SOCIO-TECHNICAL SYSTEMS

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Chapter 2 Page 20

What is a socio-technical system?

A system which includes:

- People
- Software
- hardware

We use the term ***System*** universally:

- Computer system
- Operating systems
- Payment systems
- Educational system
- Government system
- etc.

All use the word ***system*** but in different contexts

We are concerned with systems that:

- Include computers as opposed to abstract systems (Government system)
- Have a specific purpose
  - Enable communication
  - Support navigation
  - Compute salaries/Process a sale/Game Playing

Such systems might be defined as:

A system is a purposeful collection of interrelated components that work together to achieve some object

For Example:

- A very simple system: A ***Pen***, which has only three or four hardware components
  - Shaft, nib, ink cartridge

- A very complex system such as an ***air traffic control*** system which has ***thousands*** of hardware and software components plus people who make decisions based on information from the computer system

Systems which include software can be categorised as:

- Technical computer-based systems
- Socio-technical systems

Technical Computer-based System

Include:

- Hardware
- Software

Does NOT include:

- Procedures
- processes

Examples:

- Televisions
- Mobile phones
- PC

Such systems are used by individuals and organisations to achieve some purpose – knowledge of the purpose is not part of the system (e.g. WP not aware that it is being used to write a book)

Socio-technical System

Include:

- One or more technical systems
- Knowledge of how system should be used to achieve objectives

Such systems:

- Have defined operational processes
- Include people
- Are governed by policies and rules
- May be affected by external constraints

Socio-technical System: External Characteristics

1. Have emergent properties

Properties of system as a whole rather than with individual parts of the system.

Emergent properties depend on both the system components and the relationships between them.

Can only be evaluated when the system is assembled.

2. Are often Nondeterministic

A system in which the output cannot be predicted because there are multiple possible outcomes for each input

When presented with a specific input, may not always produce the same output.

System's behaviour is dependent on human operators, who do not always react in same way, and may change emergent behaviour

3. Varied support for organisation's objectives

Extent to which system supports organisational objectives depends on:

- Stability of objectives
- Relationships and conflicts between organisational objectives
- How people interpret these objectives

re-interpretation of an objective may result in a successful system becoming a failure.

- System properties and behaviour of components are intermingled. Successful functioning of one component depends on functioning of other components

- Systems are usually hierarchical – contain other systems (sub-systems).

  For example: A police command/control system might contain a geographical information system to provide details of location of incidents

  Sub-systems can operate as independent systems and so may generally be used in several different systems

Emergent Properties

There are two types of emergent properties:

- Functional emergent properties
- Non-functional emergent properties

Functional emergent properties appear when all parts of a system work together to achieve some goal.

For example: a bicycle has the functional property of being a transportation device once it has been assembled from its components

Non-Functional emergent properties relate to the behaviour of a system in its operational environment.

Examples:

- Reliability
- Performance
- Safety
- Security

Emergent properties are complex.

Reliability must be considered at system level rather than at individual component level.

Components in a system are interdependent – failures in one component can affect the operation of other components.

Three related influences on overall system reliability:

1. Hardware reliability: what is the probability of a HW component failing and how long does it take to repair??
2. Software reliability: how likely is it that a SW component will produce an incorrect result? Will not cause a system to crash; will carry on working after incorrect result is produced.
3. Operator reliability: How likely is it that an operator will make an error?

Emergent properties such as performance or usability are difficult to assess. Such properties can be ***measured*** after the system is operational.

Properties such as safety and security bring different problems. Here, we are concerned with behaviour that the system should NOT exhibit.

Can not predict all possible modes of access to system data and explicitly forbid them.

Can only assess this property by default.

Know that a system is insecure only when someone breaks into it.

Systems Engineering

The activity of:

- Specifying
- Designing
- Implementing
- Validating
- Deploying
- Maintaining

Socio-technical systems

Systems Engineering phases