It Seems Overwhelming

- "There has been an alarming increase in the number of things I know nothing about."
  
  
  Ashley Brilliant

What is Systems Thinking?

Seeking to understand system behavior by examining "the whole"

... instead of by analyzing the parts.

An unusual approach raises concerns:

Outline

- A Very Brief Project Overview
- Systems Thinking Overview
- Problems & Challenges
- Structures & Prioritizing Loops
- Policies & Initiatives to influence Structures
- How to Go from Systems Thinking to Action
- Conclusion
Phases of Systems Thinking Approach to Improve Organizational Performance

1. Problems & Challenges: examine & prioritize
2. Examine Systems Structures:
   - Sustainable Computing
   - Calls for Service Dynamics
3. Examine influences of Problems & Challenges on Structures
4. Feedback Loops: Prioritize, considering the influences of Problems & Challenges
5. Policies & Initiatives: Suggest, consider & prioritize to improve behavior of high priority loops
6. Initiate and complete projects to implement the Policies & Initiatives coordinating or combining projects affecting the same feedback loops

Why Consider Feedback Loops at all?
Feedback loops: like a bicycle chain. Show "silos" to connect.

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

Human Behavior is Hardwired

- "You can take the person out of the Stone Age, … but you can’t take the Stone Age out of the person."
  Homo Sapiens: 200,000 years ago
  Agriculture: 10,000 years ago

- Our instincts:
  - Loss aversion except when threatened
  - Confidence before realism
  - Gossip
  - Empathy and mindreading
  - Emotions before reason
  - Classification before calculus

- Our instincts fail us when the problems we face require different responses than our hardware provides.

Classes of problems

- Problems
  Root Causes are independent & simple
- Messes
  Root Causes are feedback loops
- Wicked messes

Experiencing a Different Lens

Dr. Bob Travers
**Complexity Happens**

*TRUZMS*

*Is life always this complicated? Or is it just me?*

- Examples:
  - *showering*
  - *driving*

---

**Using Systems Thinking is Getting in Touch with the Nature of Reality**

*Frank & Ernest*

*He says he can put me in touch with reality, but he'll have to charge me long distance rates.*

---

**A Story about a Popular Restaurant**

- "That place is too popular. Nobody goes there anymore."  
  - Yogi Berra

---

**What the … ???”**

---

**Interdependencies … What Causes What?**

- Athletic or Academic Performance
- Self-Confidence

---

**Systems Thinking is Storytelling**

---

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The Language of Structure: S&Fs & CLDs

A Population Stock & Flow Diagram

An Accountants Stock & Flow Diagram

A Causal Diagram

A Combined Stock & Flow & Causal Loop Diagram

Reinforcing (positive) Feedback Loop:

Initial Value = 100 persons

Balance Sheet

Reinforcing Feedback:

Exponential Increase - World Population

Exponential Increase - Trade Deficit

Continuous Improvement Results - ASICs

Continuous Improvement in Hours/Prototype

This is Exponential Improvement (TQM-like)

The only function that can maintain its form around a feedback loop is an exponential function.

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A "Limits to Growth" Structure

Shifting Loop Dominance

- After years of steady growth, organizations falter and sometimes fail?
- Senior managers in these organizations, who are acknowledged as heroes in the press for their wisdom and success, seem to suddenly manage a series of failures that seriously damage their reputations?

The "Other" Structure: Mental Models

Making Mental Models Explicit

Perspectives are deeply buried

And often very difficult to change
Mental Models & Feedback are Everywhere

Frank Changes a Mental Model

You ever get that urge, Frank? It begins with looking down from 50 stories up, thinking about the meaningfulness of life, listening to dark voices deep inside you, and you think, 'Should I... Should I push someone off?'

System as Cause & System Leverage

EVENTS

LEVERAGE TO INFLUENCE

LOW

High

High

MENTAL MODELS

SUCCESS AND FAILURE

"Success and failure arise primarily as a result of the internal system structure and policies, even where it’s clear there was an external cause."

Jay Forrester

... founder of system dynamics

ITS Problems & Challenges:

examine & prioritize

Bob Powell, Ph.D., MBA

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Examine System Structures
- Sustainable Computing & "Limits to Growth"
- Calls for Service & "Fixes That Fail"

Examine influences of Problems & Challenges on the Structures

Prioritize Feedback Loops (considering the influences of Problems & Challenges)
Focusing Problem Statement: Computing Capability & Support Dynamics

- How can we …
- … understand the dynamics of “Sustainable Computing”
- … including the long-term costs and maintainability of a growing computer inventory and increasing associated costs.

We Went through a Complex Model

Warning & Apology

... but it really wasn’t all that bad ...

Sustainable Computing - Main Chains

Sustainable Computing - Some Reinforcing Loops

Sustainable Computing - Some Balancing Loops
**Short-term versus Long-term tradeoffs**

Delays in the system can cause us to take action toooo late ...  

**Sustainable Computing - with Problems & Challenges influence on structure w/3 top-ranked feedback loops**

Calls for Service Dynamics & “Fixes That Fail”

**Focusing Problem Statement Calls for Service Dynamics**
- Basic model originally developed relative to community policing ...

  ➡️ … to understand the interactions between officer workload and officer ability to handle Calls for Service (CFS).

  ➡️ Problem: How are call backlog and call response affected by an increasing number of calls with limited resources?

  ■ The parallel: crime reports ~ problem reports

**Calls for Service Model - Balancing Loop Fixes**
Calls for Service Model
- Reinforcing Loop Failures

"Fixes that Fail" are about Side-effects!

Calls for Service - with Problems & Challenges
influence on structure w/5 top-ranked feedback loops

ITS - Feedback Loops, Prioritized

<table>
<thead>
<tr>
<th>Priority</th>
<th>Structure</th>
<th>Loop</th>
<th>Feedback Loops</th>
<th>Votes</th>
<th>Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CFS &amp; SC</td>
<td>R9</td>
<td>IT College Strategic Feedback</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>CFS</td>
<td>R3</td>
<td>Education &amp; Prevention Reduces Problems</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>SC</td>
<td>B5a, b,c</td>
<td>Staff/Maintenance/Infrastructure Support Costs</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>CFS</td>
<td>R4</td>
<td>Long-term Strategic Improvement</td>
<td>22</td>
<td>14</td>
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<tr>
<td>5</td>
<td>SC</td>
<td>B8</td>
<td>Obsolete Old Comp Support Requirements</td>
<td>19</td>
<td>12</td>
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<tr>
<td>6</td>
<td>CFS</td>
<td>B1</td>
<td>Answer CFS, Cut Education &amp; Prevention</td>
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<td>13</td>
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<tr>
<td>7</td>
<td>CFS</td>
<td>R6</td>
<td>Time Pressure Affects Morale</td>
<td>15</td>
<td>13</td>
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<tr>
<td>8</td>
<td>CFS</td>
<td>R4</td>
<td>Interruptions Affect CFS Time</td>
<td>12</td>
<td>11</td>
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<tr>
<td>9</td>
<td>CFS</td>
<td>R5</td>
<td>Productivity from Training</td>
<td>8</td>
<td>6</td>
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<tr>
<td>10</td>
<td>SC</td>
<td>B4</td>
<td>Computer Initial Purchase Costs</td>
<td>8</td>
<td>6</td>
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<tr>
<td>11</td>
<td>SC</td>
<td>R2</td>
<td>New Comp: I Like It</td>
<td>5</td>
<td>5</td>
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<tr>
<td>12</td>
<td>CFS</td>
<td>R7</td>
<td>Training Affects Morale</td>
<td>4</td>
<td>4</td>
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<tr>
<td>13</td>
<td>SC</td>
<td>B6a</td>
<td>Software Upgrade Costs</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>SC</td>
<td>B7a</td>
<td>Opportunity Costs of Learning</td>
<td>2</td>
<td>2</td>
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<tr>
<td>15</td>
<td>SC</td>
<td>R1</td>
<td>New Comp: Productivity Incentive</td>
<td>2</td>
<td>2</td>
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<tr>
<td>16</td>
<td>SC</td>
<td>R3</td>
<td>Old Comp: Want New One</td>
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<tr>
<td>17</td>
<td>SC</td>
<td>B6b</td>
<td>Computer Disposal Costs</td>
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<td>1</td>
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<tr>
<td>18</td>
<td>CFS</td>
<td>B2</td>
<td>Staff Involvement Increases CFS</td>
<td>9</td>
<td>9</td>
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<tr>
<td>19</td>
<td>SC</td>
<td>B7b</td>
<td>Opportunity Costs of Old Computer Productivity</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

ITS - Prioritized Policies & Initiatives

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Impact</th>
<th>Policies &amp; Initiatives</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>High</td>
<td>ITS Planning &amp; Project Template</td>
<td>P1</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Defining Limits / Service Level Agreement (SLA)</td>
<td>P2</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>SWAT Team</td>
<td>P3</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>Information Campaign (prep for charge backs)</td>
<td>P4</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>Strategy: Enhanced IT communication w/administrative counterpart to tech specs</td>
<td>P5</td>
</tr>
<tr>
<td>Hard</td>
<td>High</td>
<td>Make Time for Internal Planning</td>
<td>P6</td>
</tr>
<tr>
<td>Hard</td>
<td>Medium</td>
<td>ITS Website</td>
<td>P7</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Life Cycle SW</td>
<td>P8</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Orientation of New Admin personel</td>
<td>P9</td>
</tr>
<tr>
<td>Hard</td>
<td>Medium</td>
<td>Hire best available student</td>
<td>P10</td>
</tr>
<tr>
<td>Easy</td>
<td>High</td>
<td>Dissemination of meeting decisions</td>
<td>P11</td>
</tr>
<tr>
<td>Easy</td>
<td>Medium</td>
<td>Meeting Split between Admin &amp; Technical</td>
<td>P12</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Par Par Par</td>
<td>P13</td>
</tr>
<tr>
<td>Hard</td>
<td>High</td>
<td>Change Backs for Capacity (bandwidth &amp; storage)</td>
<td>P14</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Tech Liaisons</td>
<td>P15</td>
</tr>
<tr>
<td>Hard</td>
<td>High</td>
<td>Change Backs on Services</td>
<td>P16</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Problem Tracking / Improvement</td>
<td>P17</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>Display phones</td>
<td>P18</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>Student Workforce</td>
<td>P19</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>Coordinated Advocacy</td>
<td>P20</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>Centralized</td>
<td>P21</td>
</tr>
<tr>
<td>Easy</td>
<td>Low</td>
<td>Candy Jar at Help Desk</td>
<td>P22</td>
</tr>
</tbody>
</table>

Policies & Initiatives to influence Structures ... prioritized. [...] "solutions to the mess" [...]

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P1. ITS Planning & Project Template

P2. Defining Limits / Service Level Agreement (SLA)

P3. SWAT Team

Policies & Initiatives to Influence CFS Behavior, Team 3

Policies & Initiatives to Influence CFS Behavior, Team 1

Policies & Initiatives to Influence SC Behavior, Team 3

Chargebacks - Adds New Feedback & Addresses a "Tragedy of the Commons"

From Systems Thinking to Action

"I think you should be more explicit here in step two."
### Strategy Matrix: Functions vs. Key Success Loops & Driving Forces

<table>
<thead>
<tr>
<th>Group or Individual</th>
<th>Loop R9 (IT/College Strategic Feedback)</th>
<th>Loop R3 (Education &amp; Prevention)</th>
<th>Loop BS 2,3,4 (Staff/Maintenance/Infrastructure Support Costs)</th>
<th>Loop XX</th>
<th>Driving Force YY</th>
<th>Summary of Strategy for each Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITS</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>President</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Development</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Human Resources</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary of Strategy for Each Loop or Driving Force</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


### Practical Systems Thinking is Organic

- The reinforcing processes.
- ... and pull the weeds!
- ... of the balancing processes
- For improved performance!

### Learning in Workshops ...

### Learning as We Work ...

"Maybe we should write that spot down."

### ... to avoid "Bad Luck" ...

### Conclusion
We need systems thinking to increase our ability to think about the problems we face ...

Change Takes Time

- Railroad gauge in England = 4' 8½"
- The same gauge as tramways before trains.
- The same spacing as wagon wheels before tramways.
- Wagon wheels would break if not the same spacing as ruts in Roman roads.
- The ruts in Roman roads were the width of Imperial Roman war chariots.
- The width is just wide enough to accommodate the rear ends of two war horses.

As told by Daniel Kim, The Power of Systems Thinking Conference, May 1997

... and change can be ugly ...

... and we must take a long-term view ...

Systems Thinking: We make it look easy ... and it's fun, too!