

In each issue, we present a different systems tool using relevant business examples. Readers are encouraged to practice using these tools by applying them to issues of personal interest. See page 10 for a symbol key for the diagrams.

# Toolbox

## The Vocabulary of Systems Thinking: A Pocket Guide

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Systems thinking can be thought of as a language for communicating about complexity and interdependencies (see "Systems Thinking as a Language," *Viewpoint*, April 1991). To be fully conversant in any language, it is important to gain some mastery of the vocabulary—especially the phrases and idioms that are particular to that language. To help you with this task, we have put together the following pocket guide to systems thinking which lists some terms that may come in handy when you are faced with a systems problem.

**Accumulator**—a structural term for anything that accumulates, e.g., water in a bathtub, savings in a bank account, current inventory. In the STELLA modeling software, an accumulator is used as a generic symbol for anything that accumulates. Also referred to as a *Stock* or a *Level*.

**Balancing Loop/Process with Delay**—(a systems archetype). When a balancing process has a long delay, the usual response is to *overcorrect*, leading to wild swings in behavior such as real estate cycles.

**Balancing Loop/Process**—along with reinforcing loops, it forms the two building blocks of dynamic systems. Balancing processes seek equilibrium—they try to bring things to a desired state and keep them there. They also limit and constrain. A balancing loop depicts a balancing process. Also called *Negative Loop*.

### Behavior Over Time (BOT)

**Diagram**—(one of the ten tools of systems thinking). BOT diagrams capture the history or future trend of one or more variables over time. By sketching the variables on the same

graph, we can gain an explicit understanding of how they interact over time. Also called *Reference Modes*.

**Causal Loop Diagram**—(one of the ten tools of systems thinking). A closed loop of cause-and-effect linkages which captures how variables in a system are interrelated.

**Eroding Goals**—(a systems archetype). In an "Eroding Goals" scenario, a gradual downward slide in performance goals goes unnoticed, threatening the long-term future of the system or organization. Example: lengthening delivery delays.

**Escalation**—(a systems archetype). In this archetype, two parties compete for superiority in an arena. As one party's actions put it ahead, the other party "retaliates" by increasing its actions. The result is a continual ratcheting up of activity on both sides. Examples: price wars, the U.S.-U.S.S.R. arms race.

**Feedback**—the return of information about the status of a process. For example, annual performance reviews are a way of returning information to an employee about the status of his/her work.

**Fixes that Fail**—(a systems archetype). In a "Fixes that Fail" situation, a fix is applied to a problem that has immediate positive results, but has unforeseen long-term consequences that eventually make the problem worse. Also known as *Fixes that Backfire*.

**Flow**—the amount of change something undergoes during a particular unit of time. For example, the amount of water that flows out of a tub each minute, or the amount of interest earned in a savings account each month. Also called a *Rate*.

**Generic Structures**—structures that can be generalized across many different

settings because the underlying relationships are fundamentally the same or "generic." Systems archetypes comprise a particular class of generic structures.

**Graphical Function Diagram (GFD)**—(one of the ten tools of systems thinking). GFD's show how one variable interacts with another (such as the effect of delivery delays on sales) by plotting the relationship between the two over the entire range of relevant values. The resulting diagram is a concise hypothesis of how the two variables interrelate. Also called *Table Functions*.

**Growth and Underinvestment**—(a systems archetype). In this situation, resource investments in a growing area are not made due to short-term pressures. As growth begins to stall due to the lack of resources, there is less incentive for adding capacity, which further slows the growth.

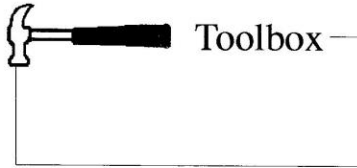
**Learning Laboratory**—(one of the ten tools of systems thinking). A learning laboratory takes a management flight simulator and embeds it in a learning environment. There, groups of managers use a combination of systems thinking tools to explore the dynamics of a particular system and inquire into their own understanding of that system. Learning labs serve as a manager's practice field.

**Level**—see *Accumulator*.

**Leverage Point**—an area where small change can yield large improvements in a system.

**Limits to Success**—(a systems archetype). In a "Limits to Success" scenario, a company or product line grows rapidly at first, but eventually begins to slow or even decline. The reason is that the system has hit some

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“limit”—capacity constraints, resource limits, market saturation, etc.—that is inhibiting further growth. Also called *Limits to Growth*.

**Management Flight Simulator (MFS)**—(one of the ten tools of systems thinking). Similar to a pilot’s flight simulator, a MFS allows managers to test the outcome of different policies and decisions without “crashing and burning” real companies. It is based on a system dynamics computer model that has been changed into an interactive decision making simulator through the use of an interface.

**Negative Feedback Loop**—see *Balancing Loop*.

**Policy Structure Diagram**—(one of the ten tools of systems thinking). Policy Structure Diagrams are used to create a conceptual “map” of the decision-making process that is embedded in an organization. It highlights the factors which are weighed at each decision point.

**Positive Feedback Loop**—see *Reinforcing Loop*.

**Rate**—see *Flow*.

**Reinforcing Loop/Process**—along with balancing loops, it forms the two building blocks of dynamic systems. Reinforcing processes produce both growth and collapse—they compound change in one direction with even more change. A reinforcing loop depicts a reinforcing process. Also known as *Vicious Cycles* or *Virtuous Cycles* and *Positive Feedback Loops*.

**Shifting the Burden**—(a systems archetype). In a “Shifting the Burden” situation, a short-term solution is tried that successfully solves an ongoing problem. As the solution is used over and over again, it takes attention away from more fundamental solutions. Over time, the ability to apply a fundamental solution may decrease, resulting in a

greater reliance on the symptomatic solution. Example: drug or alcohol dependency in response to stress.

**Shifting the Burden to the**

**Intervener**—(a systems archetype). A special case of “Shifting the Burden” which occurs when an intervener is brought in to help solve an ongoing problem. Over time, as the intervener successfully handles the problem, the people within the system become less capable of dealing with the problem themselves, leading to further dependence on the intervener. Example: ongoing use of outside consultants.

**Simulation Model**—(one of the ten tools of systems thinking). A computer model that allows you to map the relationships that are important to a problem or an issue and then simulate the interaction of those variables over time.

**Stock**—see *Accumulator*.

**Structural Diagram**—Draws out the accumulators and flows in a system, giving an overview of the major structural elements that produce the system’s behavior. Also called *Flow Diagrams* or *Accumulator/Flow Diagrams*.

**Structure-Behavior Pairs**—(one of the ten tools of systems thinking). Structure-Behavior Pairs consist of a structural representation of a business issue (using accumulators and flows) and the corresponding Behavior Over Time (BOT) Diagram for the issue being studied.

**Structure**—the manner in which the elements of a system are organized or interrelated; the building blocks of a larger system. It includes not only the organizational chart, but incentive systems, information flows, and interpersonal interactions. The terms *structure* and *system* are sometimes used interchangeably.

**Success to the Successful**—(a systems archetype). In this situation, two activities compete for a common but limited resource. The more successful activity is consistently given more resources, allowing it to succeed even more, while the less successful one becomes starved for resources and eventually dies out.

**System Dynamics**—a field of study which includes a methodology for constructing computer simulation models to achieve better understanding and control of social and corporate systems. It draws on organizational studies, behavioral decision theory, and engineering to provide a theoretical and empirical base for structuring the relationships in complex systems.

**System**—a group of interacting, interrelated, or interdependent elements forming a complex whole. Almost always defined with respect to a specific purpose. The terms *system* and *structure* are sometimes used interchangeably.

**Systems Archetypes**—(one of the ten tools of systems thinking). Systems archetypes are the “classic storylines” in systems thinking—common patterns and structures that occur repeatedly in different settings.

**Systems Thinking**—a school of thought which focuses on recognizing the interconnections between the parts of a system and synthesizing them into a unified view of the whole.

**Table Function**—see *Graphical Function Diagram*.

**Templates**—a tool used for quickly identifying systems archetypes by “filling in the blanks” in causal loop diagrams.

**Tragedy of the Commons**—(a systems archetype). In a “Tragedy of the Commons” scenario, a shared resource becomes overburdened as each person uses more and more of it for individual gain. Eventually, the resource dwindles or is wiped out, resulting in lower gains for everyone involved. Example: the depletion of fish stock due to overfishing. ↻

*The above glossary is a compilation of definitions from many sources, including Innovation Associates’ Systems Thinking: A Business Perspective coursebook, Gould-Kreutzer Associates’ Introduction to Systems Thinking coursebook, The Fifth Discipline by Peter Senge, High Performance Systems’ Academic User’s Guide to STELLA, and The American Heritage and Random House Dictionaries.*