Systems Thinking and Decision Making

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This article (1) provides an overview of systems thinking, (2) argues the relevance of applying systems thinking to decision making, and (3) concludes that systems thinking is not a bad idea for decision making/problem solving.

1. Systems Thinking for understanding an object

Systems thinking is the attitude of recognizing an object as a system, “a set or arrangement of things so related or connected as to form a unity or organic whole”. It implies that the system is constituted in the perception of the observer/researcher as a recognized image or model of the object. Such systems thinking is originally proposed under the banner of dealing with complexity, with emphasis on the interconnectedness and interdependence (systemhood) of different elements (thinghood) within a system and how they influence each other.

To understand and describe an object, the approach constructs a model relevant to the object, focusing specifically on what we call systemic properties or systemicities such as

(1) Emergent properties: It is the interactions or interdependencies among the elements that give rise to the system-specific properties of the system: The properties of a system cannot necessarily be derived from the properties of its individual components (holism). The properties of a system that cannot be reduced to the properties of its components are called emergent properties.

(2) Complexity and Hierarchy: Systems thinking asserts that "it does not make sense to see complexity as an internal and inherent property of an object", saying that "the complexity of the object is in the eye of the observer". The interaction between an "object" and a "person" who perceives the object determines complexity by the difficulty of understanding or dealing with it. H.A. Simon argues that "complexity always appears in the form of a hierarchy," *i.e.*, a complex system consists of several subsystems, each of which consists of its own subsystems, and so on. In this context, the "Law of Requisite Hierarchies" discusses the relationship and balance between complexity and hierarchy.

(3) Communication and control: The human activity system is an effective model for studying systems that include and are composed of humans, such as societies and organizations. The model assumes that humans are not anonymous like molecules in the physical world but have their own individuality and create purposes and act autonomously according to their own intentions. Systems thinking argues that to understand the object as an open human activity system with a hierarchical structure, control or regulation/coordination is necessary to maintain the hierarchy, and communication is indispensable for this purpose. The Viable Systems Model (VSM) is a normative five-layer model relevant to a viable and sustainable organization inspired by analogy to living systems to discuss communication between the layers.

(4) Adaptation: Adaptation refers to the ability of a system to change its own structure, objectives, and assumptions in response to changes in the environment surrounding it. Along with negative feedback, the "Law of Requisite Varieties", one of the most important and well-known principles in systems sciences, explains systems adaptation. This law asserts that "only the (internal) diversity of the system can destroy the (external) diversity of the environment" with respect to the relationship between the system and its environment. Panarchy model describes adaptation dynamically as the interaction of two seemingly mutually contradictory processes, stability and transformation. This model asserts that adaptation of any

type of system forms a continuous cycle of four phases: growth, conservation, release, and reorganization.

(5) Self-organization: In contrast to adaptation, self-organization means that the system creates a new order in place of the existing one, or that the system generates itself anew and gives itself a direction. The concept argues for a change in the system's own structure or processes, rather than basing the explanation of adaptation on environmental change.

(6) Ecosystem and sustainability/viability: An ecosystem is a system in which the elements depend on each other for sustainability or viability to maintain their survival.

The concepts of panarchy, adaptation, and self-organization mentioned above are important theoretical perspectives to explain the resilience of the entire ecosystem, not just the individual elements that make up the system.

2. Systems Thinking for decision making

Decision-making is not simply choosing something "desirable" but is defined as a problem-solving process that involves several stages such as: (1) understanding, describing, and defining the problem; (2) gathering information; (3) generating alternatives; (4) analyzing options; (5) selecting an alternative, (6) implementing the decision and (7) evaluating the outcome. As mentioned above, systems thinking is especially helpful for the first stage. The process is, though, not linear and but takes a cyclical form by allowing for back and forth.

A basic approach of systems thinking to problem solving is adaptation, called the contingent approach, which attempts to select and apply appropriate methodologies according to the characteristics of the problematic situation. Applied Systems Thinking (AST), a typical contingent approach, uses the "System of Systems Methodologies (SOSM)" framework to characterize a problem situation by (1) the complexity of the system related to the problem, (2) how the values and beliefs of the stakeholders involved in the problem are related, and (3) the direction in which the solution to the problem situation aims to go. It suggests, for example, that if the stakeholders in the situation have some kind of common understanding of the problem and share a goal, then it would be appropriate to use an optimization approach to achieve that goal efficiently. If the stakeholders have conflicting understandings of the problem, some soft systems approach would be helpful to accommodate them to achieve mutual understanding and implement some actions.

According to the Law of Requisite Variety, the more complexity there exists in the problem, the more variety of the methods and methodologies should be available to the problem solver. Since it implies that the problem solver needs to be familiar with a certain enough methodologies, it is, in practice, more feasible to amplify the methodological variety through teams with a wide range of diverse members and advanced technology (diversity and inclusion principle).

3. Systems thinking is not a bad idea for decision making/problem solving

Systems thinking is not a bad idea (W. Churchman) to adopt for decision making because: (1) systems thinking promotes a holistic understanding of complex problems and phenomena. (2) By considering the whole system and its dynamics, systems thinking can help identify the root causes of problems. It seems superior to traditional linear thinking, which often focuses on symptoms rather than underlying causes. (3) Systems thinking allows for a more realistic and nuanced examination of the complexity and uncertainty observed in many situations.

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