

Systems and Systems Thinking

System concepts, complexity, cybernetics

Complexity

Difference between complex and complicated

- Complex systems
 - Self-organized without a central organizing authority
 - System elements in isolation are not descriptive of the system
- Complicated systems
 - Do not adapt, halts on key defect
- Engineering is about purpose -> Complicated systems are constructed
- Complex systems emerge and adapt

Systems theory: An Interdisciplinary field

Influences from psychology and biology, and GST

- In the 1920s biologists viewed organisms as sums of cells with a mechanistic approach
 - Ludwig von Bertalanffy found it odd that the lack of system in organisms was neglected and even denied
- Bertalanffy also found that there exists laws that apply to any system of a certain type
 - The particular properties or the elements involved are irrelevant
- The General System Theory aims at unifying principles and run «vertically» through the individual sciences
 - In term, this can bring us nearer to unifying science, and..
 - Minimize duplication of theoretical effort in different fields

Closed and Open Systems

- From Bertalanffy, closed systems are simply considered **isolated** from their environments
 - Now we consider closed systems to **only exchange energy/information** with its environments
- A closed system tends to a state of most probable distribution which is the state of maximum disorder and also maximum entropy
- In open systems there is a continuous inflow and outflow, build-up and breakdown of components
- An open system is never in the state of equilibrium but in the **steady state**
- Equifinality:
 - In open systems, the same final state can be achieved from different initial conditions, contrary to closed systems

Aims of Cybernetics

And history of the Complex system perspective

- Cybernetics is the science of **control** and communication
 - Co-ordination, regulation and control
 - Steermanship
- Cybernetics offers a **framework** in which all individual machines may be **ordered**, related and understood
- Cybernetics offers a single vocabulary and a single set of concepts for the most diverse types of **systems**
- In 1956, a complex system was treated as those systems that were so dynamic and interconnected that one could not alter one factor without causing alternations in other
 - As presented earlier, today, a complex system is interpreted as a **self-organized** system that emerges and **adapts**, that contains elements that are not descriptive of the system as a whole, in isolation