

FRAME: Leverage Points to Provoke Change in Complex Systems

Places to Intervene in a System (In Increasing Order of Effectiveness)

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Introduction

First we need to understand a few concepts about how a system works.

All systems and their components have system “states,” which refers to the amount of something (physical or non-material) that’s on hand—like items a store might keep in stock for sale. One state of a bathtub might be the amount of water in it. Another state might be the temperature of the water. We might answer on a survey that our amount, or “stock” of happiness (how happy we are today) is a 9 out of 10. That’s a non-material state.

Stocks change over time based on flows—inflows and outflows. The amount of water in a bathtub changes based on how much water flows into it or how much water drains out of it. Heat flows out of the bath water into the adjacent air or is added by opening the hot water tap.

If you want to take a bath, you have in mind a goal for the depth and temperature of the water. You plug up the drain (thereby setting the outflow to zero) and turn on the faucets using a combination of hot and cold water. Then you watch the water rise, and use your hand to test the temperature. If it’s too hot, you’ll use that information and cut back on the hot water tap. If the water is too high, you’ll open the drain to let a little out.

That’s feedback. You take information regarding the state of the system and use it to adjust the flows that affect that state.

Feedback isn’t always immediate. When you first turn on the hot water tap in your house, you probably don’t get hot water immediately. It may take a while. The amount of time between making a change to a flow and seeing the change affect the stock it’s connected to is called lag. The longer the lag time, the more

difficult it is to figure out how the system works. For example, switching to a reasonable diet does not result in immediate weight loss, nor does the start of an exercise program result in immediate gain in muscle mass.

Components of the Model

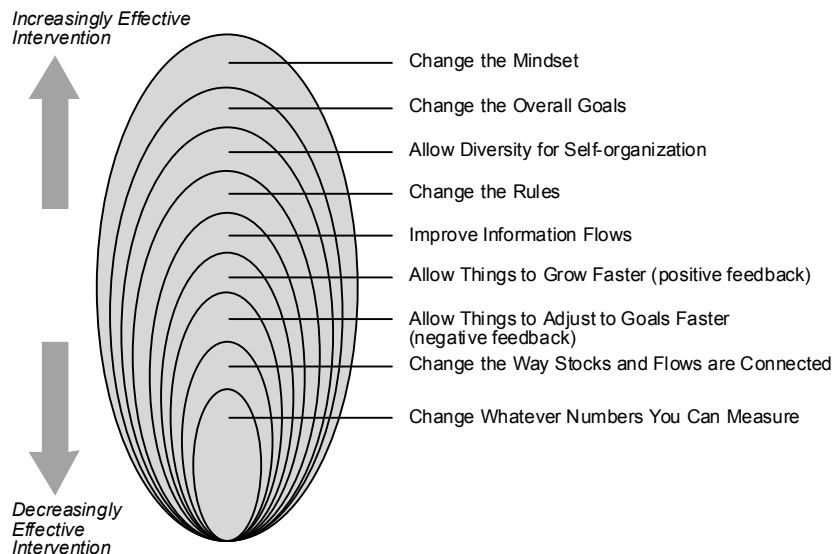
Following is a list and brief description of the components of the model

Numbers

The least effective place to intervene is by arbitrarily changing various parameters. These are things we can measure, but which don’t really represent an important state of the system. Changing the temperature inside the passenger compartment of a car may be easy, but it won’t help reduce the temperature of an overheating engine. We also try often to make changes to numbers without understanding how the system that creates them works. Therefore, a manager might demand that next year’s sales figures exceed \$1,000,000. Simply writing a new number down won’t make it happen.

Material Stocks and Flows

The next least effective place to intervene is by adjusting the plumbing and arrangement of the stocks and flows. Although some systems are just laid out wrong and the only way to get them to work



better is to change the way that people and processes are connected to one another and in what order, changing the way things are connected to one another is often expensive (like moving two departments closer together so they can communicate better with one another).

Regulating Negative Feedback Loops

A thermostat is the classic example of a negative feedback subsystem. The user sets a goal by entering a target temperature. The thermostat compares room temperature to the target, and then compensates for any difference by either turning on the air conditioning or the furnace. Negative feedback loops self-correct. If some stock is out of whack with our goal for it (like our weight) chances are it's because there's an inadequate or weak negative.

Driving Positive Feedback Loops

Positive feedback is self-reinforcing. Imagine a small group of rabbits that breed to have baby rabbits, who grow up to breed and create yet more rabbits. The increasing rabbit population is governed by positive feedback — rabbits create more rabbits and more rabbits create even more rabbits. The reproductive cycle is a positive feedback loop. So is investing money in a bank at a constant rate of interest with reinvestment. These loops drive growth. They can also precipitate collapse. A virus that infects one rabbit is transmitted to two, who transmit it to four others, and then to eight and so on. (An immune system is a negative feedback loop.) Finding ways to either create positive feedback loops (like fashion crazes) or to impede them is a very powerful way to influence what is happening in a system.

Information Flows

Often we don't have the information we need in order to know what to change in a system. It's like trying to fill a bathtub to the right level without either being able to look at the bath or to use your hand to gauge the amount of water that's already in it. Sometimes just showing people information about the state of a stock (how much cash they have in the bank), or the rate of a flow (how fast their cash is entering the bank through income or leaving the bank through expenses) is enough to get them to make the necessary changes to improve the system

they're working with (cut down on eating out or find a little higher paying job).

The Rules of the System

The rules relate to incentives, punishments and constraints, including a system's scope and boundaries. The tax code of the IRS is an example of a complex body of rules that radically influences the behavior of corporations and individuals. A subsidy is another example of a rule that influences behavior. The cost of water and gasoline in the United States are both heavily subsidized. If the subsidies were removed, and people had to pay the true cost of these things, their behavior would likely be altered. Rules change behavior. Power over rules is real power.

The Power of Self-Organization

Self-organization shows up as evolution and revolution. This is an extremely powerful type of change. New systems are successful if they evolve to be more fit in their environment than the systems they are replacing. The replacement of horses by automobiles is an example. The introduction of the car required the evolution of whole new systems and subsystems like gas stations, paved roads, petroleum refinement, and mass production techniques. Both evolution and revolution have a common impetus — diversity. To increase the chances of creating a new type of system that replaces a less efficient one, allow for more diversity of ideas and experiments to take place.

The Goals of the System

Goals influence everything further down the list. If the overall goal is to take a whirlpool bath instead of just a normal one, major components of the system must be changed — like the addition of air jets and the controls for how forceful they are, as well as the size of the tub.

The Mindset or Paradigm

The highest place to intervene — the most effective and the most difficult — is how we think about the systems we are trying to change. Egyptians built pyramids because they believed in an afterlife. We build skyscrapers because we believe that downtown space is extremely valuable. We engage in capitalism because we agree with Adam Smith that the selfish actions of individual players in markets wonderfully accumulate to the common good.

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