

Social and Ethical Aspects in Engineering IME-251

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Week12 Agenda

- Commitment to Safety
 - Safety and risk, assessing and reducing risk

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Assessing and Reducing Risk

- Cost of safety verses non-Safety
- Uncertainties in Design
 - Mostly, Risk is not intentional, it arises because of uncertainties in Design, Manufacturing, Sales and Services.
 - Maximizing the Profit verses Maximizing the return on investment (ROI)
 - Unconsidered conditions (e.g. Dynamic Loading)
 - Manufacturing Uncertainties (e.g. Temperature)
 - Remedy: Factor of Safety
 - However the safety factor completely ignores the facts of variability.
 - Remedy: Margin of Safety

Important Words:

- Incur
- Render
- Worrisome

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Assessing and Reducing Risk

- Cost of safety verses non-Safety
- Uncertainties in Design

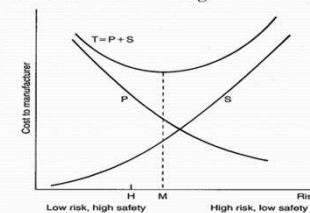


Figure 5-1
Why both low-risk and high-risk products are costly. P = primary cost of product, including cost of safety measures involved; S = secondary costs, including warranties, loss of customer goodwill, litigation costs, costs of downtime, and other secondary costs. T = total cost. Minimum total cost occurs at M , where incremental savings in primary cost (slope of P) are offset by an equal incremental increase in secondary cost (slope of S). Highest acceptable risk (H) may fall below risk at least cost (M), in which case H and its higher cost must be selected as the design or operating point.

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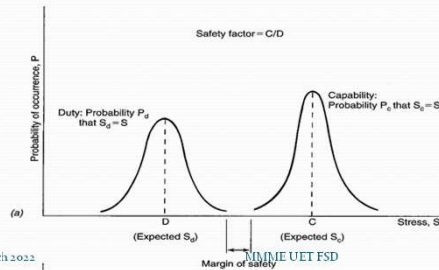
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Assessing and Reducing Risk

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Figure 5-2
Probability density curves for stress in an engineered system. (a) Variability of stresses in a relatively safe case. (b) Lower safety caused by overlap in stress distributions.

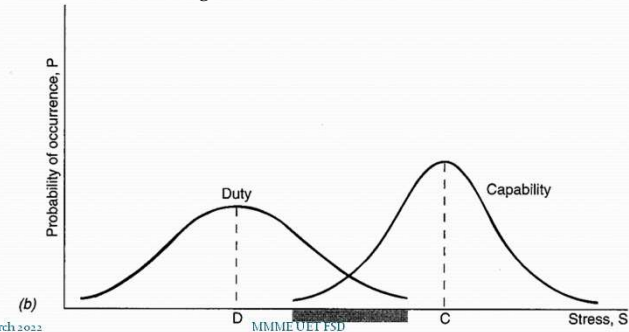


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Assessing and Reducing Risk

- Cost of safety versus non-Safety
- Uncertainties in Design



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Assessing and Reducing Risk

- Risk-Benefit Analyses
 - Is the product worth the risks connected with its use?
 - What are the benefits?
 - Do they outweigh the risks?
 - A discounted Future
 - 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?
 - Rights violations?
 - Safer Alternatives?
 - Examples:
 - An inoculation/vaccination Program
 - Automobile Design

Important Words:

- Imminent
- Immanent
- Eminent
- Accrue
- Discounted
- Amorphous

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Assessing and Reducing Risk

- Personal Risk versus Public Risk
 - Value of individual's life
 - Volunteer Activities
 - Risks and Benefits to the Public

Important Words:

- Fatality
- Veto

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Assessing and Reducing Risk

- Examples of Improved Safety

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Assessing and Reducing Risk

- Three Mile Island: A Case Study

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Assessing and Reducing Risk

- Safe Exits
 - Product should fail safely
 - Product can be abandoned safely
 - The user can escape the product safely

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Discussion Questions

1. A worker accepts a dangerous job after being offered an annual bonus of \$2,000. The probability that the worker may be killed in any one year is 1 in 10,000. This is known to the worker. The bonus may therefore be interpreted as a self-assessment of life with a value equal to \$2,000 divided by $1/10,000$, or \$20 million. Is the worker more or less likely to accept the job if presented with the statistically nearly identical figures of a \$100,000 bonus over 50 years (neglecting interest) and a $1/200$ probability of a fatal accident during that period?

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Discussion Questions

2. "Airless" paint spray guns do not need an external source of compressed air connected to the gun by a heavy hose (although they do need a cord to attach them to a power source) because they have incorporated a small electric motor and pump. One common design uses an induction motor that does not cause sparking because it does not require a commutator and brushes (which are sources of sparking). Nevertheless the gun carries a label warning users that electrical devices operated in paint spray environments pose special dangers. Another type of gun that, like the first, also requires only a power cord is designed to weigh less by using a high-speed universal motor and a disk-type pump. The universal motor does require a commutator and brushes, which cause sparking. This second kind of spray gun carries a warning similar to that attached to the first, but it states in addition that the gun should never be used with paints that employ highly volatile and flammable thinners such as naphtha. The instruction booklet is quite detailed in its warnings.

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Discussion Questions

A painter had been lent one of the latter types of spray guns. To clean the apparatus, he partially filled it with paint thinner and operated it. It caught fire, and the painter was severely burned as the fire spread. The instruction booklet was in the cardboard box in which the gun was kept, but it had not been read by the painter, who was a recent immigrant and did not read English very well. He had, however, used the first type of airless paint spray gun in a similar manner without mishap. The warning messages on both guns looked pretty much the same. Do you see any ethical problems in continuing over-the-counter sales of this second type of spray gun? What should the manufacturer of this novel, lightweight device do?

In answering these questions, consider the fact that courts have ruled that hidden design defects are not excused by warnings attached to the defective products or posted in salesrooms. Informed consent must rest on a more thorough understanding than can be transmitted to buyers by warning labels.

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Discussion Questions

3. It has been said that Three Mile Island showed us the risks of nuclear power and the Arab oil embargo the risk of having no energy. Forcing hazardous products or services from the market has been criticized as closing out the options of those individuals or countries with rising aspirations who can now afford them and who may all along have borne more than their share of the risks without any of the benefits. Finally, pioneers have always exposed themselves to risk. Without risk there would be no progress. Discuss this problem of "the risk of no risk."²¹
4. Discuss the notion of safe exit, using evacuation plans for communities near nuclear power plants or chemical process plants.
5. Research the events at Chernobyl in 1986, and discuss what you see as the main similarities and differences with Three Mile Island.

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Q & A

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