Introduction to systems thinking for identifying disease management strategies

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Day 2
7 Dec 2022
11:00a-12:00p

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6th cycle Training of National Wildlife Focal Points
6e cycle de formation des Points focaux nationaux pour la faune sauvage
Africa Region Afrique
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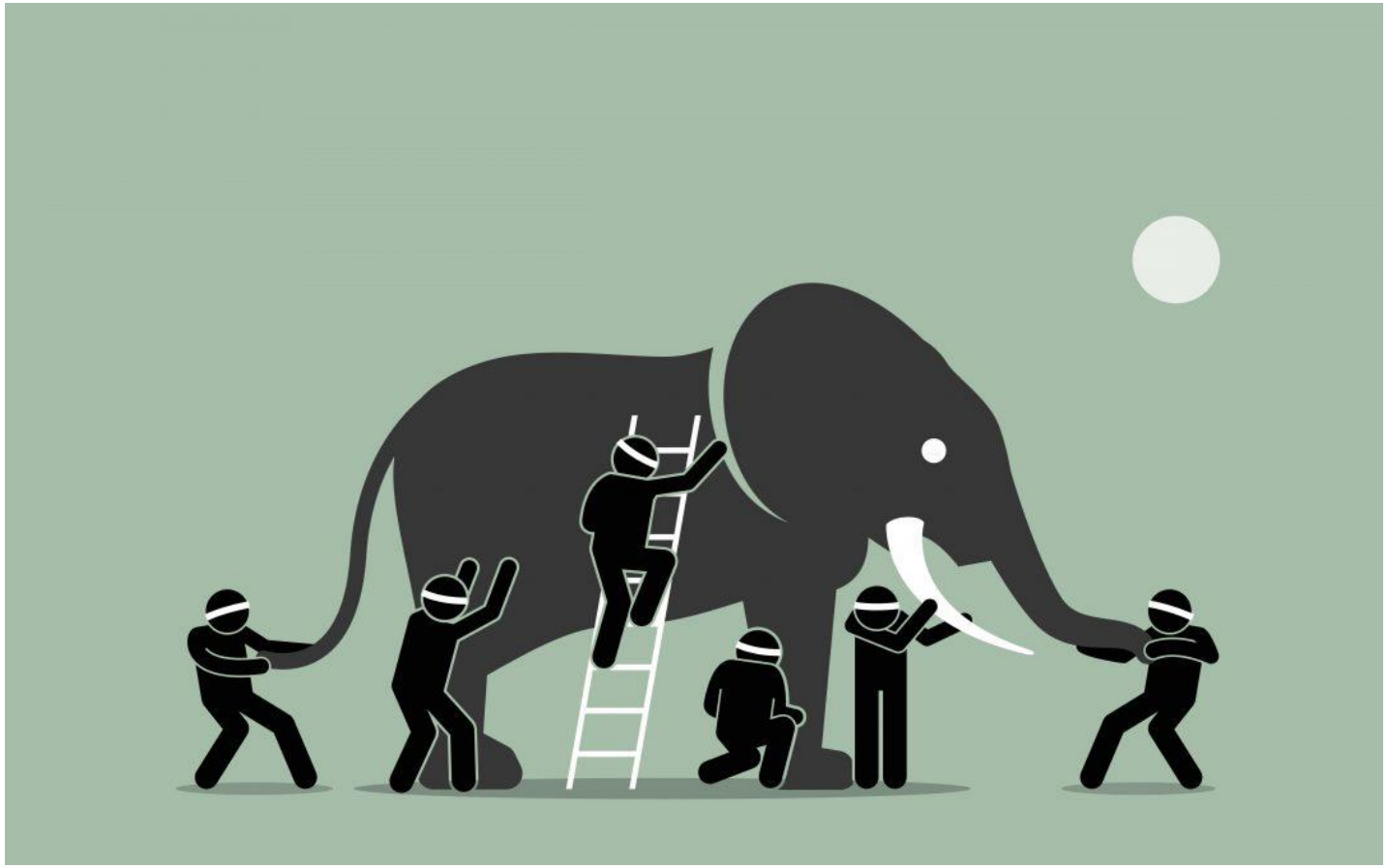
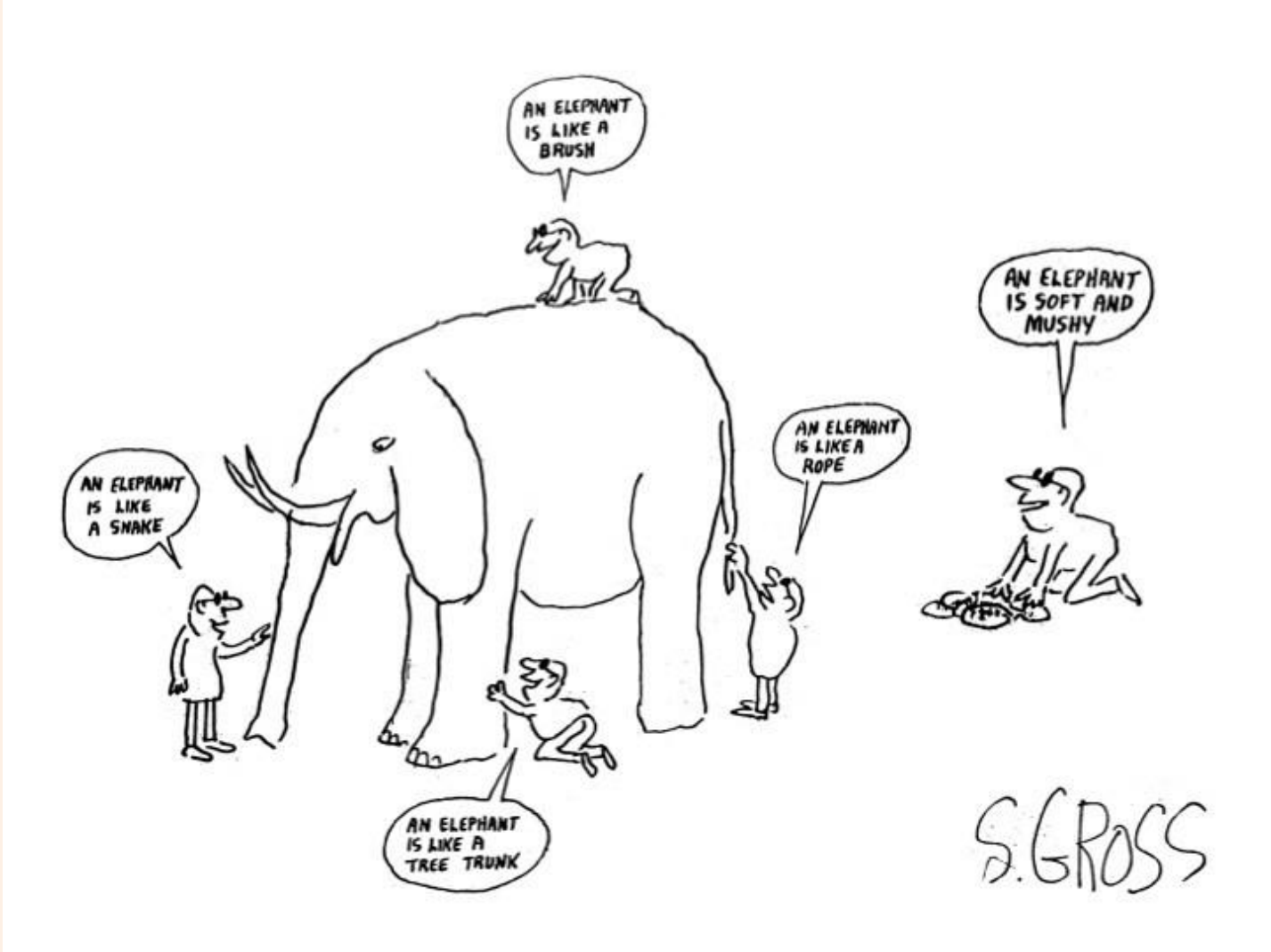
Systems thinking perspective



The *behavior* of the system cannot be known by only knowing the elements of the system-

Meadows 2008



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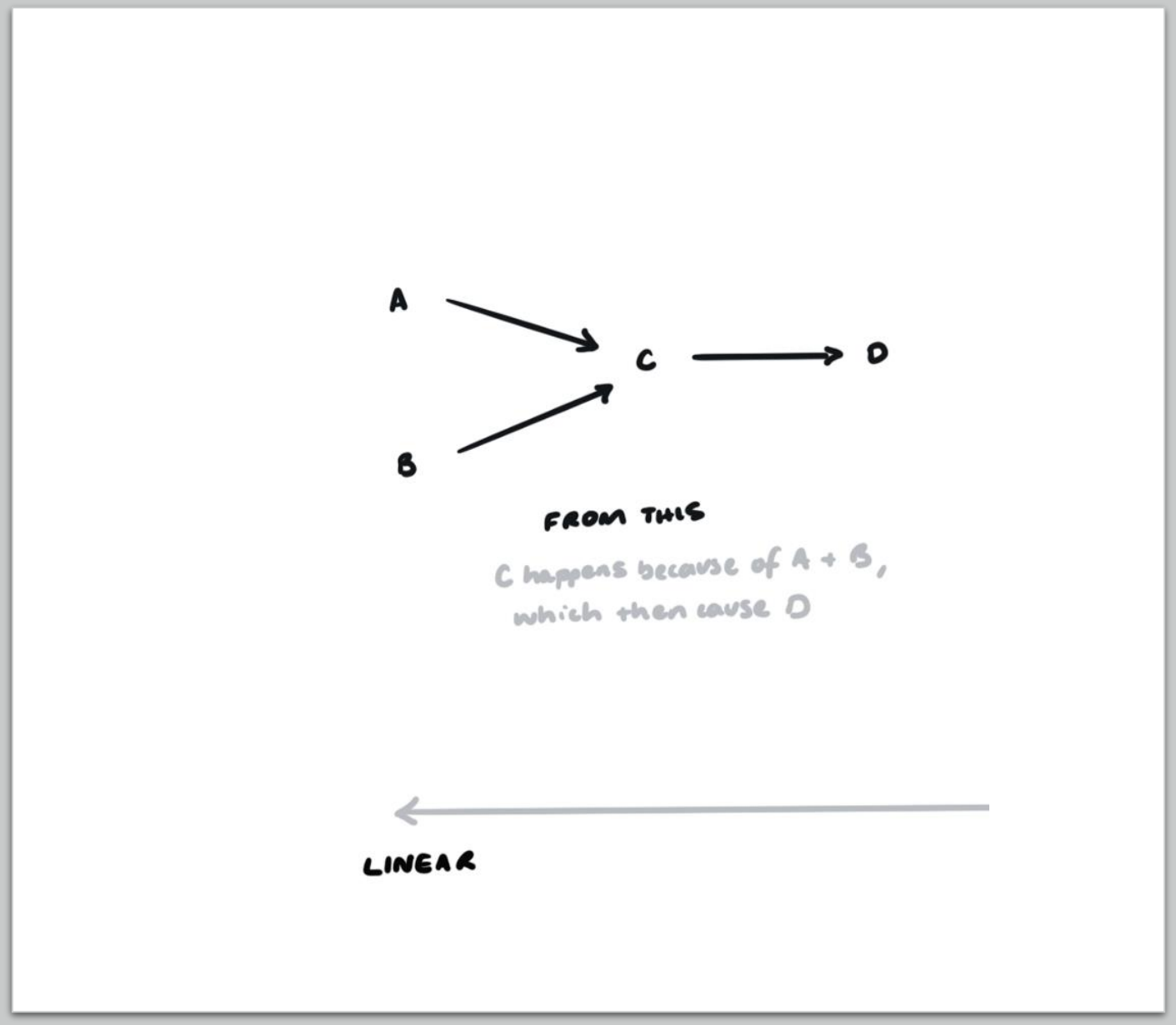
Systems can be simple

- **System**: set of interacting components that are organized in a way that achieves *something*
- **Simple systems** have clear cause and effect
  - Reductionist techniques work well for problem solving



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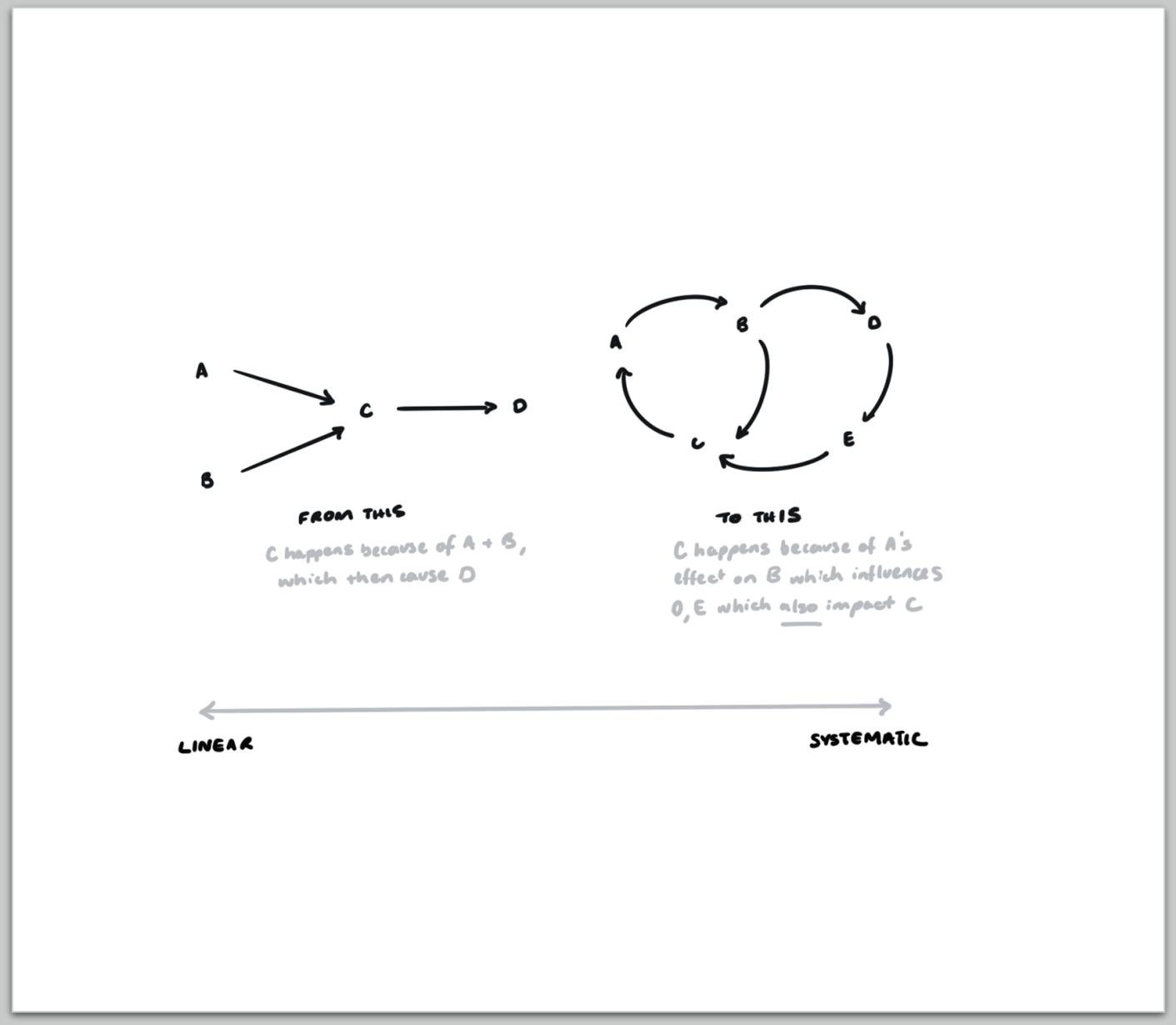
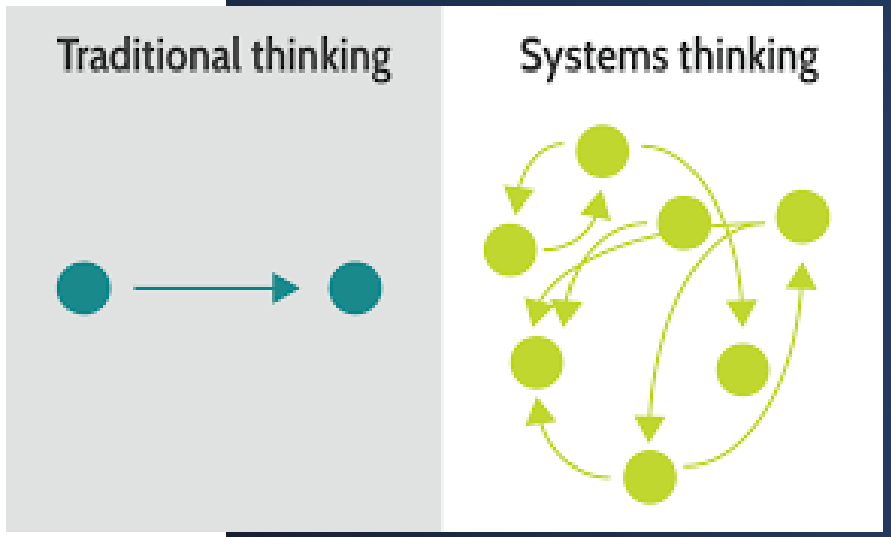
Systems can be complex

- **Complex systems**
  - Natural selection, genetic diversity
  - But can create wicked problems
  - Poverty, global food supply, loss of biodiversity, wildlife trade, etc.
  - All involve interactions of environment, political structures, and economics



Systems thinking

- Helps us understand more deeply how complex systems operate
- Address how parts are connected, not just the parts themselves
- Help recognize hidden and unintended consequences
- Help push behavioral change
- Help look for small changes that can have meaningful impacts



How we tend to think

vs

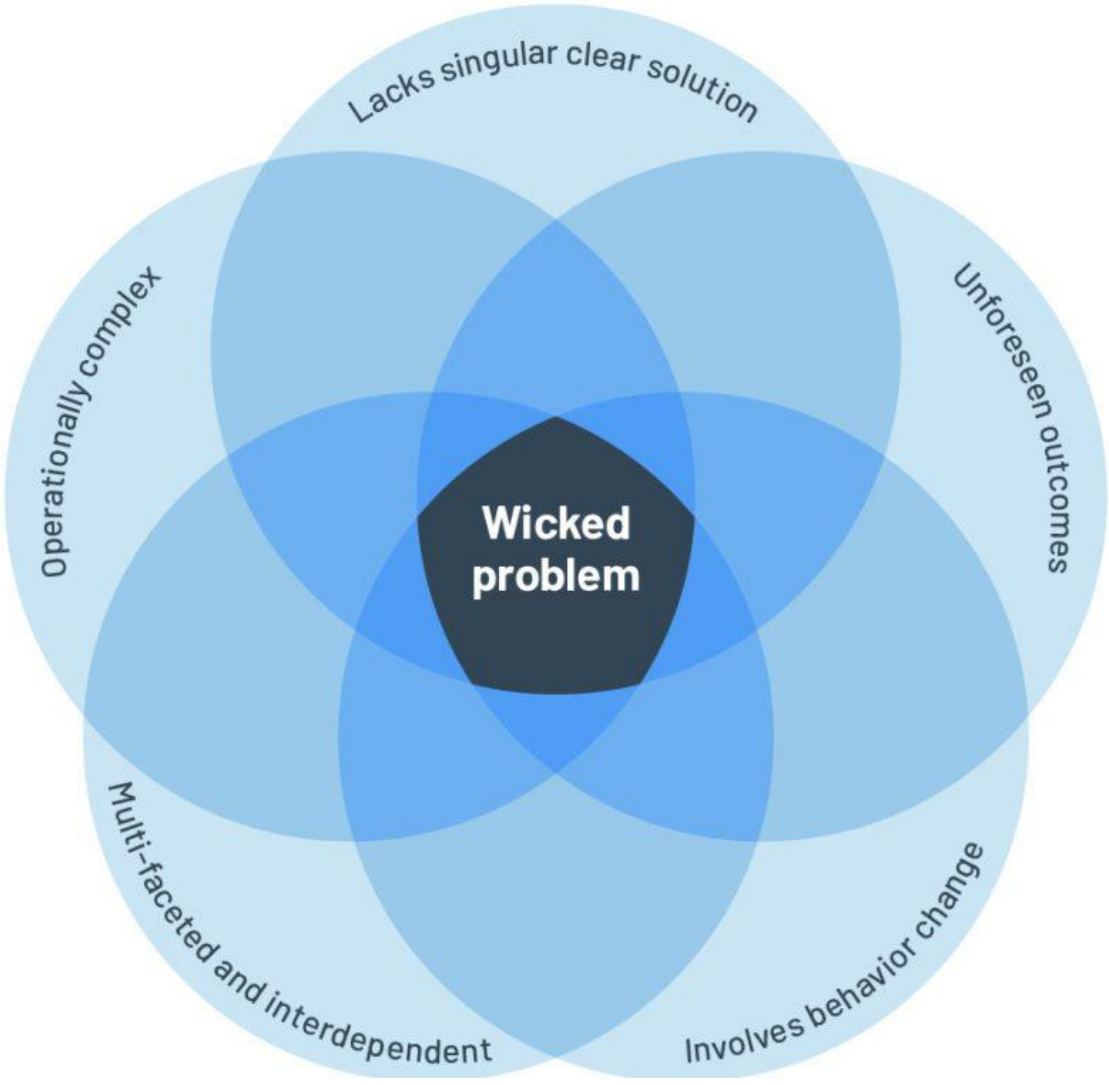
How we can learn to think

Conventional Thinking	Systems Thinking
The connection between problems and their causes is obvious and easy to trace	*The relationship between problems and their causes is indirect and not obvious*
Others, whether within or outside our organization, are to blame for our problems and must be the ones to change	*We unwittingly create our own problems and have significant control or influence in solving them through changing our behavior*
A policy designed to achieve short-term success will also assure long-term success	*Most quick fixes have unintended consequences: They make no difference or make matters worse in the long run*
In order to optimize the whole, we must optimize the parts	*In order to optimize the whole, we must improve* relationships *among the parts*

Source: David Peter Stroh, *Systems Thinking for Social Change*, 2015.

Wicked problem?

- Problem is chronic and has defied people's best intentions to solve it
- Multiple perspectives on why we have the problem and what should be done
- Diverse stakeholders find it difficult to align their efforts despite shared intentions
- People are working on a large number of disparate initiatives to solve the problem at the same time

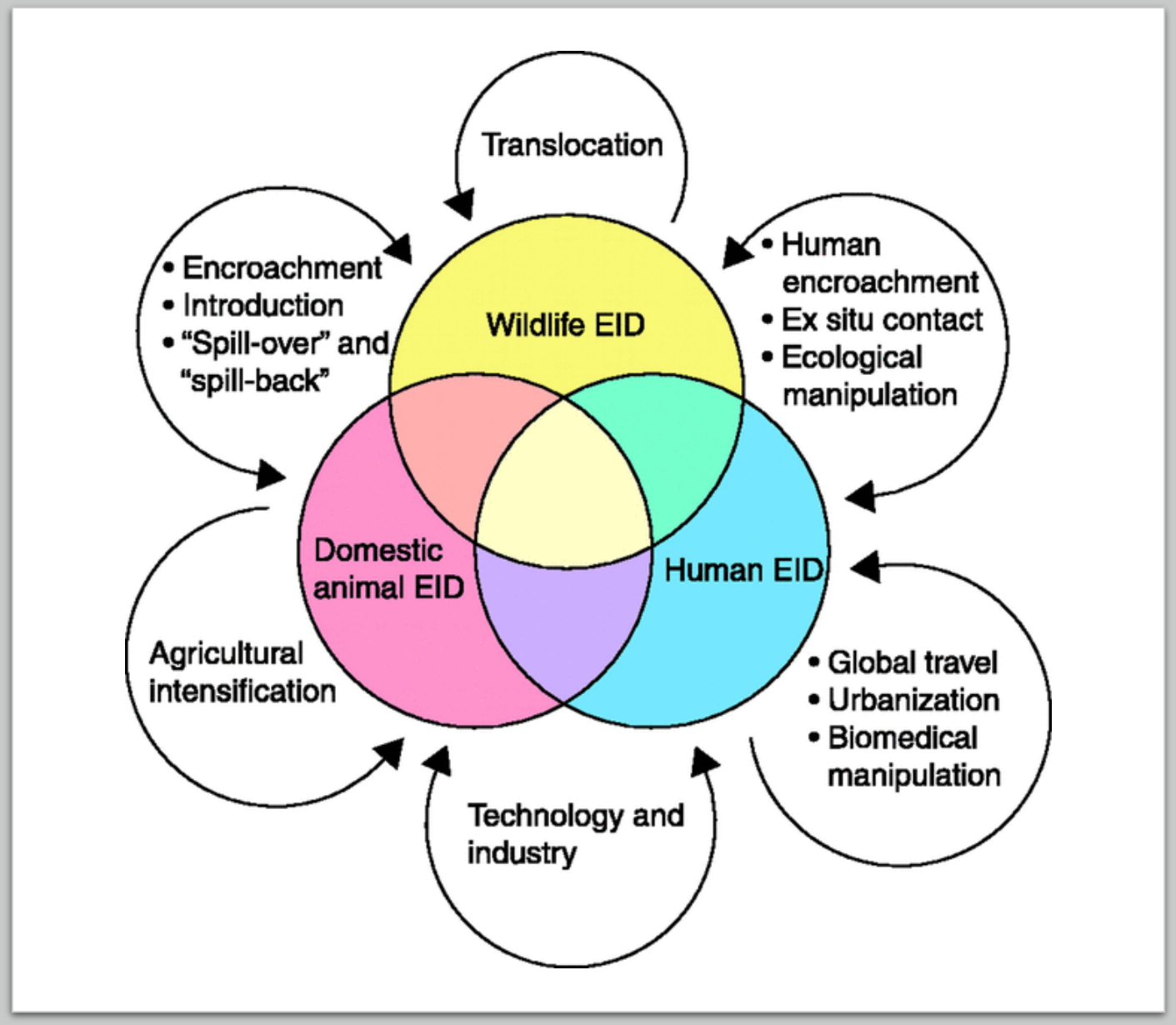


https://www.intapp.com/blog_posts/tackling-wicked-problem-firm-leadership-continued-success-conundrum-part-1/

Management of wildlife disease a wicked problem?

- Drivers of wildlife disease are complex
- Many interconnected ecological and social factors

YES!



Systems Thinking Tools

A few examples

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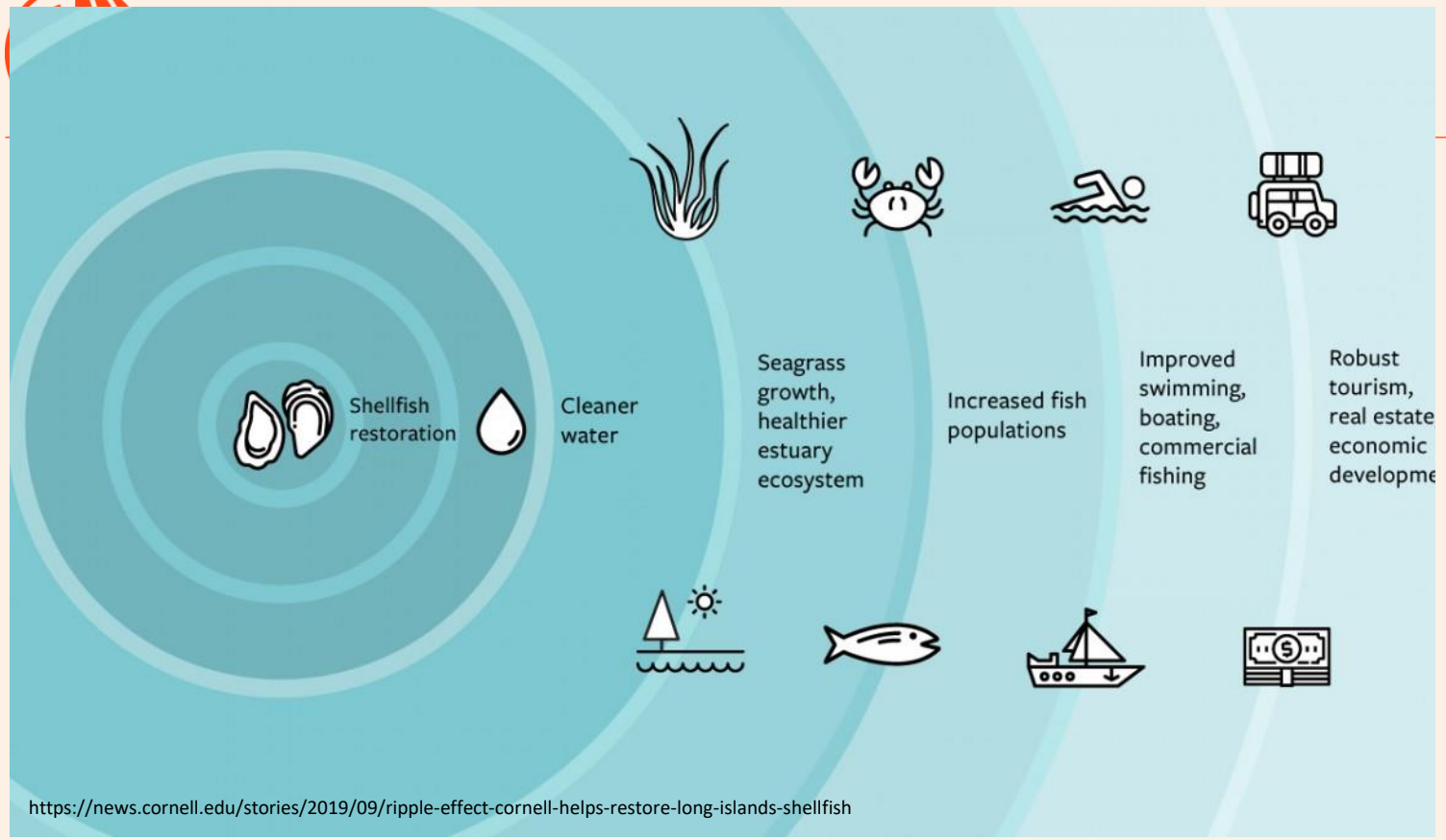


https://news.cornell.edu/stories/2019/09/ripple-effect-cornell-helps-restore-long-islands-shellfish

The behavior of the system is created by the relationships among elements

- A change in one element causes a change in another element
- Elements in a system are interconnected, distantly related factors can influence one another
- This can cause a ripple effect or chain reaction

Tool #1: Iceberg Model

Event

- Unexpected problems an IT feature

Patterns

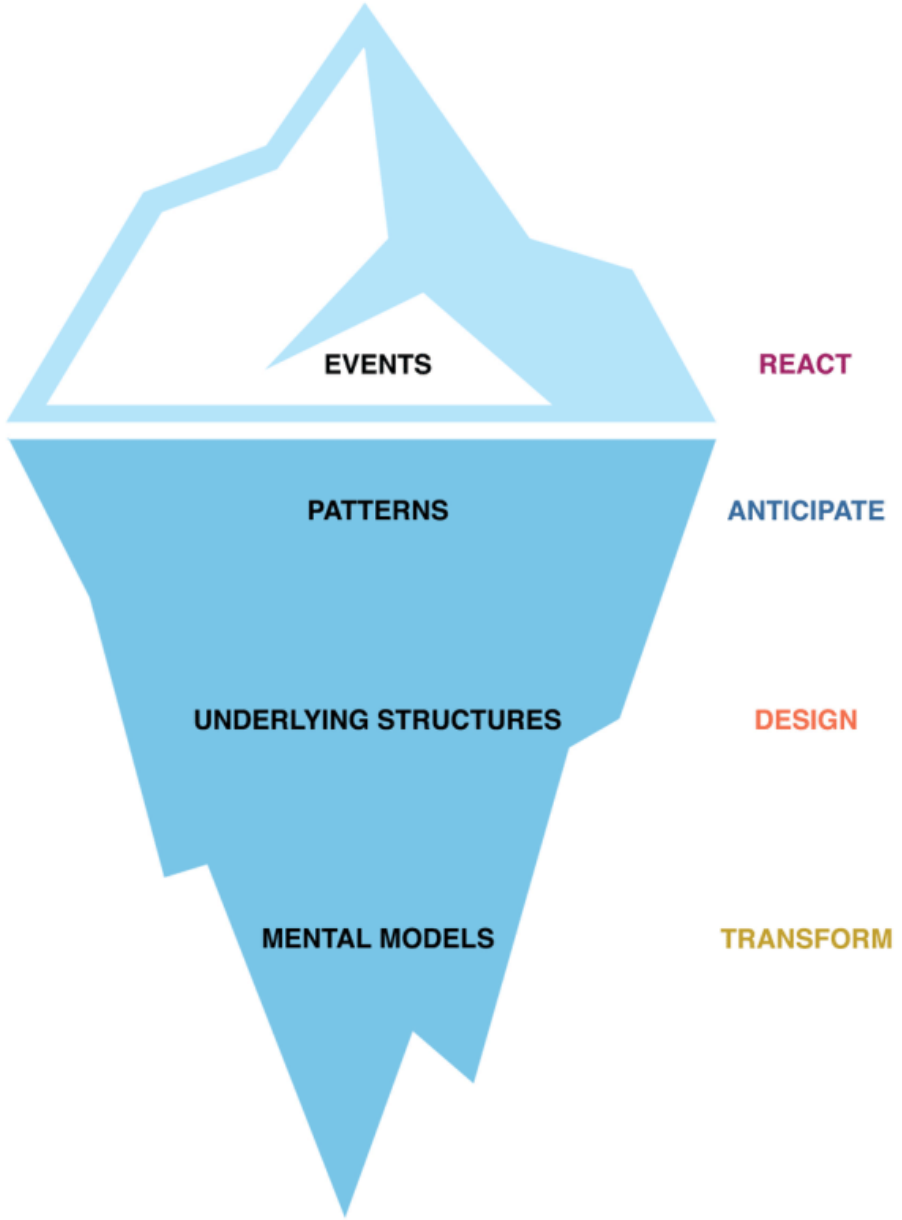
- Unexpected errors the last 3-4 times a feature was released by your team

Underlying Structures

- No plan for testing
- Tight deadlines

Mental models

- On-time shipping valued over quality of work
- Teams don’t believe they should pushback on manager deadlines



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Feedback loops

- Circular causality
- Visualize the relationships among variables
- Find delays in the system
- Understand system behavior and unintended consequences

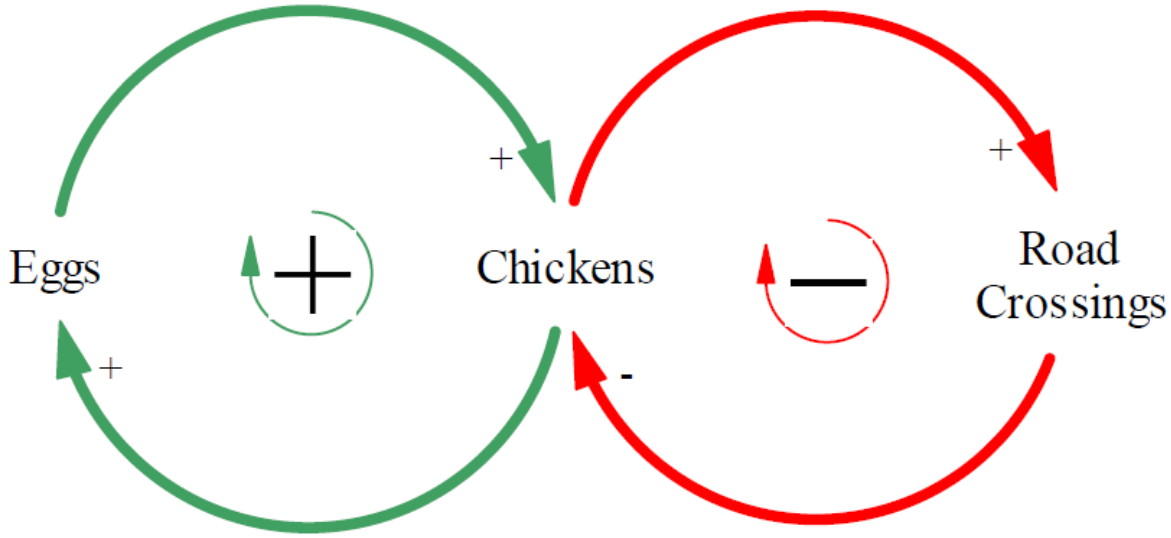


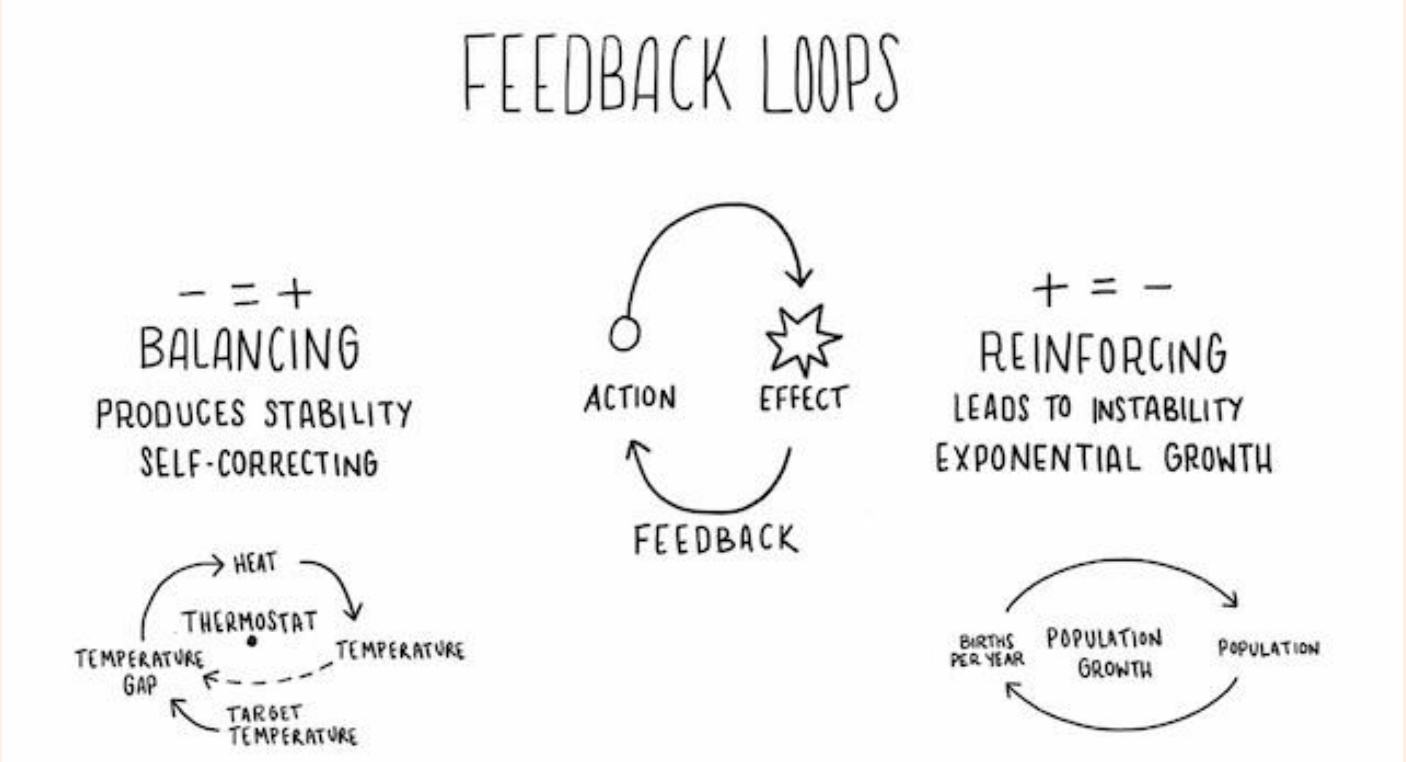
Photo credit: Protracted learning

(B) Balancing processes

- Negative feedback
- Self-corrective
- Self-regulating
- Seek stability
- Maintain condition or state
- Primary source of resistance to change

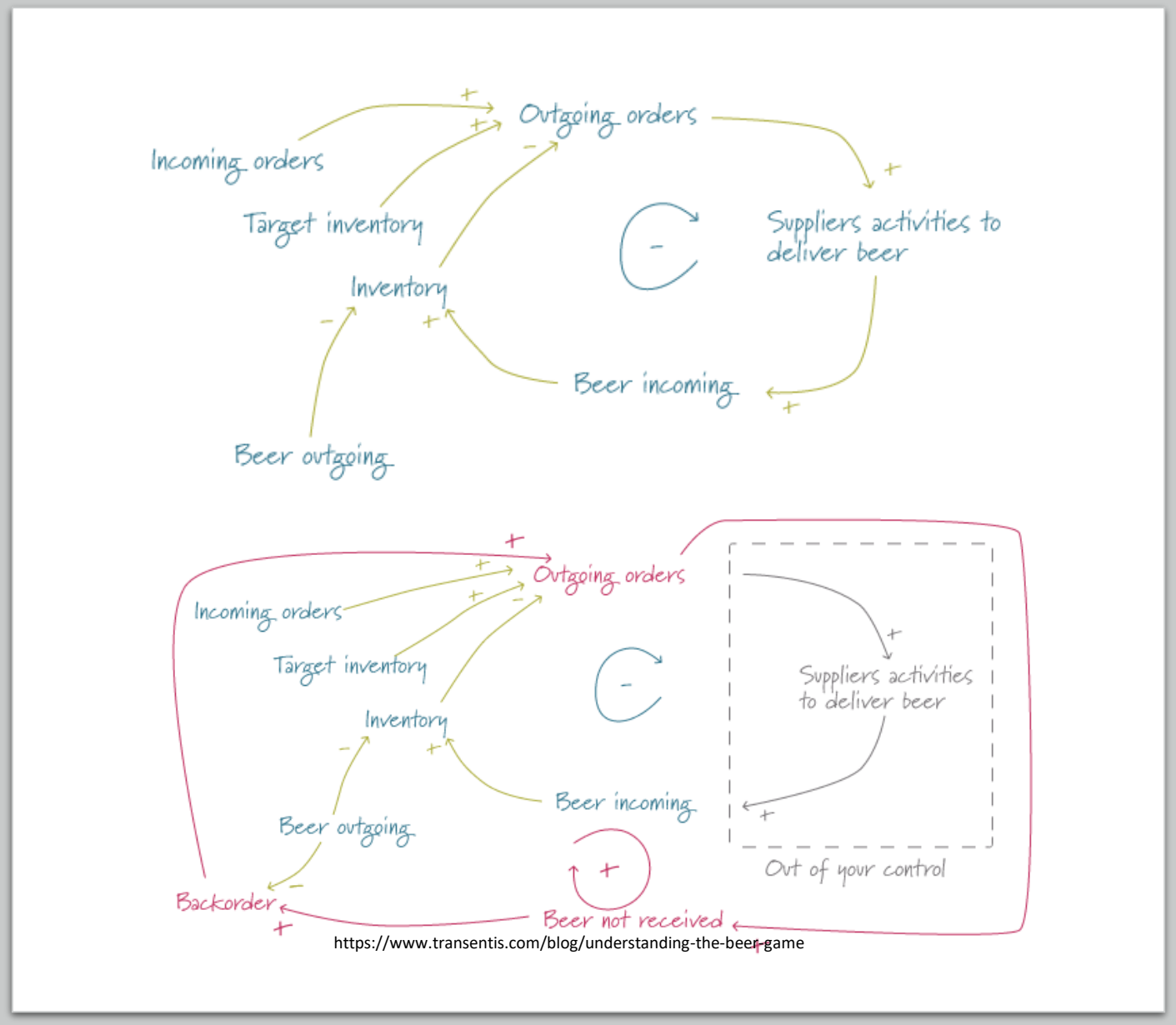
(R) Reinforcing processes

- Positive feedback
- Virtuous cycles that generate growth
- Vicious cycles that grow the problem



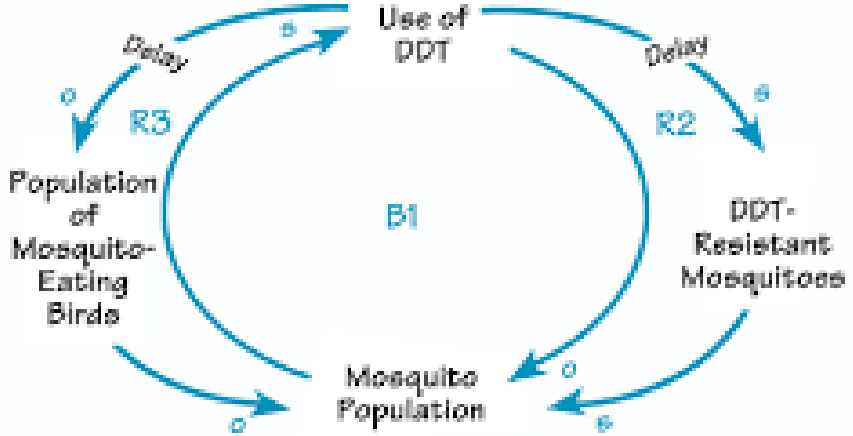
System delays occur because it takes time to:

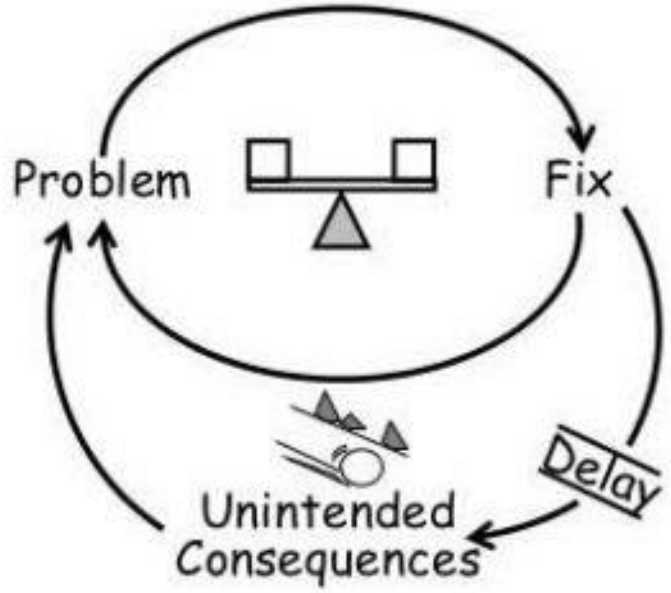
- Recognize (measure, assess) the current state/status
- Decide which actions to take
- Implement actions or make corrections
- Alter/impact current state/status with an action



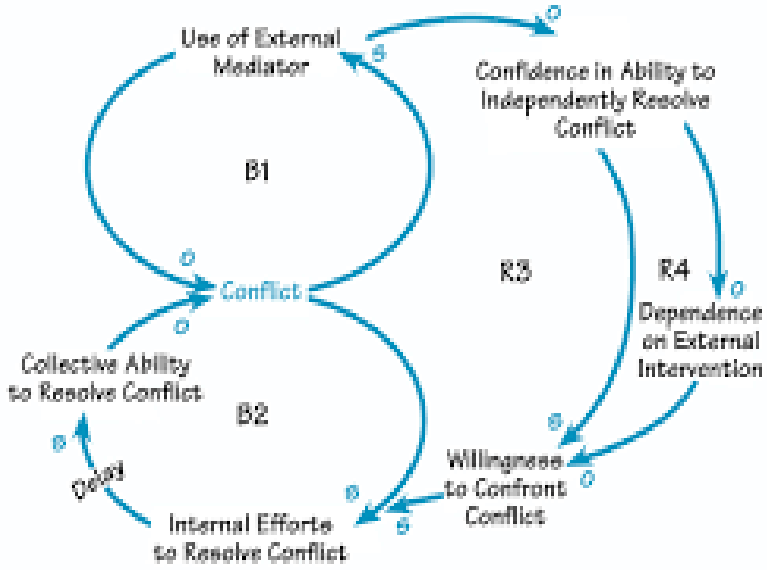
https://www.transentis.com/blog/understanding-the-beer-game

System delays can create **unintended consequences**





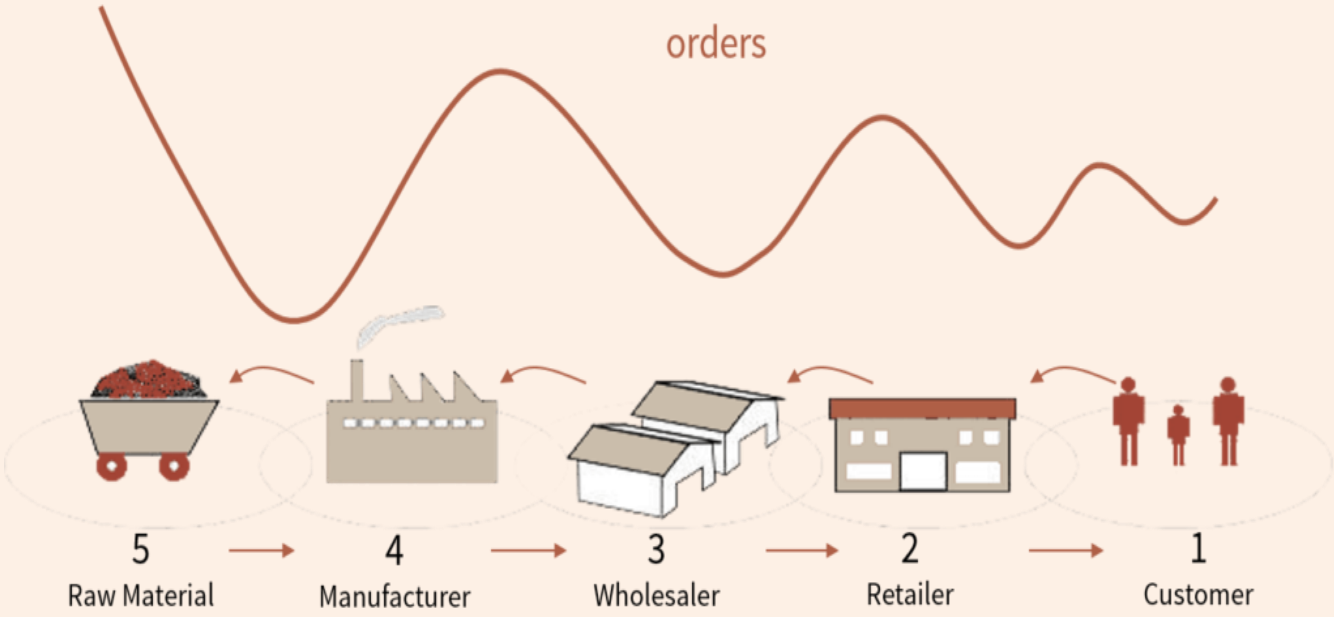
https://systemsthinking.blog.gov.uk/



Thesystemsthinker.com

The **bullwhip effect** is created by system delays

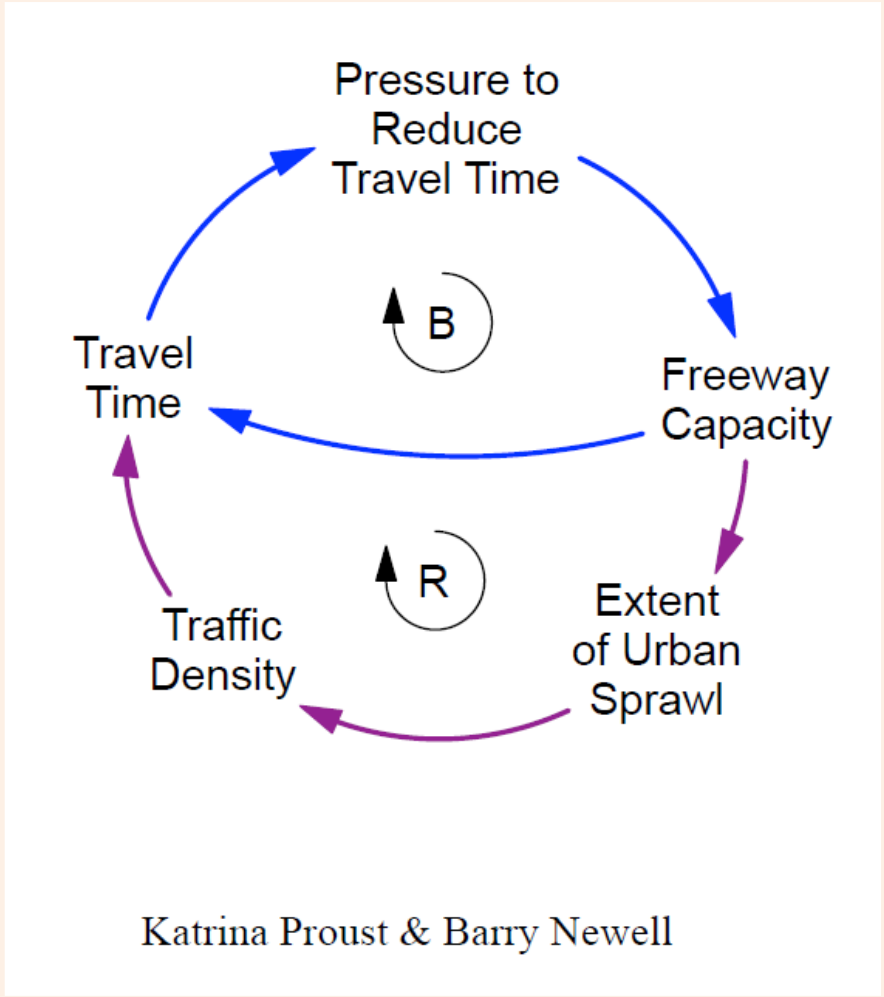
- Can have significant impact on behavior and create system oscillations
- Often hidden part of the structure



https://learnandgrowspace.com/5-causes-you-need-to-know-about-the-bullwhip-effect/

Tool #2: Causal loop diagrams

- Conceptually model dynamic systems
- Map how variables influence one another
- Useful for uncovering underlying feedback structures
- May be able to identify natural constraints and leverage points in the system



Conservation Science and Practice
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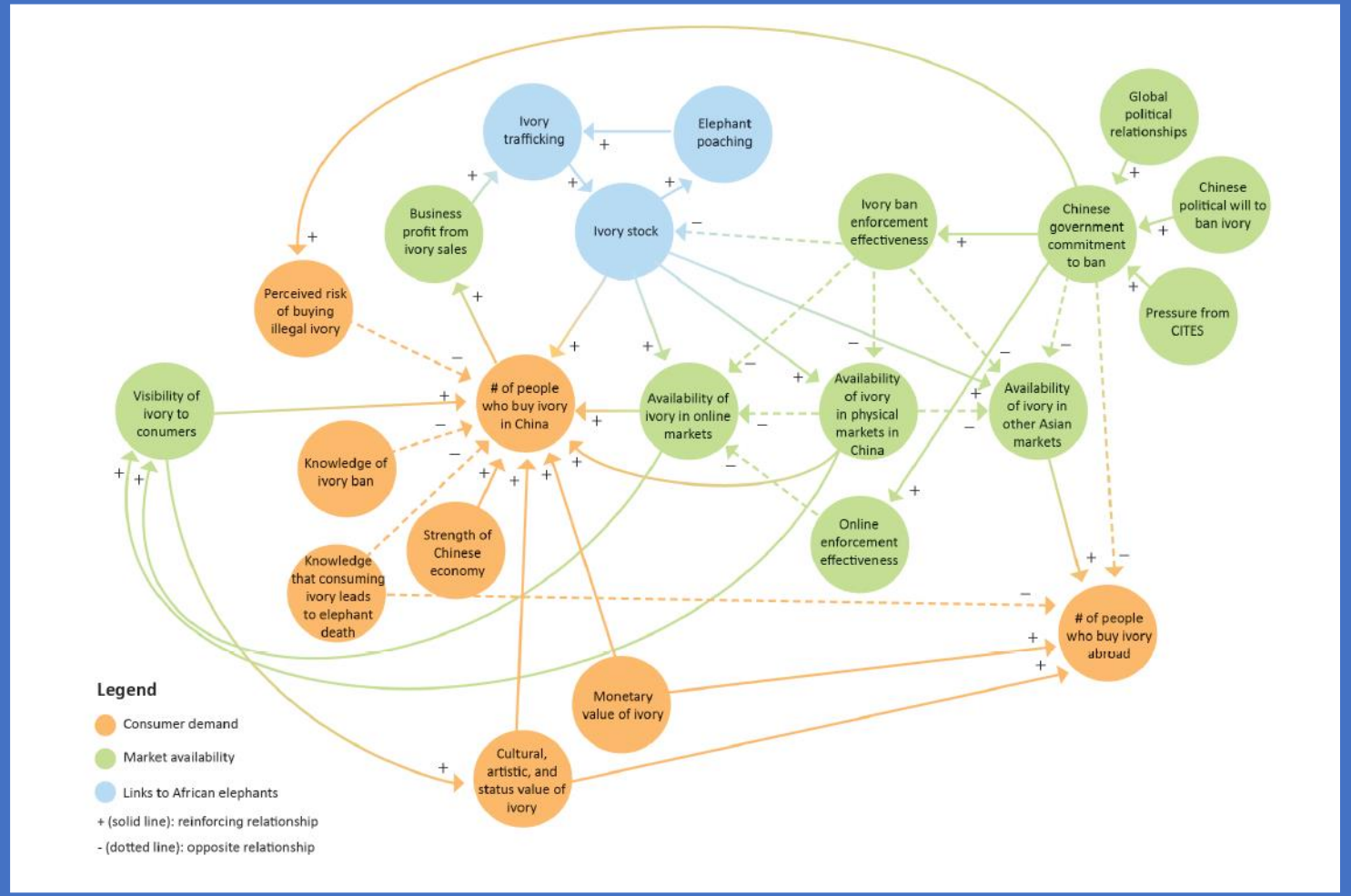
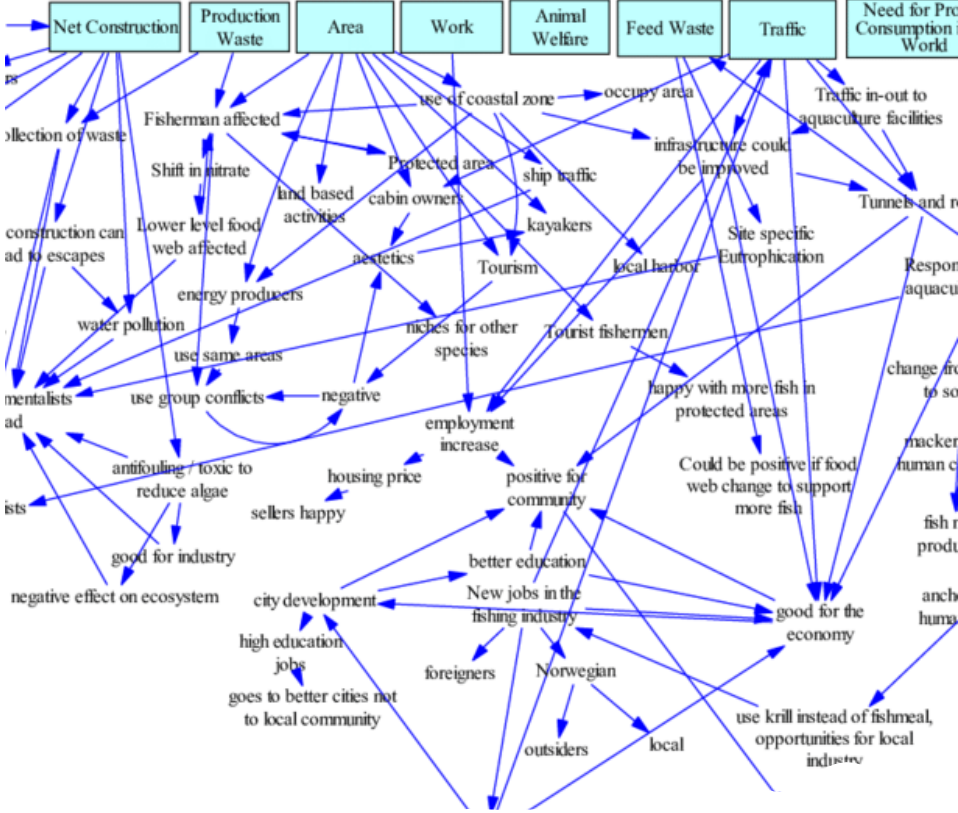
PERSPECTIVES AND NOTES | Open Access

Systems thinking for planning and evaluating conservation interventions

Shauna L. Mahajan, Louise Glew, Erica Rieder, Gabby Ahmadia, Emily Darling, Helen E. Fox, Michael B. Mascia, Madeleine McKinnon

First published: 29 April 2019 | https://doi.org/10.1111/csp2.44 | Citations: 13





Assessing tradeoffs and making decisions in complex systems

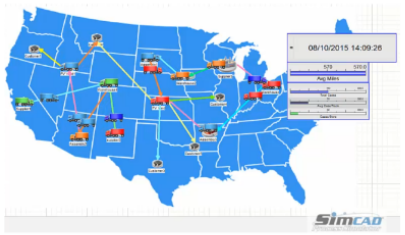
While pilots can crash and burn in a flight simulator, surgeons haven't been afforded the same luxury of confronting life-threatening problems during simulated surgery.

At Precision OS, we're changing that, precisionostech.com #DigitalHealth #VR

Tool #3: Management flight simulators

- Simulated environment
- Explore consequences of different strategies
- Learn from experience

Supply Chain Distribution Networks



With Simcad Pro's ability to dynamically interact with **external data**, companies have successfully implemented simulation to analyze the location of **warehouses and distribution centers** with respect to demand.

Product allocation is no longer a guessing game, but a simulated science that simplifies one of the most complex problems in this industry.

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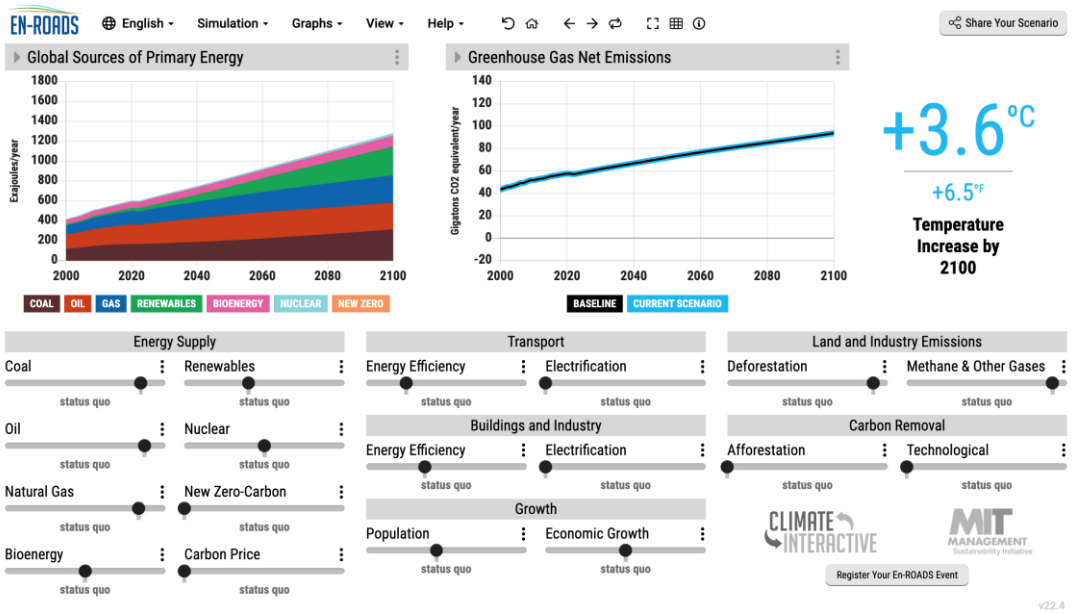
tools for a thriving future



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Systems thinking also requires willingness to continually learn

- Expect to continually adjust policies and practices by learning from the outcome of previously used policies and practices
- Crucial for addressing wicked problems!

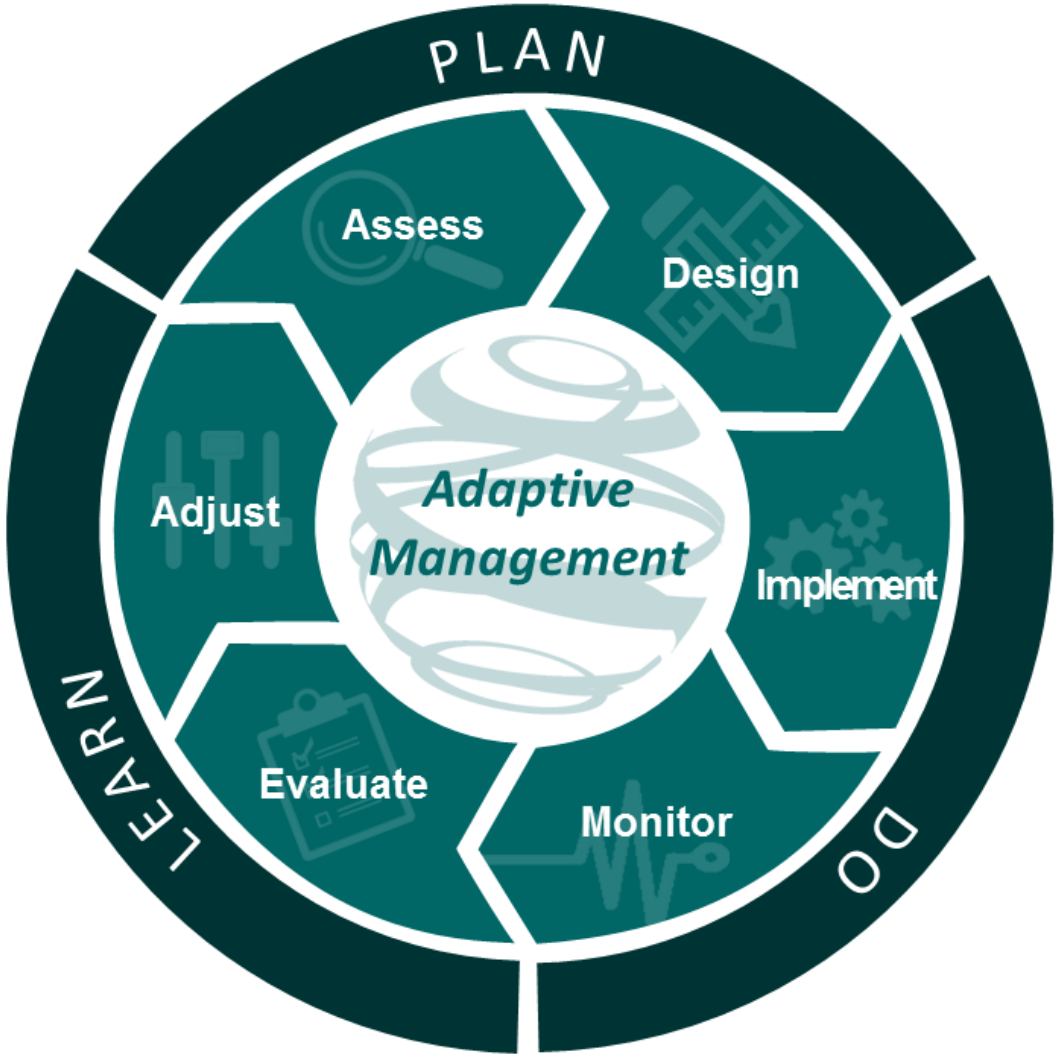
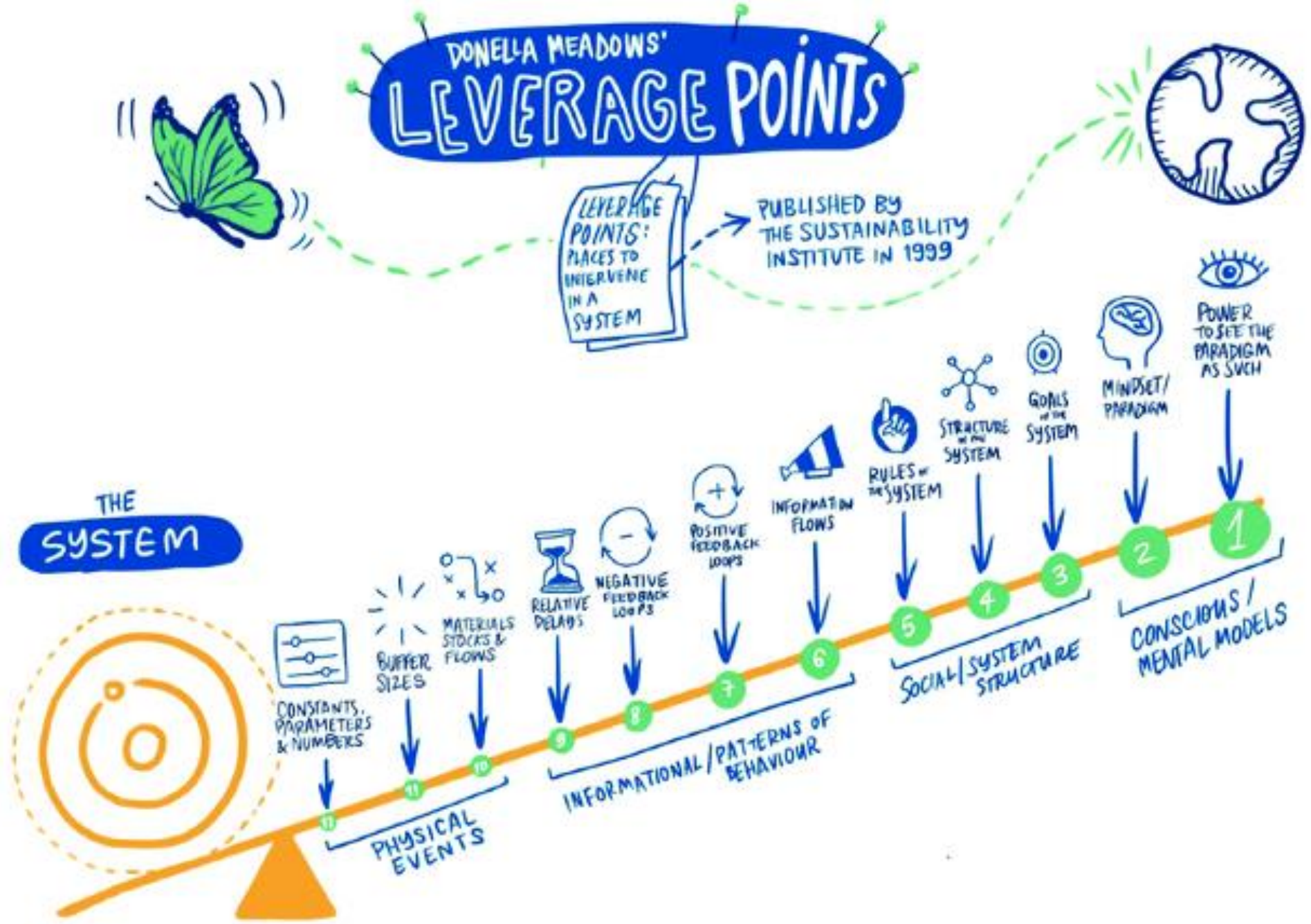


Image credit: https://www.essa.com/approach/



Donella Meadows' leverage points (Source: based on Meadows, 1999; credit: UNDP/Carlotta Cataldi)

PEOPLE AND NATURE
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PERSPECTIVE | Open Access

A leverage points perspective on sustainability

Joern Fischer, Maraja Riechers

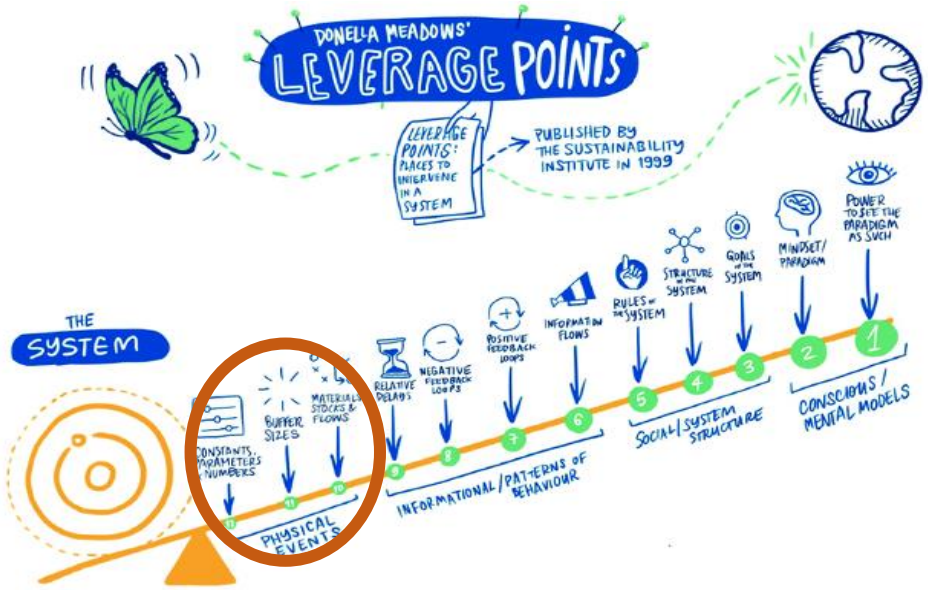
First published: 31 January 2019 | https://doi.org/10.1002/pan3.13 | Citations: 113

Parameters

Constants, parameters, numbers: Average fuel consumption of a car

Size of buffer stocks, relative to flows: Amount of total standing timber in a production forest

Structure of material stocks and flows: Run-off dynamics of nutrients from agricultural fields into adjacent water bodies



Donella Meadows' leverage points (Source: based on Meadows, 1999; credit: UNDP/Carlotta Cataldi)

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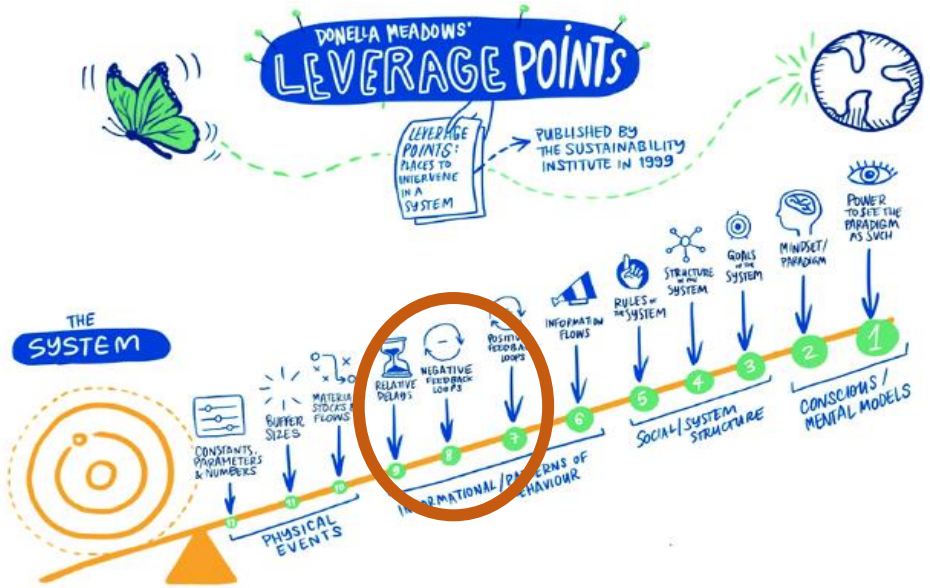
Feedbacks

Length of delays, relative to rate of system change: Time it takes for the ozone hole to close after harmful emissions seize

Strength of negative feedback loops: The extent to which a lake can absorb nutrients and thus remain clear

Gain around positive feedback loops: The extent to which poverty leads to population growth, which may further exacerbate poverty



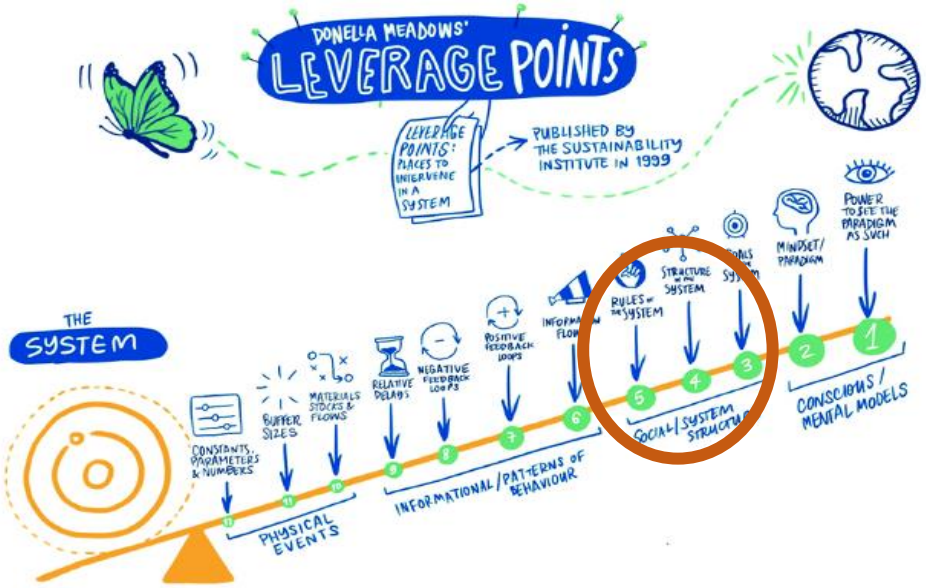
Donella Meadows' leverage points (Source: based on Meadows, 1999; credit: UNDP/Carlotta Cataldi)

Design

Structure of information flows: Consumer knowledge about where certain products come from

Rules of the system (incentives, constraints): Policies governing natural resources, including among others taxes and regulations

Power to change system structure or self-organize: Ability of farmers to organize the sustainable use of a communal pasture



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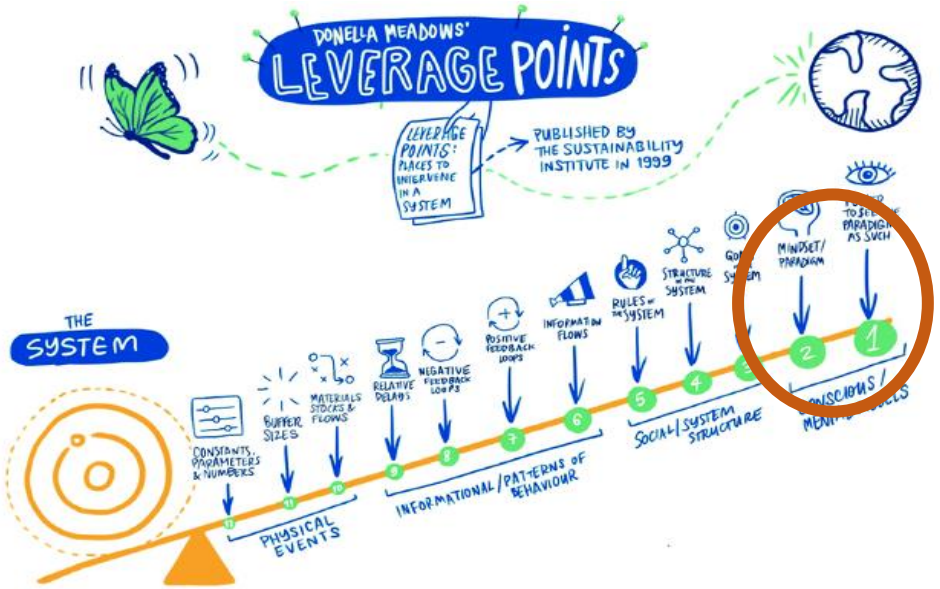
Intent

Goals of the system: Organization of global institutions to support free trade versus global equity

Paradigm underpinning the system: A ‘green revolution’ paradigm underpinning agricultural policies

Power to transcend paradigms: The conscious shift from a growth-based economy growth to a steady-state economy



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Many free on-line tools for systems thinking and mapping