Systems thinking

From Wikipedia, the free encyclopedia

Systems thinking is any process of estimating or inferring how local policies, actions, or changes influence the state of the neighboring universe. It also can be defined, as an approach to problem solving, as viewing "problems" as parts of an overall system, rather than reacting to present outcomes or events and potentially contributing to further development of the undesired issue or problem.[1] Systems thinking is a framework that is based on the belief that the component parts of a system can best be understood in the context of relationships with each other and with other systems, rather than in isolation. The only way to fully understand why a problem or element occurs and persists is to understand the part in relation to the whole.[2] Standing in contrast to Descartes's scientific reductionism and philosophical analysis, it proposes to view systems in a holistic manner. Consistent with systems philosophy, systems thinking concerns an understanding of a system by examining the linkages and interactions between the elements that compose the entirety of the system.

Systems thinking attempts to illustrate that events are separated by distance and time and that small catalytic events can cause large changes in complex systems. Acknowledging that an improvement in one area of a system can adversely affect another area of the system, it promotes organizational communication at all levels in order to avoid the silo effect. Systems thinking techniques may be used to study any kind of system — natural, scientific, engineered, human, or conceptual.

Contents

- 1 The concept of a system
- 2 The systems approach
- 3 Applications
- 4 See also
- 5 Bibliography
- 6 References
- 7 External links

The concept of a system

Both systems thinkers and futurists consider that:

- a "system" is a dynamic and complex whole, interacting as a structured functional unit;
- energy, material and information flow among the different elements that compose the system;
- a system is a community situated within an environment;
- energy, material and information flow from and to the surrounding environment via semi-permeable membranes or boundaries;
- systems are often composed of entities seeking equilibrium but can exhibit oscillating, chaotic, or exponential behavior.

A holistic system is any set (group) of interdependent or temporally interacting parts. *Parts* are generally systems themselves and are composed of other parts, just as systems are generally parts or *holons* of other systems.

Systems and the application of systems thinking has been grouped into three categories based on the techniques used to tackle a system:

- Hard systems — involving simulations, often using computers and the techniques of operations research. Useful for problems that can justifiably be quantified. However it cannot easily take into account unquantifiable variables (opinions, culture, politics, etc), and may treat people as being passive, rather than having complex motivations.
- Soft systems — For systems that cannot easily be quantified, especially those involving people holding multiple and conflicting frames of reference. Useful for understanding motivations, viewpoints, and interactions and addressing qualitative as well as quantitative dimensions of problem situations. Soft systems are a field that utilizes foundation methodological work developed by Peter Checkland, Brian Wilson and their colleagues at Lancaster University. Morphological analysis is a complementary method for structuring and analysing non-quantifiable problem complexes.
- Evolutionary systems — Béla H. Bánáthy developed a methodology that is applicable to the design of complex social systems. This technique integrates critical systems inquiry with soft systems methodologies. Evolutionary systems, similar to dynamic systems are understood as open, complex systems, but with the capacity to evolve over time. Bánáthy uniquely integrated the interdisciplinary perspectives of systems research (including chaos, complexity, cybernetics), cultural anthropology, evolutionary theory, and others.

The systems approach

The systems thinking approach incorporates several tenets:[3]

- Interdependence of objects and their attributes - independent elements can never constitute a system
- Holism - emergent properties not possible to detect by analysis should be possible to define by a holistic approach
- Goal seeking - systemic interaction must result in some goal or final state
- Inputs and Outputs - in a closed system inputs are determined once and constant; in an open system additional inputs are admitted from the environment
- Transformation of inputs into outputs - this is the process by which the goals are obtained
- Entropy - the amount of disorder or randomness present in any system
- Regulation - a method of feedback is necessary for the system to operate predictably
- Hierarchy - complex wholes are made up of smaller subsystems
- Differentiation - specialized units perform specialized functions
- Equifinality - alternative ways of attaining the same objectives (convergence)
- Multifinality - attaining alternative objectives from the same inputs (divergence)

Some examples:

- Rather than trying to improve the braking system on a car by looking in great detail at the material composition of the brake pads (reductionist), the *boundary* of the braking system may be extended to include the interactions between the:
  - brake disks or drums
  - brake pedal sensors
  - hydraulics
  - driver reaction time
  - tires
  - road conditions
  - weather conditions
  - time of day
- Using the tenet of "Multifinality", a supermarket could be considered to be:

- a "profit making system" from the perspective of management and owners
- a "distribution system" from the perspective of the suppliers
- an "employment system" from the perspective of employees
- a "materials supply system" from the perspective of customers
- an "entertainment system" from the perspective of loiterers
- a "social system" from the perspective of local residents
- a "dating system" from the perspective of single customers

As a result of such thinking, new insights may be gained into how the supermarket works, why it has problems, how it can be improved or how changes made to one component of the system may impact the other components.

Applications

Systems thinking is increasingly being used to tackle a wide variety of subjects in fields such as computing, engineering, epidemiology, information science, health, manufacture, management, and the environment.

Some examples:

- Organizational architecture
- Job design
- Team Population and Work Unit Design
- Linear and Complex Process Design
- Supply Chain Design
- Business continuity planning with FMEA protocol
- Critical Infrastructure Protection via FBI Infragard
- Delphi method — developed by RAND for USAF
- Futures studies — Thought leadership mentoring
- The public sector including examples at The Systems Thinking Review [1] (http://www.thesystemsthinkingreview.co.uk/)
- Leadership development
- Oceanography — forecasting complex systems behavior
- Permaculture
- Quality function deployment (QFD)
- Quality management — Hoshin planning (http://www.qualitydigest.com/may97/html/hoshin.html) methods
- Quality storyboard — StoryTech framework (LeapfrogU-EE)
- Software quality
- Program management
- Project management
- Six Thinking Hats
- MECE - McKinsey Way

See also

- Boundary critique
- Crossdisciplinarity
- Holistic management
- Information Flow Diagram
- Interdisciplinary
- Multidisciplinary
- Lateral thinking
- Negative feedback
- Systematics - study of multi-term systems
- Systemics
- Systems engineering
- Systems intelligence
- Systems philosophy
- Systems theory
- Systems science
- Transdisciplinary

- Soft systems methodology
- System dynamics
- Terms used in systems theory

Bibliography

- Russell L. Ackoff (1999) *Ackoff's Best: His Classic Writings on Management*. (Wiley) ISBN 0-471-31634-2
- Béla H. Bánáthy (1996) *Designing Social Systems in a Changing World (Contemporary Systems Thinking)*. (Springer) ISBN 0-306-45251-0
- Béla H. Bánáthy (2000) *Guided Evolution of Society: A Systems View (Contemporary Systems Thinking)*. (Springer) ISBN 0-306-46382-2
- Ludwig von Bertalanffy (1976 - revised) *General System theory: Foundations, Development, Applications*. (George Braziller) ISBN 0-807-60453-4
- Fritjof Capra (1997) *The Web of Life* (HarperCollins) ISBN 0-00-654751-6
- Peter Checkland (1981) *Systems Thinking, Systems Practice*. (Wiley) ISBN 0-471-27911-0
- Peter Checkland, Jim Scholes (1990) *Soft Systems Methodology in Action*. (Wiley) ISBN 0-471-92768-6
- Peter Checkland, Jim Sue Holwell (1998) *Information, Systems and Information Systems*. (Wiley) ISBN 0-471-95820-4
- Peter Checkland, John Poulter (2006) *Learning for Action*. (Wiley) ISBN 0-470-02554-9
- C. West Churchman (1984 - revised) *The Systems Approach*. (Delacorte Press) ISBN 0-440-38407-9.
- John Gall (2003) *The Systems Bible: The Beginner's Guide to Systems Large and Small*. (General Systemantics Pr/Liberty) ISBN 0-961-82517-0
- Jamshid Gharajedaghi (2005) *Systems Thinking: Managing Chaos and Complexity - A Platform for Designing Business Architecture*. (Butterworth-Heinemann) ISBN 0-750-67973-5
- Charles François (ed) (1997), International Encyclopedia of Systems and Cybernetics, München: K. G. Saur.
- Charles L. Hutchins (1996) *Systemic Thinking: Solving Complex Problems* CO:PDS ISBN 1-888017-51-1
- Bradford Keeney (2002 - revised) *Aesthetics of Change*. (Guilford Press) ISBN 1-572-30830-3
- Donella Meadows (2008) *Thinking in Systems - A primer* (Earthscan) ISBN 978-1-84407-726-7
- John Seddon (2008) *Systems Thinking in the Public Sector (http://www.triarchypress.co.uk/pages /book5.htm)* . (Triarchy Press). ISBN 978-0-9550081-8-4
- Peter M. Senge (1990) *The Fifth Discipline - The Art & Practice of The Learning Organization*. (Currency Doubleday) ISBN 0-385-26095-4
- Lars Skyttner (2006) *General Systems Theory: Problems, Perspective, Practice* (World Scientific Publishing Company) ISBN 9-812-56467-5
- Frederic Vester (2007) *The Art of interconnected Thinking. Ideas and Tools for tackling with Complexity* (MCB) ISBN 3-939-31405-6
- Gerald M. Weinberg (2001 - revised) *An Introduction to General Systems Thinking*. (Dorset House) ISBN 0-932-63349-8
- Brian Wilson (1990) *Systems: Concepts, Methodologies and Applications, 2nd ed*. (Wiley) ISBN 0-471-92716-3
- Brian Wilson (2001) *Soft Systems Methodology: Conceptual Model Building and its Contribution*. (Wiley) ISBN 0-471-89489-3

References

1. ^ O'Connor, J. & McDermott, I. (1997). *The Art of Systems Thinking: Essential Skills for Creativity and Problem-Solving.* San Francisco: Thorsons Publishing. p. 11.
2. ^ Capra, F. (1996) *The web of life: a new scientific understanding of living systems* (1st Anchor Books ed). New York: Anchor Books. p. 30
3. ^ Skyttner, Lars (2006). *General Systems Theory: Problems, Perspective, Practice*. World Scientific

Publishing Company. ISBN 9-812-56467-5.

External links

- International Society for the System Sciences (http://isss.org/world/)
- UK Systems Society (http://www.ukss.org.uk)
- The Systems Thinking Review - Vanguard method (http://www.thesystemsthinkingreview.co.uk/)
- The Systems Thinker newsletter glossary (http://www.thesystemsthinker.com /systemsthinkinglearn.html)
- Bibliography of Systems Philosophy (http://chiron.valdosta.edu/whuitt/materials/sysphil.html)
- Dancing With Systems (http://www.projectworldview.org/wvtheme13.htm) from Project Worldview
- Systems-thinking.de (http://www.systems-thinking.de/) : systems thinking links displayed as a network
- Systems Thinking (http://www.systemsthinker.com/interests/systemsthinking/)
- Systems Thinking (http://www.thinking.net/Systems_Thinking/systems_thinking.html)