ENCS 521
Computer Engineering Ethics

Safety & Risk

Abdel Salam Sayyad

Engineer's Concern for Safety

- We demand safe products
  - ...but we have to pay for safety
  - (important for the public to know this)
- What may be safe enough for you, may not be for others
- Absolute safety is neither attainable nor affordable
- Example: preparedness against earthquakes...
- What exactly do we mean by "safety"?

Safety…

- Safety, definitions:
  - “A thing is safe if, were its risks fully known, those risks would be judged acceptable by a reasonable person in light of their settled value principles”
  - Safety is relative!
  - “A thing is safe (to a certain degree) with respect to a given person or group at a given time if, were they fully aware of its risks they would judge those risks to be acceptable (to a certain degree).”
  - What is “degree”?
- Relative safety, examples:
  - Safety for an engineering prototype vs. a released product
  - Safety on a manufacturing line

Risk

- Definition: A risk is the potential that something unwanted and harmful may occur
- “Experimental” risks associated with introducing new technology (“social experimentation”)
- Risks with application of familiar technology
- Remaining risk resulting from trying to make a system more safe
  - Example: ABS (Anti-lock Braking System) improves vehicle control, but does it reduce or increase the possibility of accidents?

Acceptability of Risk

- Willingness to be subjected to risk:
  - People don't have as much of a problem with subjecting themselves to risks
  - Much less willing to involuntarily be subjected to risks
- Are risks on-the-job voluntary? What about in a manufacturing job?
  - Could quit! But is this always possible?
  - If piece-work-based, will workers behave less safely?
- Safety complaints from on-the-job should always be listened to.

Magnitude and Proximity of Risk

- What if personal connections with victims?
  - What if the person on the unsafe manufacturing line is your father?
  - What if you definitely know that the “public” will immediately include your spouse and children?
  - A useful mental exercise to ensure that you are diligent!
- What creates such changed perceptions?
  - Personal/family relationships, sense of “solidarity” with workers
  - Proximity/magnitude - direct impact on you!
- What about work on a design project?
  - If risk appears small but there are hints that it may grow with time, BE CAREFUL!!
  - Example: Challenger disaster

Problems with the public's conception of safety

- Over-optimistic with regard to familiar products that have not hurt them before and that they have control over
- Over-pessimism when accidents kill or maim large numbers or harm those we know (e.g., aircraft crashes)
- Statistically speaking, the real risk may be quite small.

Experiment – Group 1

- Suppose that we are preparing for the outbreak of a dangerous disease which is **expected to kill 600 people**.
- Two alternative programs have been proposed to combat the disease. The exact scientific estimates of the consequences of the programs are as follows:

- If **Program A** is adopted, 200 people will be saved. **72%**
- If **Program B** is adopted, there is 1/3 probability that 600 people will be saved, and 2/3 probability that no people will be saved. **28%**

- Which of the two programs would you favor?

Experiment – Group 2

- Suppose that we are preparing for the outbreak of a dangerous disease which is **expected to kill 600 people**.
- Two alternative programs have been proposed to combat the disease. The exact scientific estimates of the consequences of the programs are as follows:

- If **Program C** is adopted, 400 people will die. **22%**
- If **Program D** is adopted, there is 1/3 probability that nobody will die, and 2/3 probability that 600 people will die. **78%**

- Which of the two programs would you favor?

Design Considerations, Risk

- Principles:
  - Absolute safety is not attainable
  - Improvements in safety often cost $$
  - Products that are not safe incur secondary costs:
    - Loss of customer goodwill and/or customers
    - Warranty expenses
    - Litigation
    - Business failure? Loss of your professional employees? Bad climate/hiring potential?

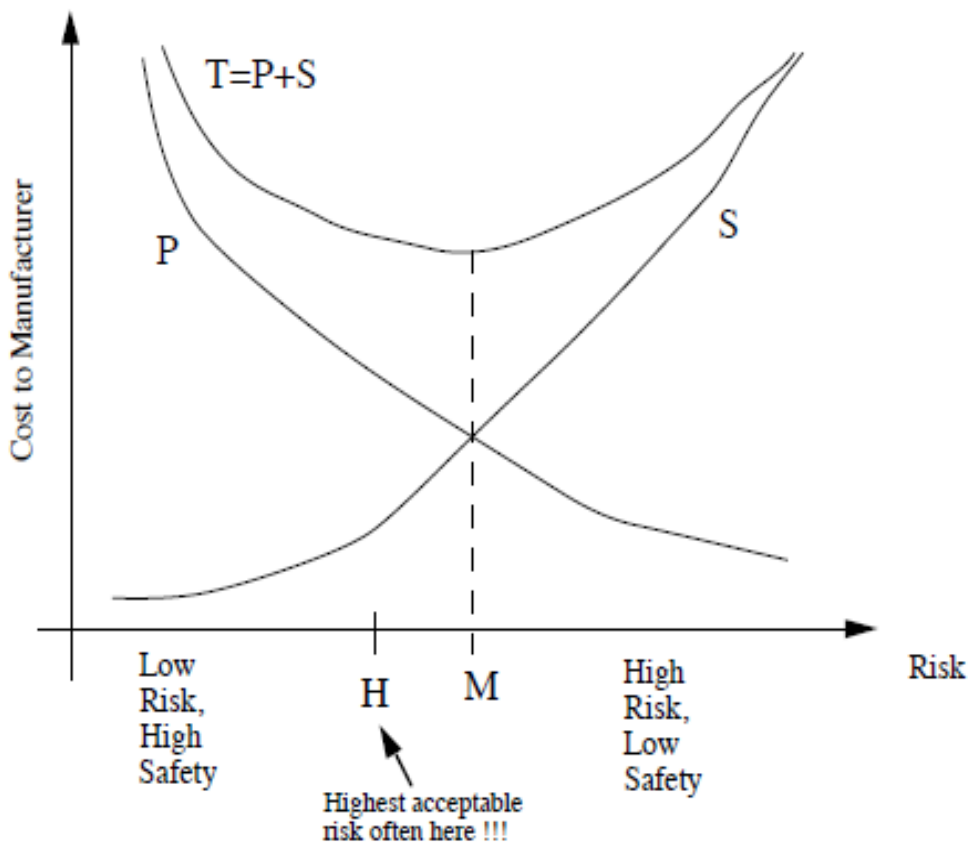
Design Principle: risk/trade-offs

How safe should we make a product?

There are trade-offs...

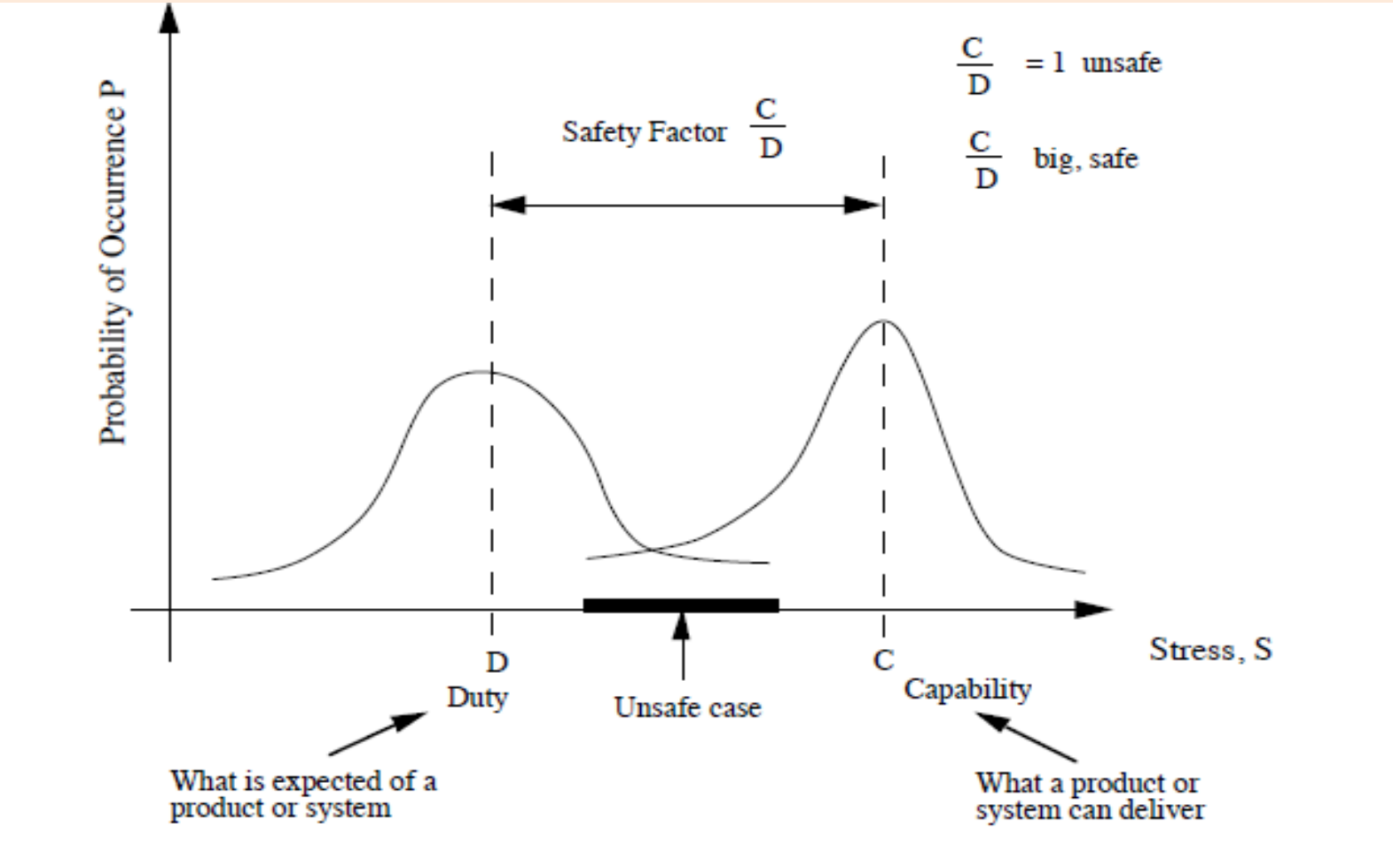
P = primary cost of a product (including safety measures)

S = secondary costs



Ethical issues!

Design Principle:
Safe if Capability Exceeds Duty



Risk-Benefit Analysis

- Risk-Benefit Analysis
  - Is a product worth the risks connected with its use?
  - What are the benefits? To whom?
  - Do they outweigh the risks? To whom? Environmental impact?
- “Under what conditions, if any, is someone in society entitled to impose a risk on someone else on behalf of a supposed benefit to yet others?”

Examples

- Nuclear accidents:
  - *Chernobyl (Ukraine 1986)*
  - *Three Mile Island (USA 1979)*
  - *Fukushima (Japan 2011)*

Part of the legacy of Three Mile Island…

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