in stating claims or estimates based on available data.”

- Canon 7 requires engineers “to seek, accept, and offer honest criticism of technical work.”

- The American Society of Mechanical Engineers (ASME) code of ethics is equally straightforward.

- Fundamental Principle II states that engineers must practice the profession by "being honest and impartial."
- The seventh Fundamental Canon states, "Engineers shall issue public statements only in an objective and truthful manner."
- A subsection enjoins engineers not to "participate in the dissemination of untrue, unfair, or exaggerated statements regarding engineering."

# Forms of Dishonesty

- ***Lying:*** When we think of dishonesty, we usually think of lying.
- Ethicists have long struggled over the definition of lying.
- One reason for the difficulty is that not every falsehood is a lie.
- If an engineer mistakenly conveys incorrect test results on soil samples, she is not lying even though she may not be telling the truth.

- ***Deliberate Deception:*** If Andrew discusses technical matters in a manner that implies knowledge that he does not have to impress an employer or potential customer, then he is certainly engaging in deliberate deception, even if he is not lying.

- In addition to misrepresenting one's own expertise, one can misrepresent the value of certain products or designs by praising their advantages inordinately.

- Such deception can sometimes have more disastrous consequences than outright lying.

- ***Withholding Information:*** Omitting or withholding information is another type of deceptive behavior.

- If Jane deliberately fails to discuss some of the negative aspects of a project she is promoting to her superior, she engages in serious deception even though she is not lying.

- Failing to report that you own stock in a company whose product you are recommending is a form of dishonesty.

- Perhaps we can say in more general terms that one is practicing a form of dishonesty by omission:

(1) if one fails to convey information that the audience would reasonably expect would not be omitted and

(2) if the intent of the omission is to deceive.

- ***Failure to Seek Out the Truth:***

- The honest engineer is one who is committed to finding the truth, not simply avoiding dishonesty.

- Suppose engineer Mary suspects that some of the data she has received from the test lab are inaccurate.

- In using the results as they are, she is neither lying nor concealing the truth.

- But she may be irresponsible in using the results without inquiring further into their accuracy.

# *Failure to Seek Out the Truth: (Contd.)*

- Honesty in this positive sense is part of what is involved in being a responsible engineer.

- It would not be correct to assume that lying is always more serious than deliberate deception, withholding information, failing to adequately promote the dissemination of information, or failing to seek out the truth.

# Dishonesty on Campus

Three students were working on a senior engineering design project. The project was to design, build, and test an inexpensive meter that would be mounted on the dashboard of automobiles and would measure the distance a car could travel on a gallon of gasoline. Even though personal computers, microchip calculators, and ‘‘smart instruments’’ were not available at the time, the students came up with a clever approach that had a good chance of success.

- They devised a scheme to instantaneously measure voltage equivalents of both gasoline flow to the engine and speedometer readings on the odometer while keeping a cumulative record of the quotient of the two. In other words, miles per hour divided by gallons per hour would give the figure for the miles the automobile is traveling per gallon of gasoline. The students even devised a way to filter and smooth out instantaneous fluctuations in

either signal to ensure time-averaged data. Finally, they devised a bench-top experiment to prove the feasibility of their concept. The only thing missing was a flow meter that would measure the flow of gasoline to the engine in gallons per hour and produce a proportional voltage signal.

- Nowadays, customers can order this feature as an option on some automobiles, but at the time the design was remarkably innovative. The professor directing the project was so impressed that he found a source of funds to buy the flow meter. He also encouraged the three students to draft an article describing their design for a technical journal.

- Several weeks later, the professor was surprised to receive a letter from the editor of a prominent journal, accepting for publication the ‘‘excellent article’’ that, according to the letter, he had ‘‘coauthored’’ with his three senior design students.

- The professor knew that the flow meter had not yet arrived, nor had he seen any draft version of the paper, so he asked the three students for an explanation.

- They explained that they had followed the professor’s advice and prepared an article about their design.

- They had put the professor’s name on the paper as senior author because, after all, it was his idea to write the paper and he was the faculty advisor.
- They did not want to bother the professor with the early draft.
- Furthermore, they really could not wait for the flow-measuring instrument to arrive because they were all graduating in a few weeks and planned to begin new jobs.

- Finally, because they were sure the data would give the predicted results, they simulated some time-varying voltages on a power supply unit to replicate what they thought the flow-measuring voltages would be.

- They had every intention, they said, of checking the flow voltage and the overall system behavior after the flow meter arrived and, if necessary, making minor modifications in the paper.

- As a matter of fact, the students incorrectly assumed that the flow and voltages would be related linearly. They also made false assumptions about the response of the professor to their actions.
- The result was that the paper was withdrawn from the journal, and the students sent letters of apology to the journal.
- Copies of the letter were placed in their files, the students received an “F” in the senior design course, and their graduation was delayed 6 months.

- A student’s experience in engineering school is a training period for his or her professional career.
- If dishonesty is as detrimental to engineering professionalism as we have suggested, then part of this training should be in professional honesty.
- Furthermore, the pressures that students experience in the academic setting are not that different from (and perhaps less than) those they will experience in their jobs.
- If it is morally permissible to cheat on exams and misrepresent data on laboratory reports and design projects, then why isn’t it permissible to misrepresent data to please the boss, get a promotion, or keep a job?

# Dishonesty in Engineering

- Dishonesty in science and engineering takes several forms:

- ***falsification of data,***
- ***fabrication of data, and***
- ***plagiarism.***

- ***Falsification*** involves distorting data by smoothing out irregularities or presenting only those data which fit one's favored theory and discarding the rest.

- ***Fabrication*** involves inventing data and even reporting results of experiments that were never conducted.

- ***Plagiarism*** is the use of the intellectual property of others without proper permission or credit. It takes many different forms.