Complex Adaptive Systems

# Complex Adaptive Systems

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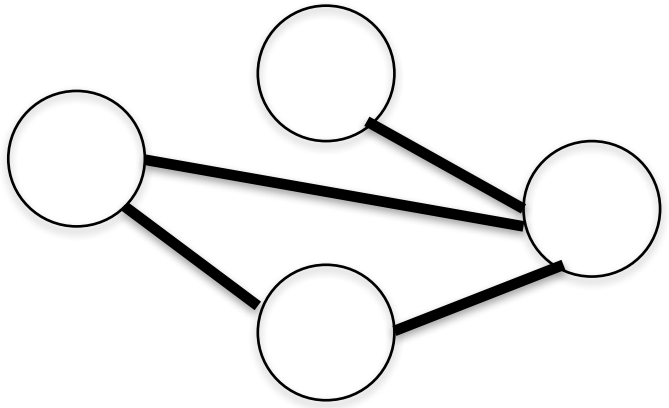
# Systems Basics

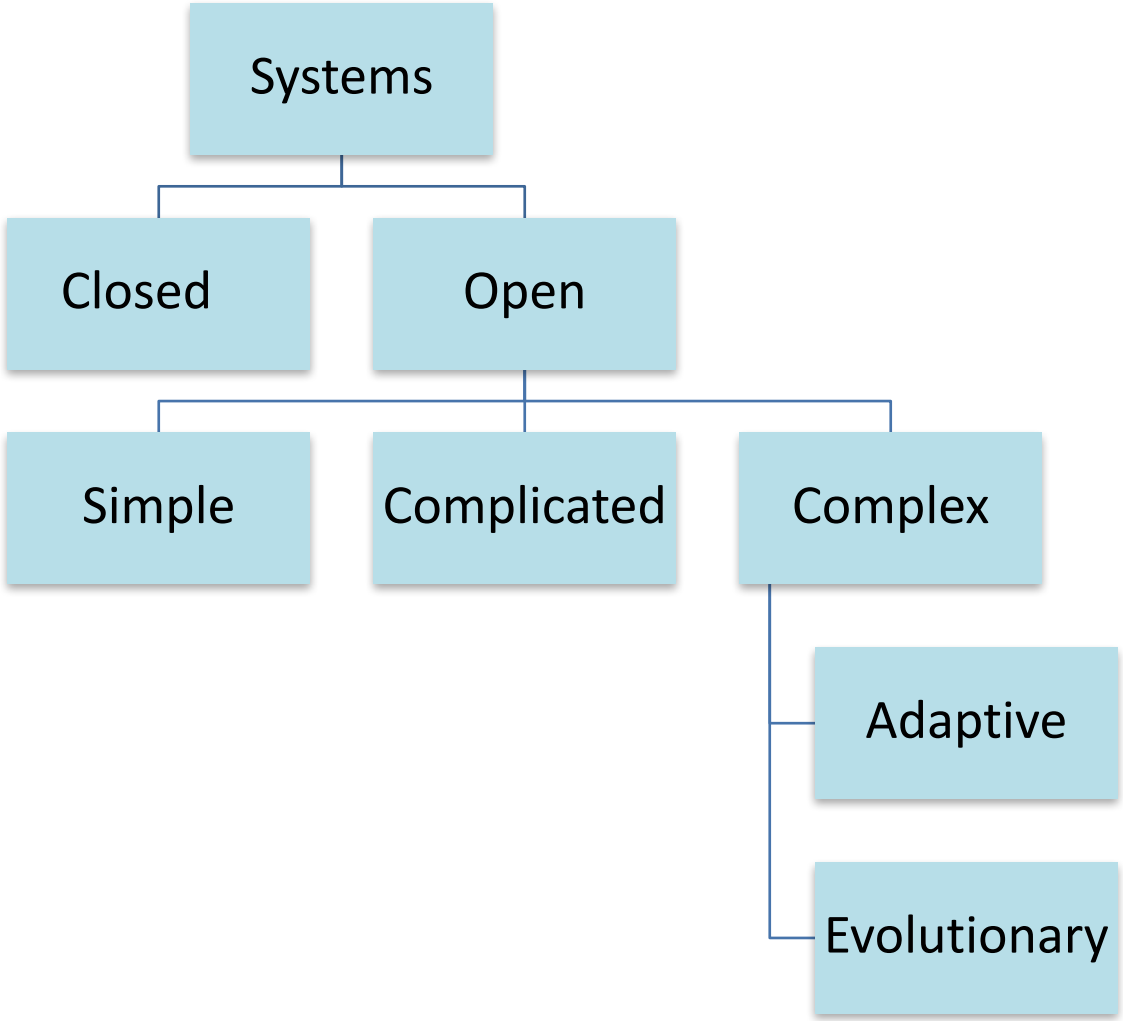
# Systems Basics

- A **network** is a set of agents (nodes) and links (relationships).
- A **system** is a set of interrelated elements exhibiting behavior according to Meadows (2008). Thus, three things are present: elements, relationships between elements, and some sort of behavior(s).



Meadows, D. H. (2008). *Thinking in systems: A primer*. White River Junction, VT: Chelsea Green.

# Systems Taxonomy



# Systems Taxonomy

- Closed systems
  - No exchange of material, information, or energy (MIE) with its environment
- Open systems
  - Exchange of MIE with its environment
- Simple systems
  - Few parts, few linear interactions

# Systems Taxonomy (cont)

- Complicated systems
  - Many parts, few interactions
  - Examples: Cars, airplanes, trains ..
- Complex systems
  - Few to many parts, few to many nonlinear interactions
  - Examples: a jazz group, a social organization
- Adaptive systems
  - Examples: people, families, organizations
- Evolutionary systems
  - Examples: industries, species, the economy, technology, language, religion

# Boulding's Hierarchy Of Systems Complexity

- Transcendental
- Social Organizations
- Human
- Animal
- Genetic-Societal
- Open Systems
- Cybernetic
- Clockwork
- Framework

- Unknowable
- Social Organizations
- Human Individuals
- Animal Level
- Plant Level
- Input-Throughput-Output
- Control Mechanisms
- Predetermined Motion
- Static Structures

# Boulding's Hierarchy

- Properties within a given level of the hierarchy are inherited or exhibited in the next and higher levels.
  - For example, the first level or frameworks level is about static structure and it is observable that each higher level includes at least some static structures, the static structure of a molecule being one
  - Thus properties contained within frameworks are found in clockworks, properties found within clockworks are found within cybernetic systems, and so on.

# Open Systems

- A system open to its environment such that information, energy, or material is exchanged.
- An organization is a example of an open system, wherein information and raw materials are obtained from the external environment, processed into goods or services and are sold in the marketplace.
- Concerned with systems that are open to their environment (contrasted with closed systems).
- Organizations are open systems for example as they exchange information with systems outside of it – for example, customers, suppliers, …

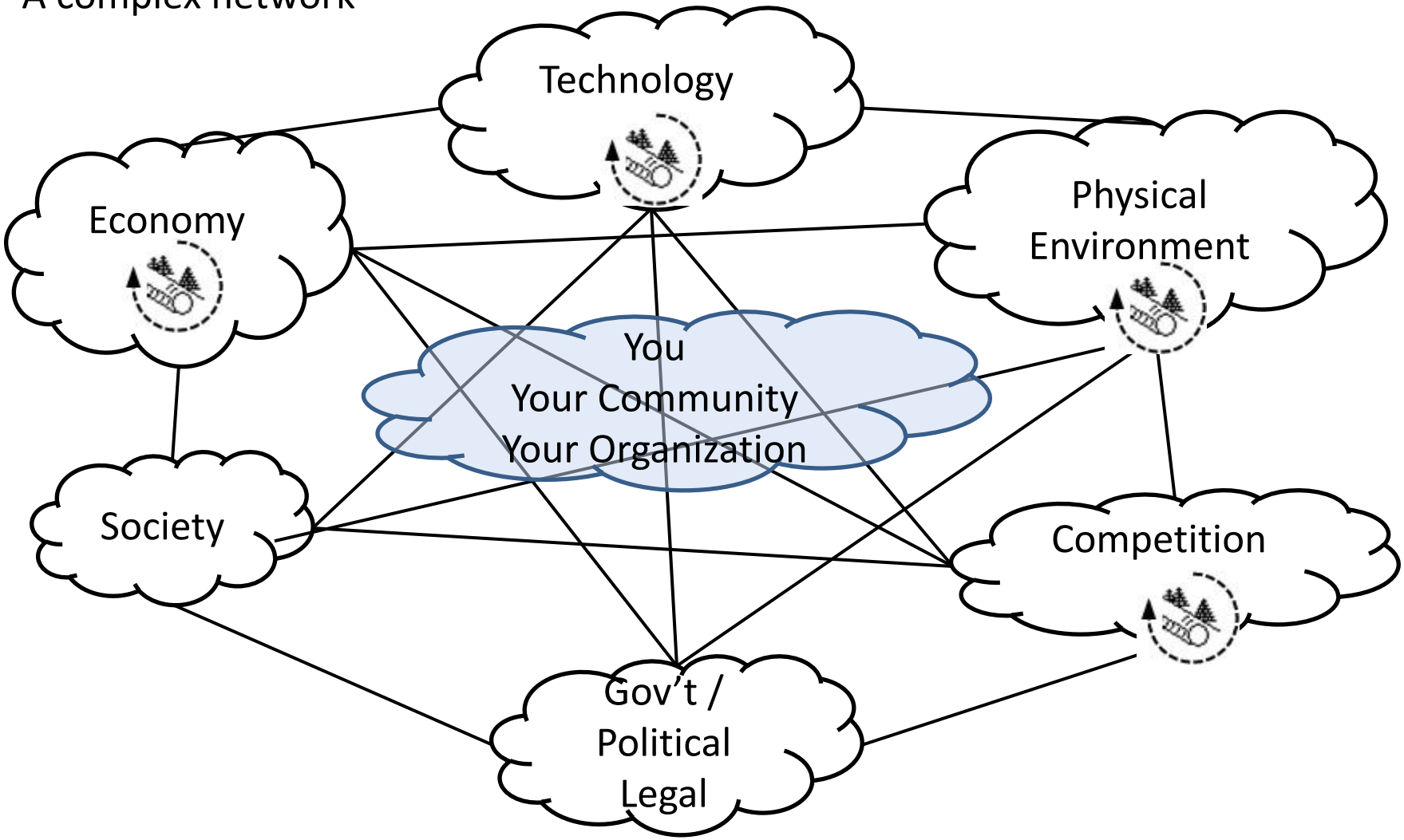
# Complex Systems

A complex system is a group of “agents” existing far from equilibrium, interacting through positive and negative feedbacks, forming interdependent, dynamic, evolutionary networks, that are sensitive dependent, fractionally organized, and exhibit avalanche behavior (abrupt changes) that follow power-law distributions.

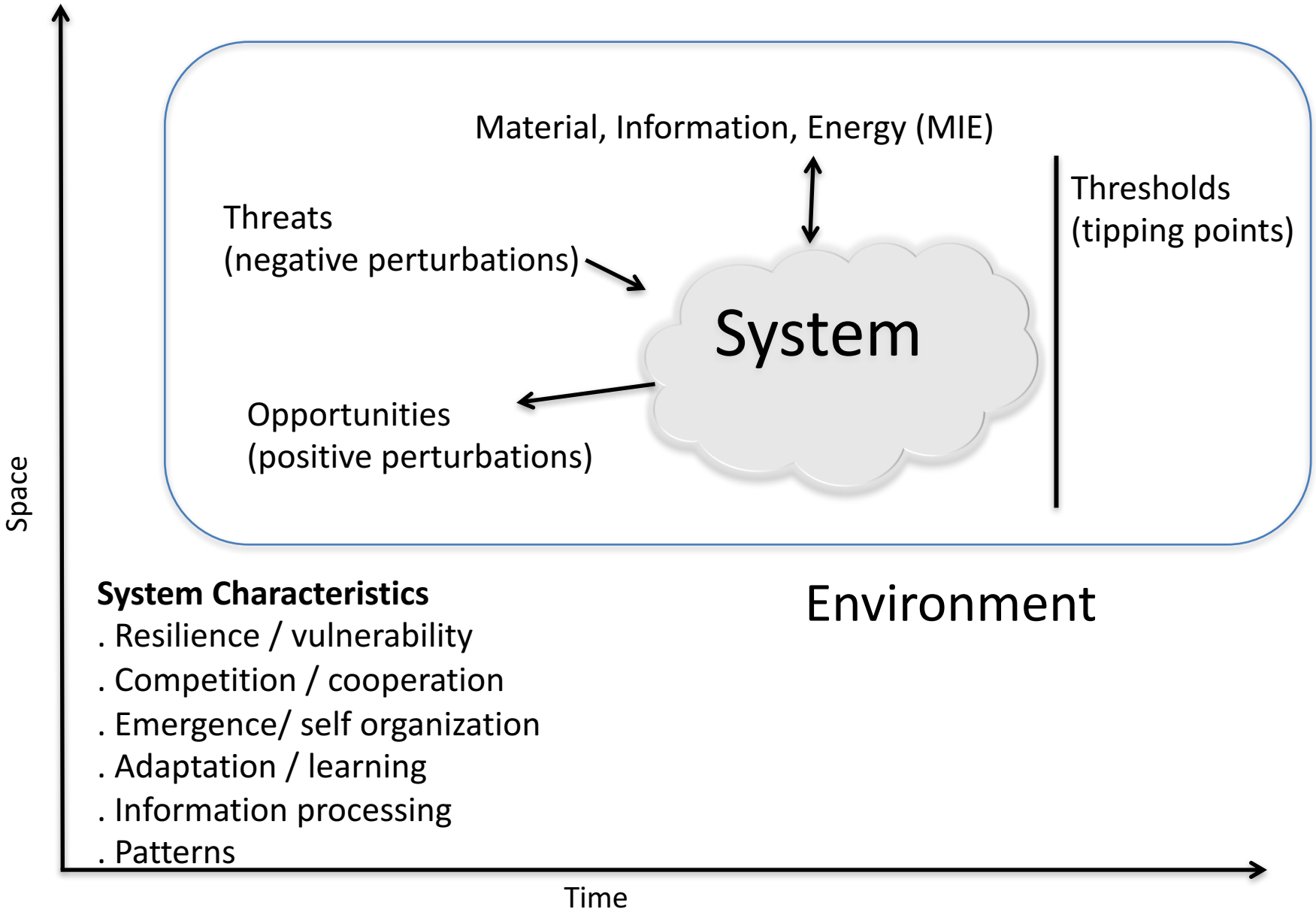
Fichter, L.S., Pyle, E.J., & Whitmeyer, S.J. (2010). Strategies and Rubrics for Teaching Chaos and Complex Systems as Elaborating, Self-Organizing, and Fractionating Evolutionary Systems. *Journal of Geoscience Education*. *58*(2)

# The Environment (for Social Systems)

A complex network



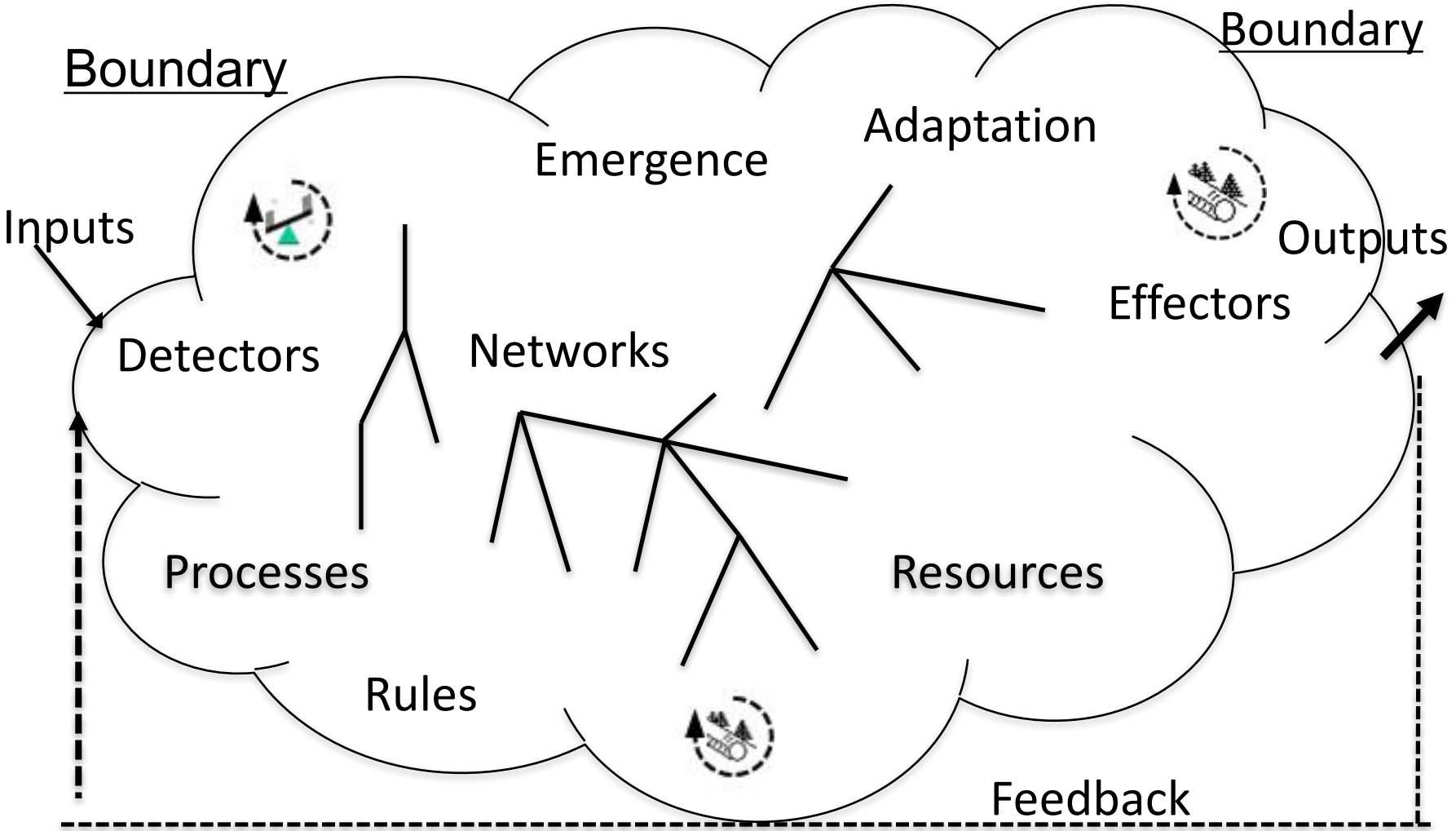
# A Complex Systems Model



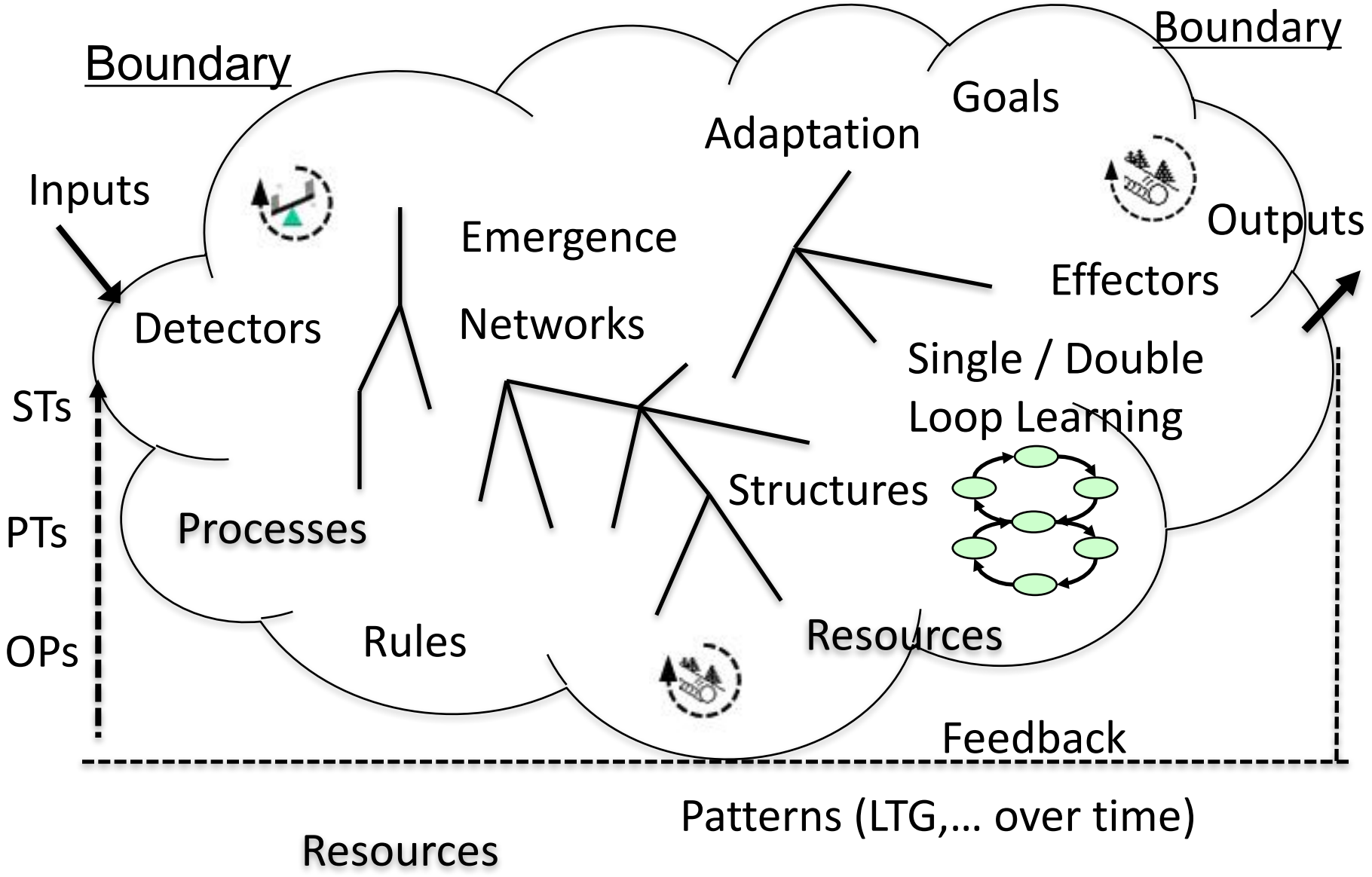

**System Characteristics**

. Resilience / vulnerability
. Competition / cooperation
. Emergence/ self organization
. Adaptation / learning
. Information processing
. Patterns

# Complex Systems Model



# Complex Social Systems Model



# Complexity Theories

- One of the early theories of complexity is that complex phenomena arise from simple rules.
- Consider the rules for the flocking behavior of birds: Fly to the center of the flock, match speed, and avoid collision.
- This simple-rule theory was applied to industrial modeling and production early on, and it promised much; but it did not deliver in isolation.
- More recently, some thinkers and practitioners have started to argue that human complex systems are very different from those in nature and cannot be modeled in the same ways because of human unpredictability and intellect.

Source: Snowden & Boone

# Complexity Theories (cont)

- Consider the following ways in which humans are distinct from other animals:
  - They have multiple identities and can fluidly switch between them without conscious thought. (For example, a person can be a respected member of the community as well as a terrorist.)
  - They make decisions based on past patterns of success and failure, rather than on logical, definable rules.
  - They can, in certain circumstances, purposefully change the systems in which they operate to equilibrium states (think of a Six Sigma project) in order to create predictable outcomes.

Source: Snowden & Boone

# Complex Systems

## Characteristics

- It involves large numbers of interacting elements
- The interactions are non linear, and minor changes can produce disproportionately major consequences.
- The system is dynamic, the whole is greater than the sum of its parts, and solutions can't be imposed; rather, they arise from the circumstances. This is frequently referred to as *emergence*
- The system has a history, and the past is integrated with the present; the elements evolve with one another and with the environment; and evolution is irreversible.

Source: Snowden & Boone

# Complex Systems (cont)

## Characteristics

- Though a complex system may, in retrospect, appear to be ordered and predictable, hindsight does not lead to foresight because the external conditions and systems constantly change.
- Unlike in ordered systems (where the system constrains the agents), or chaotic systems (where there are no constraints), in a complex system the agents and the system constrain one another, especially over time. This means that we cannot forecast or predict what will happen.

Source: Snowden & Boone

# Complex Adaptive Systems

- Diversity
  - Complex, nonlinear behavior is possible without component diversity, for instance in a turbulent but otherwise homogeneous fluid, but adaptation relies on variations and differences between system components.
  - Diversity means more than simply having a range of different individuals, strategies, or populations. From the perspective of the entire system, diversity means having a greater range of options for responding to environmental change and a corresponding higher likelihood that a solution to a particular problem will be found.

Source: Norberg & Cumming

# Complex Adaptive Systems

- Diversity
  - Diversity in complex adaptive systems arises by chance and imperfection, recombination, and in social sciences by innovation and foresight.
  - Diversity is maintained by successful innovation that replace those that are lost from the system through selection.
    - Diversity is maintained via innovation
    - Diversity is lost by selection

Source: Norberg & Cumming,

# Complex Adaptive Systems

Examples

- Central Nervous System
- Cities
- Economy
- Ecosystems
- Immune System
- **Organizations**
- Technology

# Types of Systems

- Systems may be natural, social, or artificial
- Examples:
  - The universe, solar systems, planets, atmosphere, hydrosphere, lithosphere, ecosystems, floral, fauna, …
  - Society, organizations, communities, families, …
  - Artificial life, artificial societies …

# Notes

Open systems, including *complex adaptive systems*, are open to the environment and exchange information, energy, or material to survive

A threshold is a breakpoint between two regimes of a system. (aka, tipping point)

Source: Walker and Meyers

Opportunities are favorable changes in the environment

Threats are unfavorable changes in the environment

# Notes

An environment for a social system includes the economy, technology, society, the physical environment, government / legal / military, and competition

These six elements comprise the framework used by many strategic planners and futurists.

While a framework perspective is appropriate; it is more complete to note that each of these elements is not just an environment but a complex adaptive system as well

# Notes

The boundary of a system delineates it from its environment

Detectors sense environmental stimuli

Processes transform inputs to outputs

Effectors express outputs to the environment

# Notes

Physical Technologies or PTs are methods and designs for transforming matter, energy, and information from one state to another

Examples: blueprints, diagrams, models, …

Social Technologies or STs are methods and designs for organizing people

Examples: rule of law, job descriptions, cultural norms

Organization Plans or OPs are schema that code for the design of an organization

Example: A business plan

Beinhocker, E. D. (2010). *Evolution as computation: Implications for economic theory and ontology*. Retrieved from http://www.santafe.edu

# Notes

Complex systems contain structures and algorithms and exhibit patterns and behaviors

Evolution is an algorithm

The general evolutionary algorithm (GAE) is replication or reproduction with variation, selection, amplification, and repeat.

Beinhocker, E. D. (2010). *Evolution as computation: Implications for economic theory and ontology*. Retrieved from http://www.santafe.edu

# Notes

Evolutionary change is any process that leads to increases in complexity, diversity, order, and / or interconnectedness.

Three mechanisms of evolution are elaboration (e.g., GAE), self-organization, and fractionation.

Fichter, L.S., Pyle, E.J., & Whitmeyer, S.J. (2010). Explanding evolutionary theory beyond Darwinism, with elaborating, self-organizing, and fractionating complex evolutionary systems. *Journal of Geoscience Education*. *58*(2), 58-64.

# Agent

- System elements are referred to by different names such as component, element, entity, object, part, unit, or agent.
- Agents process material, information, or energy
- An agent's behavior is determined by a set of rules
- Agents may be aggregated into meta-agents

# Relationships

- Agents are connected to other agents via one or more links or relationships.
- Relationships may be
  - Strong / weak
  - Attract / repel
  - Competitive / cooperative
  - Necessary
  - Synergistic
  - Redundant

# Relationships (Examples)

- Is the parent of
- Is the child of
- Is the sibling of
- Is a
- Is part of
- Is contained in
- Is consumed by
- Is transformed by

# Relationships
## Classification in Social Relations

- Interactions
  - Helped
  - Hindered
  - Consulted with
  - Talked to
  - Had sex with
- Flows
  - Information
  - Beliefs
  - Resources

Caldarelli, G., & Catanzaro, M. (2012). *Networks*. Oxford, UK: Oxford University Press.

# Relationships
## Classification in Social Relations

- Similarities
  - Location (same spatial or temporal space)
  - Membership (same clubs, events, activities …)
  - Attributes (same gender, attitude, …)
- Social Relations
  - Kinship  (mother of, father of, sibling of, ….)
  - Other role (friend of, student of, professor of, …)
  - Affective (likes, dislikes, neutral, …)
  - Cognitive (knows, knows about, …)

Caldarelli, G., & Catanzaro, M. (2012). *Networks*. Oxford, UK: Oxford University Press.

# Interdependencies

- Agents are interdependent with other agents …
- Examples
  - Agents may trade with other agents
  - Agents may cooperate with other agents to achieve something
  - Agents may consult with other agents
  - Agents may provide inputs to other agents

# Rules (Information)

- A formal means of defining agents
- Stimulus response or if then else rules
  - Basic format: If Then Else
  - Example:
    - If (income > 40%) then (distribute bonuses + merit) else (distribute merit only)
    - If (customer walks in the door) then (greet) else (continue working on current projects)
    - If (our products lose money) then (….)
    - BOIDS / Schools

Holland, J. H. (1995). *Hidden Order*

# Rules (Information)

- Examples within human social systems
  - Code of conduct
  - Job descriptions
  - Processes (steps by which inputs are transformed into outputs. *Note*: processes are executed by agents)
  - Team charters

# Resources

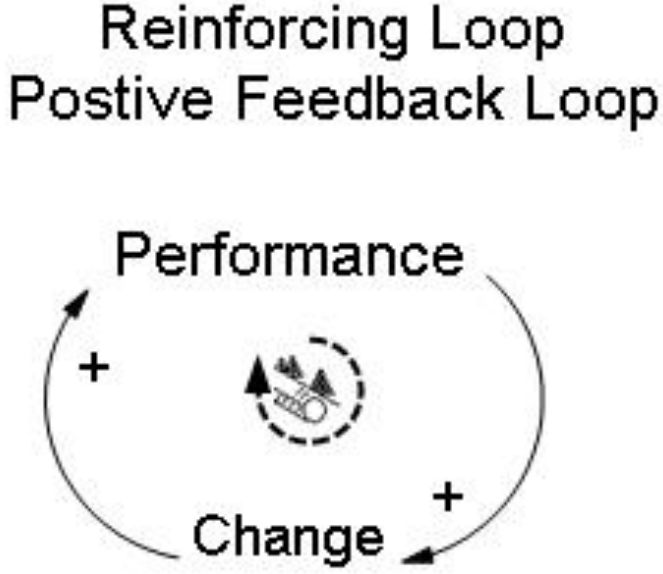
- Resources are Material, Information, or Energy
  - Examples in human social systems
    - Computers
    - Data
    - Raw materials
    - Processes
    - Software
    - Tools

# Feedback

- Complex systems exhibit positive and negative feedback loops
- Positive feedback is an amplifying feedback
- Negative feedback is balancing or goal seeking feedback
- Positive feedback example: customers recommending other customers

# Positive Feedback Loop

A positive feedback loop is also called a reinforcing or amplifying loop and is designated with an R or a growing snowball



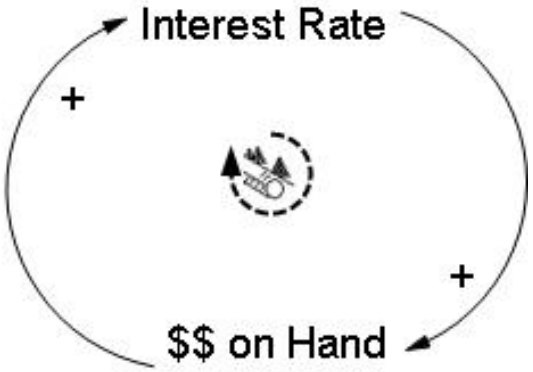

The behavior of a positive feedback loop is the growth / decline of the systems state.

# Positive Feedback Loop

## Examples

Example of a positive feedback loop in economics

Interest Rate Example

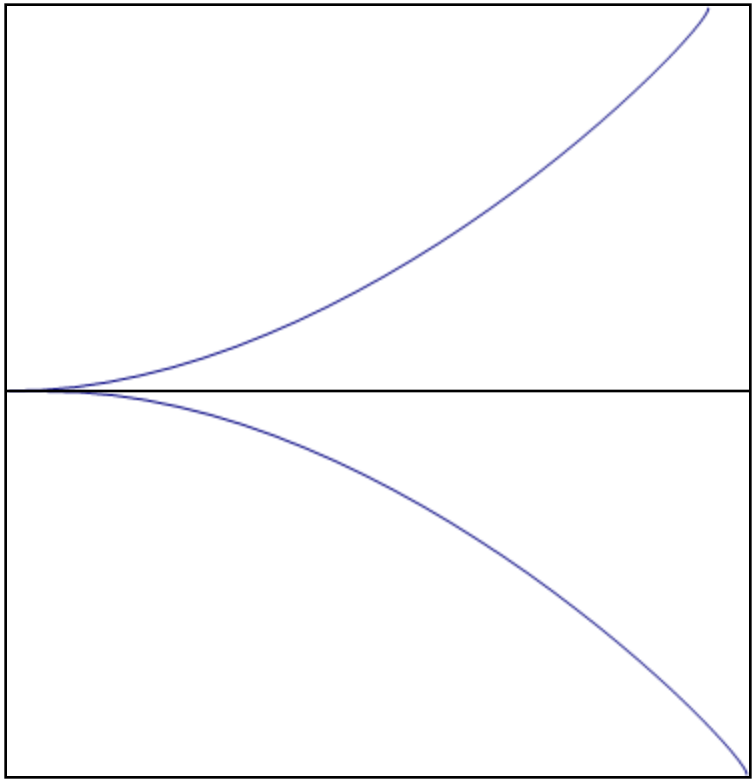



Example of a positive feedback loop in populations

Birth Example


Note: The state of the system will continue to grow or decline unless some intervention occurs.

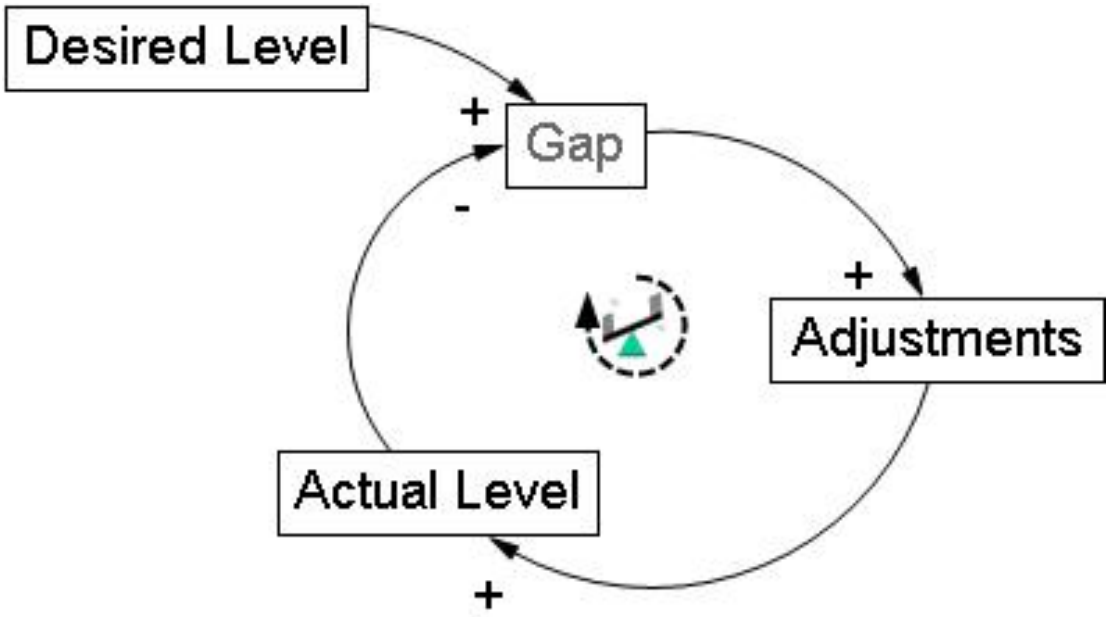
# Positive Feedback – Behavior Over Time



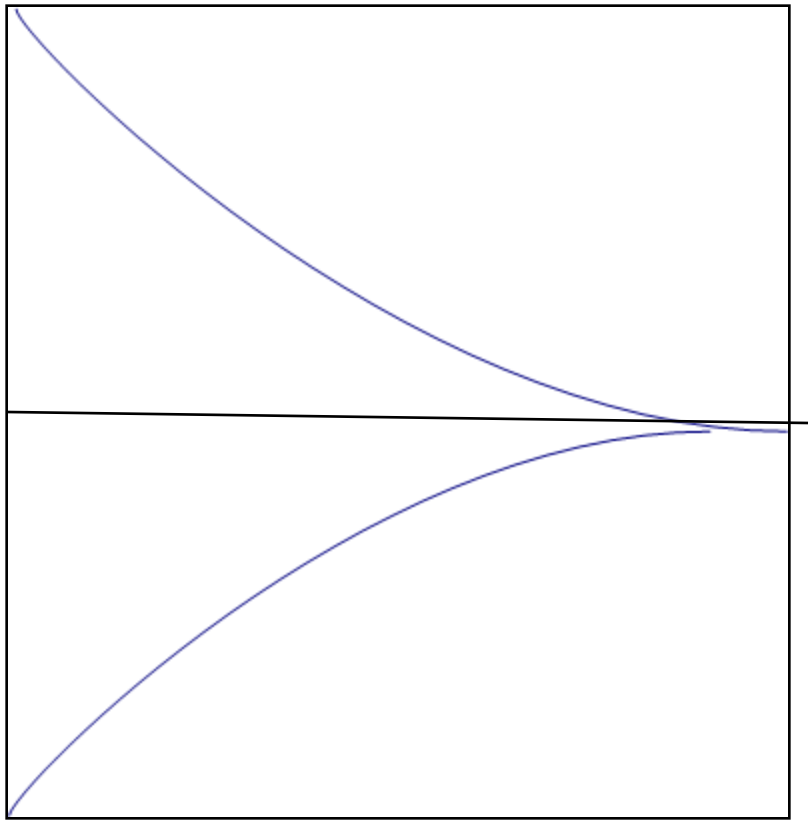
Virtuous or Vicious Cycles

# Negative Feedback Loop

Negative feedback or a balancing loop is a goal seeking behavior or systems regulation behavior. A generic model is provided below.



# Negative Feedback – Behavior Over Time



Goal Seeking

# Systems Archetypes

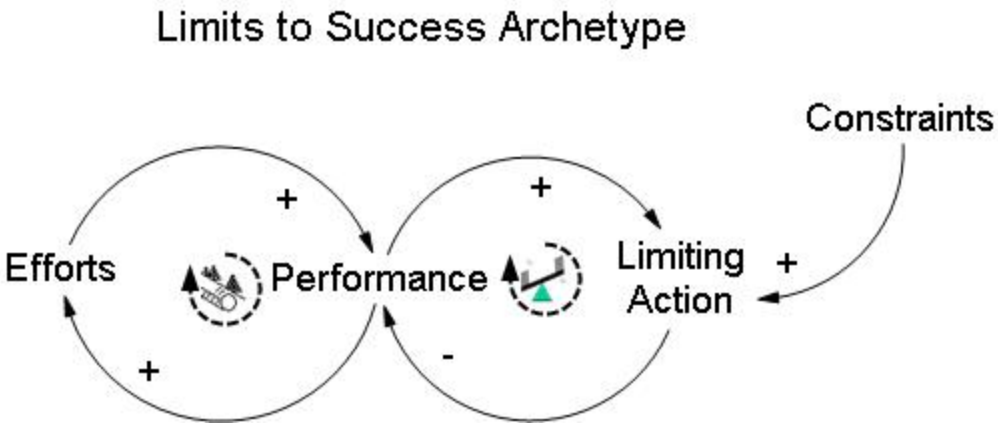
- Archetypes describe commonly observed patterns in natural, social, or artificial systems
- Examples
  - Limits to success
  - Tragedy of the commons
  - Escalation
  - Shifting the burden
  - Success to the successful

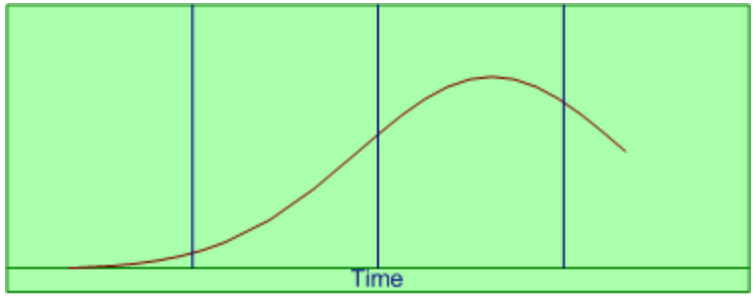
# Limits to Success

- At some point, growth slows due to limiting factors and depending on circumstances overshoots and flattens, collapses, or oscillates around some equilibrium.
- Examples of limiting factors of a population include the average lifespan and the carrying capacity of the environment such as the availability of food or water

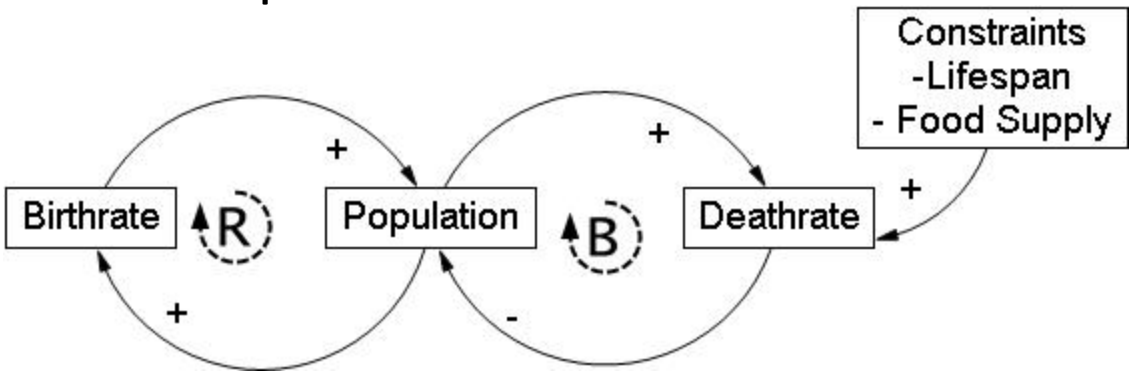
# Limits to Success

## Generic Structure

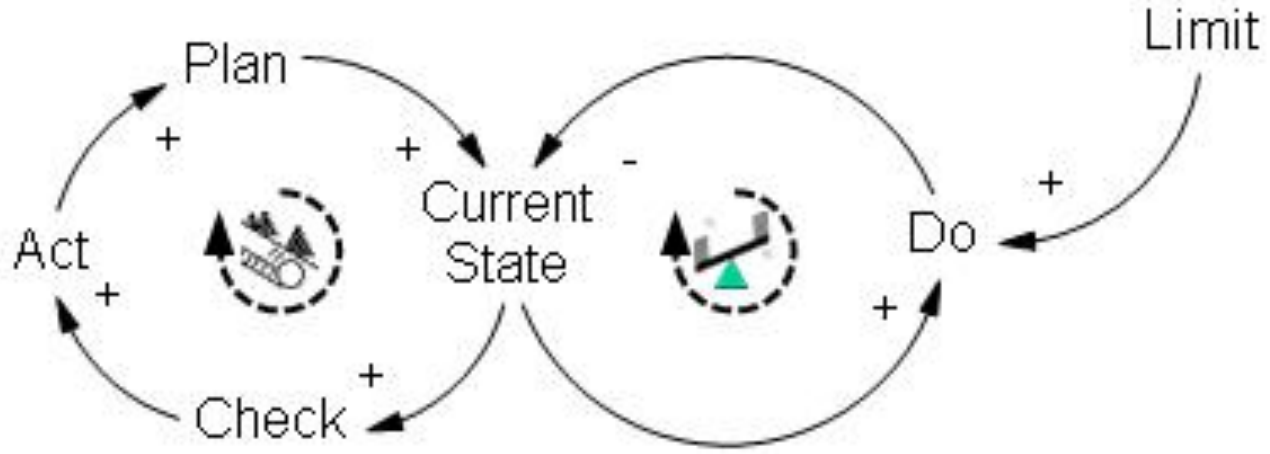



## Example

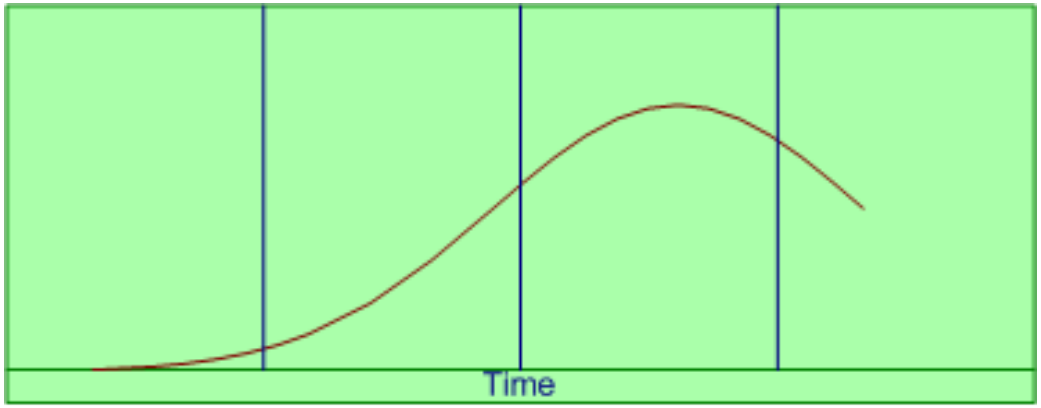


# PCDA – Limits To Success Model




There are limits to improvement such as the laws of physics, investment capital, time, mental models, interest ….

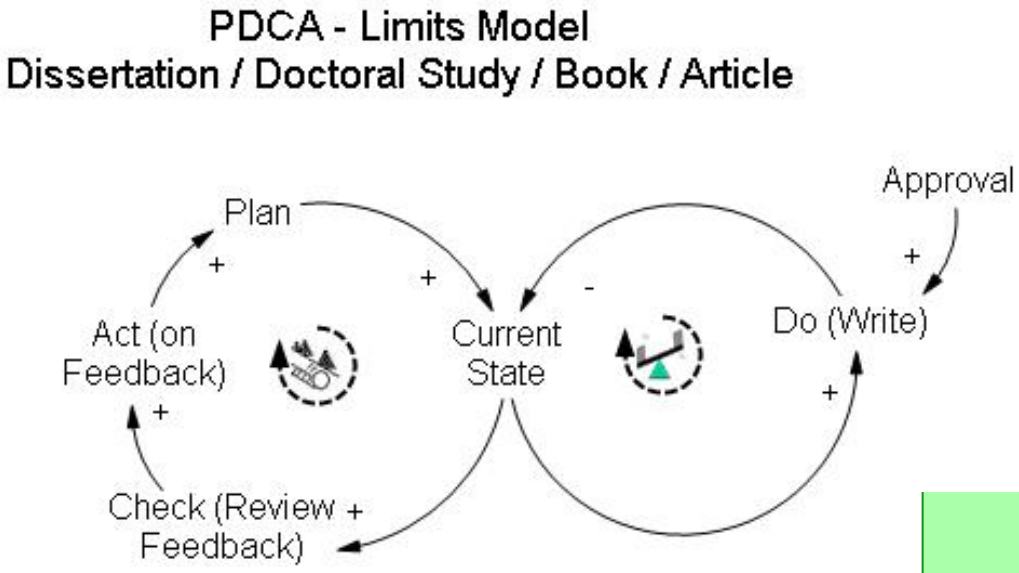
# PDCA Behavior Over Time



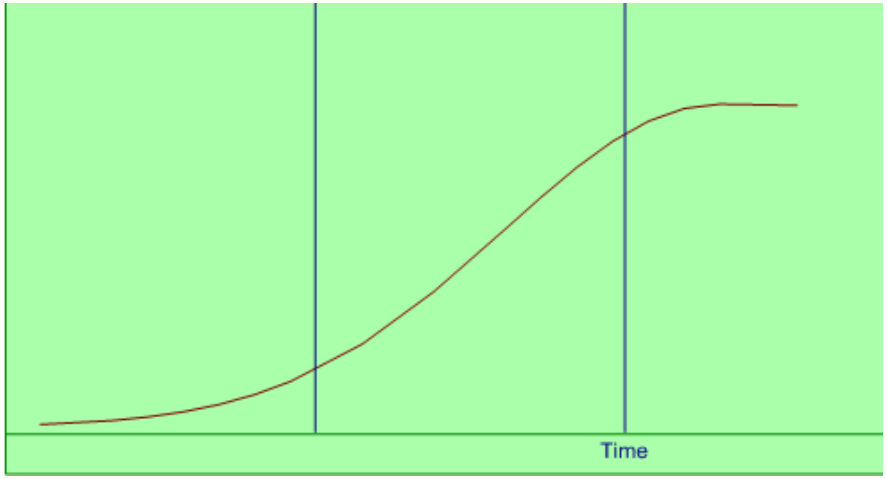

Improvements may start slow, speed up, slow to stop, oscillate about a line, or even decline as limits to improvements are reached

Any thoughts here?

# PDCA with Applications




Behavior of Writing Progress

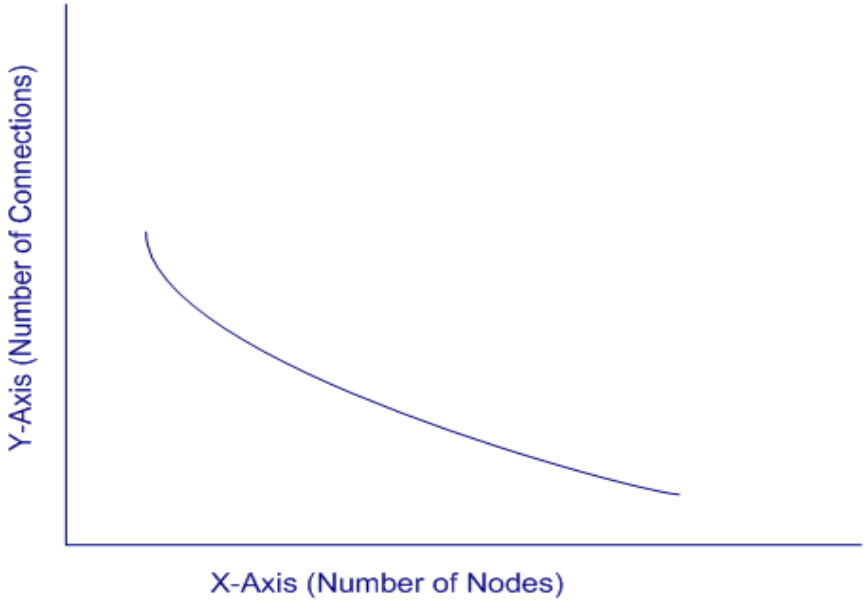


# Scale Free Networks

Scale free networks are characterized by a few nodes having large numbers of connections while most nodes have considerably fewer connections. This distribution follows a power law.

Examples of scale free networks include social networks, the Internet, and ecological networks.

Scale free networks are robust against accidental or random failure; however, they are vulnerable to targeted destruction.

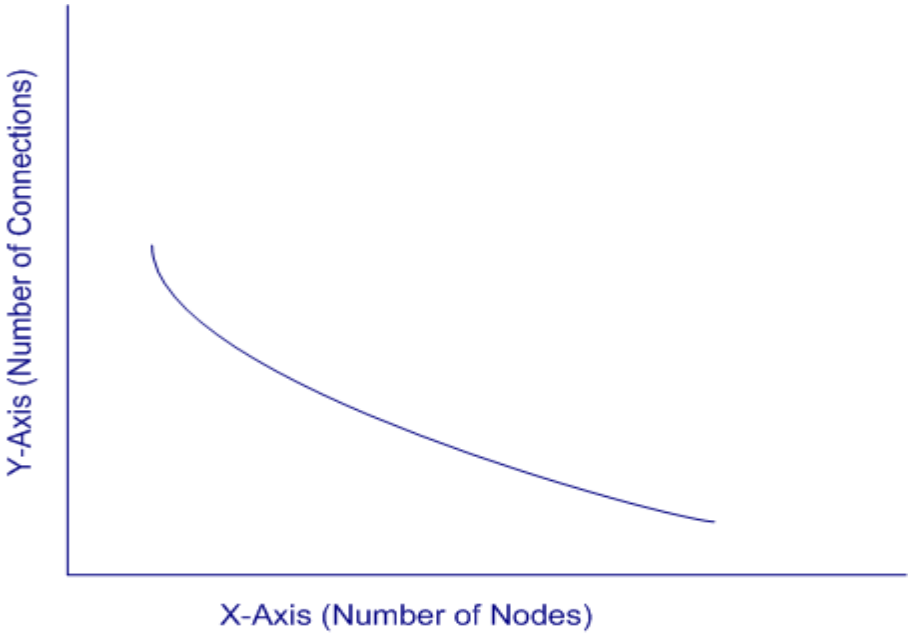



Buchanan, M. (2002). *Nexus: Small worlds and the groundbreaking science of networks*. New York: W.W. Norton & Company

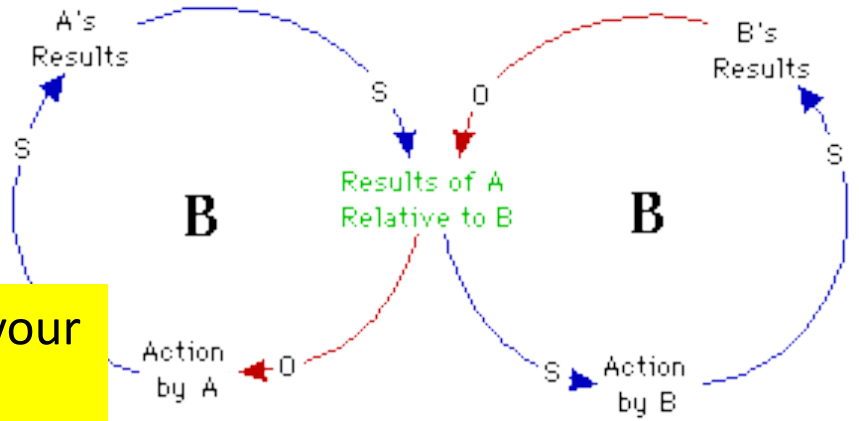
# Scale Free

This graph represents the power law or a scale free network distribution.

In terms of human populations, non-behavioral attributes such as height or weight typically follow a bell shaped curve, while behavioral attributes such as wealth accumulation, popularity, and such follow the power law.




Success to the successful Archetype

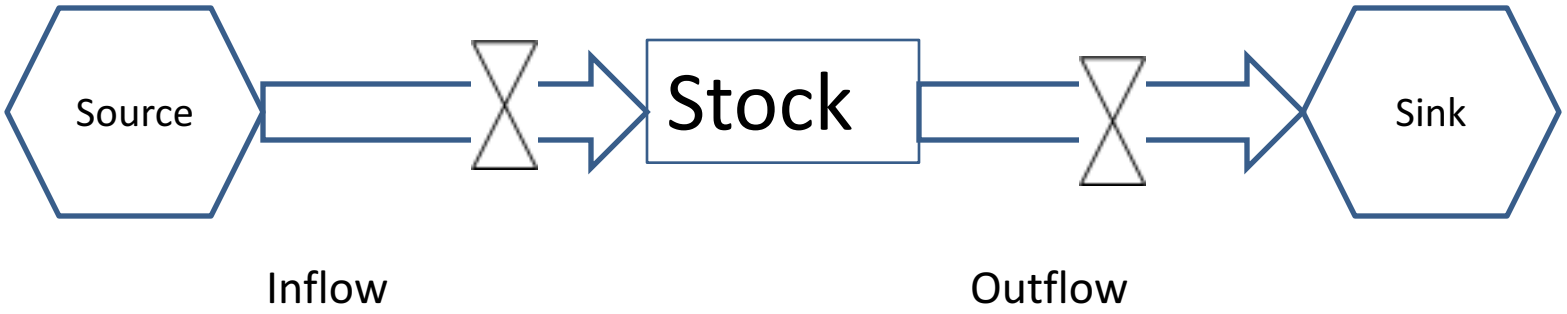



Thought experiment: How might this affect your organization, your community, or you?

Buchanan, M. (2002). *Nexus: Small worlds and the groundbreaking science of networks*. New York: W.W. Norton & Company

# Stock and Flow Diagram

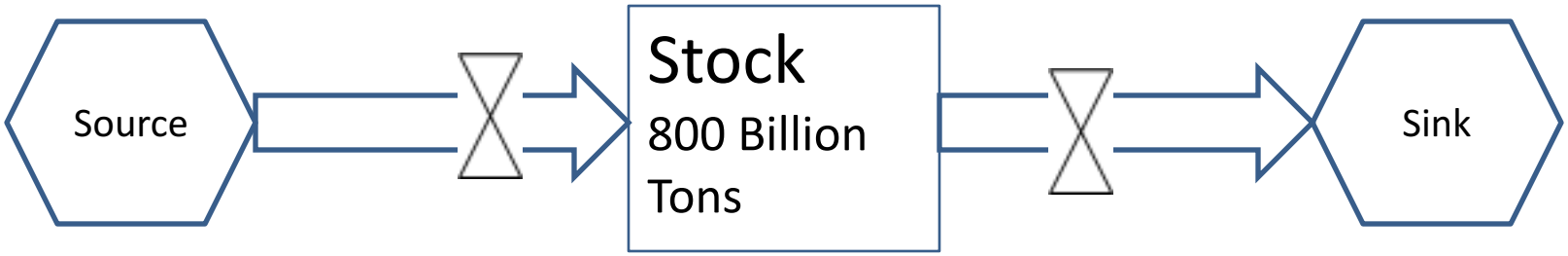
## Birth Death Template




Source: John Sterman, *Business Dynamics.*

# Stock and Flow Diagram

## Atmospheric $CO_2$




Inflow: 8 Billion Tons

Outflow: 3 Billion Tons

Currently the level of CO2 is 35% higher than anytime in the past half million years.

The increase of CO2 has been exponential during the industrial age

Source: Peter Senge, The Next Industrial Imperative, S*trategy+Business*

# Resilience

- The capacity of a system to absorb disturbance and re-organize so as to retain essentially the same function, structure, and feedbacks—to have the same identity.
  - Source: David Salt
- The opposite of resiliency is vulnerability
  - Brian Walker
- Resilience is the capacity of a system to continually change and adapt yet remain within critical thresholds
  - Stockholm Resilience Centre
- Components
  - Robustness, redundancy, resourcefulness, response, recovery

# Resilience Examples

- An ecosystem is resilient to change if it can withstand storms, fire, or other perturbations
- A society is resilient if it can manage political instability, natural disasters, population growth, economic disasters, or other perturbations.
- A company is resilient if it can manage financial swings, increasing / decreasing numbers of customers, increasing competition, lawsuits, ….

# Tipping Point

- That point beyond which something becomes something different and at which point becomes difficult to reverse
- Example:
  - Heating water up to 99.9999 degrees Celsius is hot, but still water. The tipping point is the boiling temperature at which point, water changes from a liquid to a gas
  - A company continues to lose money, but remains in business. If the company declares bankruptcy or is acquired, it tips.

# Adaptation

Adaptation is successful change to either external forces or internal capabilities

What happens to societies, organizations, communities, or families that cannot adapt?

# Mitigation

The effort to reduce the effects of a problem or situation

# CAS Properties

Tags

Internal Models

Nonlinearity

Flows

Diversity

Building Blocks

Aggregation

Source: John Holland*, Hidden Order*

# Information Organization Patterns
# Aggregation Possibilities

Alphanumeric

Chronological

Color

Geography

Hierarchical

Size

Type

Agents can be aggregated in a few possibilities.

Examples of types: clusters of managers, technical staff, …

Organization charts are organized by hierarchy

May organize by the size of cities, countries, ..

# Patterns in Systems

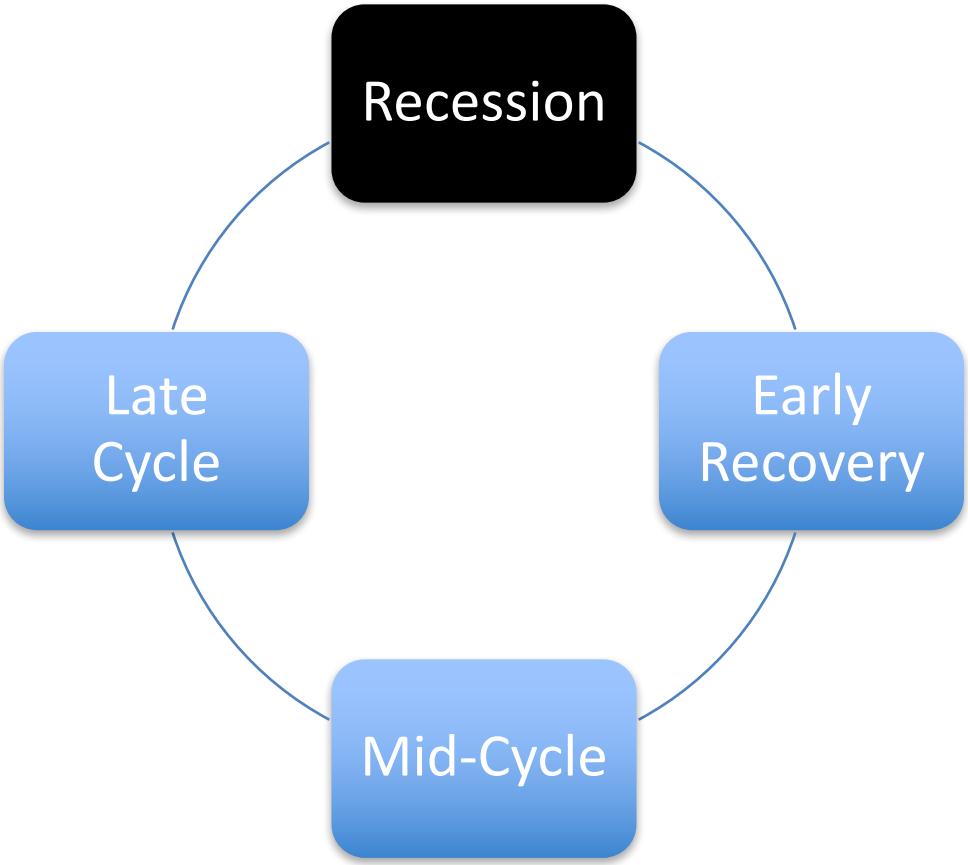
Systems Archetypes

- Limits to Success
- Shifting the Burden
- Tragedy of the Commons
- Growth and Underinvestment
- Attractiveness
- Escalation
- Positive Feedback
- Negative Feedback
- Birth / Death
- Success to the Successful

# Cycles in Human Social Systems

- Adaptive Cycle (conservation, release, reorganization, exploitation)
- Economic Cycles
- Innovation Cycles
- Secular Cycles
- Plus ……

# Economic Cycles



# Collapse

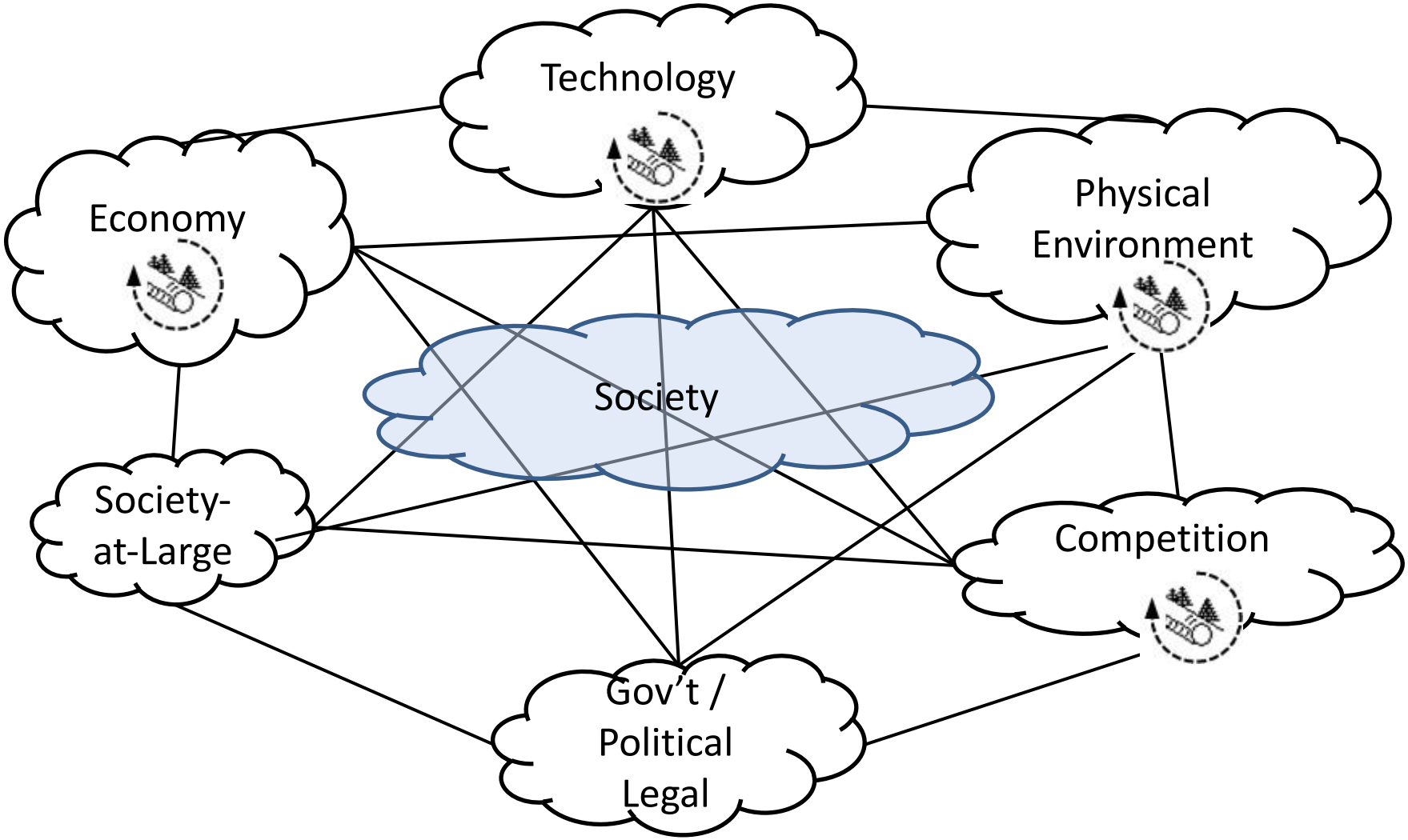
Some say the world will end in fire. Some say in ice.

- Robert Frost

# Collapse

- Systems, including societies, collapse for a variety of reasons.
- Threats from the external environment may overwhelm a system
- Weaknesses within a system may cause it collapse

# System Collapse or Failure



# Collapse (cont)

- From the systems model (previous page).
  - Human social systems are dependent on their environment (independent variables).
  - Human social systems are dependent on supplies (within a range) of MIE.
  - Changes (perturbations) to MIE supplies flowing into a system may result in threats or opportunities

# Collapse (cont)

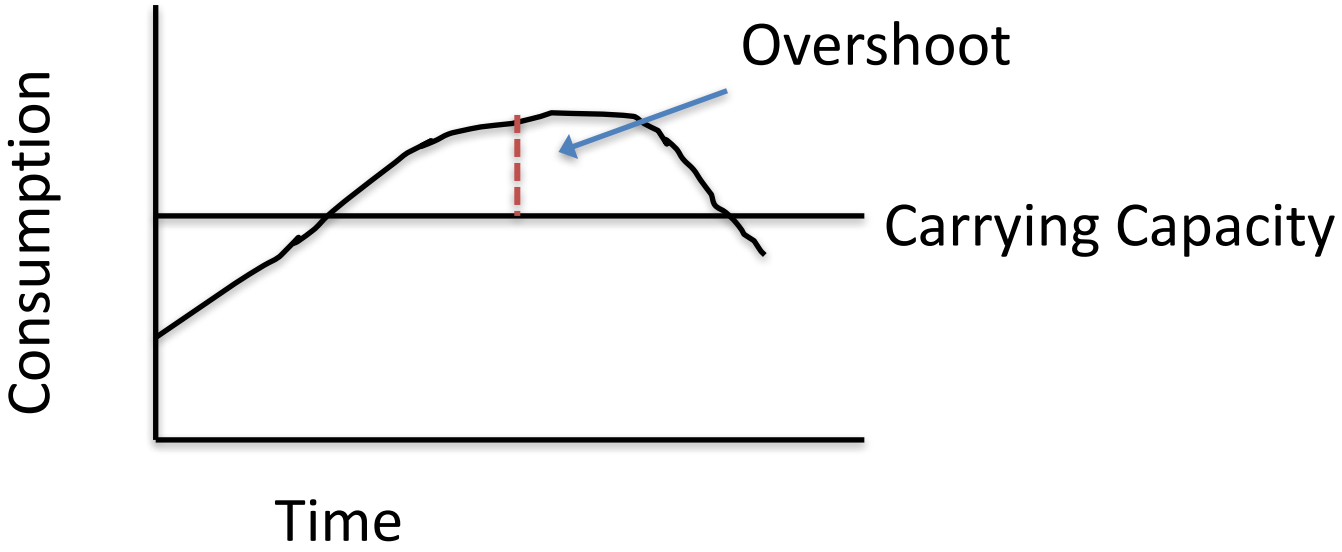
- Exogenous perturbations to a social system may cause it to fail and collapse
  - Physical environment (climate change, pests / bugs / disease…)
  - Economics (The law of diminishing returns, economic conflict, disruption of MIE from suppliers, …)
  - Competition (conflict, disruption of MIE,  )
  - Technology (unable to keep up with advanced technology)
  - Political (revolution, take over, apathy…)
  - Society-at-large (disruption of MIE flows)

# Collapse (cont)

- Endogenous perturbations to a social system may cause it to fail and collapse
  - Weaknesses such as a lack of resources, talent, leadership, interest, financing, energy to survive among many others.

**Essentially systems fail or collapse when a system-threatening problem cannot be solved.**

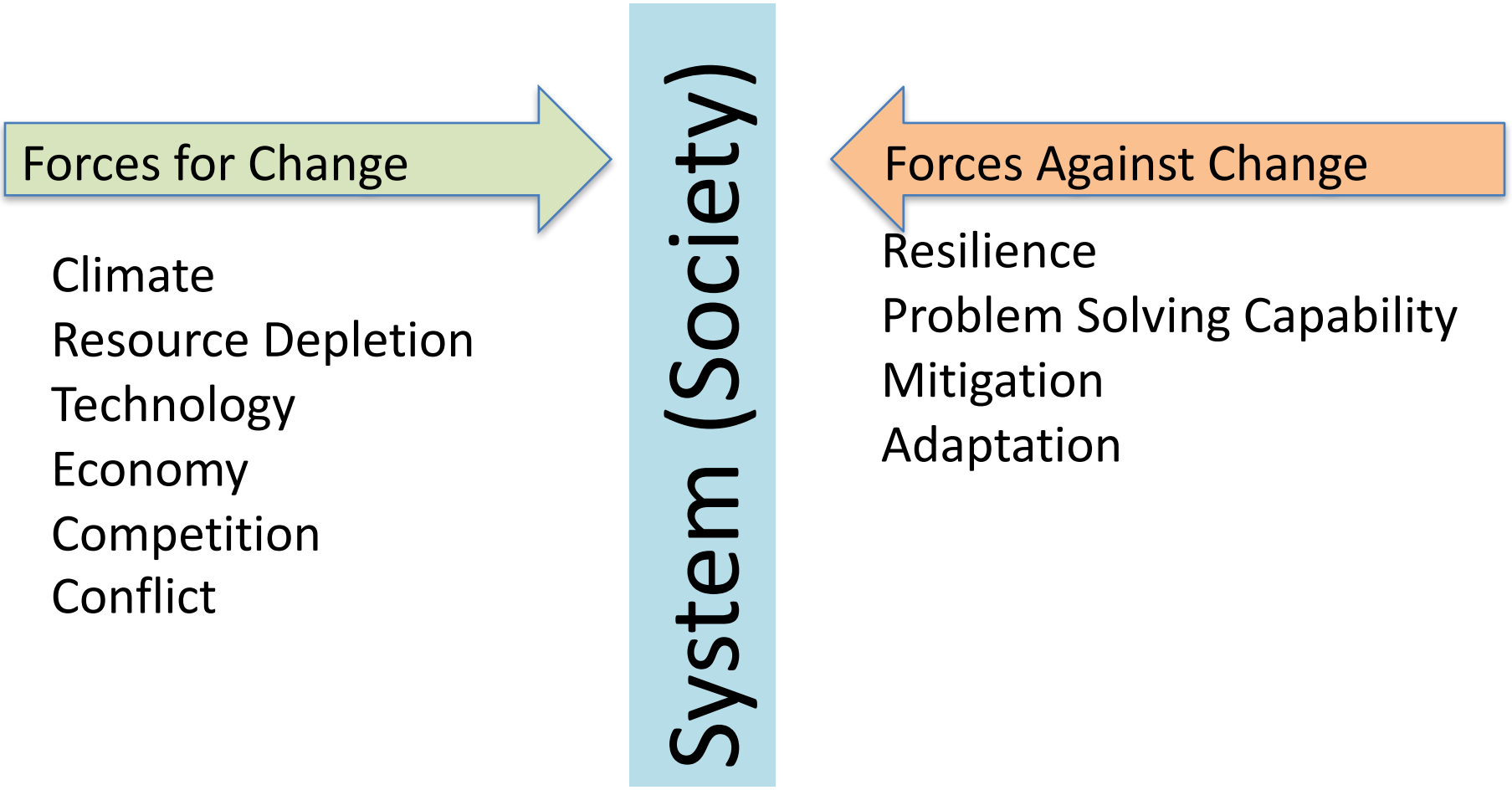
# Collapse (overshoot)




Overshoot occurs when a population exceeds the carrying capacity of its environment. Note: The carrying capacity varies depending on factors in the environment such as the availability of food and water, climate change, ….

# Force Field Analysis

## Example

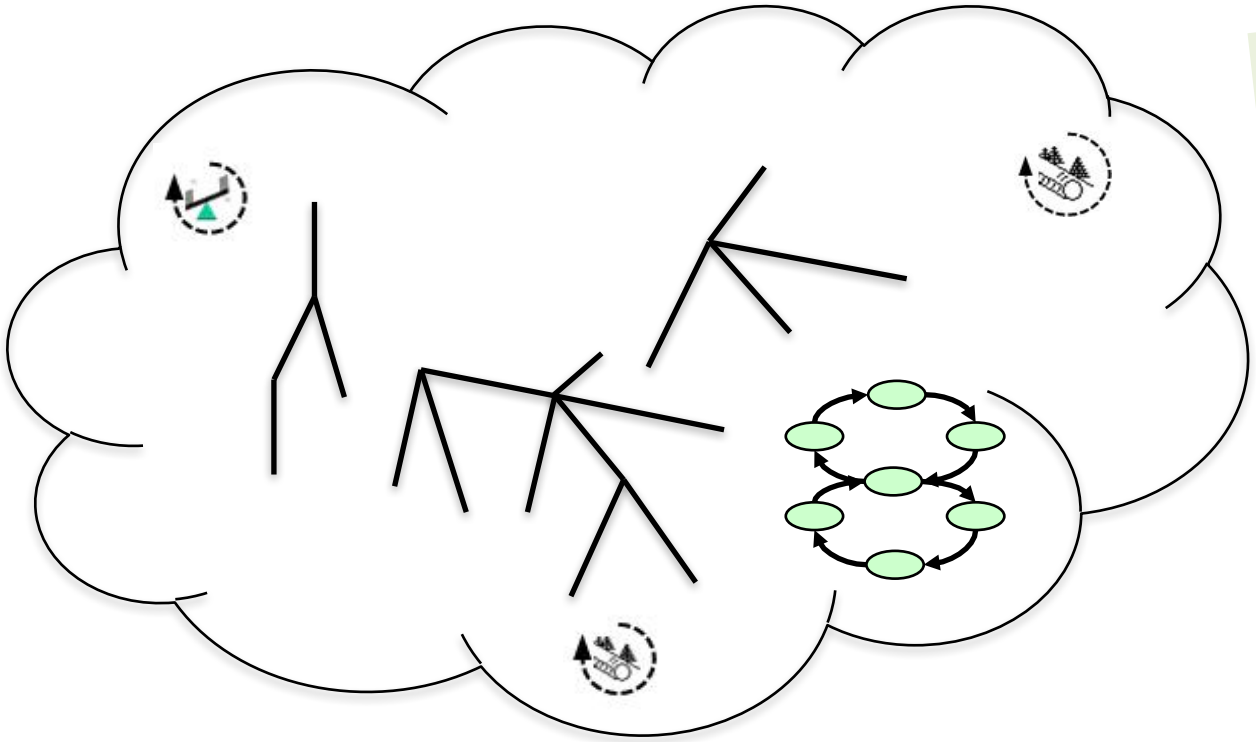


# Some Trends / Forecasts

- U.S. Top 1%
  - 25 years ago, 12% of income, 33% of wealth; today 25% of income and 40% of wealth.
- The processing speed of a laptop will exceed the processing speed of the human brain by 2020
- U.S. population projected to increase from 308 million to 440 million by 2050, and 1 billion by 2100.
- Political gridlock (divergent world views or philosophical civil war?)
- Human consumption is now 23% larger than nature's capacity to regenerate or to absorb our "ecological footprint."

# Complex Social Systems

## Behavior Patterns Over Time



Equilibrium

Periodic

Random / Chaotic

Complex

Perturbing a system results in one of four possible system outcomes: equilibrium, periodic, chaotic, or complex. Note: equilibrium means stable, possibly because of systems failure / collapse

Understanding complex adaptive and evolutionary systems provides insights into change that affect ourselves, our families, communities, organizations, and society.

Complex systems are composed of structures and algorithms or processes.

We understand some structures such as boundaries and networks, while quantitative algorithmic understanding is very limited


But, are things as rosy
as we might think?

Change

# Pace of Change

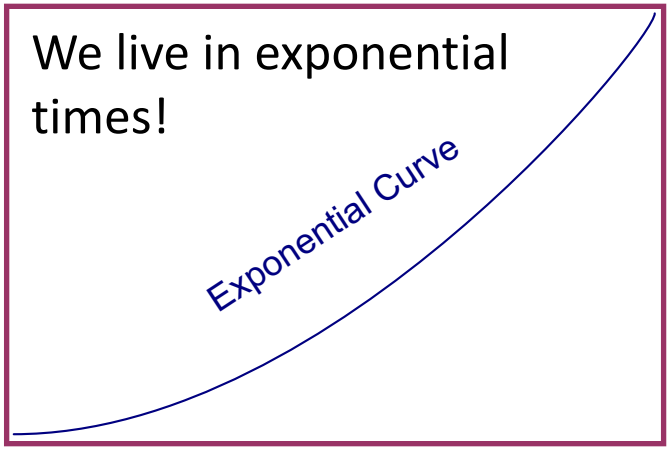
Some Characteristics of the Future

*Speed* – *the rate of change will accelerate*
*Complexity* – *continuously increasing*
*Risk* – *new and higher risks*
*Change* – *radical changes will force faster adaptation*
*Surprise* – *will become a daily feature of life*

Source: Dr. James Canton

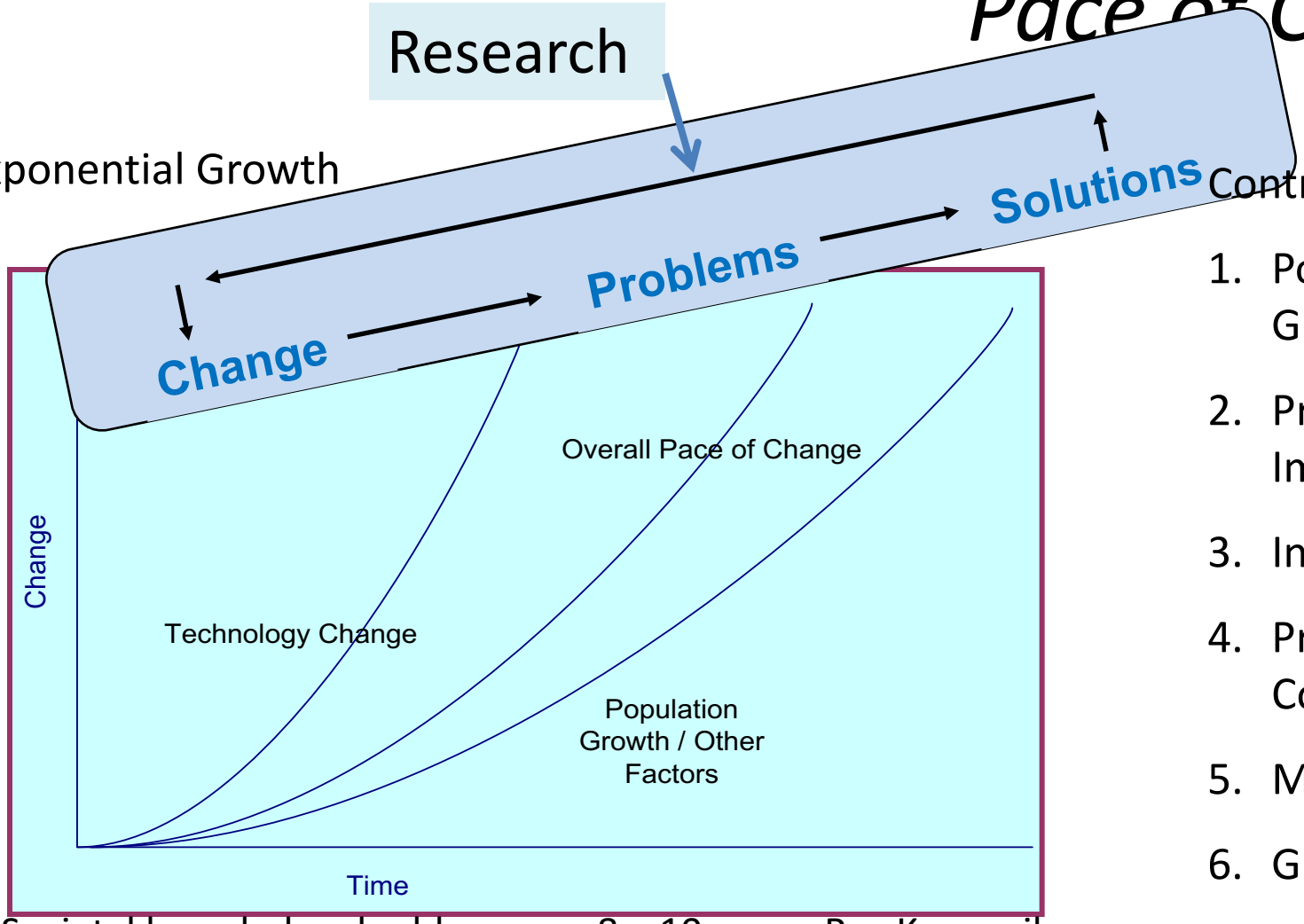
Plus,
*increasing* interdependency
and interaction

We live in exponential times!



# *Pace of Change*

Exponential Growth




Societal knowledge doubles every 8 – 10 years: Ray Kurzweil

Processing speed doubles every 12 – 18 months: Moore's Law

Contributing Factors

1. Population Growth
2. Process Improvement
3. Innovation
4. Product Combinatorics
5. Market Demand
6. Globalization
7. Cost Reductions

# Change

- The **Why** of change
  - Forces and sources of change
- The **What** of change
  - First and second order change, scale, timing
- The **How** of change
  - Adaptive / generative, proactive / reactive, planned / unplanned
- The **Target** of change
  - Outcomes

Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Change

As your organization begins a change process, management needs to understand **why** they are changing, **what** they are changing (degree of change), the approach (**how**) to adopt, and what the **outcome** will be.

Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Change Management

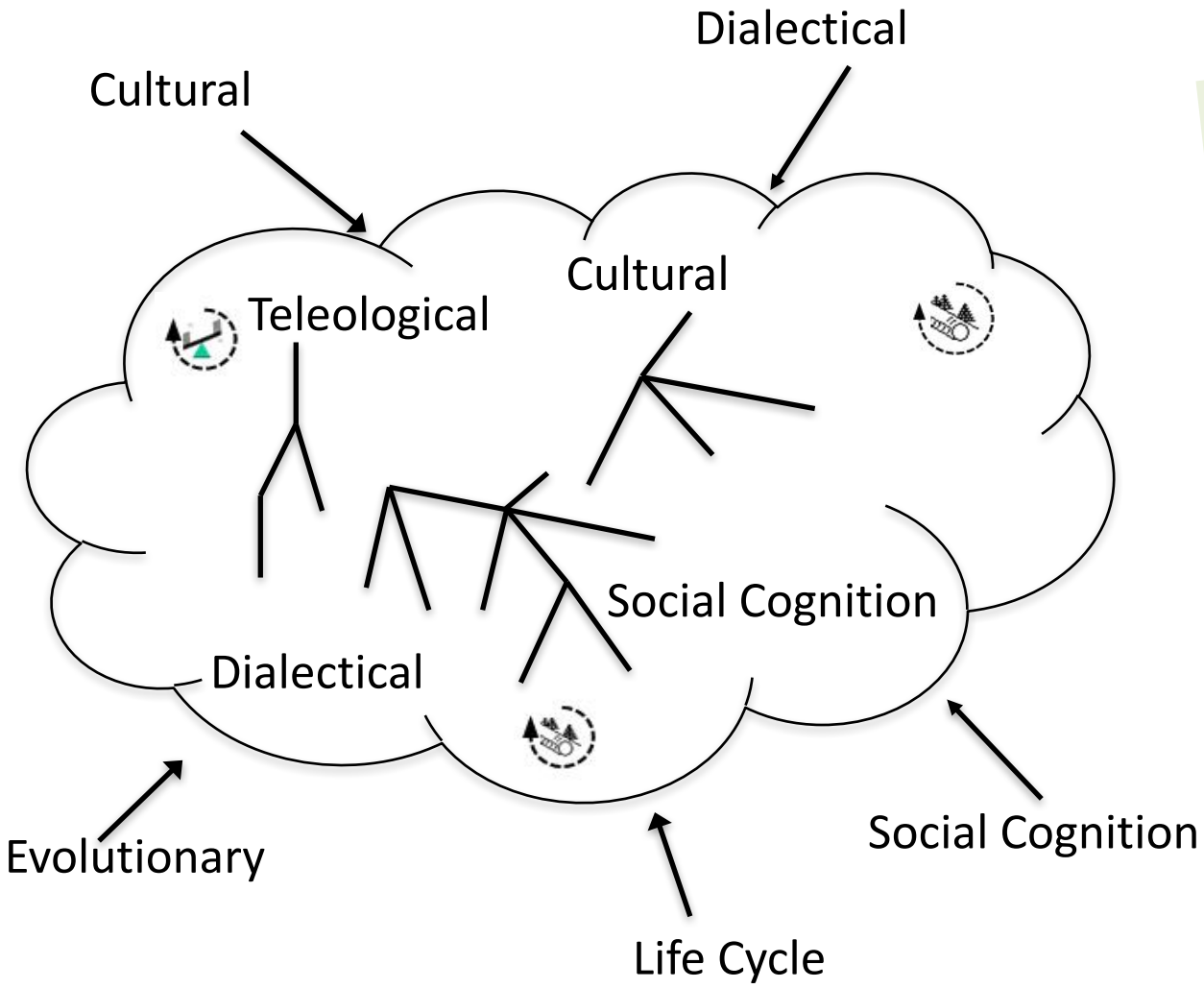
## Key Theories of Change – A Taxonomy

1. Evolutionary
2. Teleological
3. Life Cycle
4. Dialectical
5. Social Cognition
6. Cultural

Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Complex Adaptive (Social) Systems

## Behavior Patterns Over Time and Change Factors




Equilibrium

Periodic

Random / Chaotic

Complex

# Evolutionary Change

- Change is a response to external circumstances, situational variables, and the environment
  - Social evolutional models
  - Biological models
- Change is mostly unplanned – instead, it is an adaptive or selection-based process
- Examples
  - Strategic-choice
  - Population-ecology
  - Abiotic evolution

Sources: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

Eric Beinhocker, "The Origin of Wealth"

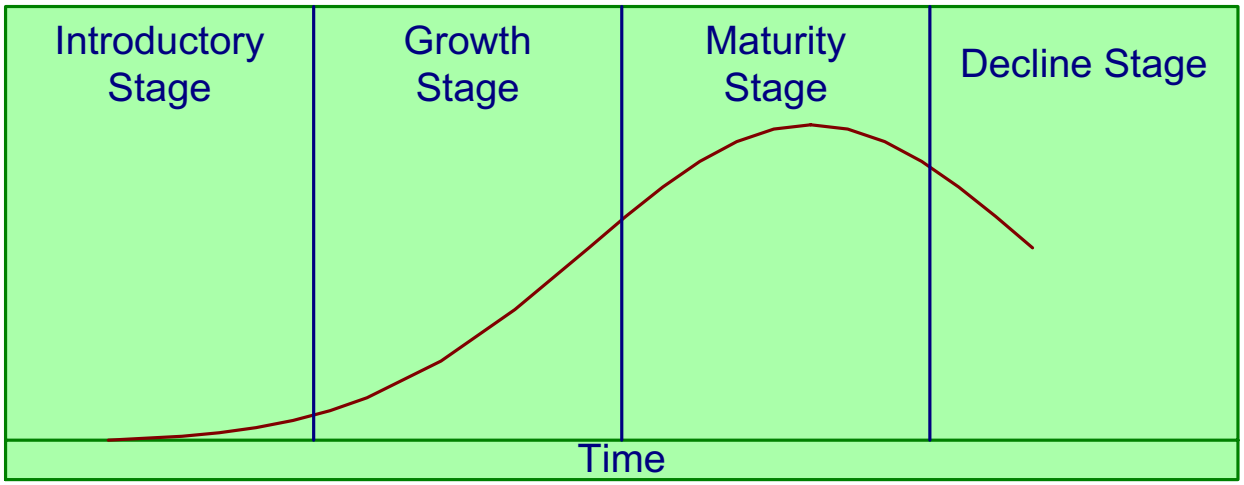
# Teleological Change

- Teleological or planned change occurs because organizations are assumed to be purposeful and adaptive
- The process is rational with managers instrumental in the process
- Models
  - Strategic planning
  - Organizational Development
  - Adaptive learning
  - Total Quality Management
  - Business Process Reengineering
  - Problem Solving
  - Kotter's 8 Step Process
  - Action Research
  - SEI CMM (Capability Maturity Model)
  - SEI PCMM (People Capability Maturity Model)

Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Life Cycle Change

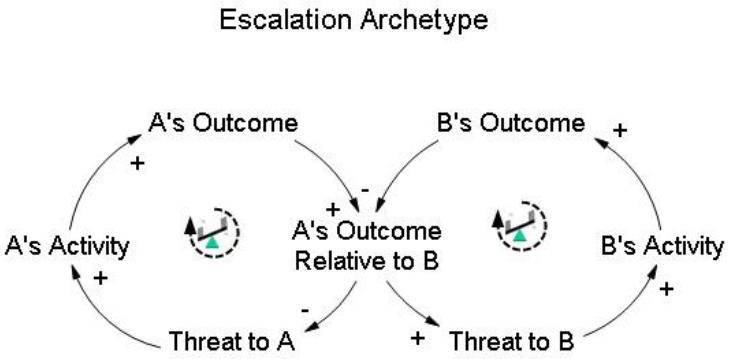
- Life cycle change is focused on stages of growth, organizational maturity, and organizational decline.




Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Dialectical Change

- Dialectical change or political change is change that is the result of clashing ideologies or belief systems
- Conflict is seen as an inherent attribute of human interaction
- Change processes are considered to be predominately bargaining, consciousness-raising, persuasion, influence, and power




Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Social Cognition Change

- This is change tied to learning and mental processes such as sense making and mental models
- Change occurs because individuals see a need to grow, learn, and change their behavior

Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# Cultural Change

- Change occurs naturally as a response to alternations in the human environment; cultures are always changing
- The change process tends to be long-term and slow

Source: Adrianna Kezar, "Understanding and Facilitating Organizational Change in the 21st Century"

# The Why of change

# Forces and Sources of Change

- External environment
  - Remote environment
  - Competitive environment
- Internal environment
  - Culture
  - Resources
  - Leader and employee behaviors / objectives
  - Organizational learning / adaptation

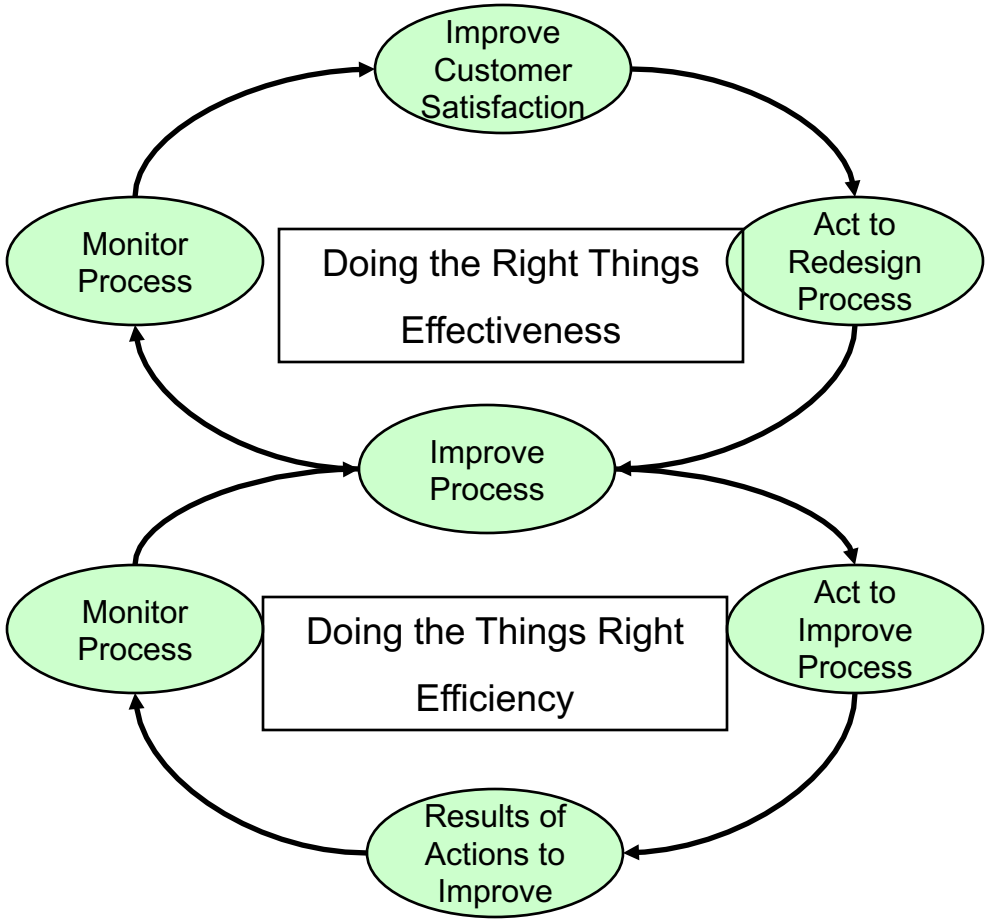
# The What of change

# Degree of Change

- First Order Change
  - Involve minor adjustments / improvements, but does not change the organization's core
  - Characterized by evolutionary change, a linear process, developmental efforts, single loop learning
  - Organization development (OD)
- Second Order Change
  - Transformational change, core change, underlying values, mission , culture, structure
  - Irreversible change
  - Associated with a crisis
  - Double loop learning

Kezar, *Understanding and Facilitating Organizational Change in the 21st Century*

# Single / Double Loop Learning




Double Loop Learning - Information about process effectiveness in serving customers

Single Loop Learning -- Information about process improvement and efficiency in serving customer

# Types of Change

- Developmental change
- Transitional change
  - (unfreeze, change, freeze)
- Transformational change
  - (near death experience)

Some theorists refer to developmental and transitional change (listed here) as first order change and transformational change as second order change. See Kezar

Source: Anderson and Anderson, "Beyond Change Management"

# Timing of Change

- Revolutionary change
  - Departs significantly from the existing organization
  - Occurs suddenly, with drastic changes within the mission, culture, and structure
  - Associated with second order change
- Evolutionary change
  - Less likely to be adopted as it may be seen as very long-term

Kezar, *Understanding and Facilitating Organizational Change in the 21st Century*

# The How of Change

# Planned / Unplanned

- Planned change
  - Changes deliberately made or shaped by the organizational members
- Unplanned change
  - Evolutionary and accidental change are not considered to be planned change

Kezar, *Understanding and Facilitating Organizational Change in the 21st Century*

# Half Full or Half Empty?

# Activities

# Strategic Planning made Simple

1. Where are you?
2. Where do you want to go?
3. How are you going to get there?
4. Who is going to do what and when?

# Activity 1

- Using the system environment framework (economy, technology, government, society, competition and the physical environment), list some:
  - Key events
  - Trends
  - Forecasts

# Activity 2

- What are examples in your organization of:
  - Suppliers / Inputs / Detectors
  - Effectors / Outputs / Customers
  - Resources / PTs / STs / OPs
  - Agents / Meta-agents (roles)
    - Leadership
    - Staff
    - Change agents / Gatekeepers
  - Rules
  - Relationships
  - Interdependencies
  - Processes
  - Resilience
  - Thresholds
  - Feedback loops

# Activity 3: Resilience

- Let's explore resilience in more detail—on a 1 – 5 scale with 1 being high and 5 being low:
  - How **Robust** is your organization?
  - Do **Redundancies** exist in critical functions, programs, …?
  - How **Resourceful** is your organization?
  - How capable is your organization to **Respond** to threats? To opportunities?
  - How capable is your organization to **Recover** from disasters?

# Activity 4

- Summarize where you are
- Summarize where you want to go

# Activity 5

- Given the outcome of activities 1, 2, 3, and 4 what change models might your organization embrace over the next 3-5 years?

# Activity 6

How might your organization be quantified?

***Thank You***

***for***

***Embracing Change!!***

**EMBRACING**

**CHANGE**

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