Cartesian Thinking
vs.
Systems Thinking

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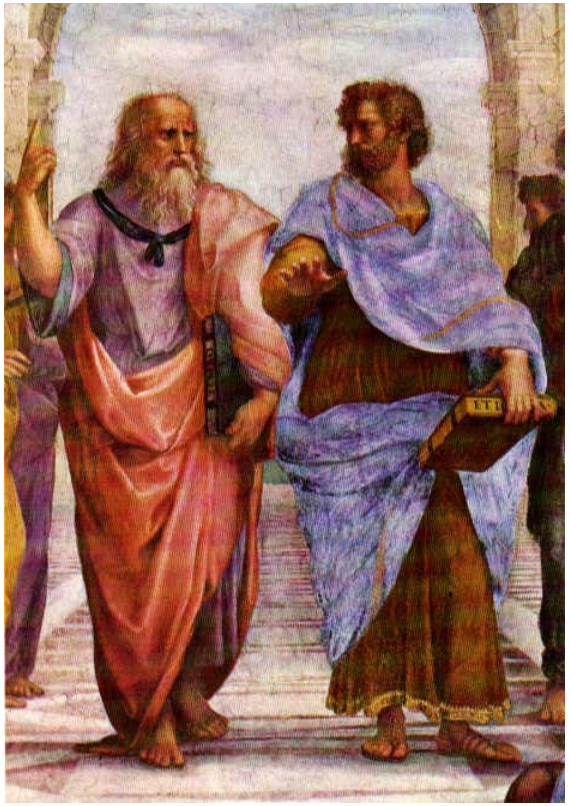


For good or ill, ideas guide our economic, social and cultural development

Descartes – (1596 – 1650)
Birth of Modern Philosophy

1644 – *Meditations* - Descartes proposes that logical reasoning is our highest faculty.

"I concluded that I might take as a general rule the principle that all things which we very clearly and obviously conceive are true: only observing, however, that there is some difficulty in rightly determining the objects which we distinctly conceive."

Discours de la Méthode. 1637.

Cartesian Thinking

Rules for evaluating reality:

- Never accept anything for true that we do not clearly know to be such
- Divide each part of the difficulties under examination into as many parts as possible
- Begin with the simplest and easiest and then work step-by-step to the more complex
- Make enumeration so complete and reviews so general that it might be assured that nothing is omitted.

Descartes (1619)

What went wrong?

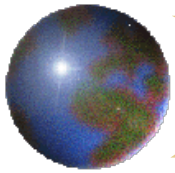
The concern we've considered: "Linear Thinking"

A concern we have not considered:

This Platonic and Cartesian framework for the world (all of being) necessarily restricts how we look at all things, ourselves, and the world.

Reductionism

Newton 1642-1726

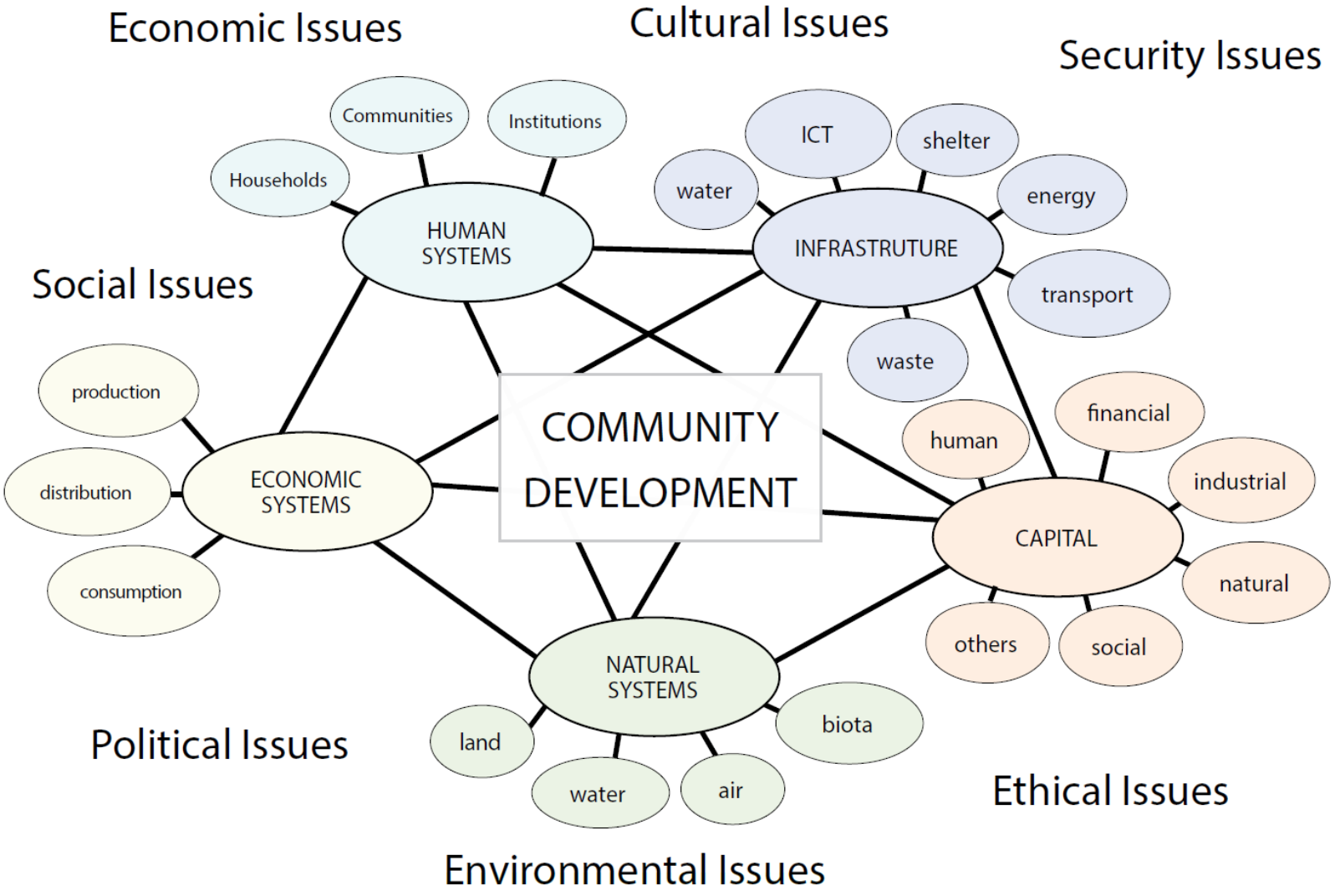


What makes a system?

- The parts or components
- The relationship between the parts
- The purpose of the system (subsystems may have several purposes conflicting or not)
- Components operate under certain rules that control their behavior

"Nothing is completely itself without everything else"

(T. Berry)


Economic Issues
Cultural Issues
Security Issues
Social Issues
Political Issues
Ethical Issues
Environmental Issues
COMMUNITY DEVELOPMENT
HUMAN SYSTEMS
Communities
Institutions
Households
INFRASTRUTURE
ICT
shelter
water
energy
transport
waste
ECONOMIC SYSTEMS
production
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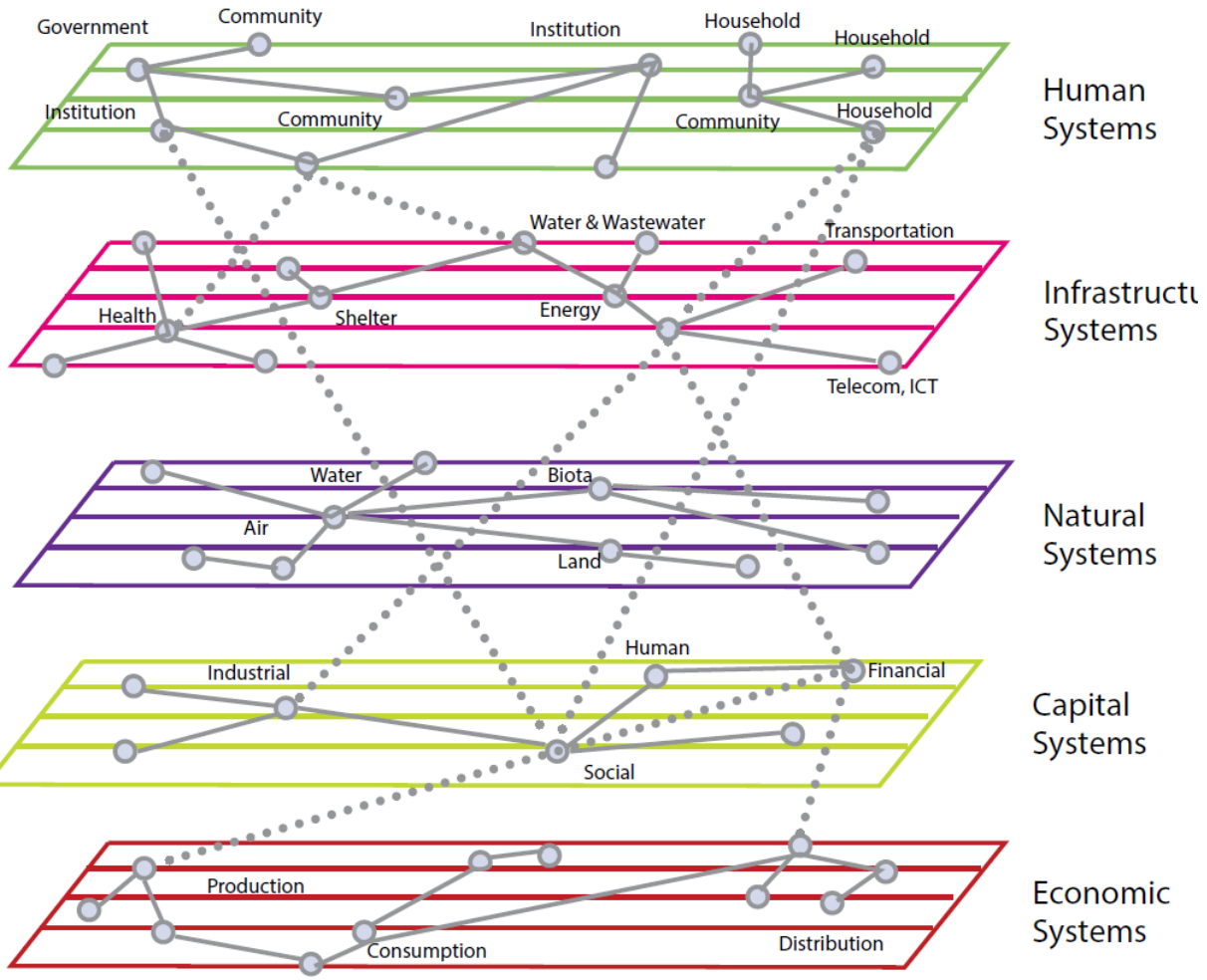
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Transportation
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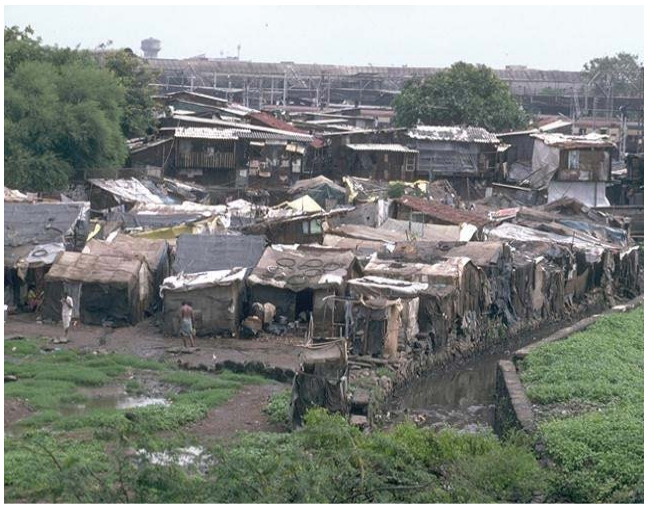
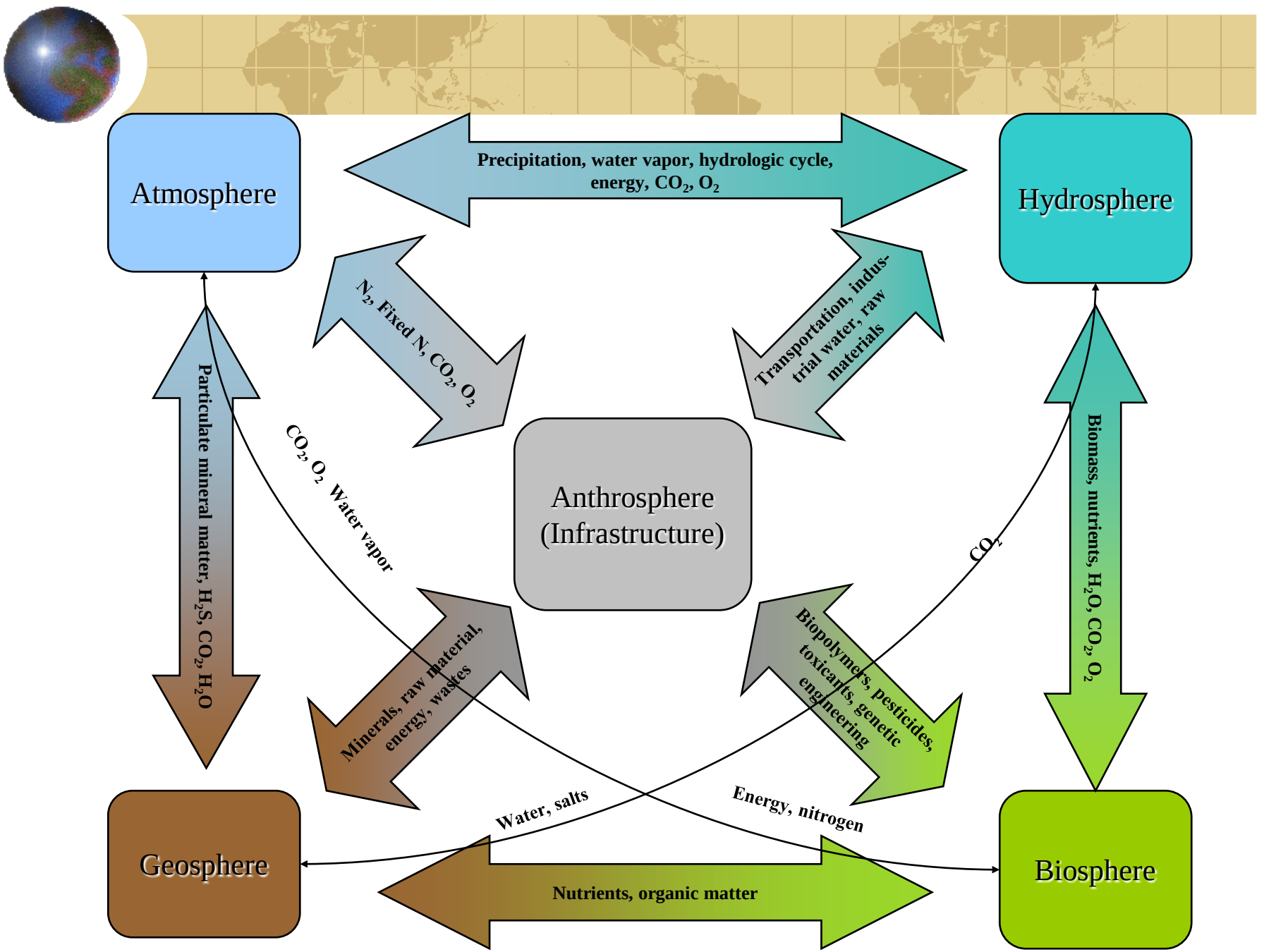
Biota
Air
Land
Human
Industrial
Financial
Social
Production
Consumption
Distribution
Human Systems
Infrastructu Systems
Natural Systems
Capital Systems
Economic Systems

Infrastructure

Infrastructure is that part of the anthrosphere composed of the utilities, facilities, and systems used in common by members of a society and upon which the society depends for its normal function.



Water – Waste – Sanitation - Energy – Shelter - Transportation – Land Use



FROM: Figure 1.1, Industrial Ecology, Environmental Chemistry and Hazardous Waste, Stanley E. Manahan

NON-NATURAL SYSTEMS
(Built Environment - Anthrosphere)

NATURAL SYSTEMS
(Biosphere- Hydrosphere- Geosphere – Atmosphere)

Types of Systems

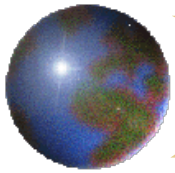
- Isolated: boundaries closed to import or export of both mass and energy
- Closed: boundaries closed to import or export of mass, but not of energy
- Open: exchange of both mass and energy with surroundings

"When we try to pick up anything by itself, we find it is attached to everything in the universe" (John Muir)

Simple, Complicated, Complex

- Simple: we know the knowns
- Complicated: we know the unknowns
- Complex: we don't know the unknowns
- Chaotic: it is all over the place

The type of system dictates the methods of intervention



Community as Adaptive System

- Constantly evolve and grow
- Self-organization, self-correction, and adaptation by changing structure, behavior, rules of interaction through evolutionary and co-evolutionary change
- Communities interact with their environment through feedback mechanisms

Communities as Complex Adaptive Systems

- In order to address community issues and problems, complexity and uncertainty must be embraced and dealt with.
- Ill-defined problems, uncertainty: no unique and best solutions to complex problems exist, only satisficing (i.e., good enough) solutions.

Habits of a Systems Thinker

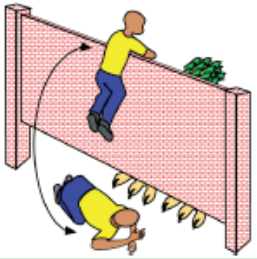
Seeks to understand the big picture

Observes how elements within systems change over time, generating patterns and trends

Recognizes that a system's structure generates its behavior

Identifies the circular nature of complex cause and effect relationships

Changes perspectives to increase understanding



Surfaces and tests assumptions

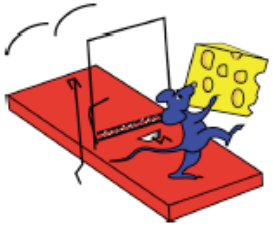
Considers an issue fully and resists the urge to come to a quick conclusion

Considers how mental models affect current reality and the future

Uses understanding of system structure to identify possible leverage actions

Considers both short and long-term consequences of actions

Finds where unintended consequences emerge

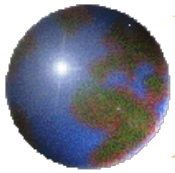


Recognizes the impact of time delays when exploring cause and effect relationships

Checks results and changes actions if needed: "successive approximation"

Systems Thinking

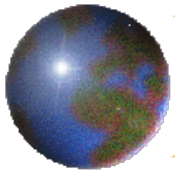
- “The art and science of making reliable inferences about behavior by developing an increasingly deep understanding of underlying structure” (Richmond, 1994)
- “An iterative learning process in which we replace a reductionist, narrow, short-term, static view of the world with a holistic, broad, long-term, dynamic view, reinventing our policies and institutions accordingly” (Sterman, 2006)
- “A paradigm that provides a unique vantage point and a set of skills when looking at the world. It is also a learning method which provides a language to communicate the complexity of that world to others” (Richmond, 1994)



A Global View of System Thinking

- See the world around us in wholes instead of snapshots
- See and sense how the parts of systems work together
- See relationships between the elements from multiple levels of perspective rather than cause-effect chains (31)
- Help understand the dynamic and changing nature of life including the effect of time and delays (34)
- Help understand how one small event can influence another and unintended consequences (33)
- Help understand that what we see happening around us depends on where we are in the system
- Challenges our own assumptions (mental models)

(Linda Sweeney, 2001)

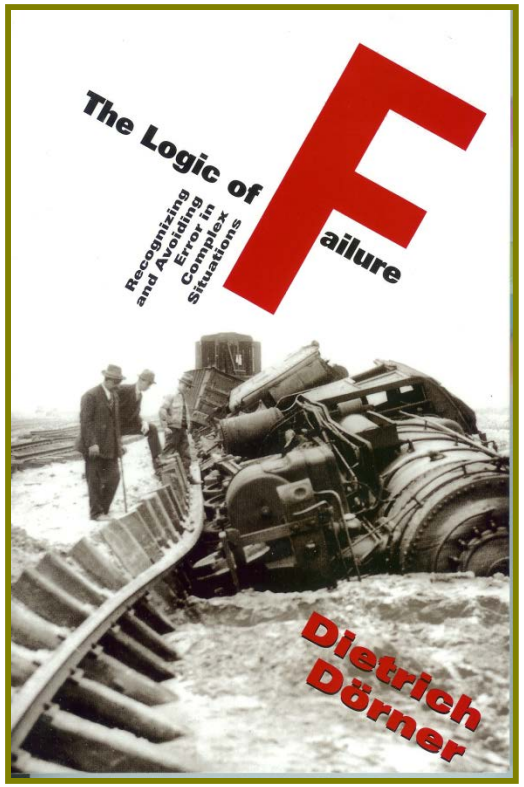


What is NOT Systems Thinking?…

- It is NOT analysis
- Analyzing something involves breaking it down into bite-size, manageable pieces.
- Analysis works fine for: organizing your CD collection, or finding out exactly how your clock works, or examining a water molecule.
- Problems arise when we use analysis *mindlessly!*
- Systems are dynamic, and there are relationships

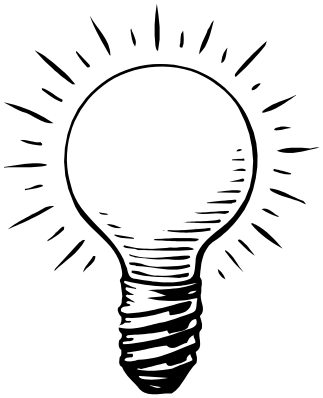
Why Things Fail?

- Slowness of human thinking. We feel obliged to economize and simplify
- Slow speed in absorbing new material. We don't think about problems we don't have.
- Self protection. We need to have things easier and under control to preserve our expectation of success
- Limited understanding of systems: complexity, dynamics, mistaken hypotheses and ignorance



"The significant problems we face today cannot be solved at the same level of thinking we were at when we created them."

Albert Einstein



Contact: amadei@colorado.edu