Systems Approaches to Information Systems
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Introductory Definitions
• **Data** – unstructured or raw facts
• **Information** – data processed to make it useful in decision making
• **Communication** - to transmit information, by speech, writing, signal, …

from *Information, Systems and Information Systems*, by Checkland and Holwell

Mathematical Theory of Communications
• Developed by Claude Shannon, 1949

Source – Develops information in form of message
Transmitter – Encodes message, into a signal, a format acceptable to communication channel
Channel – Path by which message is transferred from Source to Destination e.g. telephone wire, fiber optics, air (sound wave)
Receiver – Accepts signal from transmitter and decodes it into back into message
Destination – Accepts message from transmitter

• concept used to create and optimize most modern information systems *bandwidth, relays, transmitting and receiving, processing*

Definitions of Information Technology (IT) and Information Systems (IS)
• **Information Technology** - focused mainly on computer hardware and communication equipment and the transfer of information between them
  – Interested in microelectronics, software, telecommunications
• **Information Systems** – intersection of aspects of information technology and social & behavioral sciences

Two Methods for Handling
• Hard Systems Approach –
  – adoption of Herbert Simon’s management ideas to IS field
    • scientific approach to management of system, *The New Science of Management Decision, 1960*
    • founded on goal seeking nature of organizations, control theory, systems engineering, …
• Soft Systems Methodology (SSM) –
  – learning organization approach championed by G. Vickers
  – implementation and management of information system exhibits adaptive behavior

**Hard Systems Approach**

• Problem Definition
• Data Collection / Gap Assessment (information is received from the IS in this stage)
• Creating Alternative System Solutions
• Assessing Possible Outcomes
• Selecting System Solution
• Implementing System Solution (information for change may be released to IS at this stage)
• Monitoring System

reductionist by design

“Each problem generates sub-problems, until we find a sub-problem that we can solve. We proceed until, by successive solution of such sub-problems, we eventually achieve, our goal – or give up.” Simon, 1960

**Soft Systems Methodology**
Difference Between Hard and Soft Approaches

<table>
<thead>
<tr>
<th>Hard Systems Approach</th>
<th>Soft Systems Methodology</th>
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</thead>
<tbody>
<tr>
<td>- social entities achieving goals</td>
<td>- social entities managing relationships</td>
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<tr>
<td>- information system aids pursuit of goals</td>
<td>- information system helps interpret world, helps to manage relationship</td>
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<tr>
<td>- assumes a systemic world</td>
<td>- assumes a process of inquiry will shed light on a world that is capable of systemic organization</td>
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<tr>
<td>- research focused on hypothesis investigation</td>
<td>- research focused on the pursuit of insight and understanding</td>
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<td>- quantitative when possible</td>
<td>- more qualitative</td>
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(presenter and class expressed reservations on some of the comparisons made by this table from, *Information, Systems and Information Systems*, by Checkland and Holwell)

Examples Information System Development

- **Hard Systems Approach**
  - Design of corporate / public Information Systems
    - telephone networks, radio broadcasting, cable TV, corporate networks
  - Design of traditional control systems
    - chemical plants, utilities, …
  - Wiring systems in product design
    - electronics, computers, automobiles, …
- **Soft System Methodology**
  - Development of corporate Intranet Systems
  - Implementation of lean production systems
  - Evolution of communication technologies

Example of Information Systems for Electric Utilities

- **Prior to 1920**
  - Electric utilities were run locally
  - Information/Control system controlled single plants
- **1920 -1990**
  - Electric utilities organized into grids (networks)
  - Necessitated broader control, centralized command center for optimization of many plants as whole system
    - broader system level optimization, during periods of low load, efficient plants stay open, least efficient plants are cycled down
  - Introduction of new techniques to help balance loads all which require control and monitoring (information systems to operate)
    - local shut down of customer air conditioning during periods of high load, for lower rates
- use of storage of power during periods of low load, water pump storage
- shut down manufacturing facilities during high load periods, in return for lower rates

• 1990 –
  – Deregulation of utilities, new small entrants
    - Again monitoring and control systems to monitor who’s electricity is whose,
    - Utilities forced to share transmission capability
  – Integration of large networks, sharing of transmission
    - Utilities can sell power to customers 1000s of miles away, requires monitoring and control
  – creation of emergent behaviors challenges traditional control
    - flow of power in path clockwise around lake Erie between utility networks
    - problem Ohio power companies at times get electricity for free due to flow and trading
    - considering solution of phase offset to force power flow in counter clockwise path

Future Challenges for IS
• Introduction of new models of communication
  – independent agent models can better optimize flow of information on internet
  – similar to traffic flow in transportation systems
• Impact of rapid evolution information technology
  – research/model development much slower than changes in technology
• Challenges emergent behavior of information systems
  – Deregulation of communications and utilities
  – intellectual property concerns on the internet
  – old economy vs. new economy business models