Engineering as Social Experimentation

Module -III

Can we consider engineering as an experiment??

If so, how it is similar to standard experiment ??

What factors make engineering projects different from standard experiments??

As an engineer, what factors state your responsibilities to the society?

Need for engineering as an *experimental* process

- The *Titanic* the greatest engineering achievement ever
  - haunting image of technological complacency
    - **for 3,547 passengers and crew, only 825 lifeboats**

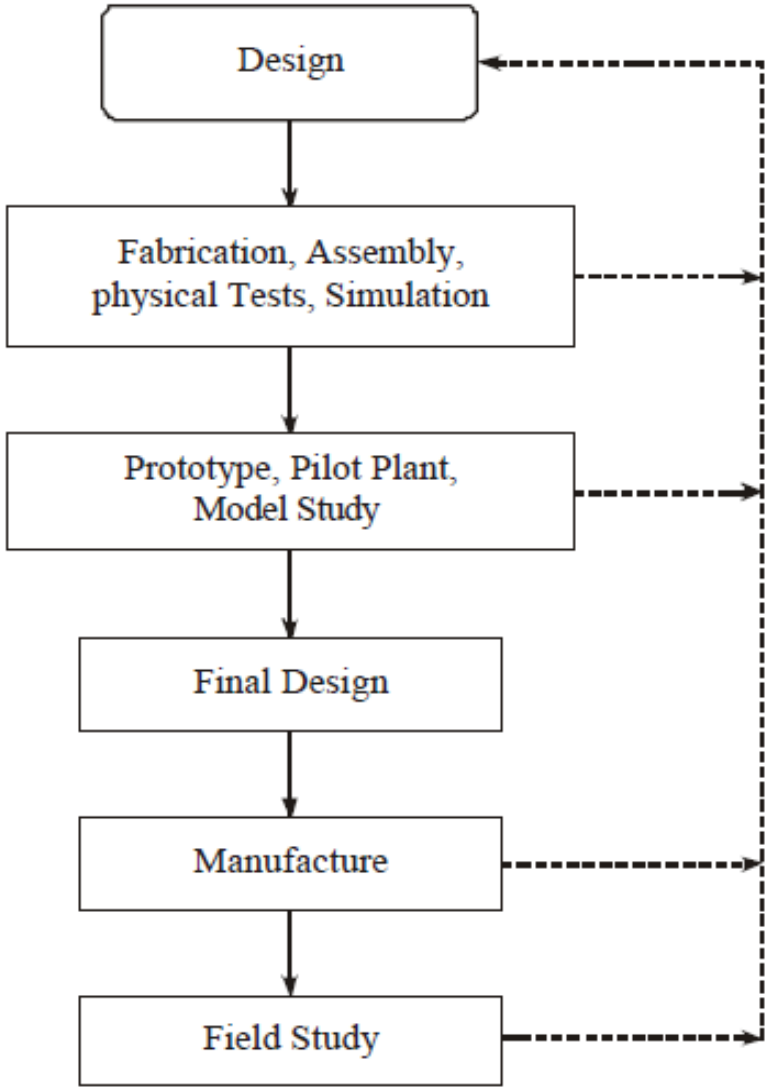
- **Lesson learned :**
  - **engineering should be regarded as an inherently risky activity**.

- To explore ethical implications in engineering
  - engineering to be viewed as an ***experimental*** process
  - an experiment on a social scale involving human subjects.

Engineering – an Iterative Process

Experimentation plays an essential role in the design process.

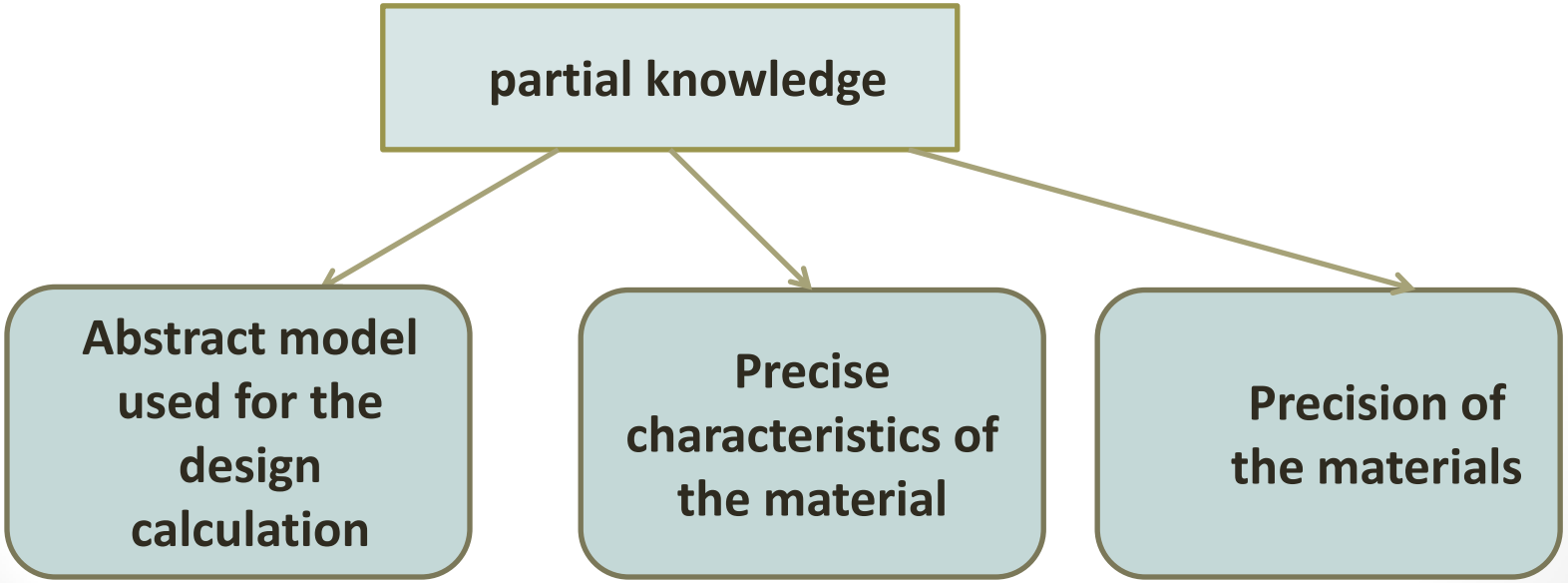
Trial designs with modifications being made on the basis of **feedback information** acquired from tests.



Engineering Projects vs Standard Experiments (Similarities)

- **Partial ignorance**

engineer's success lies precisely in the ability to accomplish tasks safely with only a partial knowledge of scientific laws about nature and society.



Engineering Projects vs Standard Experiments (Similarities)

- **Uncertainty: standard experiment**

Rubber egg

Follow these instructions to make an egg bounce while learning about chemical reactions.

You will need

Equipment needed for this activity includes:

- hard-boiled egg, with shell on
- glass of vinegar.

Engineering Projects vs Standard Experiments (Similarities)

- **Uncertainty:**
  - the final outcomes of engineering projects are uncertain
    - A reservoir may do damage to a region or to its ecosystem.
    - Development of a pesticide can put humans in danger.

Endosulfan tragedy

A pesticide developed in **1954** that is used for farming.

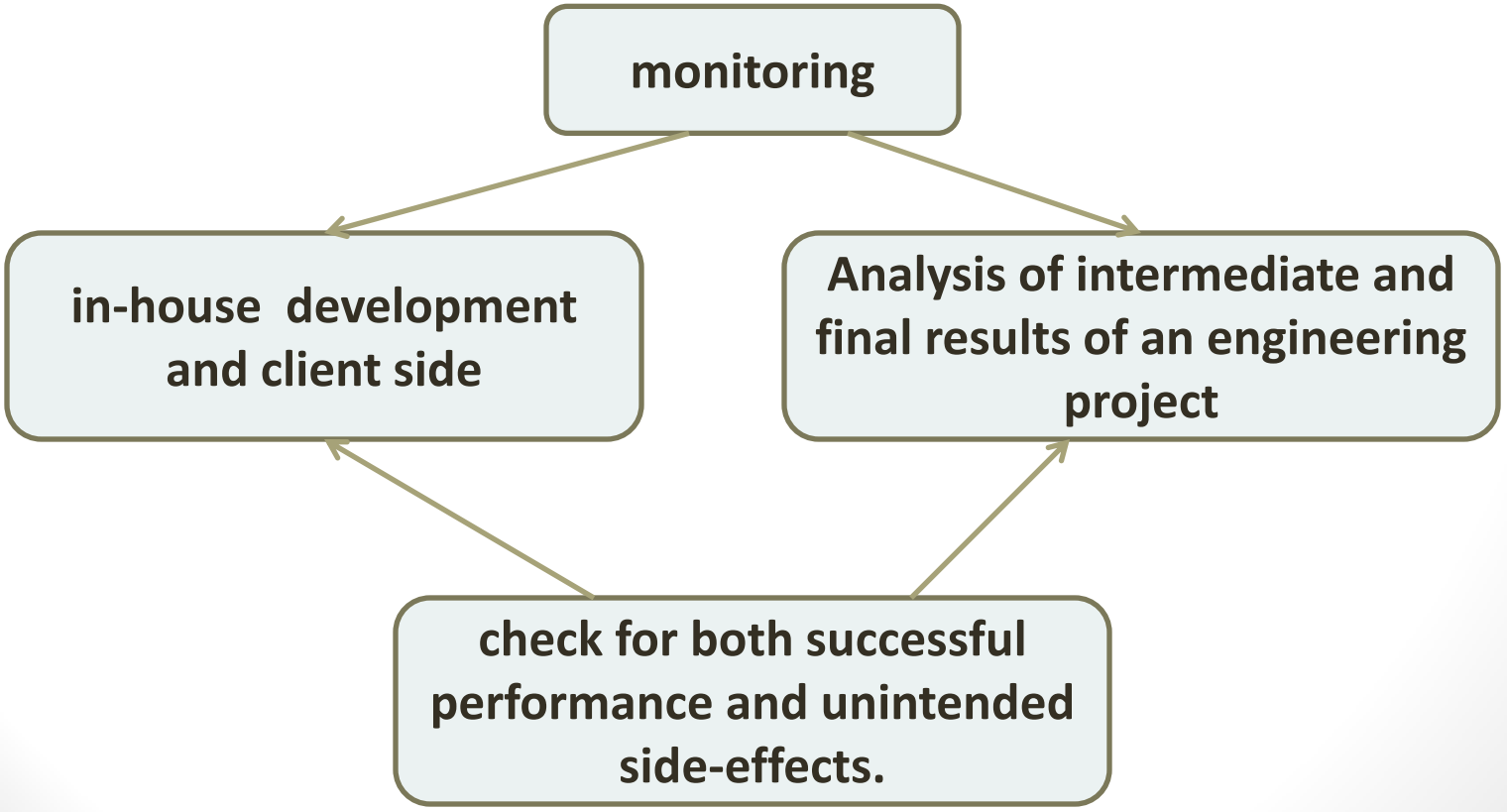
In **2001**, tests carried out by the Centre for Science and Environment in Kasargod confirmed **the deadly effects of the pesticide.**

developmental damage in human beings and animals.

Engineering Projects vs Standard Experiments (Similarities)

- **Continuous monitoring:**

effective engineering relies on knowledge needed for improving current products and creating better ones.



Engineering Projects vs Standard Experiments (Similarities)

- ***Learning from the past*:**
- **past mistakes always repeat due to**
  - lack of communication
  - misplaced pride for information
  - embarrassment at failure
  - plain neglect

The complacency that past events will not happen again and will not happen 'to me' has lead to many disasters.

Engineering Projects vs Standard Experiments (Contrasts)

Exploring the differences over experiments highlight the engineer's special responsibilities.

- **Experimental Control:**

Standard Experiment

- Random selection of members to form groups
  - Controlled
  - Uncontrolled
- Can give the experimental

  treatment for one group

Engineering Experiment

- experimental subjects are out of the experimenter's control
  - human beings
  - finished and sold products
- Should use historical and retrospective data about various groups that use the product.

Engineering Projects vs Standard Experiments (Contrasts)

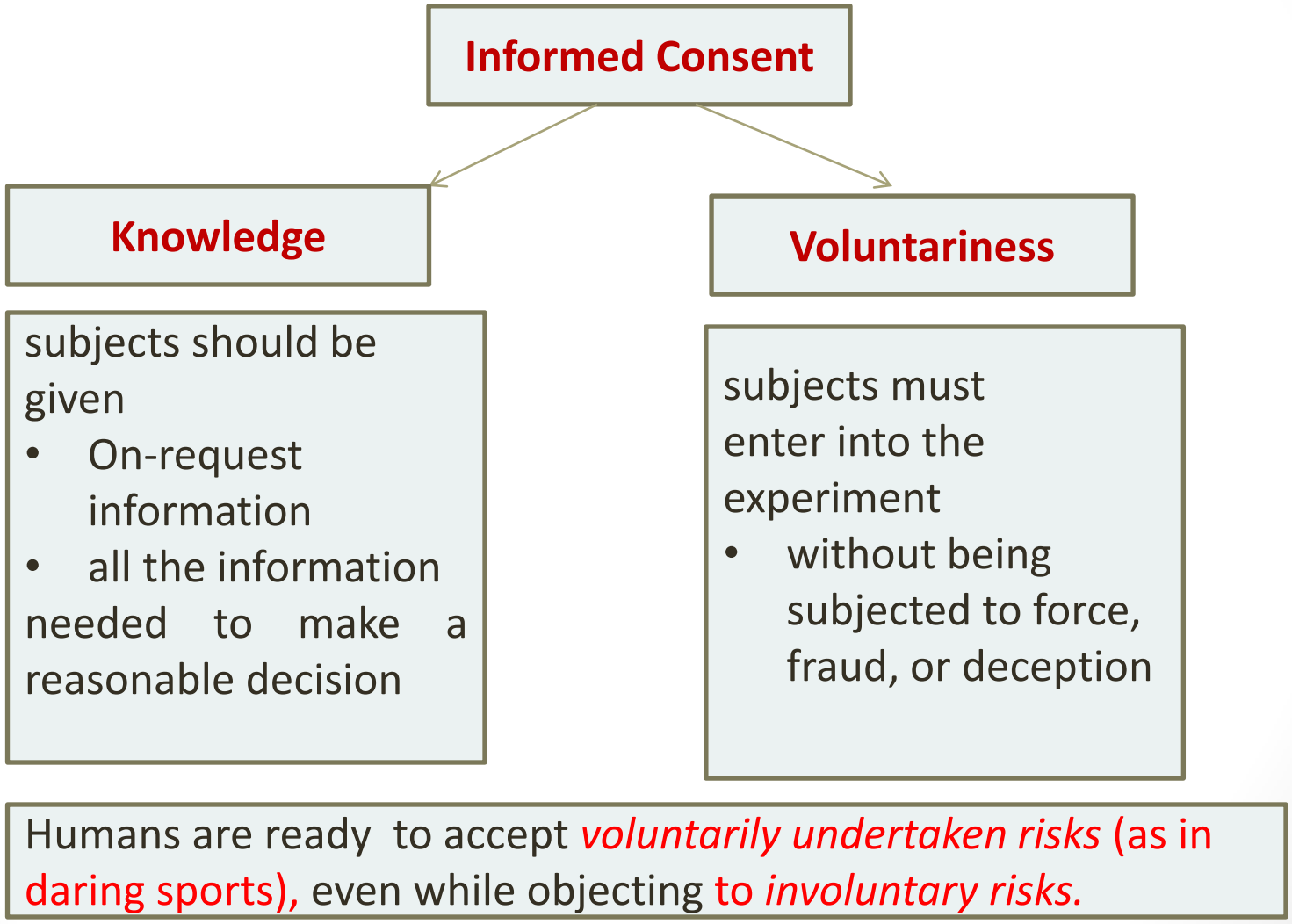
- ***Informed Consent***

  current medical practice accept subject's moral and legal rights to give informed consent before participating in an experiment

- **What about Engineering experiments ?**
- Manufacturer selling a new device to a knowledgeable firm
  - uses an agreement regarding the shared risks and benefits of trying out the technological innovation.

Informed Consent

Engineering Projects vs Standard Experiments (Contrasts)



Humans are ready to accept *voluntarily undertaken risks* (as in daring sports), even while objecting to *involuntary risks.*

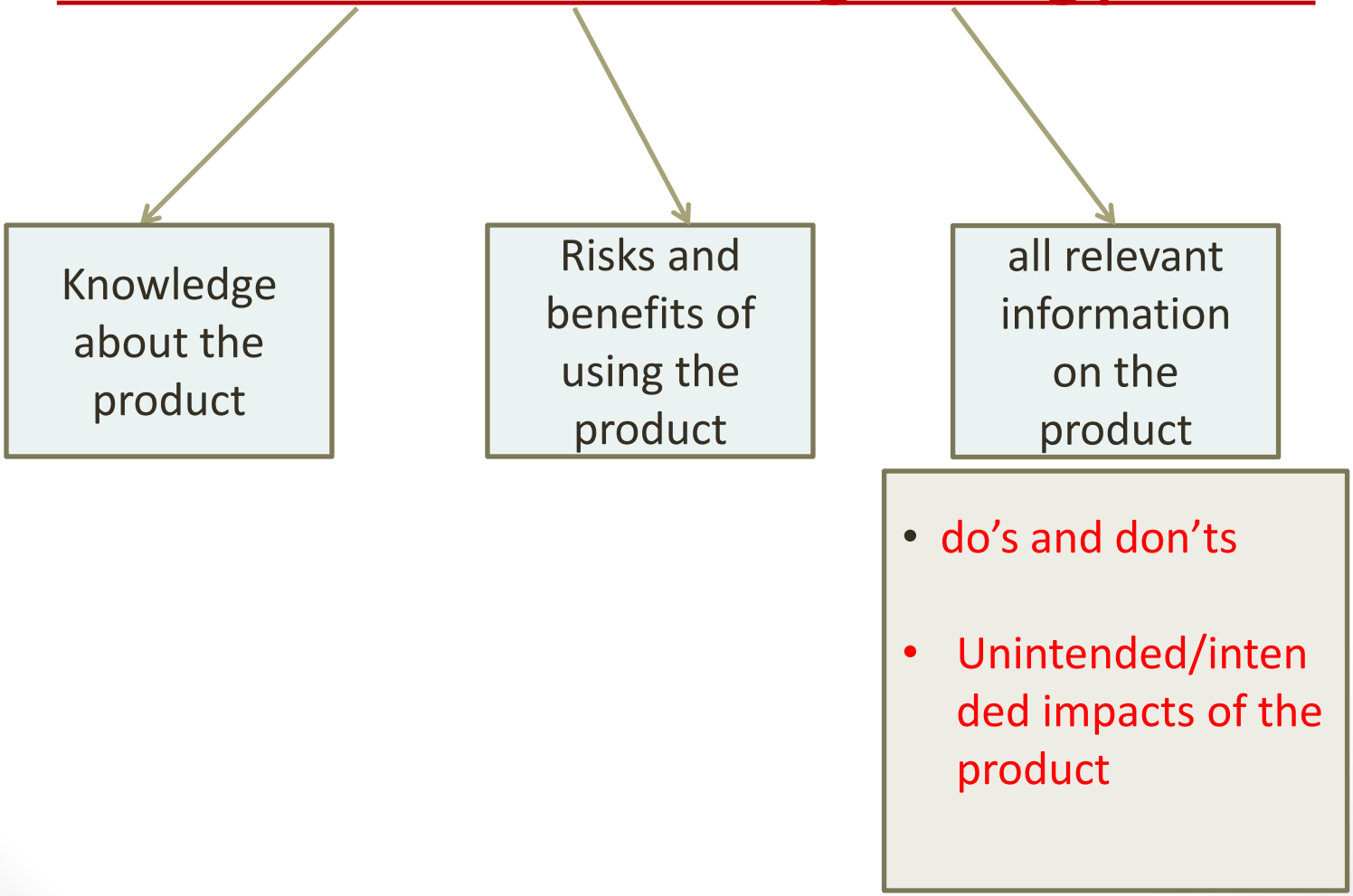
Engineering Projects vs Standard Experiments (Contrasts)

Conditions for an informed consent

(valid consent)

- consent must be voluntary
- information shall be presented/stated in a clearly understandable form
- Consenter shall be capable of processing the information and make rational decisions.
- The subject's consent may be offered in proxy by a group that represents many subjects of like-interests

Engineering Projects vs Standard Experiments (Contrasts)



Engineering Projects vs Standard Experiments (Contrasts)

- **Knowledge Gain**

  "engineering projects are experiments that are not necessarily designed to produce very much knowledge" Taft Broome

- **knowledge gain in engineering experiments**
  - verify the adequacy of the design
  - check the stability of the design parameters
  - prepare for the unexpected outcomes, in the actual field environments.

ENGINEERS AS RESPONSIBLE EXPERIMENTERS

Engineers as responsible experimenters

Responsibilities :

- **Conscientiousness**
  - commitment to live by moral values.
- **Comprehensive perspective**
  - constant awareness of the progress of the experiment and readiness to monitor the side effects, if any.
- **Autonomy**
  - Unrestricted free-personal involvement in all steps of the project/product development.
- **Accountability**
  - Be accountable for the results of the project.

Engineers as responsible experimenters

- **Conscientiousness**
  - sensitive to moral values and responsibilities relevant to the prevailing situation
    - protect the safety of human subjects
    - respect their right of consent
      - through voluntary and informed consent
  - engineers must possess consciousness
    - open eyes, open ears, and an open mind
    - moral vision, moral listening, and moral reasoning
  - the willingness to develop the skill and put efforts needed to reach the best balance possible.

Engineers as responsible experimenters

- **Comprehensive Perspective**

  Conscientiousness is blind without relevant factual information

- An engineer should be commitment to obtain and properly assess all available information that is pertinent to meeting moral obligations

- view his or her specialized activities in a project as part of a larger whole having a social impact.

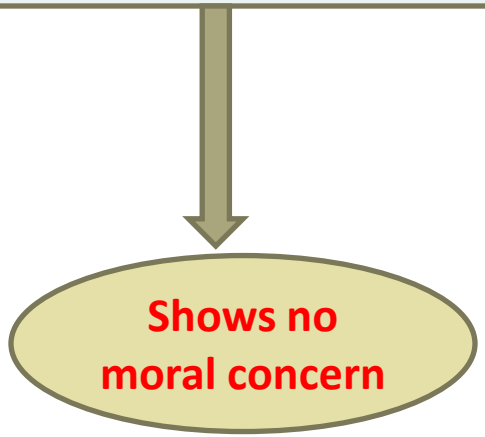
- constant effort to imaginatively foresee dangers.

Engineers as responsible experimenters

- **Comprehensive Perspective** (A scenario)

A company produce mobile phones that promote unnecessary energy usage.

Possible scenario: Putting the burden on the sales department: "Let them inform the customers—if the customers ask."



Engineers as responsible experimenters

- **Moral Autonomy**

  Moral beliefs and attitudes should be held on the basis of critical reflection rather than passive adoption of the particular conventions of one's society, church, or profession

- People are **morally autonomous** when their moral conduct and principles of action are their own.

High-technology firm should grant its engineers a great deal of freedom in exercising their professional judgment on moral and technical issues relevant to their jobs.

Engineers as responsible experimenters

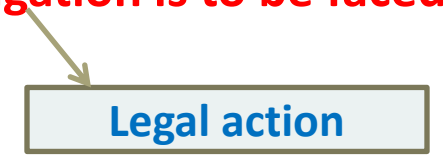
- **Accountability**

General disposition of being willing to submit one's actions to moral scrutiny and be open and responsive to the assessments of others

Engineers as responsible experimenters

- In the engineering practice, **the problems that lessens personal accountability are**

  - **fragmentation of work in a project**
    - inevitably makes the final products lie away from the immediate work place
  - **responsibilities diffuse into various hierarchies**
    - Nobody gets the real feel of personal responsibility
  - **projects executions one after another**
    - employees focus more on adherence of tight schedules rather than giving personal care for the project
  - **More litigation is to be faced by the engineers**



Thank you ☺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