

# UCS1704 – Management and Ethical Practices

## UNIT – IV

### Risk Benefit Analysis and Reducing Risk

Semester – VII

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# 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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# Determination of RISK

- In order to determine the risk one should have knowledge about the following criteria
  - 1. Knowledge of Risk
    - To assess risk, an engineer must identify risk, for that he must first know the information about the safety of standard products
    - The past experience and historical data provide good information
    - But historical data is inadequate
      - The information is not freely shared among firms
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# Determination of RISK

## ■ 2. Uncertainties in Design

- ❑ While designing a product, the design engineers must deal with uncertainties
- ❑ The uncertainties are in the form of product, materials used, economic conditions, temperature etc.,
- ❑ The 'Factor of safety' is proposed to account for unpredictably high loads . It must follow
- ❑ A product is said to be safe if its capability exceeds its duty

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# Determination of RISK

## 3. Testing For Safety

- Once the product is designed, both prototypes and finished devices must be thoroughly tested
  - It is essential that in engineering design, all the safety systems to be tested
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# Determination of RISK

## Different Approaches in testing

### ■ Scenario Analysis

- The test starts from the given event, then studies the different moments that might develop from it

### ■ Failure Modes & Effective Analysis

- It systematically examines each and every components without focusing on relationship among the elements of complex system

### ■ Fault Tree Analysis(\*\*\*)

- This approach propose system failure and then traces the events back to possible causes at component level

### ■ Event Free Analysis

- This is the reverse of the fault free analysis.
- Mathematical oriented version of Testing
- This analysis is very useful in identifying a potentially hazardous situation a plant

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# Risk Benefit Analysis

- It is technique, used to analyze the risk in project and to determine whether the project should be carried out or not
  - It answers the following questions
    - What are the benefits of product/project?
    - Is the project is worth for the risk?
    - Do benefits balance the risk?
  - Everyone is ready to accept certain level of risks
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# Conceptual difficulties in Risk-Benefit Analysis

- Both risks and benefits very difficult to calculate because lie *in future (uncertainties)*
- Ensure who takes risk are to be enjoy benefit
- It is difficult to express both risk and benefits is a common set of units.



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# Ethical implications on Risk- Benefit Analysis

- While performing Risk –benefit analysis, one should keep in mind the following ethical questions:
    - ❑ Under what condition, someone in society is entitled to impose a risk in someone else on behalf of supposed benefit to others?
    - ❑ How can we consider the worst case scenarios of persons exposed to maximum risks while they are obtaining only minimum benefits?
    - ❑ Are their rights violated?
    - ❑ Are they provided safer alternatives?
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# Personal Risk

- If sufficient information is given to a person, he can able to decide whether to participate in a risky activity or not.
- Many experiments concluded- individuals are willing to face voluntary risks than involuntary risks
- They are difficult to assess
- Examples:
  - A person living near chemical plant
  - A Person working in nuclear plant

# Assessing personal risk

- Answer following ethical questions
  - How to assess the money value of an individual's life?
  - On what basis, the compensation for a risk can be decided?
  - Is the compensation justifiable?
  - What will be the compensation if the tolerance level is above the tolerance level?

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# Minimize the difficulties in personal risk

- Life insurance
- Increased wages

# Public Risk and public acceptance

- Public Risk can be easily determine than personal Risk
- Assessment studies related to technological safety can be conducted for public risk
- According to National Highways Traffic safety Administration(NHTSA) has emphasized following two points
  - A value of human life can be estimated based on loss of future income and other costs associated with an accident
  - A estimate of quantifiable losses in social welfare is not based on maximum expenditure allocated to save a life

# Accounting publicly for Benefits and Risks

- Public accountability for risk has been affected by the following problems
  - An expert or even group of experts cant be expected to know everything
  - The uncertainties produced by scientist and **regulators\*** also infects the risk regulation
  - Since the origins of risk vary depending on how the facts are presented, therefore special cause should be given when starting probabilities if rare events
  - (*\*regulator- who assure the public that there are no risk, but they know that the answer are not at hand*)

# Accounting publicly for Benefits and Risks

Public accountability for risks faces several challenges:

1. **Experts Can't Know Everything:** Experts, or even a group of them, can't be expected to have complete knowledge about all risks.
2. **Uncertainties in Risk Regulation:** Uncertainties introduced by scientists and regulators can complicate risk regulation and assessment.
3. **Presentation of Facts Affects Risk:** How risks are presented can vary, leading to different perceptions of risk. Special consideration is needed when estimating probabilities for rare events.

# Becoming responsible engineers regarding risks



- Engineer can provide background material to prove the faulty positions
- Engineers should actively participate in debates related to safety and risks
- Engineers should always insist on meaningful numbers and figures when assessing safety and risk
- Engineers should also recognize previously mentioned difficulties with measuring risk and benefits
- Engineers should not be influenced by any influential lobby or trade organization
- Engineers need to be sensitive to various quantitative value judgement related with human and ethical values
- Engineers should be aware at the legal liabilities regarding risk.



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# Becoming responsible engineers regarding risks

1. Providing Evidence: Engineers should offer supporting information to identify faulty positions or decisions related to risks.
  2. Active Participation: Engineers should actively engage in discussions and debates about safety and risks.
  3. Demand Meaningful Data: Engineers should insist on accurate and meaningful numbers and figures when assessing safety and risk.
  4. Acknowledge Measurement Challenges: Engineers should recognize the challenges associated with measuring both risks and benefits.
  5. Independence from Influence: Engineers should not be swayed by influential lobbies or trade organizations, ensuring unbiased decision-making.
  6. Consider Human and Ethical Values: Engineers should be sensitive to various value judgments related to human and ethical values in their work.
  7. Legal Awareness: Engineers should be aware of legal liabilities associated with managing and mitigating risks.
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# Reducing Risk

- It is impossible to design and manufacture anything to be completely risk free
- Engineers responsibility to explore all the possible ways to reduce the risk under the given financial and time constraint
- Risk Management: Eradication or minimization of the adverse effects of the pure risks to which an organization is exposed
- Elements of Risk management Programme:
  - Risk identification
  - Risk Evaluation( Risk measurement)
  - Risk Control

# Elements of Risk Management

## ■ Risk Identification

- Risk can be identified by various techniques such as physical inspection, safety audit, job-safety analysis, management and worker discussions,& historical data analysis

## ■ Risk Evaluation

- Risk can be evaluated on the basis of economic, social or legal considerations
- Economic and social considerations include financial aspects, uninsured cost of accidents, insurance premium, overall effect of profitability, possible loss of production
- Legal considerations include possible health and safety law, code of practice, guidance notes & accepted standards, fire prevention, pollution and product liability

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# Elements of Risk Management

## Risk Control

- ❑ Risk control consists of 4 areas

### 1. Risk Avoidance

- ❑ It refers to the conscious decision by the management to avoid completely a particular risk by discontinuing the operation producing risk

### 2. Risk retention

- ❑ Retaining a particular risk for which any consequent loss is financed by organization

### 3. Risk transfer

- ❑ Legal assignment of cost of certain potential losses from one party to another (insurance)

### 4. Risk reduction

- ❑ Reduction or elimination of all aspect of accidental loss lead to wastage of an organizations assets.
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# Three approaches to acceptable risk

- The Experts Approach
  - The Layperson's Approach
  - The Government Regulator's Approach
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# Experts Approach to Acceptable Risk

- Identifying risk:
  - Utilitarianism and acceptable risk
  - Risk as maximizing benefit
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# Identifying risk

- concept of risk involves adverse effect or **harm**.  
Harm is a limitation of a persons freedom or well being. (physical well being, psychological well being, economical well being)
  - Risk can be defined as: “a compound measure of the probability and magnitude of adverse effect”  
(William W. Lowrance)
  - We can add : “probability of death or injury”
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## Utilitarianism and Acceptable risk

- The experts approach to risk is usually utilitarian. That the answer to any moral question is to be found by determining the course of action that maximizes well being.
- Cost/benefit technique is often called risk/benefit analysis. Cost is measured in terms of risk of deaths, injuries, or other harms associated with a given course of action.

\* Utilitarian - Practical

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# Risk as maximizing benefit

- An acceptable risk is one of where , given the options available, the risk of harm is at least equaled by the probability of producing benefit.

Limitations: (that will yield the cost/benefit approach inconclusive)

- It might not be possible to anticipate all of the costs and benefits associated with each option
- It is not always possible to translate all of the risks and benefits into monetary terms. What is the monetary value of human life?
- The method makes no allowances for the distributions of costs and benefits.
- The method gives no place for informed consent to the risk imposed by technology.

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# The Laypersons Approach to Acceptable Risk

- Expert and Layperson

Public is sometimes mistaken in estimating the probability of death and injury from various activities of technology. Experts and lay person understand risk differently.

- Informed consent and justice: lay person approach follows more closely the ethics of respect of persons than utilitarianism.

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## Free and informed consent and compensation

Three necessities to give free and informed consent to the risks imposed by technology:

- A person must not be forced
  - A person must have the relative information
  - A person must be rational and competent enough to evaluate the information.
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## Lay criterion of acceptable risk:

An acceptable risk is one in which risk is freely assumed by free and informed consent, or properly compensated, and which is justly distributed.

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# The Government Regulator's Approach to Risk

- An acceptable risk is one in which protecting the public from harm has been weighted more heavily than benefiting the public.
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## Three approaches to acceptable risk

- **Risk Expert**: wants to balance risk and benefit in a way that optimizes overall public well-being.
  - **Layperson**: wants to protect himself or herself from risk.
  - **The government regulator**: wants as much assurance as possible that the public is not being exposed to unexpected harm.
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# Becoming a Responsible Engineer Regarding Risk

Includes to be aware

- that risk is often difficult to estimate
  - that there are different approaches to the determination of acceptable risk
  - of the legal liabilities regarding risk.
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## (A more general) Principle of Acceptable Risk

- People should be protected from the harmful effects of technology, especially when the harms are not consented to or when they are unjustly distributed, accept that this protection must sometimes be balanced against (1) the need to preserve great and irreplaceable benefits and (2) the limitations on our ability to obtain informed consent.

### Principle of Acceptable Risk:

1. Protect People: Ensure people are shielded from the negative impacts of technology, particularly when they haven't agreed to these harms or when they're unfairly distributed.
2. Balance Protection: Recognize that this protection must be balanced against the need to preserve significant and irreplaceable benefits.
3. Informed Consent Limitations: Acknowledge the limitations on our ability to obtain informed consent in certain situations.



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# Bhopal Gas Tragedy

- On December 3, 1984, Union Carbide's pesticide-manufacturing plant in Bhopal, India leaked 40 tons of the deadly gas, methyl isocyanate into a sleeping, impoverished community - killing 2,500 within a few days, 10000 permanently disabled and injuring 100,000 people. Ten years later, it increased to 4000 to 7000 deaths and injuries to 600,000.
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## ***Risks taken:***

- Storage tank of Methyl Isocyanate gas was filled to *more than 75% capacity* as against Union Carbide's spec. that it should *never be more than 60% full*.
  - The company's West Virginia plant was controlling the safety systems and *detected leakages thro' computers* but the Bhopal plant *only used manual labour for control and leak detection*.
  - The Methyl Isocyanate gas, being highly concentrated, *burns parts of body* with which it comes into contact, even *blinding eyes and destroying lungs*.
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## Causal Factors:

- Three protective systems *out of service*
  - Plant was *understaffed* due to costs.
  - Very *high inventory of MIC*, an extremely toxic material.
  - The accident occurred in the *early morning*.
  - Most of the people killed lived in a shanty (poorly built) town located very close to the plant fence.
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