Systems Thinking & Problem Solving:
(Understanding Our Most Important Messes)
Systems Thinking Skills

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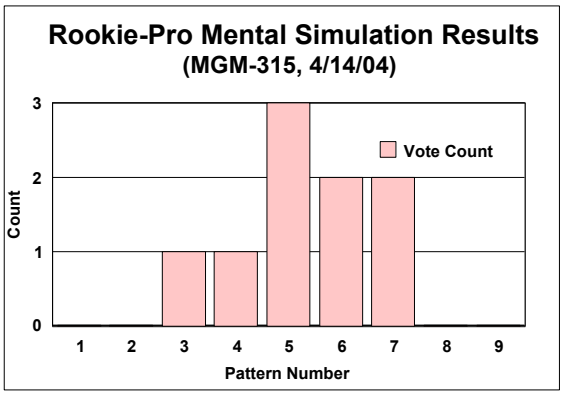
Rookie-Pro Mental Simulation Results



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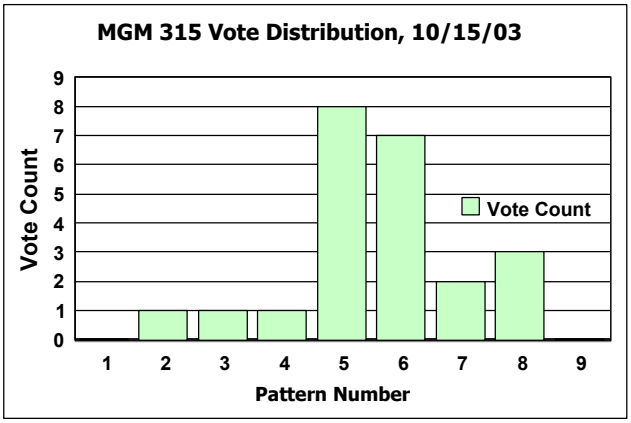

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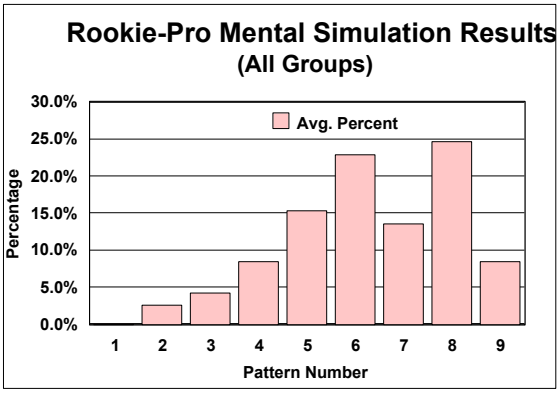
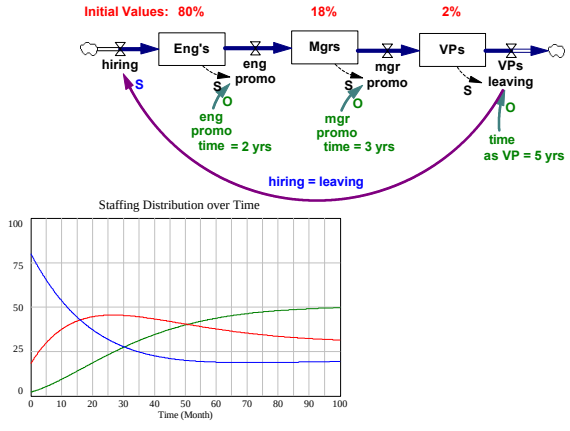


Promotion Chain



Institutions

- "We live in an era of massive institutional failure."

  Dee Hock - Founder and CEO Emeritus of VISA USA and VISA International
  1996 Systems Thinking in Action Conference

- "Why isn't system dynamics spreading like wildfire?
- We live in institutions whose fundamental way of being is antithetical to the tools
- … other than that no big problem."

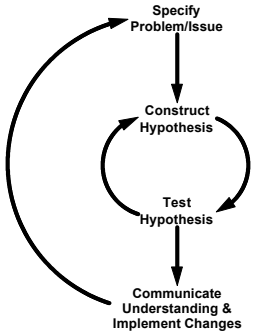
  Peter Senge - Author of The Fifth Discipline
  1996 Power of Systems Thinking Conference

How Long Do Companies Live?

- "In 1983, a Royal/Dutch Shell survey found that 1/3rd of the firms in the Fortune "500" in 1970 had vanished."
- … the average life of organizations is less than 40 years.
- "The ability to learn faster than your competitors may be the only sustainable competitive advantage."

Arie de Geus, "Planning as Learning," Harvard Business Review, Mar/Apr 1988

Steps in the Systems Thinking Method (per Richmond)



Traditional Business Thinking vs. Systems Thinking Skills

Static Thinking	Dynamic Thinking	Specify Problem/Issue
System-as-Effect	System-as-Cause	Construct Hypothesis
Tree	Forest	
Factor	Operational	
Linear	Closed-Loop	
Measurement	Quantitative	
Proving Truth	Scientific	Test Hypothesis

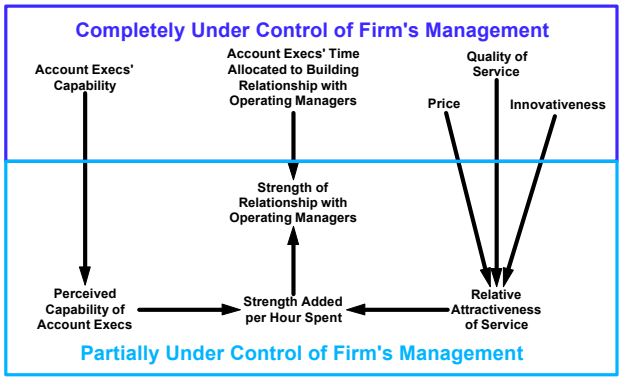
Systems Thinking Skills - Dynamic Thinking

- Dynamic thinking vs. static thinking:
  - ➡ We know a system comes to its current state through a trajectory … it has momentum.
  - ➡ We describe the "reference behavior pattern" (RBP) over the appropriate time frame.
  - ➡ We investigate the relationships (& loops) that led the system to its current state.
  - ➡ We develop an "entertainable hypothesis" for the pattern.
  - ➡ It often demonstrates "worse before better" behavior when we do the right thing for the long term … investment required!
  - ➡ The opposite is "static thinking" where we estimate that the future will extend monotonically, perhaps even linearly, from its current value in the direction we intend.
  - ➡ From a mechanistic to an organic perspective.

Systems Thinking Skills (continued) - System-as-Cause Thinking

- System-as-cause thinking vs. system-as-effect thinking:
  - ➡ "We're being preyed upon" ➔"how do we make ourselves like prey"
  - ➡ Predict & prepare, reactive, & defensive ➔proactive & offensive
  - ➡ We look to internal factors to understand system behavior, instead of primarily looking for external causes (system-as-effect thinking).
  - ➡ Look to alter relationships to
    - prevent the blow from being directed at us
    - deflect and mitigate the blow
  - ➡ Look at variables within our control vs. variables outside our control
  - ➡ Look for leverage that works despite uncontrollable outside forces
  - ➡ Insight: when things go wrong, often there is no one to blame … except perhaps those who did not properly design processes & systems.
  - ➡ Heros of history? Do great leaders create circumstances or do circumstances draw out great leaders that fit the needs of the times?

Variables & Model Extensive Boundary



Completely Beyond Control of Firm's Management

Systems Thinking Skills (continued)
- Forest Thinking

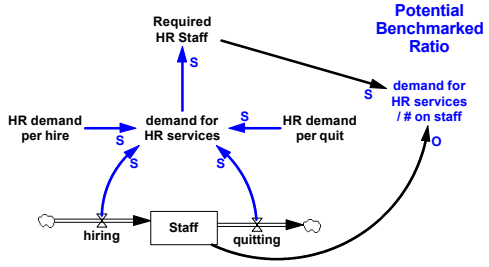
- Forest thinking vs. tree thinking:
- "Tree thinking": functions, business units, silos
- To understand problems we need to know the context of the problems and not look at parts of the structure and events in isolation ("tree thinking").
- Detailed, dense ➔general, less dense
- Look for important relationships removed in time & space
- Look for similarities, rather than differences
- This is synthesis versus analysis

Systems Thinking Skills (continued)
- Operational Thinking

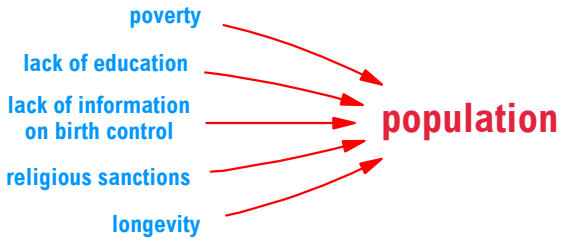
- Operational thinking vs. factor thinking:
- Factor thinking: Milk production (GDP, Interest Rate, fertilizer cost)
- Where are the "COWS" ???
- Define the "plumbing", "main chains", "spinal cords"
- Causal vs correlational
- Seeing behavior as a result of system structure, the "plumbing" of the system, not as a result of multiple factors ("laundry list" or "factor thinking"; e.g., a best-fit equation to parameters).
- Covey's "7 Habits of Highly-Effective People" is "factor thinking"
- We recognize the difference between stocks & flows, and we know this difference has enormous influence on operational behavior.

Systems Thinking Skills (continued)
- Operational Thinking

- Don't do "factor thinking" as is done when "benchmarking" based on "operating ratios"



Factor Thinking



Barry Richmond, "Systems thinking: critical thinking skills for the 1990s and beyond" System Dynamics Review, Vol. 9, no. 2, Summer 1993

Factor Thinking Modeling & Assumptions

Typical Solution: A multiple regression equation:

$$population = a_o + a_1X_1 + a_2X_2 + \ldots a_nX_n$$

- Each factor contributes as a cause to the effect (i.e., causality runs one way)
- Each factor acts independently
- The weighting factor of each is fixed
- The way each factor works to cause the effect is left implicit (i.e., an effect indicated by the coefficient without explanation of operational causes)

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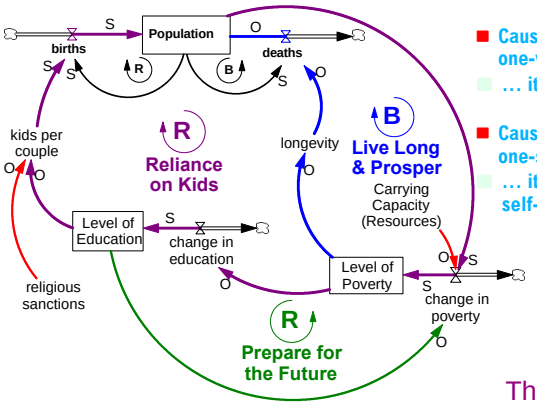
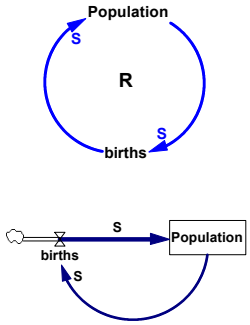
An Operational Model - Theory



- Causality isn't a one-way street … it's circular
- Causality isn't a one-shot deal … it's dynamic & self-sustaining

Theory!

Causal Loop vs.. Stocks & Flows



Slowing an inflow doesn't decrease the level of the stock … it only slows the rate of increase.

Even if the inflow goes to zero, the level of the stock doesn't decrease … it would just stay the same.

The only way to decrease the level of a stock is to create an outflow.

The point:

A major flaw in using causal loop diagrams is that it's not obvious which variables are stocks and which are flows.

They are fundamentally different: a stock is the integral (the accumulation) of the net flow.

Systems Thinking Skills (continued)
- Closed-Loop Thinking

- Closed-loop thinking vs. linear thinking:
  - ➡ Adding "nerve structure" that carries information
  - ➡ Instead of "linear thinking", with simply cause & effect, we understand feedback from effects come back to influence causes.
  - ➡ It's for answering "chicken or egg" type question
  - ➡ Sees causality as circular, instead of one-way. Causality is an ongoing process … not a one-shot deal.
  - ➡ We can see "unintended" consequences that arise after delayed feedback, not just "intended" consequences
  - ➡ Leads us to see organization failures as due to delayed resistance that develops … "Policy Resistance"

Systems Thinking Skills (continued)
- Quantitative Thinking

- Quantitative thinking vs. measurement thinking:
  - ➡ We accept that many important, even absolutely critical, "soft" variables (e.g., motivation, morale, burnout) can't be measured.
  - ➡ With "measurement thinking" we ignore what can't be accurately measured … it's the typical "scientific" perspective where we must measure accurately to be in control
  - ➡ But they, and their impacts, can be quantitatively estimated.
  - ➡ Leaving them out, is equivalent to setting their values to zero … the one value that we absolutely know is wrong.
  - ➡ Define:
    - Initial values of stocks and values of constants
    - Graphical functions: range and points on the curve

Systems Thinking Skills (continued)
- Scientific Thinking

- Scientific thinking vs. proving-truth thinking:
  - ➡ Current prevailing wisdom is always regarded as an "entertainable hypothesis."
  - ➡ "Scientific thinking" raises the quality of our thinking by using models as working hypotheses with limited domains of applicability, which we examine against reality to determine where they break down.
  - ➡ "Proving-truth thinking" seeks to prove models are true under all conditions.
  - ➡ The problem with validating models against history is that loops that have been "dormant" in the past become dominant in the future.
  - ➡ Technique: put a model in "steady state" and "shock" it.