

UCS1704 – Management and Ethical Practices

UNIT – IV
Safety and Risk



OUTLINE

- Safety and Risk
 - Assessment of Safety and Risk
 - Risk Benefit Analysis and Reducing Risk
 - Respect for Authority
 - Collective Bargaining
 - Confidentiality
 - Conflicts of Interest
 - Occupational Crime
 - Professional Rights
 - Employee Rights
 - Intellectual Property Rights (IPR)
 - Discrimination
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“A ship in harbor is safe, but that is not what ships are built for” – John A. Shedd

Safety & Risk

- Safety was defined as *the risk that is known and judged as acceptable*. (William W. Lawrence)
- But, risk is a potential that something unwanted and harmful may occur.
- Probability of safety = $1 - \text{Probability of risk}$
- Risk = Probability of occurrence \times Consequence in magnitude*

* Severity

Drawbacks of Lawrence's Definition

■ Under-Estimation of Risk

- ❑ Misjudgment of person
- ❑ Example: Coil Type Water heater

■ Over-Estimation of Risk

- ❑ Risks of product/products comparatively less
- ❑ But people think “Unsafe”
- ❑ Example: Chlorine in drinking water

■ No estimation of Risk

- ❑ A person who does not judge risks
- ❑ Example: LPG Car

A modified Definition of Safety

- “ A thing is safe (to a certain degree) with respect to a given person or group at a given time, if its risks were fully known, if those risks would be judged acceptable (to a certain degree), in light of settled value principles”
 - Here things means not only products but also services, processes etc.,
- Mike Martin and Roland Schinzinger

Relative Safety (fair safety)

- Safety is expressed in terms of degree and comparisons.
 - It means the safety of the thing in comparison with the safety of similar things.
 - Example
 - Air travel > Car Travel > Bike Travel
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Engineers and Safety

- Safety should be integral part of any engineering design.
- In order to ensure safety following criteria should meet
 - Design follow legal standards
 - Alternate designs that are potentially safer should be explored.
 - All possible misuse by the consumer should be identified, and that is to be avoided.
 - Designed product should be tested using prototypes.

Designing for safety

- *Alan D. Wilcox* has summarized the process of incorporating safety into the engineering design as follows
 - ❑ 1. Define the problem (issues of safety in the product design)
 - ❑ 2. Generate alternate design solutions
 - ❑ 3. Analyze each design solutions
 - ❑ 4. Test the solutions
 - ❑ 5. Select the best ones
 - ❑ 6. Implement the chosen solution
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Risk

- Risk increases because engineers are constantly involved in innovation.
 - New machines are created, and new compounds synthesized always without full knowledge of their long-term effects on humans or the environment.
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Risk

- Dictionary Definition“ possibility of suffering harm or loss”
- Risk in technology could include:
 - bodily harm
 - economic loss
 - environmental degradation
- Engineers risk affects mostly the physical and economic well being
 - Example: Faulty design of chemical plant
- Causes of risk: Delayed job completion, faulty products or systems

Chernobyl Disaster

- 26 April 1986, No. 4 reactor of the Chernobyl Nuclear Power Plant.



What happened in the Chernobyl disaster?

- The Chernobyl disaster occurred when technicians at nuclear reactor Unit 4 attempted a poorly designed experiment.
 - They shut down the reactor's power-regulating system and its emergency safety systems.
 - These mistakes, compounded by others, led to an uncontrolled chain reaction that resulted in several massive explosions.
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How many people died as a result of the Chernobyl disaster?

- Some sources state that two people were killed in the initial explosions of the Chernobyl disaster.
 - Others report that the figure was closer to 50.
 - Dozens more contracted serious radiation sickness; some of these people later died.
 - In addition, thousands of deaths from radiation-induced illnesses and cancer were expected years later.
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Exclusion zone

- As a result of the Chernobyl disaster, the Soviet Union created an exclusion zone with a radius of about 18.6 miles (30 km) centered on the nuclear power plant, covering 1,017 square miles (2,634 square km) around the plant.
- The zone was later expanded to 1,600 square miles (4,143 square km) to include heavily radiated areas outside the initial zone.








Risk - Definition

William W. Lowrence
defined Risk as



“A Compound
measure of probability
and magnitude of
adverse effect”

$\text{Risk} = (\text{probability of the harm}) \times (\text{Consequence of harm})$

Natural Hazards and Disasters

- Natural hazards such as floods, earthquake, volcanoes etc greatly threatens and damages the long life of human populations
- A Disaster is a “ Serious disruptive event agrees with a state of insufficient preparations”

Factors influencing Risk

- 1. Voluntary Vs In voluntary Risk
 - If a person knowingly takes any risks, then he feels it safe
 - voluntary Risks are consider as safe (even if risks are really Unsafe)
 - Involuntary Risks are consider as unsafe (even if risks are really Safe)
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Factors influencing Risk

- 2. Short term vs Long term consequences
 - If a thing will cause a short-lived illness or disability is safer than the thing that will result in permanent disability

 - 3. Delayed vs immediate Risk
 - An activity whose harm is delayed for many years will seem less risky than something with an immediate effect
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Factors influencing Risk

- 4. Expected probability
 - A relatively slight harm having more probability of occurring seems to be greater / unacceptable risk than a relatively a severe harm having lesser probability of occurring
 - Example : 600 people unsafe –
 - Choose option 50% safe not probability
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Factors influencing Risk

■ 5. Reversible Effects

- Something will seem less risky if the bad effects are ultimately reversible

■ 6. Threshold levels of Risks

- Something that is risky only at fairly high exposures will seem safer than something with uniform exposure to risk
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SAFETY AND RISK

Imagine you are a fresh graduate.

- You get a job as an engineer in a large atomic power plant.
- Would you take it or not?
- Under what conditions would you take it?
- Under what conditions would you not?
- Why?

People as Consumers:

- *Active Consumers*: directly involve themselves e.g., mowing the lawn, washing clothes or toasting bread.
 - *Passive Consumers*: have less choice and less control e.g., Water, Electricity, Petrol,
 - *Bystanders*: e.g., exposed to Pollution from unknown sources
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Acceptability of Risk

- According to D.Rowe, “ A risk is acceptable when those affected are generally no longer apprehensive about it”
- Apprehensiveness- doubtfulness is mainly depends on how the risk is perceived by people

Elements of Risks

(Factors influencing the perception of Risk)

1. Whether risk is influenced **voluntarily**
 2. The effect of **knowledge** on how the probabilities of harm are perceived
 3. **Job related** or other pressures that cause people to be aware of risks
 4. Whether the **effects of risky** activity or situation are immediately noticeable
 5. Whether the **potential victims are identifiable** earlier
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Acceptability of Risk

(Effect of Risk Assessment)

1. Voluntarism & Control

Voluntary Risk : If people take risk knowingly, then their involvement of risk is known as voluntary risk

- Many people consider safer if they knowingly take on the risk. Also the people believe that they have “Full Control” over their actions

- **Example:**

- Buying a Flat near chemical plant
- Participating in adventurous sports like bike race

■ **Controlled Risk:** If the Risk taken within control limit

- **Example:** horseback riding hill climbing
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Acceptability of Risk

(Effect of Risk Assessment)

2 Effect of Information on Risk Assessment:

- The information about the danger should be in **systematic and appropriate manner**
 - Many case studies have proved **inappropriate manner lead to danger**
 - **Threshold limit varies** person to person
 - From many experiments drawn 2 conclusions
 - Options perceived as yielding company gain will lead to preferred over those from which gains are perceived as risky as convenient
 - People tend to be more willing to take risk in order to perceived company losses than they are to win only possible gains
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Acceptability of Risk

(Effect of Risk Assessment)

3.Job Related Risk:

- The Exposure of Risk depends on the person's job and his work place
- The nature of the job, and the working environment will determine the risk level of a person
 - **Example:**
 - People working in coalmines, oil mines chemical plants have probability of high risk
 - Because of competition of survival
 - The union and occupational safety regulations should regulate and enforce the employers to facilitate the standard working environment

Acceptability of Risk

(Effect of Risk Assessment)

4. Magnitude and proximity:

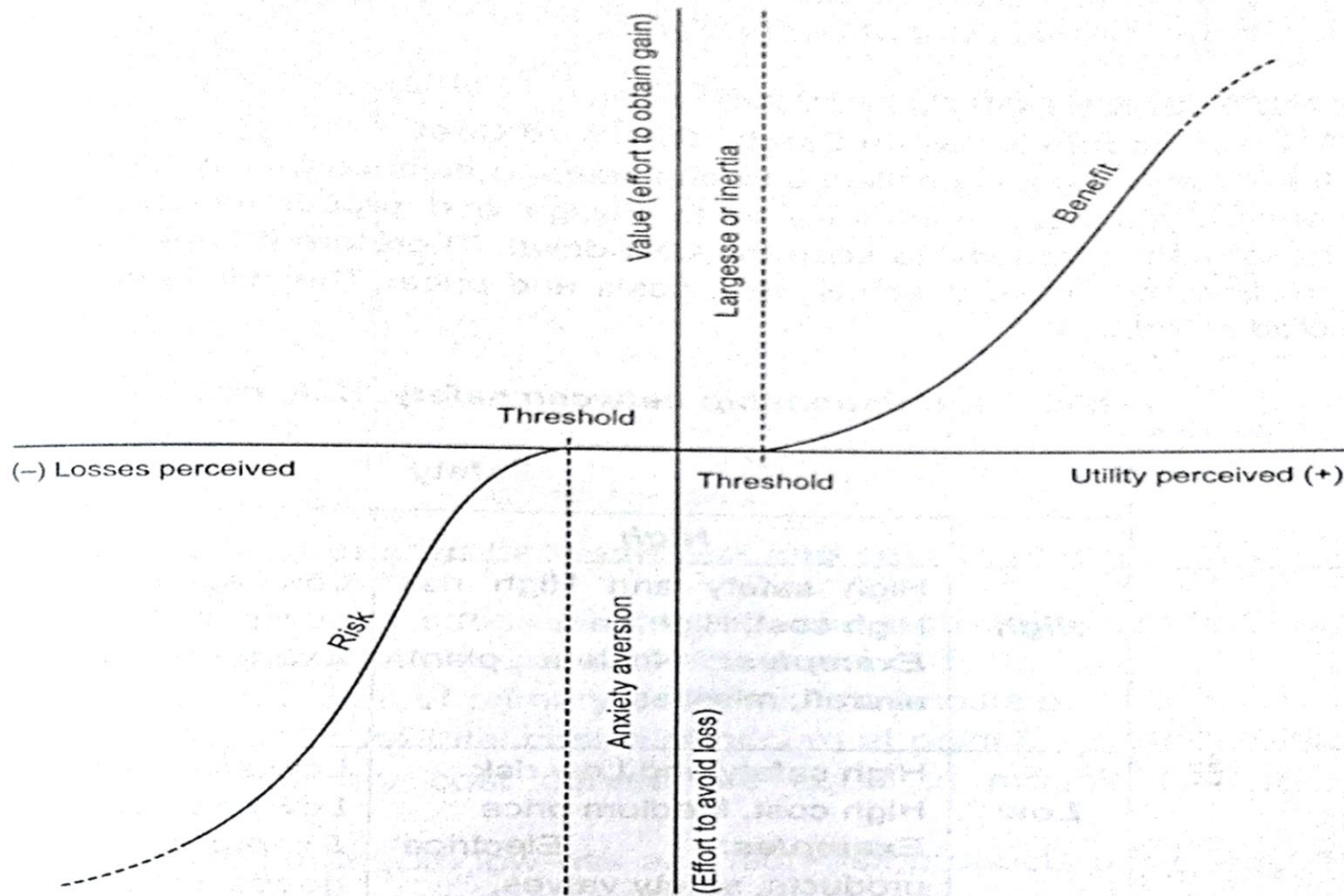
- Our reaction to risk is affected by magnification and the personal identification and relationship we have with the victims
 - For instance, We feel very bad if one of our close friends are subjected to great harm
 - Magnitude of risk and proximity with victims greatly influence the degree of reaction of the risk
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Lessons for the engineers

- Engineers have the challenge to face the following two different public conceptions of safety
- **Positive or optimistic Attitude**
 - Some people assume that things that are familiar, that have not hurt them on which they have some control present to real risk
- **Negative or pessimistic Attitude**
 - Some people feel feared when an accident kills or harms in large numbers or affects their relations, they consider those risk as high risks
- Education will not quickly change under/over estimation
- The continuous & proper information about the dangers are necessary to educate the people
- The risk communication and risk management efforts are structured as two way process

Risk-Benefit Value Function

- The risk and benefits are based on probable gain and probable loss



Types of accident

■ Procedural Accidents

- Result of **someone making bad choice** or not following established rules
 - Example: - Road accidents

■ Engineered Accidents

- Caused by **errors in design**
 - Example: minor casting defects in aircrafts turbine blade

■ Systematic Accidents

- They are **difficult to understand & difficult to control**
- Complex organization that are required to operate them
 - Example: US Space Shuttle

Assessment of Safety & Risk

Table. 4.1. Relationship between safety, risk, cost and price.

		Safety	
		High	Low
Risk	High	High safety and High risk High cost, High price Examples: Nuclear plant, aircraft, missiles.	Low safety and High risk Low cost, High price Example: Automobiles.
	Low	High safety and Low risk High cost, Medium price Examples: Electrical products, safety valves.	Low safety and Low risk Low cost, Low price Examples: Electronic goods, computers.

Assessment of Safety & Risk

■ Primary Cost:

- Production cost & Cost of Safety

■ Secondary Cost

- Cost associated with warranty expense, loss of customer good will

