SISTEM MODELING

Materi 1
System

SYSTEM

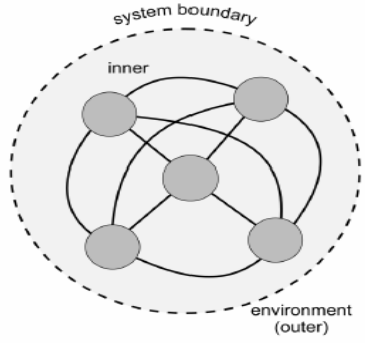
Definition:

- A system is understood to be a whole composed of elements that are related to each other.
- The cohesion will emerge from the fact that the elements are linked together by their relations.
- Briefly defined, one might say that a system is a collection of elements in their entirety and the relations between them.

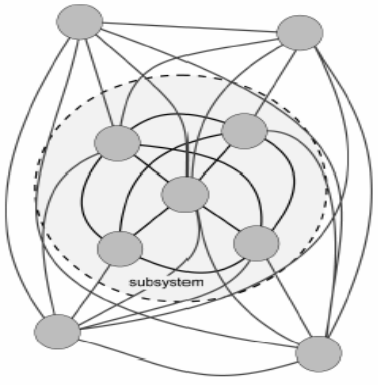
SYSTEM

- Theory: General system theory (L.V Bertalanffy,1956)
- Symbolization of the concept system
  - –Inner-System Boundary-Outer (Environment)
- Open system vs. Closed system
- Content of the system:
  - The complete collection of all elements without the interrelations of these elements being taken into consideration
- Structure of the system
  - Consists of the pattern of these relations
- Subsystem
  - A partial collection of the elements of the system

System (Inner-Outer)



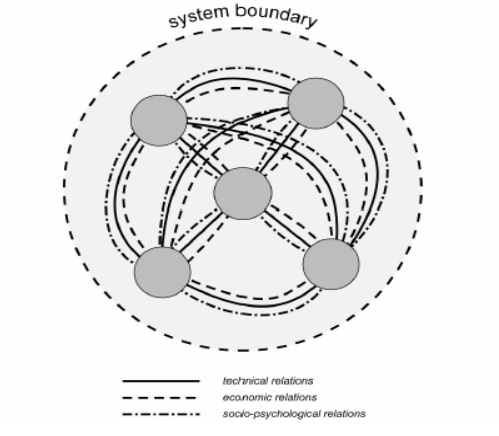
Sub-System



Elements and the Relations between Elements

- Elements of a system are characterised by certain features –e.g.
  - physical,geometrical,aesthetic,social-psychological or economic
- If a relationship exists between one or more elements then if the characteristics of those elements change then the other elements will similarly change
- Relations between the elements are indicated by means of a simple line.
- Relations can be in terms of technical, economic, socio-psychological aspects.

System: Relationship between Elements



System thinking

- **Thinking in terms of systems** -as opposed to seeing snapshots or discrete events with little or no interrelationship.
- Peter Senge, in his bestselling book The Fifth Discipline: describes how our mental models, or personal paradigms, are often developed from **our tendency to break down large problems into smaller manageable parts.**
- In doing this, we end up **mentally isolating events** and actions, mostly because their causes and effects are often widely separated in time and space.

Why we need Systems Thinking

- Senge views **the problem as systemic in nature** and not easily or quickly overcome in organizations.
- The core of the problem is that our world is one of dynamic complexity, the mastery of which **cannot be achieved by focusing on details alone** without **systems fluency**.
- Senge describes a simulation, called The Beer Game. The game clearly demonstrates how experienced decision-makers **can fall into a trap of thinking of their actions as isolated** and helps them to better understand their roles within systems.

System thinking

- System thinking: Thinking in terms of systems
- System thinking: A problem methodology approach
- System thinking: Observing is viewed as mental activity –Mental Model

System:Mental Model

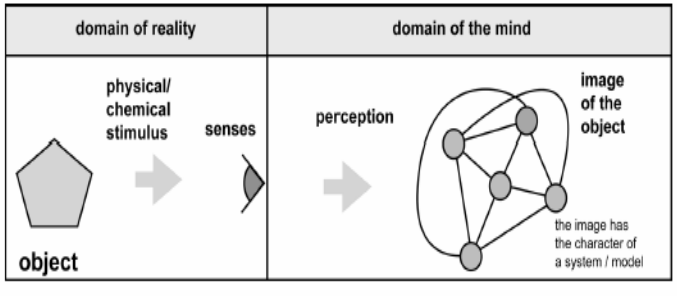
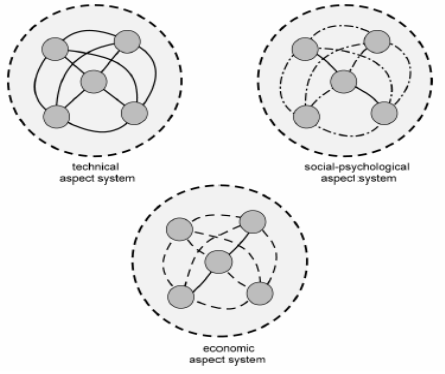


Figure 3.1 Image forming.

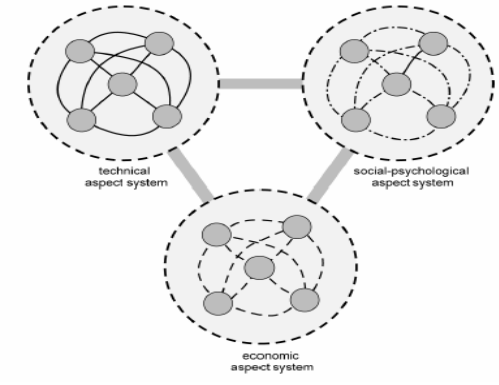
Aspects System

- Represents a partial collection of the system relation
- There are various aspects of system –e.g. technical, economic, socio-psychological aspects
- The various aspects have been connected together by means of what are termed interrelations (A multi-aspect system)
- Interrelations are seen as the relations between the different aspect systems distinguishable within the original system
- In a multi-aspect system: We need to put together the partial problem analyses to form

Multi-Aspect System: 3 Independent Aspects



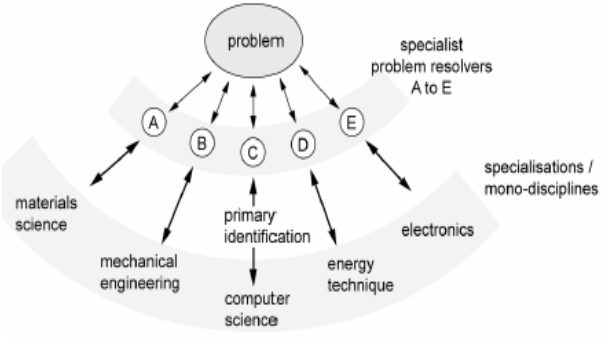
Integrated System



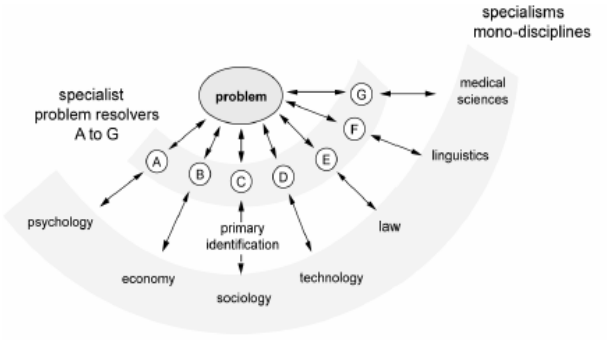
Multi-Disciplinary Approach

- A mono-disciplinist is seen as someone with specialist knowledge in the area of a single – mono-discipline (He will only be able to construe a mono-aspect view)
- With increasing complexity of technical system and increase in the number of relevant aspects – This needs A Multi-Disciplinary Approach
- A Multi-Disciplinary Approach demands **integrative skills** from the problem solver or project manager

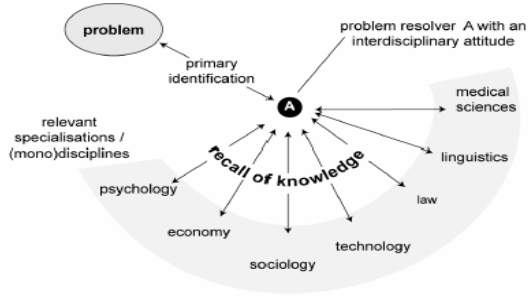
Example-1: Multi Disciplinary Approach For A Multi-Aspect Problem



Example-2: Multi Disciplinary Approach For A Multi-Aspect Problem



Example-3: An Interdisciplinary Approach For A Multi-Aspect Problem



Industrial Engineering (IE)

According to IIE:

"Industrial engineering is concerned with the design, improvement and installation of ***integrated systems*** of people, material, information, equipment and energy. It draws specialized knowledge and skills in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and ***design specify, predict and evaluate*** the results to be obtained from such systems."

What Does IE Do?

IE is about making ***decisions*** in complex systems

Design
Planning
Control
Improvement

Typical IE Questions

- Is the system providing the best possible **economic return to its owners**?
- Are some products **not economically viable**? Which ones?
- Are resources being **utilized appropriately**? Where is capacity excessive or inadequate?
- Is the **mix of resources** appropriate? Are new technologies needed?
- Are the resources **organized and managed** properly?
- Are suppliers' **prices, terms, delivery, and quality** appropriate?
- Are the products/services **meeting customers' needs**? How could they be improved?

To answer these questions

- Must consider ***economics***--money
- Must consider ***people***--organizations and individuals
- Must consider the entire "system"--complex ***network of entities*** and attributes
- Must consider ***trade-offs between criteria***
- Must consider ***constraints***
- Must consider ***risk and uncertainty***

Needs A Comprehensive Approach: Systems Modelling

To answer these questions:

Create narrative, abstract, mathematical, and computational ***models*** of the decisions