

System Dynamics Tools II

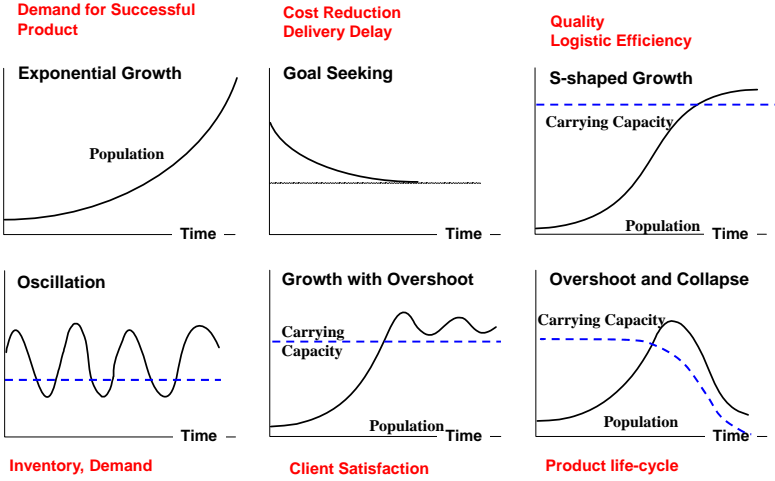
Simple Structures Generating Behavior

December 2010 – January 2011

Paulo Gonçalves



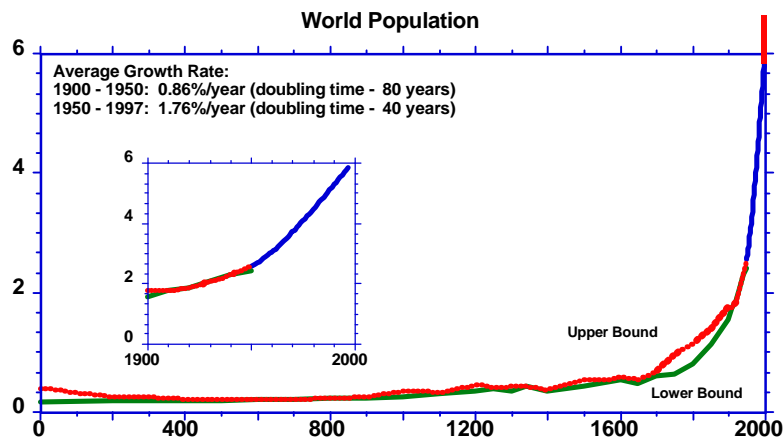
Patterns of Behavior



Which Structures give rise to such Patterns of Behavior?

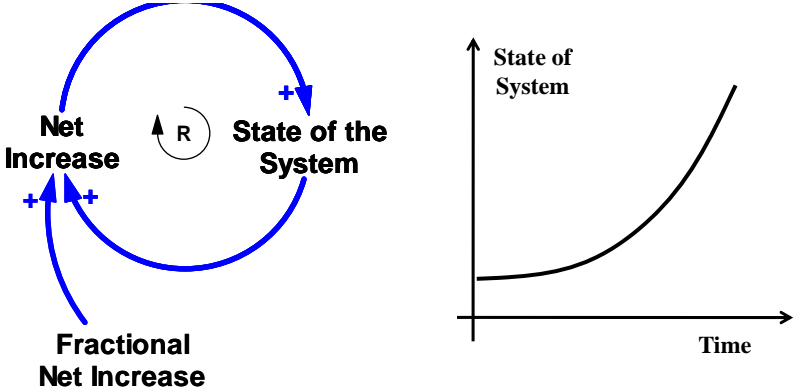
Population Growth

**Jan 10, 2011:
6.89 Billion**

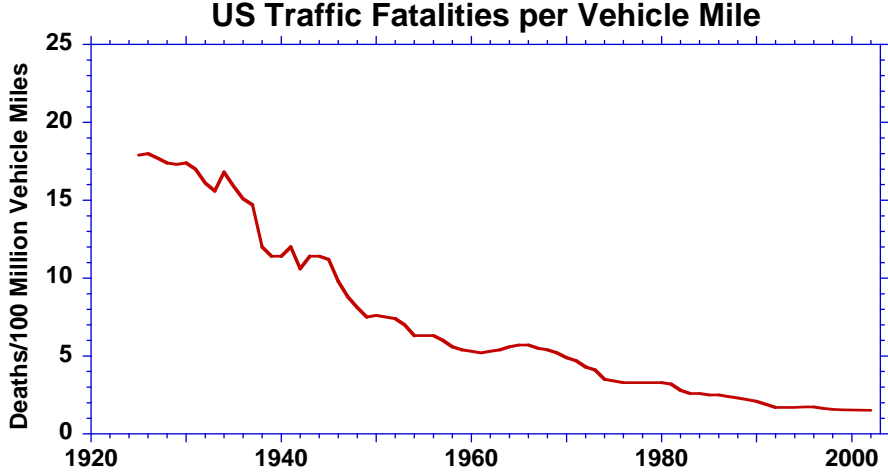


Source: John Sterman, 2000, MIT

Reinforcing Loops

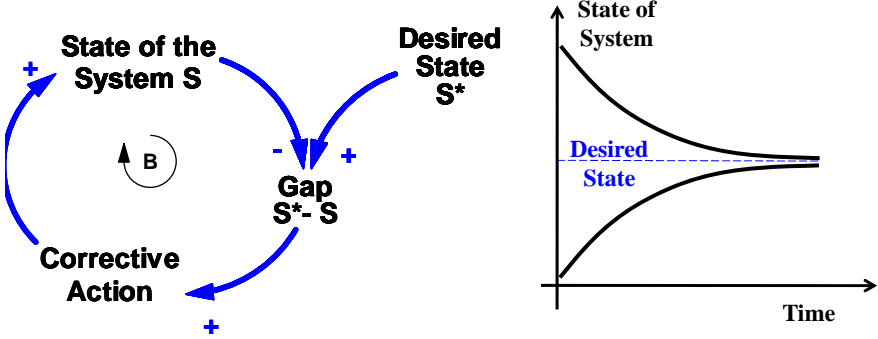


Exponential Decay

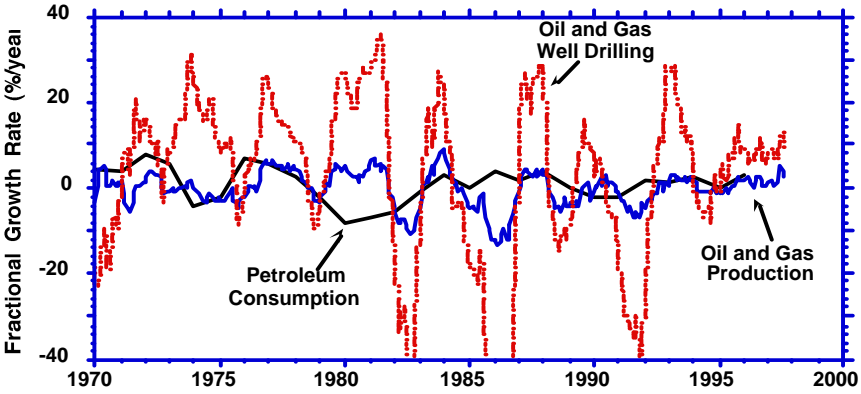


Source: John Sterman, 2000, MIT

Balancing Loops



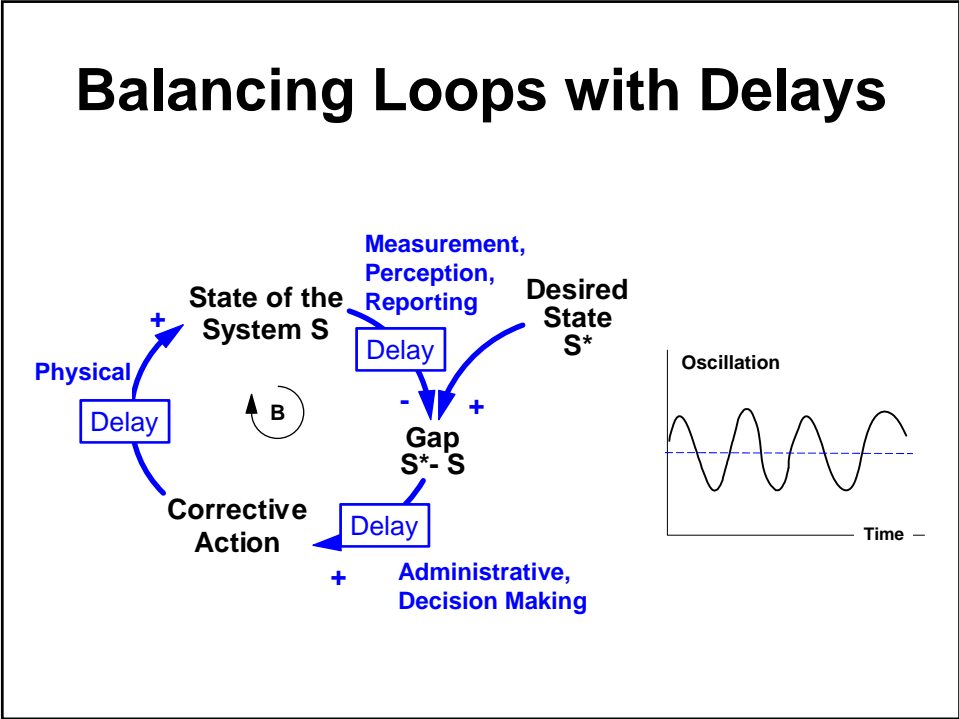
Oscillations: Oil & Gas Supply Chain



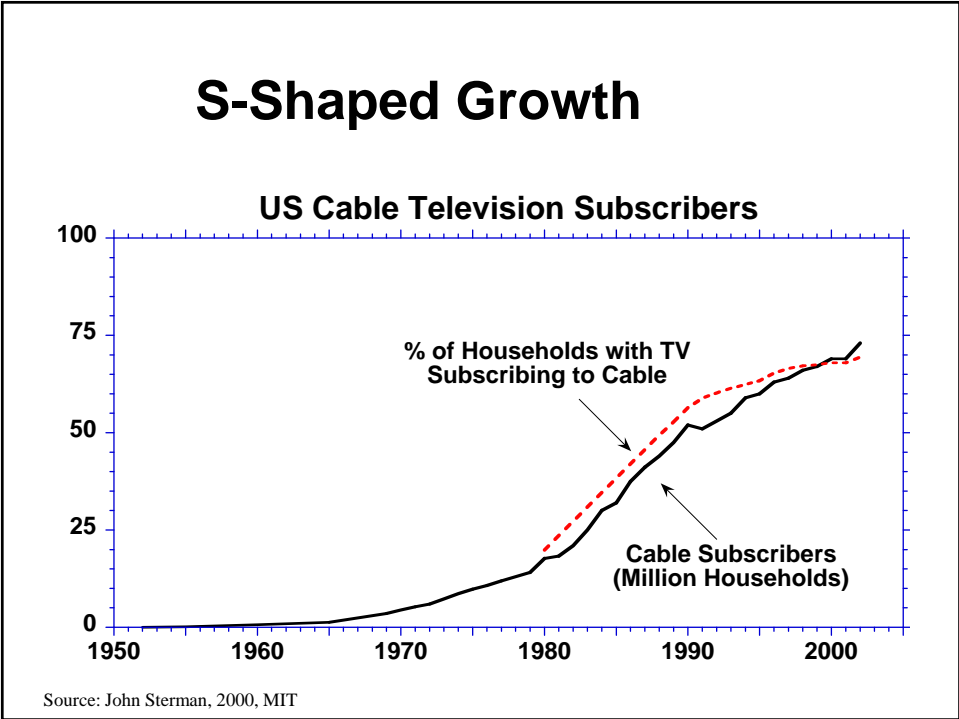
Monthly data; 12-month centered moving averages of the annualized fractional growth rate

Source: John Sterman, 2000, MIT

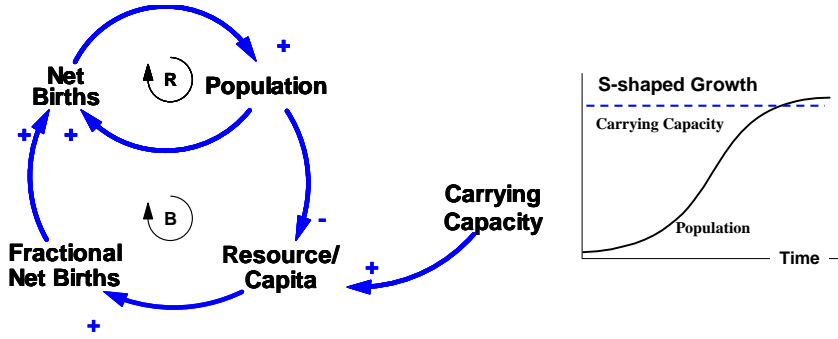
Balancing Loops with Delays



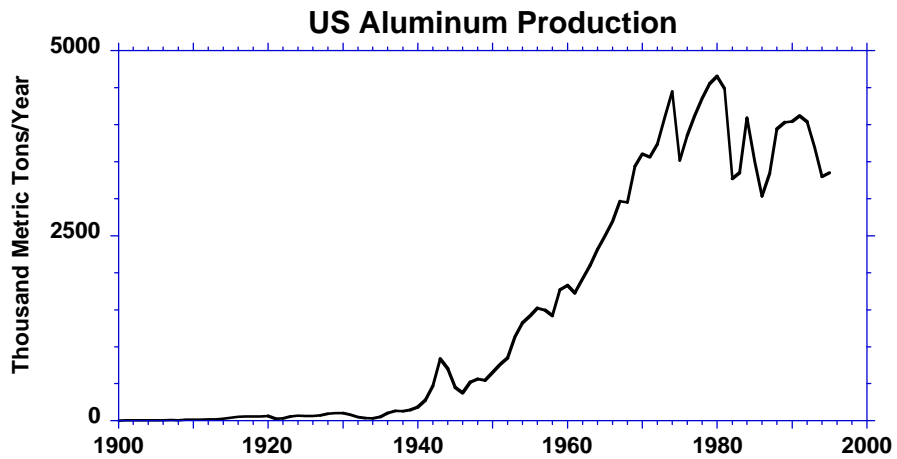
S-Shaped Growth



Reinforcing Loops Limited by Balancing ones

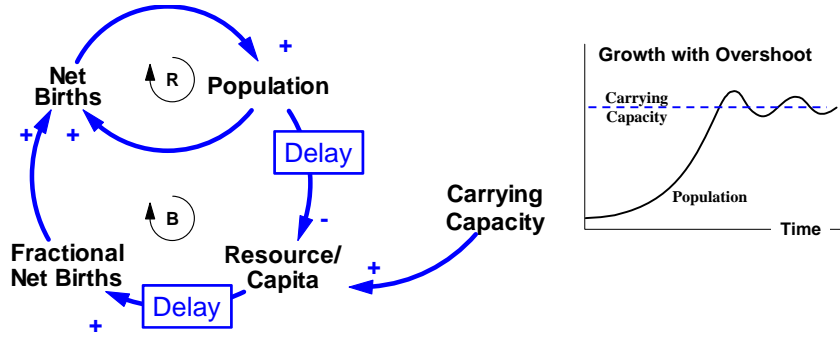


S-Shaped Growth w/Overshoot

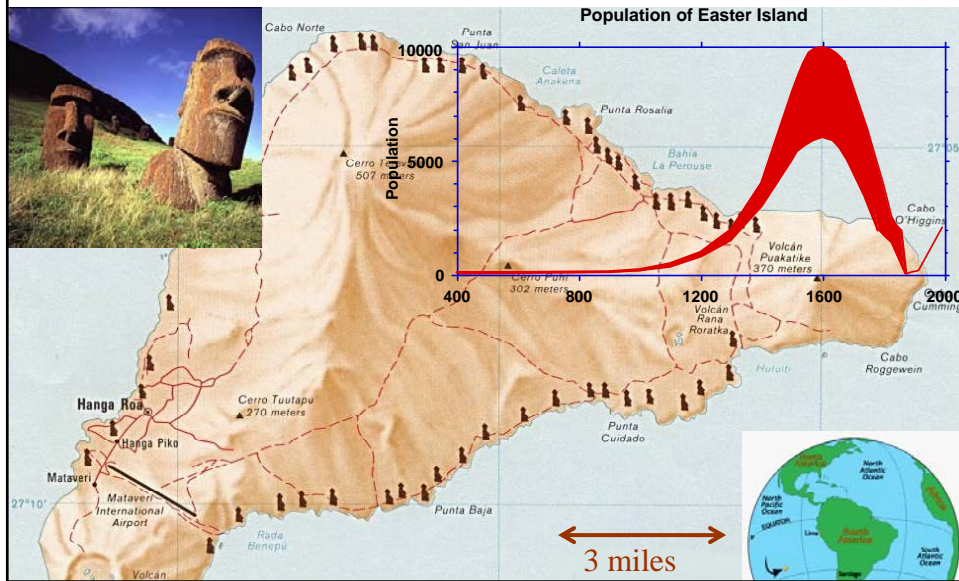


Source: John Sterman, 2000, MIT

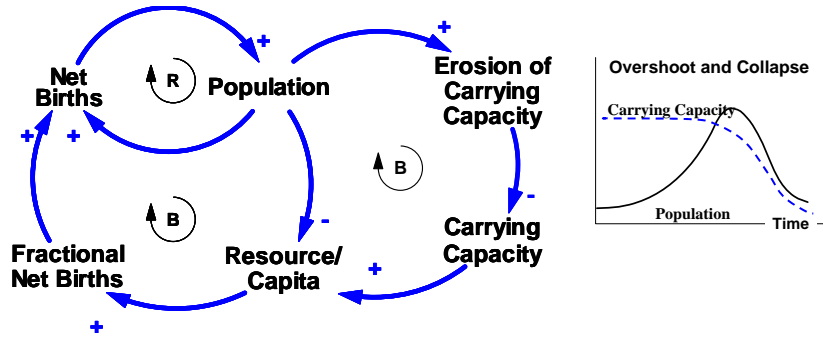
Reinforcing Loops Limited by Balancing Ones with Delays



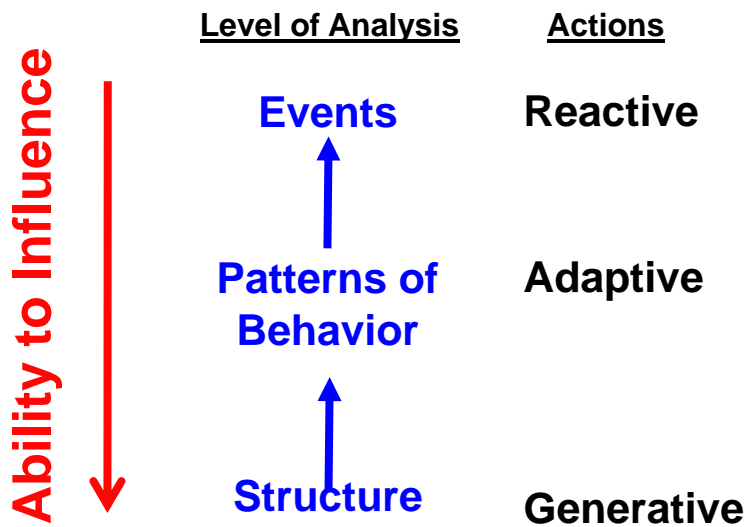
Population Collapse Easter Island



Overshoot & Collapse



Structure Generates Behavior



Events

- Common events affecting every day logistics :
 - Limited warehouse capacity to store items
 - Limited transport capacity to ship available supplies
 - Supply shortages of essential items
 - High customer demand
 - Insufficient human resources to upload/unload transports
 - Inadequate infrastructure causes accidents and excessive delays

Patterns of Behavior

