# SYSTEMS THINKING

## INTRODUCTION

**Hella Hernberg |** Aalto University | Design for Government | 14 Mar 2022

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# Today's program:

| 3 | Mon 14 Mar |
|---|---|
| 09:15 - 12:00 | **Lecture: "Introduction to Systems thinking and Systems map" Hella Hernberg (Väre F102)** |
| | ***Lunch Break*** |
| 13:15 - 15:15 | **Group exercise: System maps Hella Hernberg (Väre F102)** |
| | ***Break*** |
| | **Group tutorials: Fieldwork progress (30 min. slots)** |
| 15:30- 16:00 | **Groups 1A (Väre P210), 2A (Väre P310)** |
| 16:00- 16:30 | **Groups 1B (Väre P210), 2B (Väre P310)** |
| 16:30- 17:00 | **Groups 1C (Väre P210), 2C (Väre P310)** |

| 3 | Mon 14 Mar |
|---|---|
| 09:15 - 12:00 | **Lecture: "Introduction to Systems thinking and Systems map" Hella Hernberg (Väre F102)** |
| | ***Lunch Break*** |
| 13:15 - 14:00 | **Essay peer feedback session (M202) (prepare short topic description)** |
| 14:15 - 15:15 | **Reading circle sharing session 3: Governmentality** |
| | ***Break*** |
| | **Group tutorials: Fieldwork progress (30 min. slots)** |
| 15:30- 16:00 | **Groups 1A (Väre P210), 2A (Väre P310)** |
| 16:00- 16:30 | **Groups 1B (Väre P210), 2B (Väre P310)** |
| 16:30- 17:00 | **Groups 1C (Väre P210), 2C (Väre P310)** |

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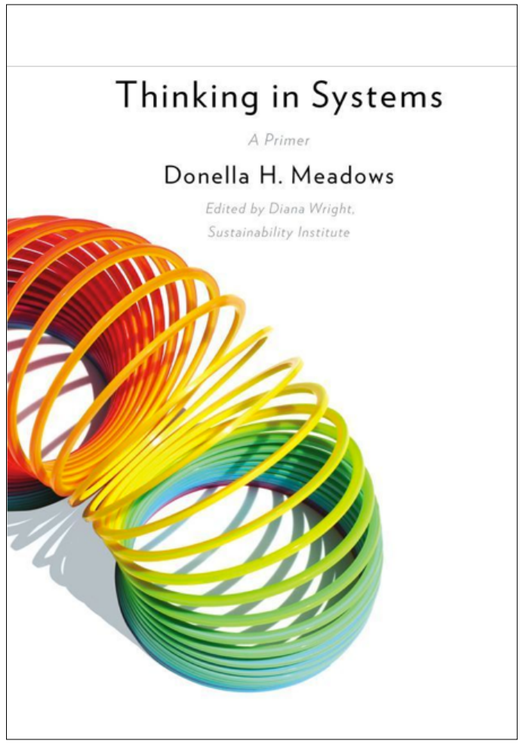


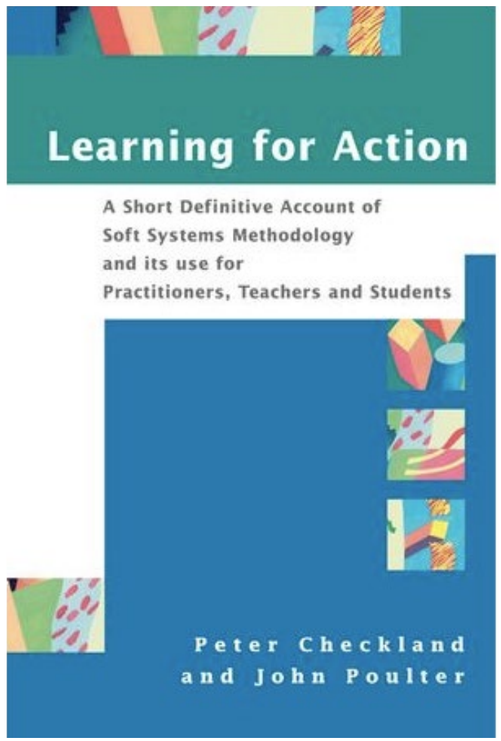



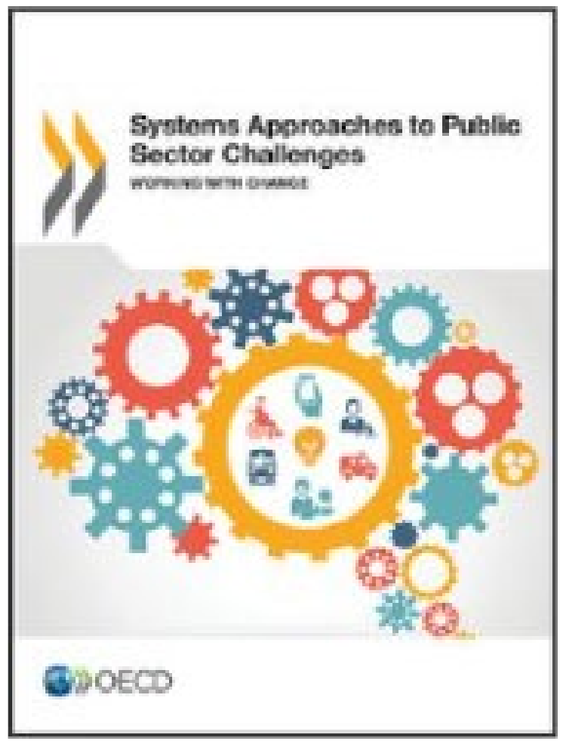


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# COMPLEXITY AND UNCERTAINTY


Finnish SOTE reform system

*"One key concern is how best to account for uncertainty while managing greater complexity and still deliver effective services."*

– OECD (2017)

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Primary problems of the 21st century are ‘**wicked problems’**:

Healthcare, education, social services, welfare state, climate change, sustainability and resiliene, economic development, immigration, democracy, etc.

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**Some key aspects of wicked problems:**

- **Multiple stakeholders**, each acting to a certain extent within their own norms.
- **Complete diagnosis or understanding is not possible.** Each perspective from which the problem is viewed provides a different understanding of its nature.
- There are **no optimum solutions** to wicked problems. Nevertheless, long-term options are often discounted in favour of short-term agreements.
- Because wicked problems are impossible to observe directly, they are **unpredictable** and their behaviour is uncertain.
- The **efficacy of solutions is difficult to determine**.

OECD (2017)

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*"A systems-oriented view of problems challenges the idea that healthcare, say, is the responsibility of a Department of Health."*

–Dan Hill

Image from arvato.com

*“Can we solve tomorrow’s problems by cutting yesterday’s world?”*

–Marco Steinberg

Photo: HUS

# WHY SYSTEMS THINKING AND DESIGN?

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*"To a degree, the answer lies in a policymaking approach that leads to* ***robust systems and adaptive structures****. The effectiveness of the decisions made will depend on* ***how completely the problem and its context are understood*** *and how well the dynamic relationship between interventions and context is tolerated."*

–OECD (2017)

**Systemic design** as integration of two disciplines**, design thinking** and **systems thinking:**

Both fields share a common orientation to complex problems:

**to effect highly-leveraged, well-reasoned, and preferred changes** in situations of concern.

**Systems thinking** promotes the **understanding of complex problem** situations (an analytical bias).

**Design** disciplines demonstrate an action-oriented or generative bias **toward creative solutions**.

Jones, 2014

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# WHAT IS THE PROBLEM?

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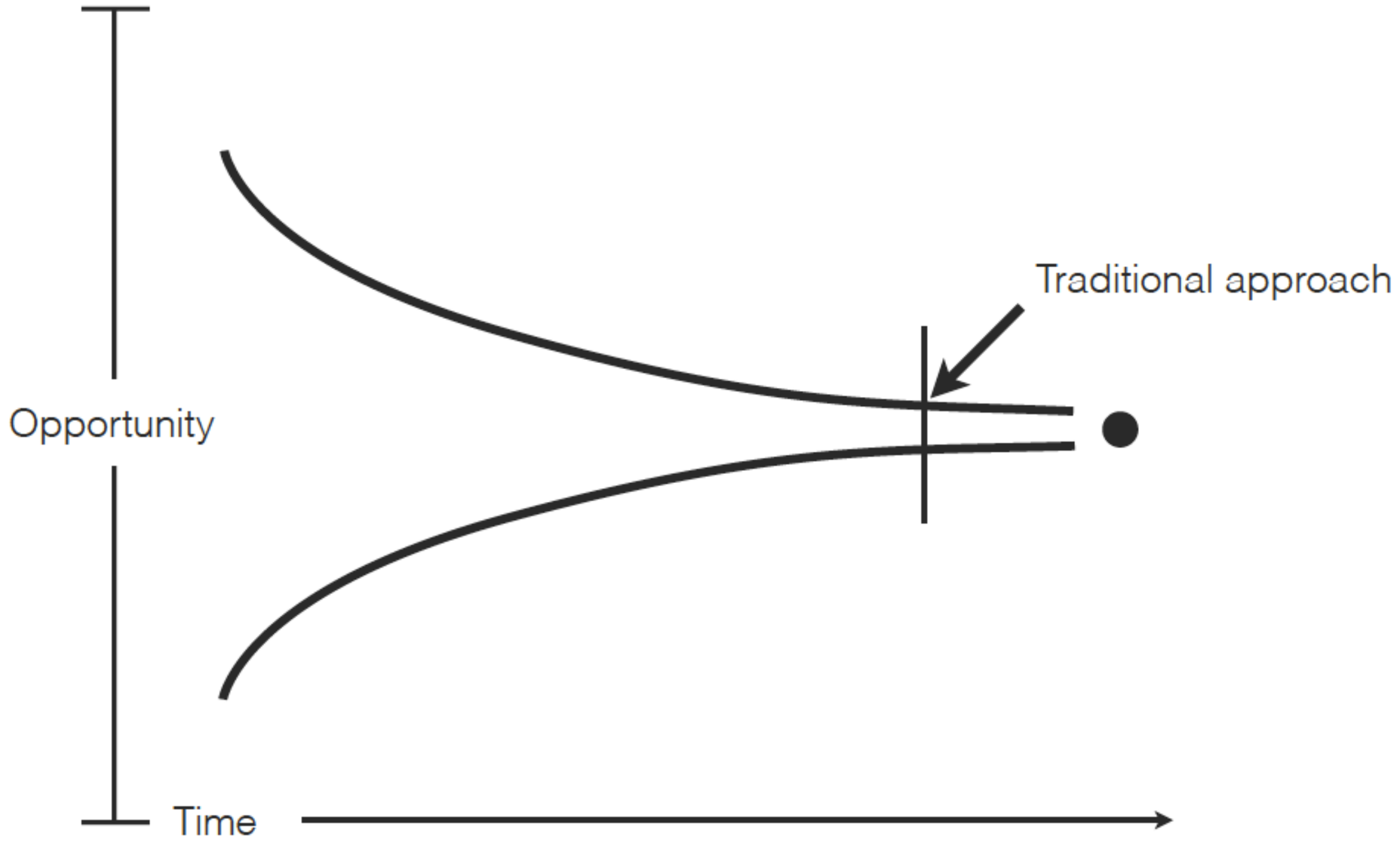
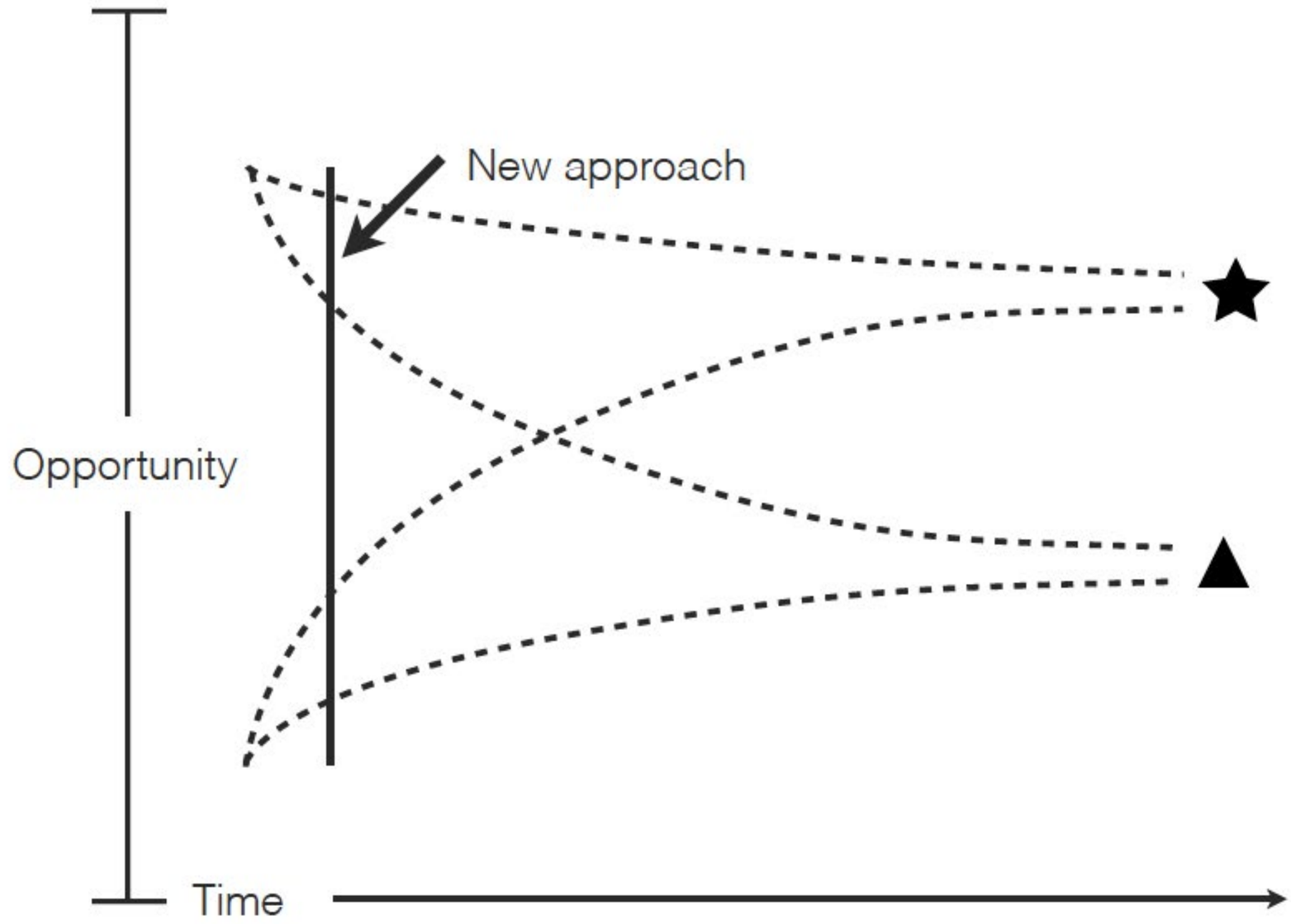
*"It has become less apparent where problem centers lie, and less apparent where and how we should intervene even if we do happen to know what aims we seek ... By now we are all beginning to realize that one of the most intractable problems is that of defining problems ... and of locating problems."*

– Rittel and Webber, 1973




Attribution: Marco Steinberg, Sitra




Attribution: Marco Steinberg, Sitra

# WHAT IS A SYSTEM?

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*A system is a **set of things** — people, cells, molecules, or whatever — **interconnected** in such a way that they produce their own **pattern of behavior over time**.*

– Donella H. Meadows (2008)

In other words,
A system has at least:

- a set of elements or entities
- links between them
- a purpose

***A System is more than the sum of its parts.***

*It may exhibit adaptive, dynamic, goal-seeking, self-preserving, and sometimes evolutionary behavior.*

Meadows, 2008

# SYSTEM STRUCTURE AND BEHAVIOR: THE BASICS

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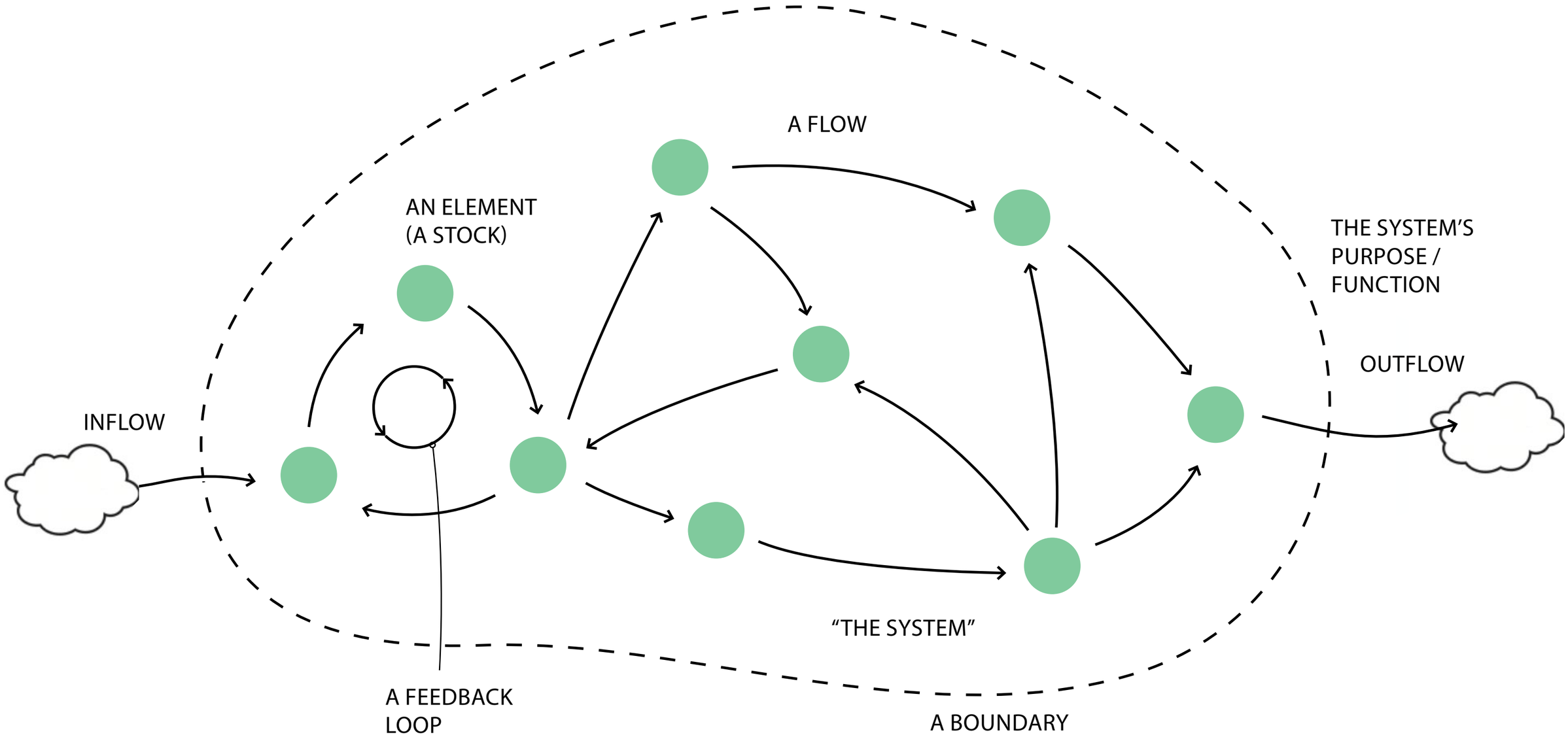
# A GENERAL CONCEPTION OF “SYSTEM”




After Flood & Jackson, 1991

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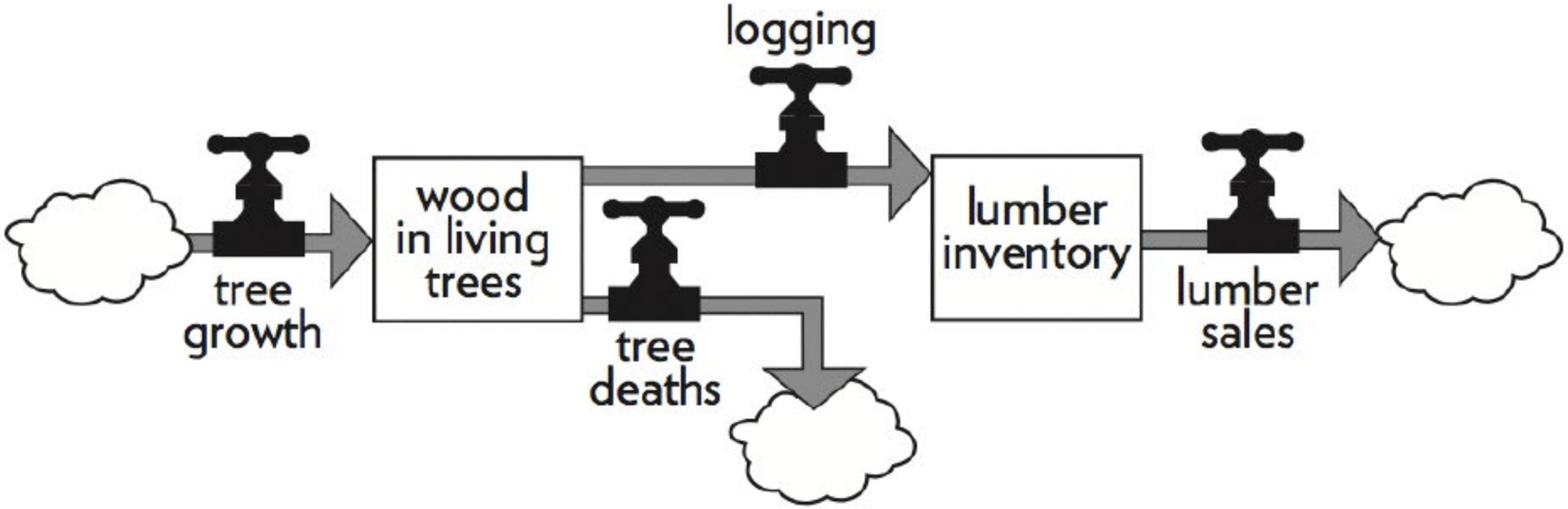
# STOCKS AND FLOWS




A Stock is the foundation of any system: elements you can see or measure.
For example: water in a bathtub, population, money in a bank.

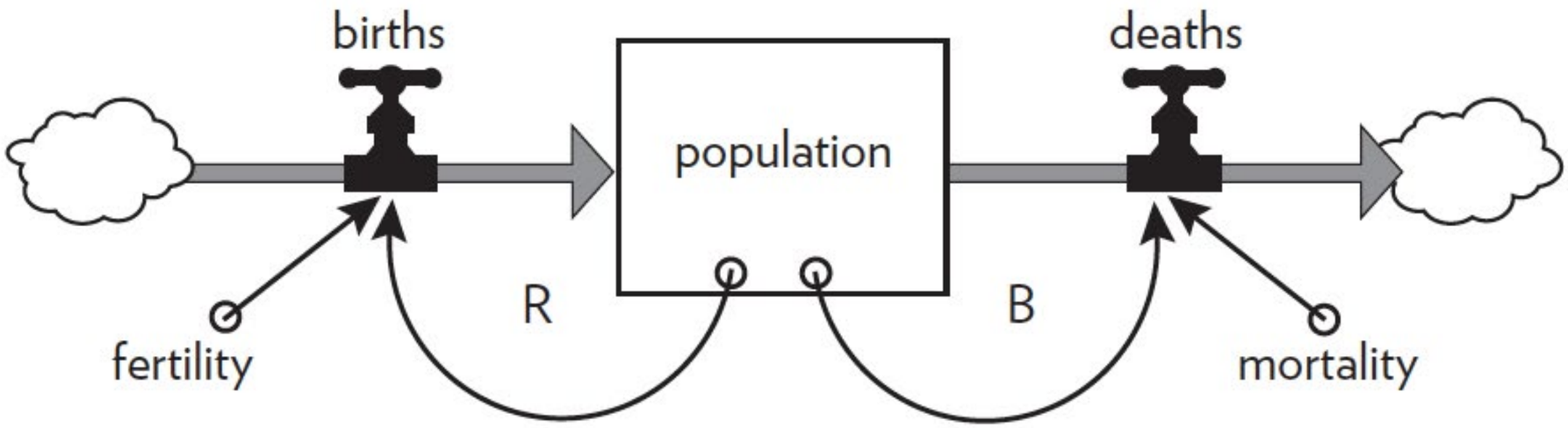
Stocks can be non-renewable or renewable. They can also be non-physical.

Stocks change over time through the actions of a flow.
Examples: inflow/outflow, birth/death, growth/decay, deposit/withdrawal

A stock takes time to change, because flows take time to flow.

Meadows, 2008

# FEEDBACK LOOPS




A Feedback loop is a control mechanism that creates consistent behavior over a long period of time.

A balancing feedback loop (B)
-> stabilizing, goal-seeking

A reinforcing feedback loop (R)
-> amplifying, self-muiltiplying, exponential
In physical, exponentially growing systems there must be at least one balancing loop along with the reinforcing loop because there are always limits to physical growth.

Meadows, 2008

## Discussion:

**What kinds of feedback loops can you think of in connection to your project brief?**

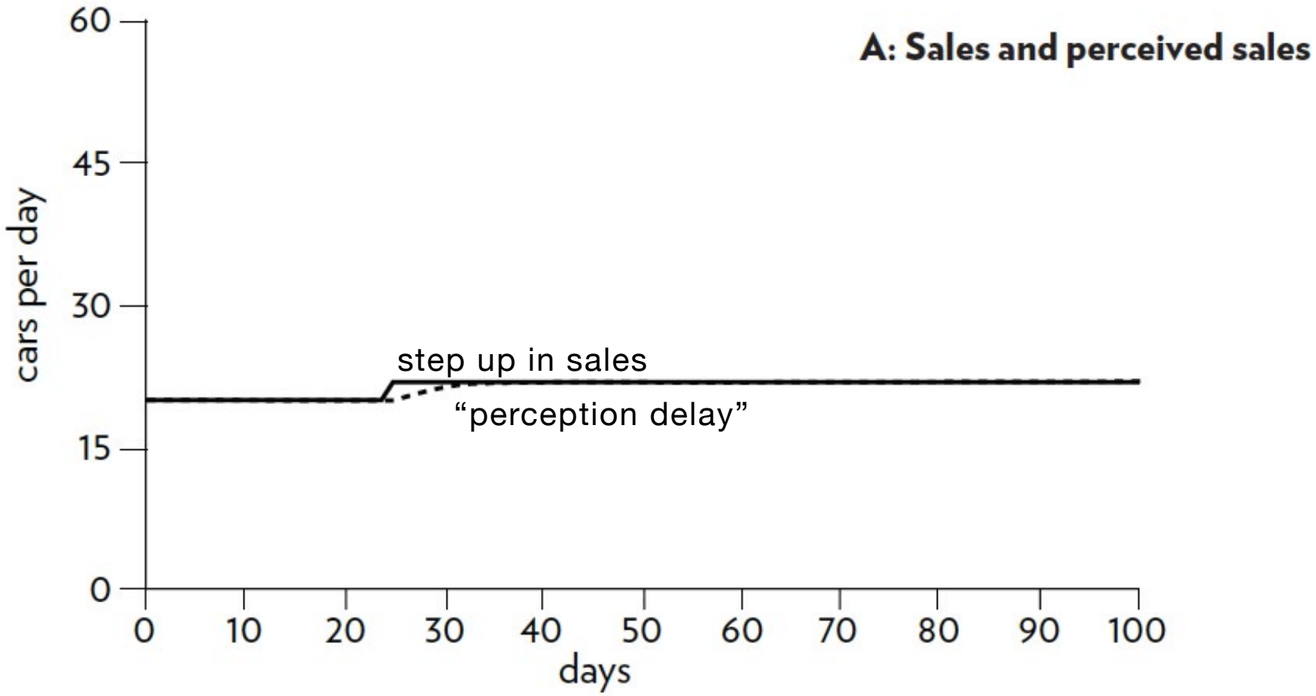
- reinforcing (positive) loops?
- balancing (negative) loops?

# DELAYS

Delays are critical determinants of system behavior.

A delay in a balancing feedback loop makes a system likely to oscillate.

Changing the length of a delay can make a large change in the behavior of the system. However, usually delays are not easily changeable.





Meadows, 2008

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# BEGUILING EVENTS

shows

## events

*what we can see*

produces

## patterns of behavior

*what is happening over time*

sustains

## structure

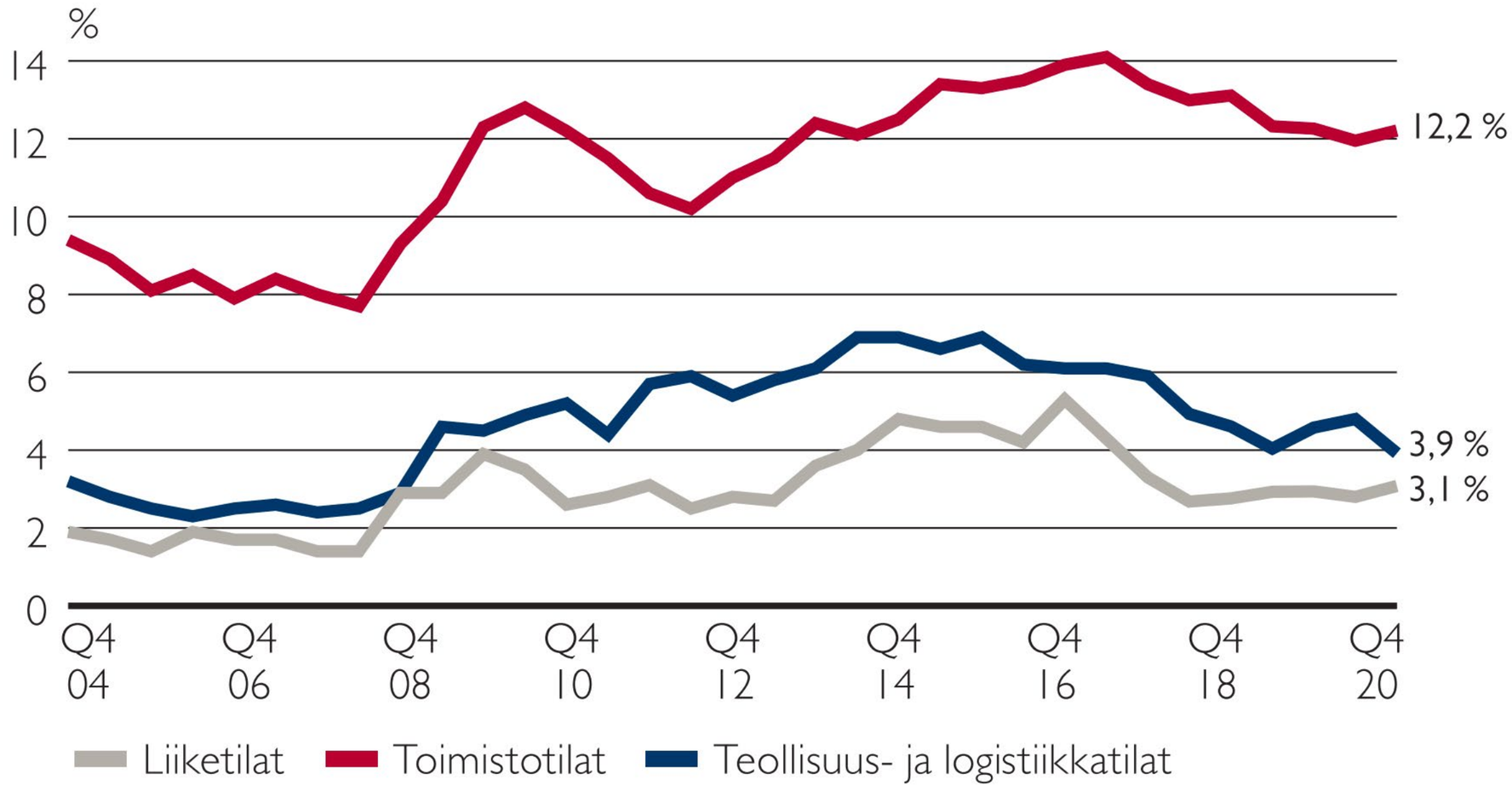
*why is this happening*

## mental models

*in what ways our mental models created and sustained the structures in place?*

after Meadows, 2008

## Vajaakäyttöasteet pääkaupunkiseudulla Q4 2020




Vacancy rates of office, retail and industrial buildings
in the Helsinki metropolitan area
Source: Catella, 2021

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BEGUILING EVENTS

# Discussion in groups:

**What kinds of events, patterns, structures and underlying mental models can you identify in your project?**

shows

**events**

*what we can see*

produces

**patterns of behavior**

*what is happening over time*

sustains

**structure**

*why is this happening*

**mental models**

*in what ways our mental models created and sustained the structures in place?*

after Meadows, 2008

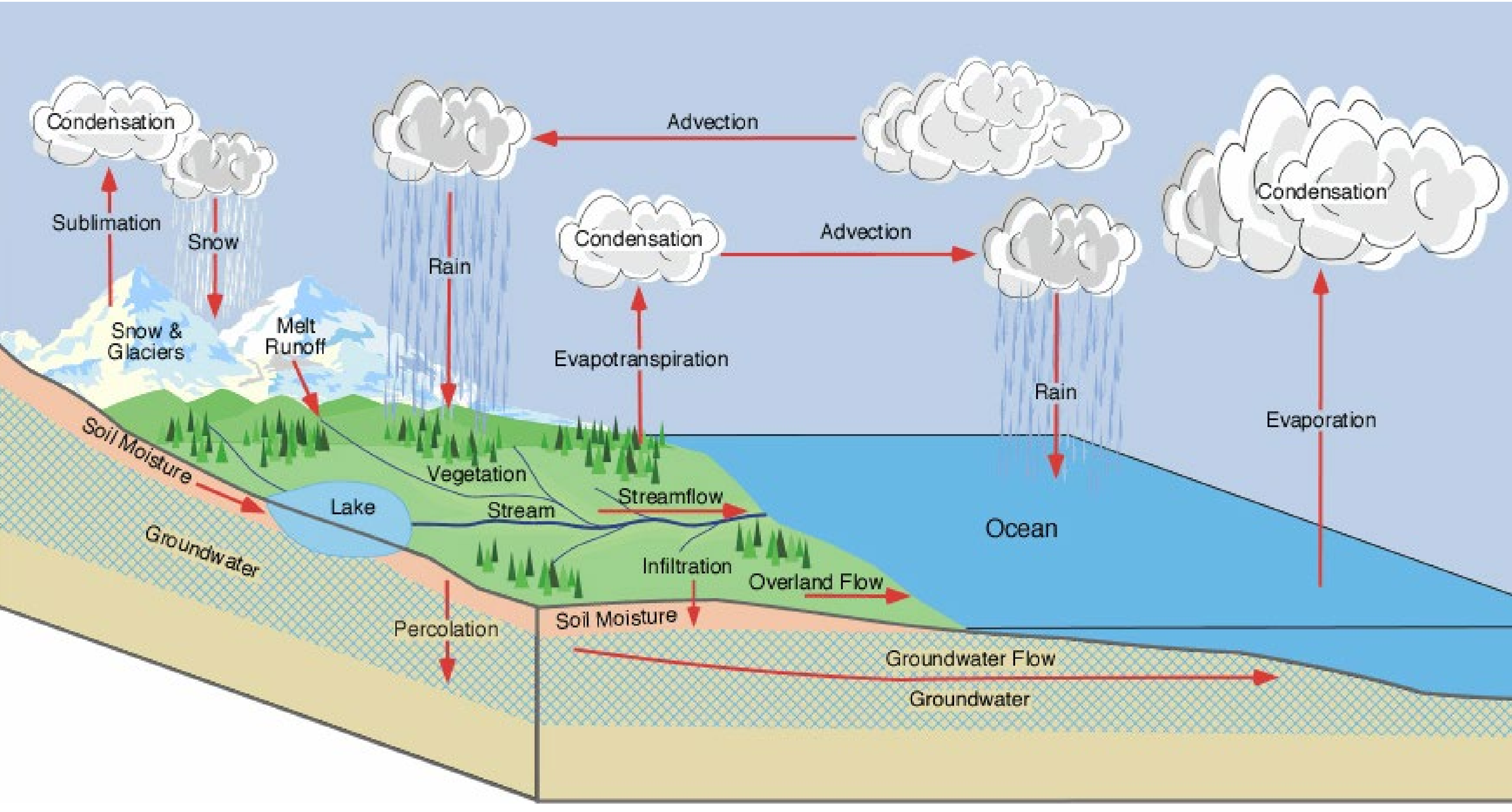
# System boundaries:

# Where do you choose to draw the boundary around your system?

## System boundaries:

- Where you choose to draw the boundary around your system influences how you think about the system.
- It depends on the purpose of the discussion: the questions you want to ask.
- A matter of inclusion and exclusion
- It is necessary to maintain an awareness of things outside your system boundaries.

# BOUNDARIES?

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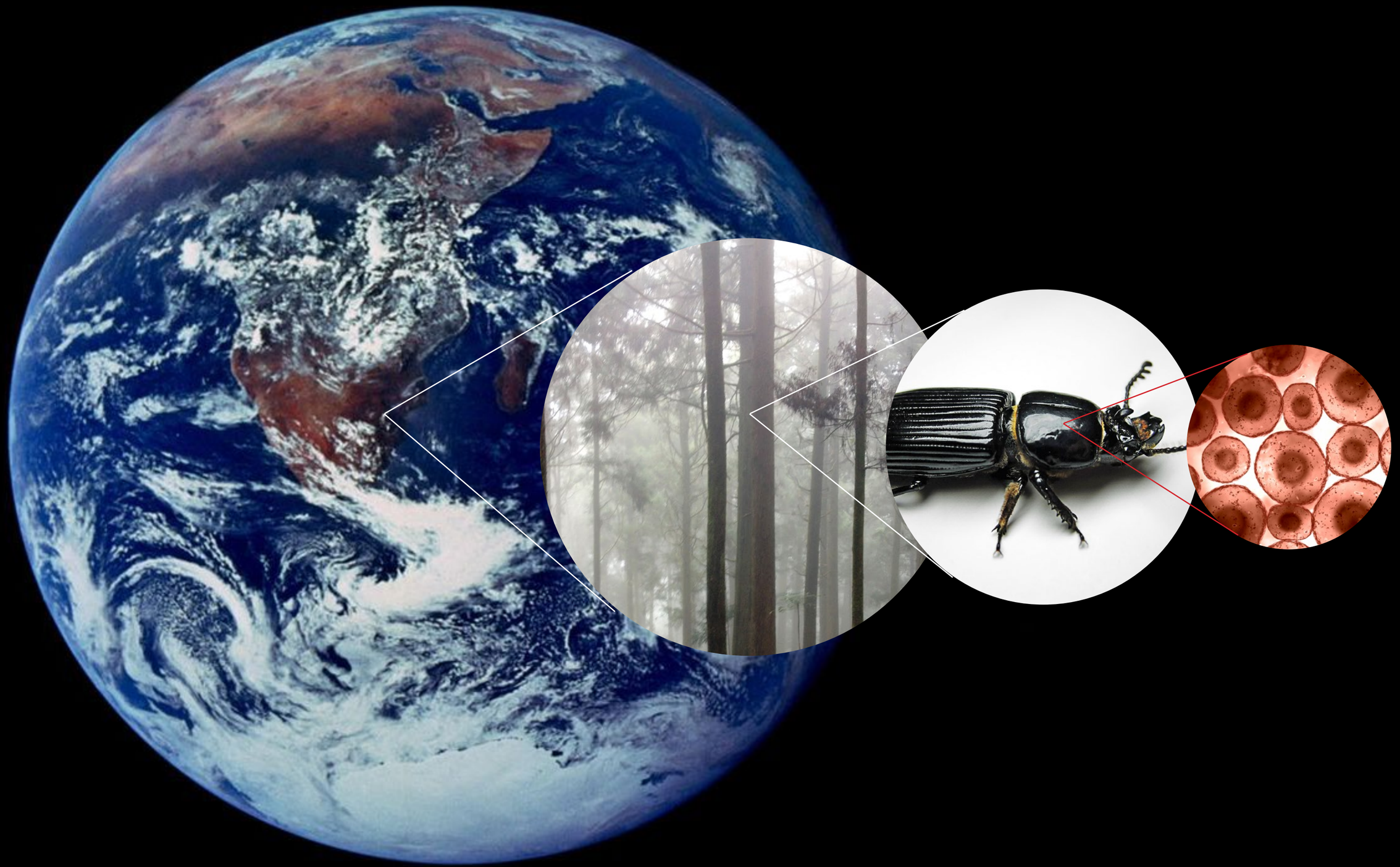
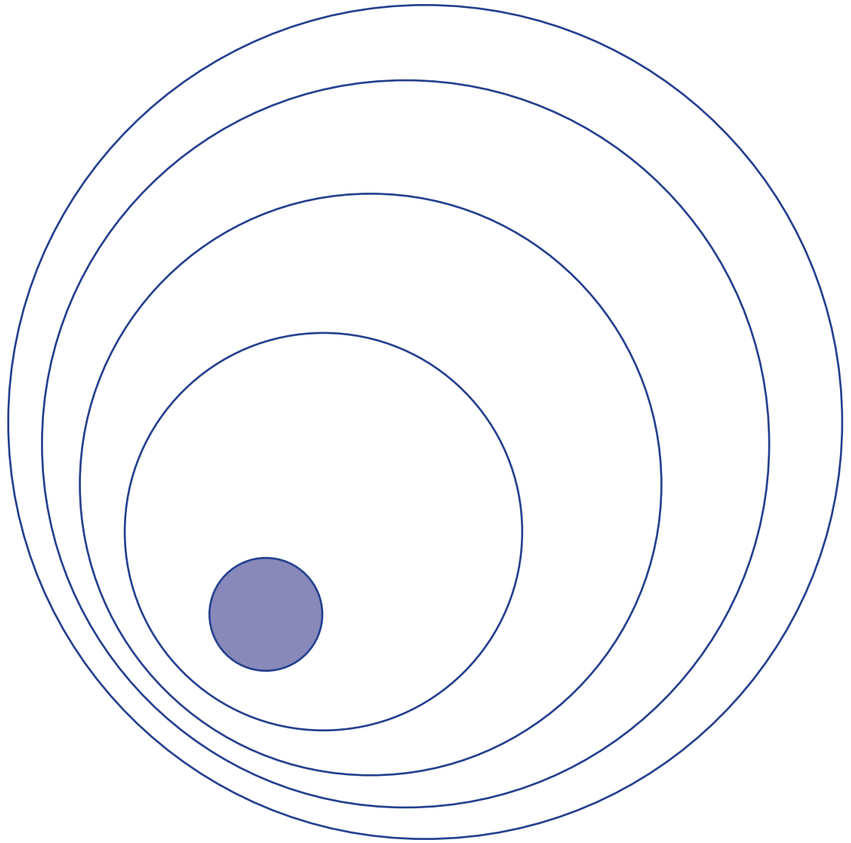
# BOUNDARIES: MICRO TO MACRO



*“Always design a thing by considering it in its next larger context – a chair in a room, a room in the house, a house in an environment, an environment in a city plan”*

–Eliel Saarinen



## Discussion:

## Boundaries and ‘Bounded rationality’

(Meadows, 2008, pp. 95.99, 105-110)

## The purpose of the system

- One of the most powerful ways to influence the behavior of a system is through its purpose or goal.
- The purpose or goal sets the direction of the system, it outputs and how its performance is measured.
- How the system’s purpose is understood depends on the perspective/vantage point of those looking at the system.

Meadows, 2008

# Discussion:
# System purpose
# and
# Seeking the wrong goal

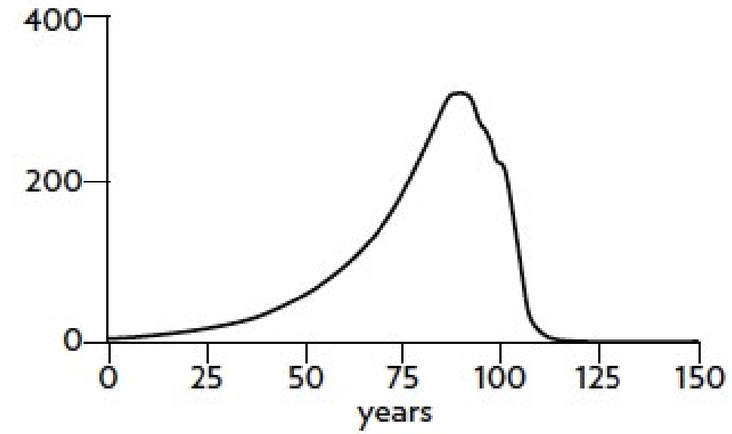
(Meadows, 2008, pp. 138-141)

RESILIENCE

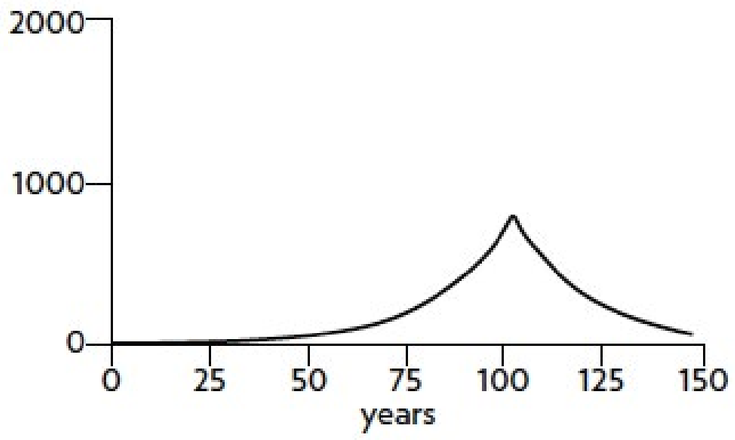
Resilience is the ability of a system to cope with change – to recover from perturbation, the ability to restore or repair themselves. Systems need to be managed not only for productivity or stability. There are always limits to resilience.

# NON-LINEARITY

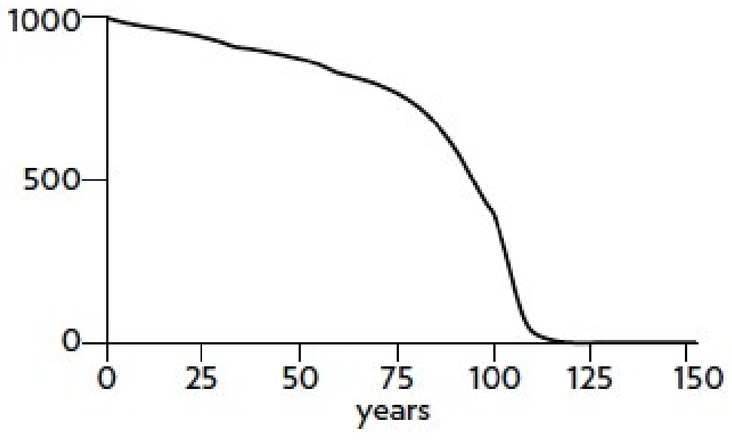
**A: Harvest rate**
(fishing industry)




**B: Capital stock**
(fishing boats)




**C: Resource stock**
(fish in the ocean)




A great increase in yield per unit of capital creates a pattern of overshoot and collapse in the harvest (A), the economic capital (B), and the resource (C).
Meadows, 2008

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## Discussion:

## Tragedy of the Commons

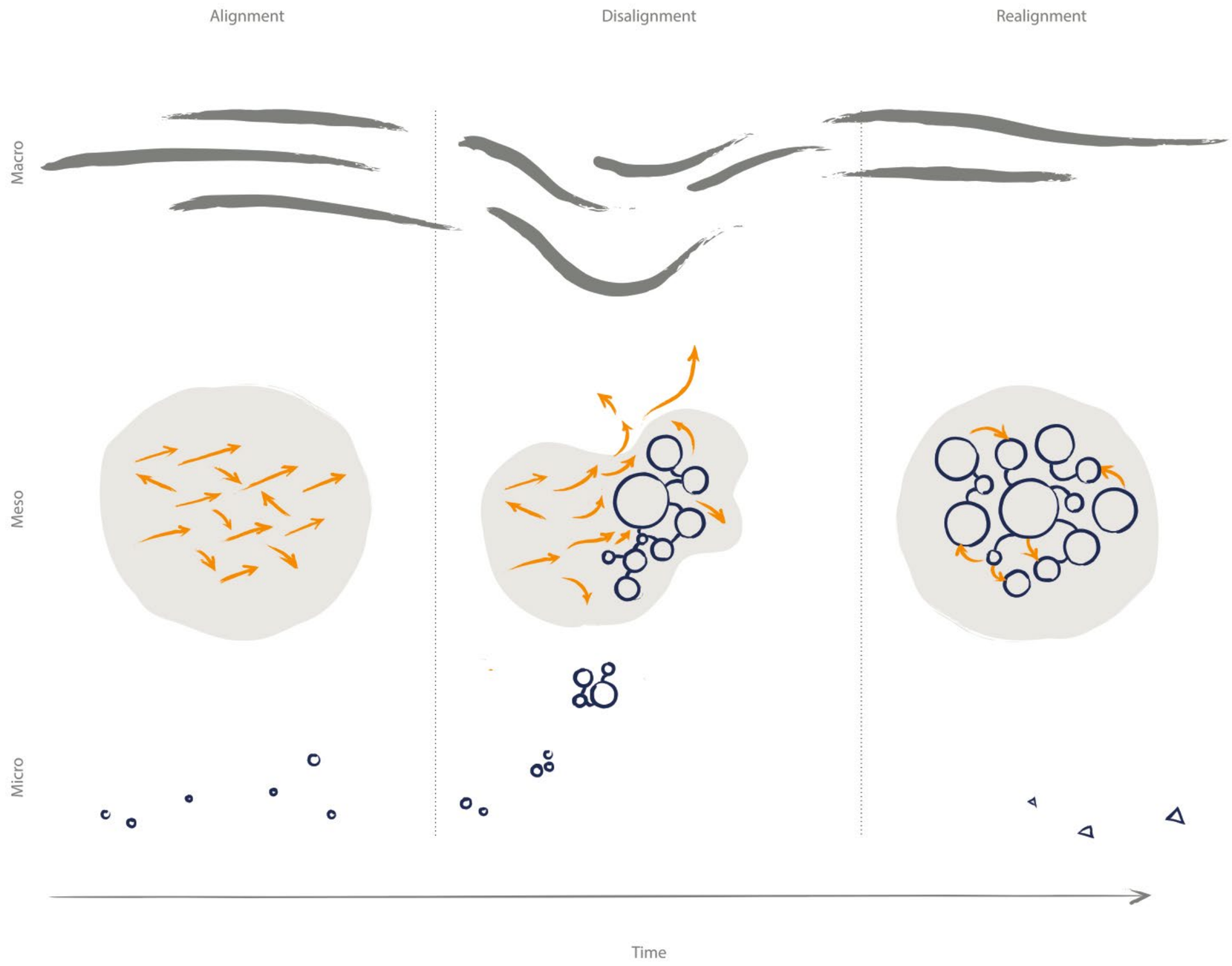
(Meadows, 2008, pp. 116-121)

# Discussion: Levels in a system

Macro
The 'landscape': values, ideologies, demographics and economic context

Meso
The 'regime': frameworks, rules and norms embedded in infrastructure, institutions and markets

Micro
'Niche' innovations: new practices, technologies and lifestyles




From Leadbeater & Winhall, 2020 'Building Better Systems'
See also, Geels, 2004, 2011, 2020

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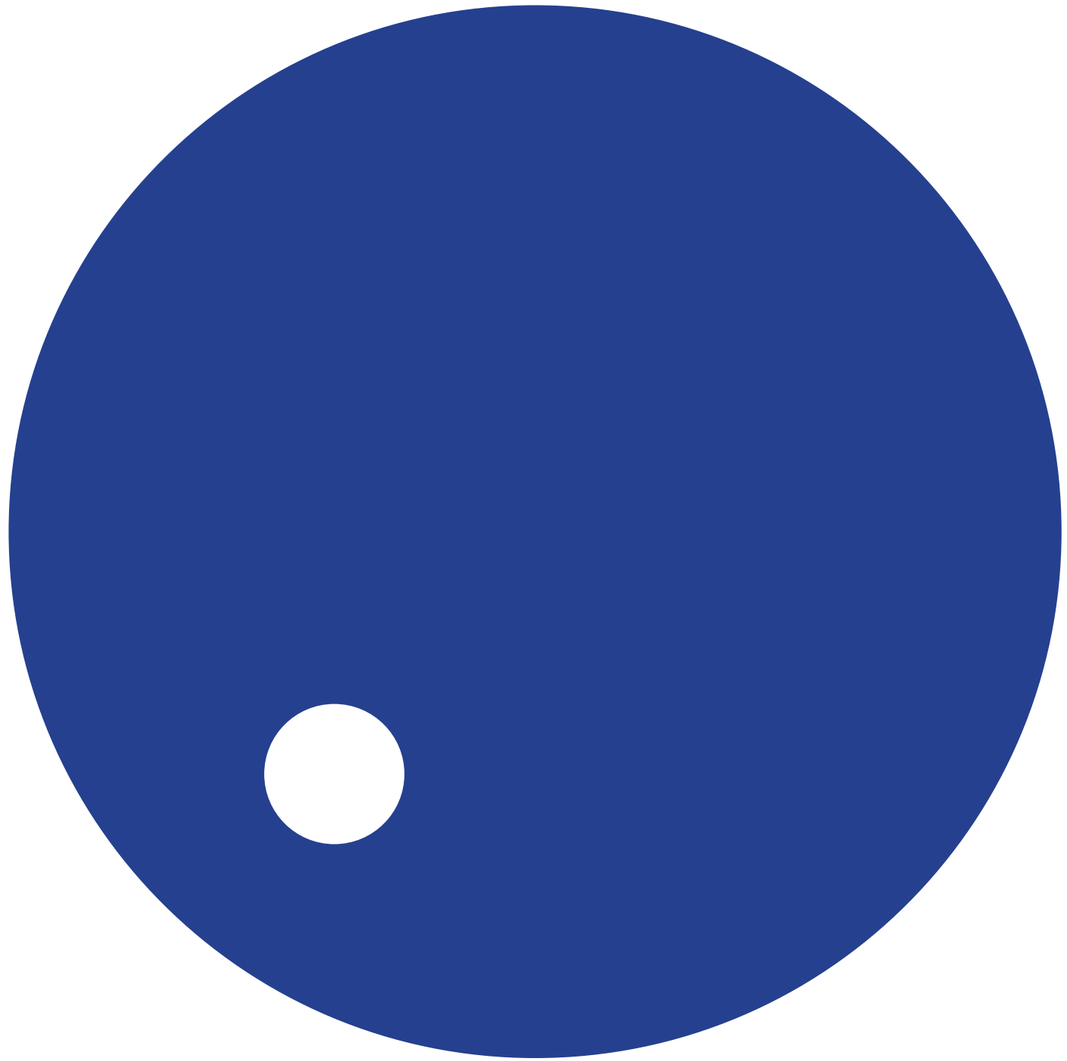
# “DARK MATTER”

In theoretical physics, dark matter is believed to constitute 83% of the matter in the universe.




after Dan Hill, 2011

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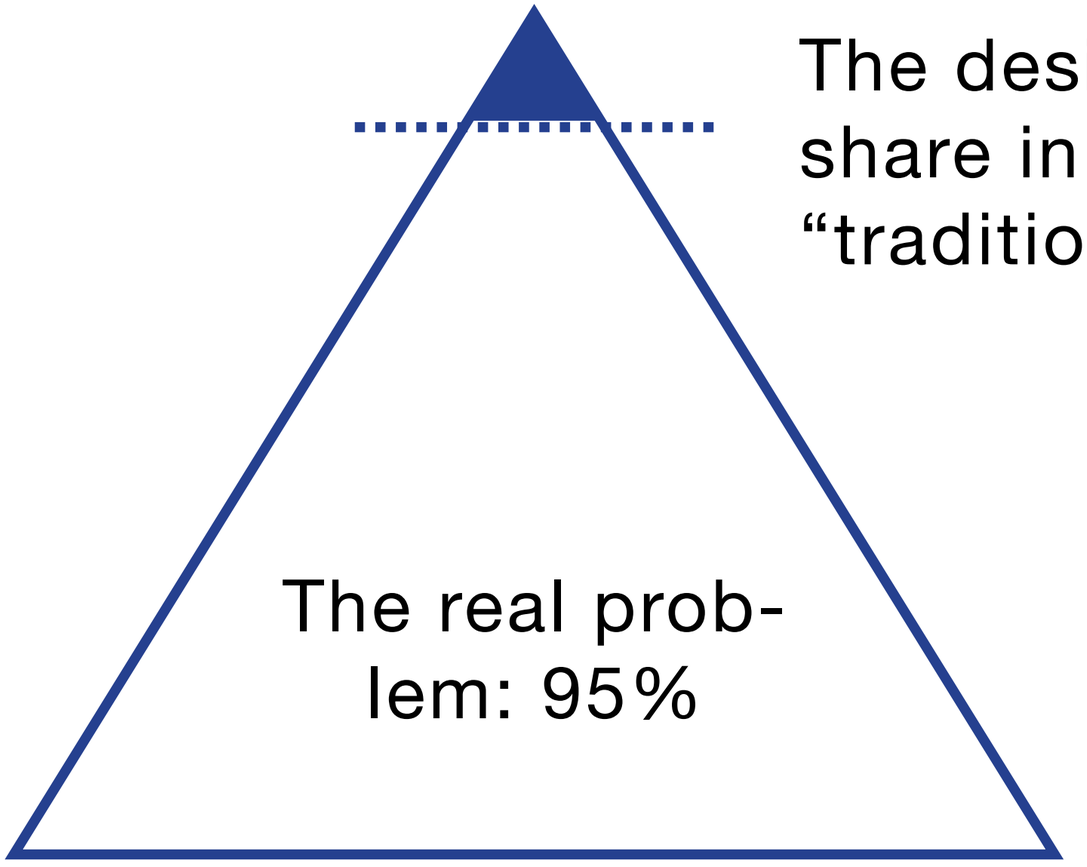


The designer's share in a "traditional" design

Strategic design recognizes that the "dark matter" is part of the design challenge.

Viktor Papanek, 1984

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*"If you really want to change the city, or want a real struggle, a real fight, then it would require re-engaging with things like public planning for example, or re-engaging with government, or re-engaging with a large-scale institutionalised developers. I think that's where the real struggles lie, that we re-engage with these structures and these institutions, this horribly complex 'dark matter'. That's where it becomes really interesting."*

– Wouter vanstiphout, 2010
(interviewed by rory hyde)