

# UCS1704 – Management and Ethical Practices

## UNIT – IV

### Assessment of Safety and Risk

Semester – VII

Dr. G. Raghuraman, Associate Professor/CSE



---

# 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
-

# Safety & Risk

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



# Drawbacks of Lawrence's Definition

## ■ Under-Estimate Risk

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

## ■ Over-Estimation of Risk

- ❑ Products Risks comparatively less risks
- ❑ But people thinks “Unsafe”
- ❑ Example: Chlorine in drinking water

## ■ No estimation of Risk

- ❑ Person who does not judge about risks
- ❑ Example: LPG Car

# A modified Definition by Lowrence

- “ A thing is safe ( to 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 certain degree), in light of settled value principles”
  - Here things means not only products but also services, processes etc.,

---

# Relatively Safety (fairly safety)

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

# 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
    - ❑ Analyze each design solutions
    - ❑ Test the solutions
    - ❑ Select the best ones
    - ❑ Implement the chosen solution
-



---

# 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.
-

# Risk

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

# 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)
-

---

# Factors influencing Risk

- 2. Short term vs Long term consequences
    - If a thing will causes 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 us delayed for many years will seem less risky than something with an immediate effect
-

# 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

---

# 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
-



---

## 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
-

# 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

---

# 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
-

# 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

# 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
-

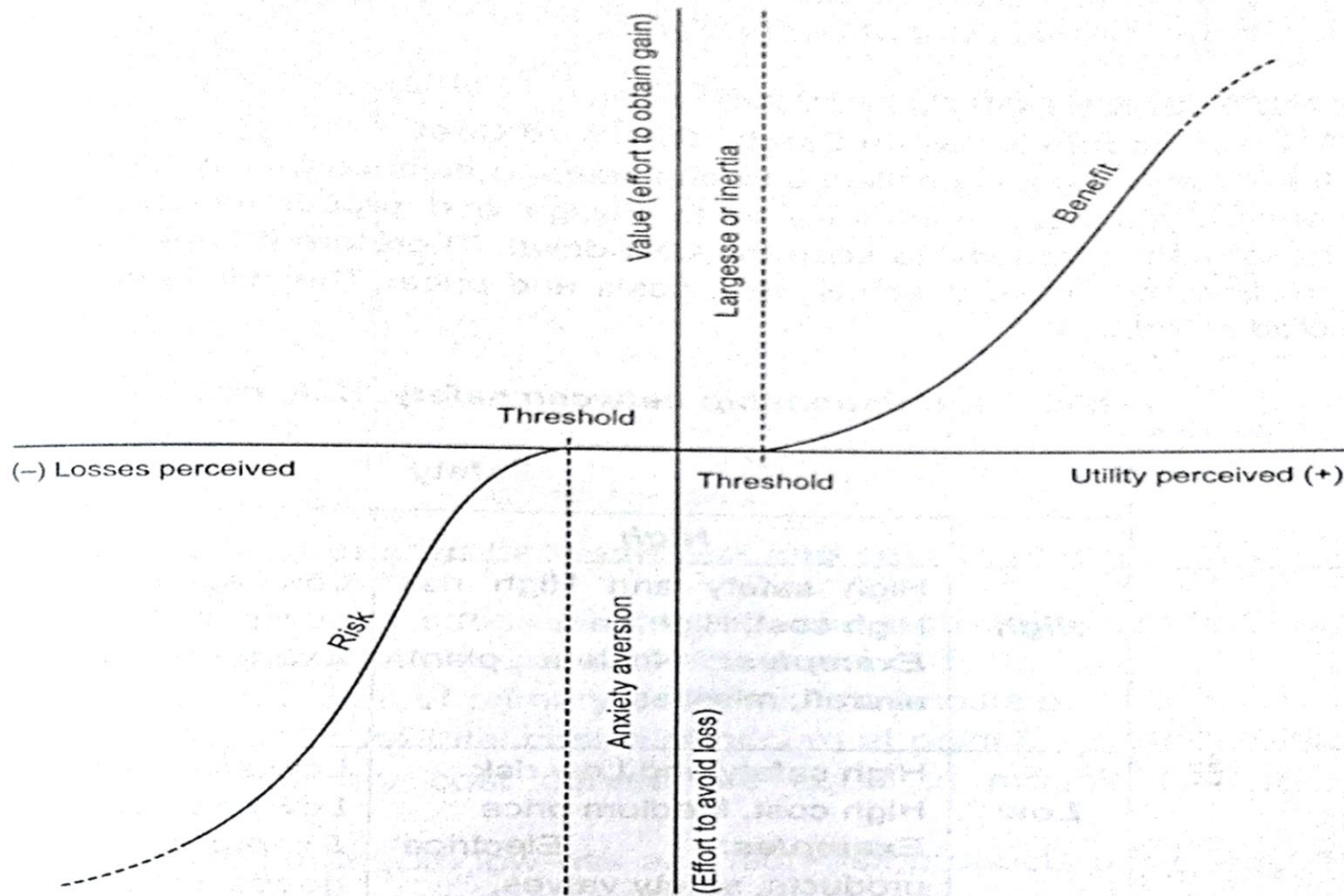
# Lessons for the engineers

- 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 <b>Examples:</b> Nuclear plant, aircraft, missiles.	Low safety and High risk Low cost, High price <b>Example:</b> Automobiles.
	Low	High safety and Low risk High cost, Medium price <b>Examples:</b> Electrical products, safety valves.	Low safety and Low risk Low cost, Low price <b>Examples:</b> Electronic goods, computers.

# Assessment of Safety & Risk

## ■ Primary Cost:

- Production cost & Cost of Safety

## ■ Secondary Cost

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

