A Journey With Systems Thinking

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Systems thinking is an orientation in thinking towards the understanding of wholes and the big picture.

All human problems are connected to each other, we have, e.g.:

- Global networks
- Global resource constraints
- Shared environment e.g. atmosphere, oceans

Some keywords

- Systems
- Models
- Behavior
- Learning

The goal can be understanding, or direct support for problem-solving.

Russell L. Ackoff, 1919-2009

“To manage a system effectively, focus on the interactions of the parts rather than their behavior taken separately.”

“Over time, every way of thinking generates important problems that it cannot solve”

Donella Meadows, 1941-2001

“We can’t control systems or figure them out. But we can dance with them!”

“Go for the good of the whole.”

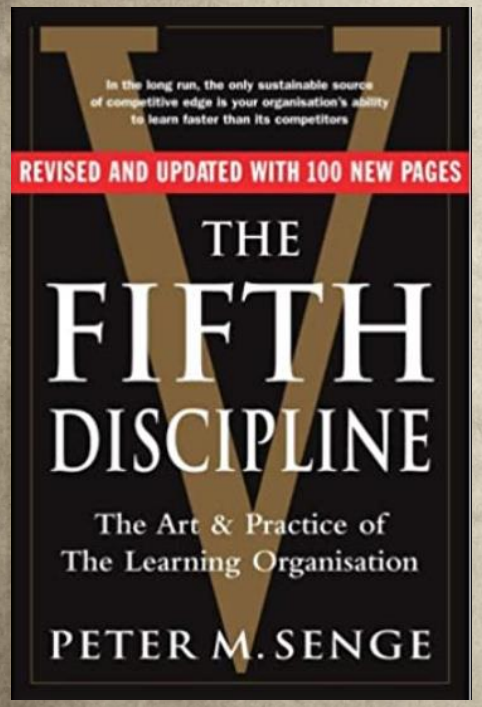
Peter Senge, 1947-

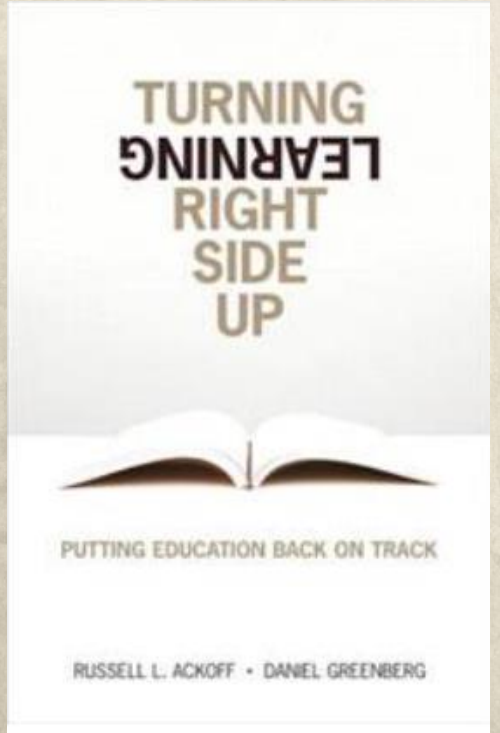
“When people in organizations focus only on their position, they have little sense of responsibility for the results produced when all positions interact. Moreover, when results are disappointing, it can be very difficult to know why. All you can do is assume that “someone screwed up.”

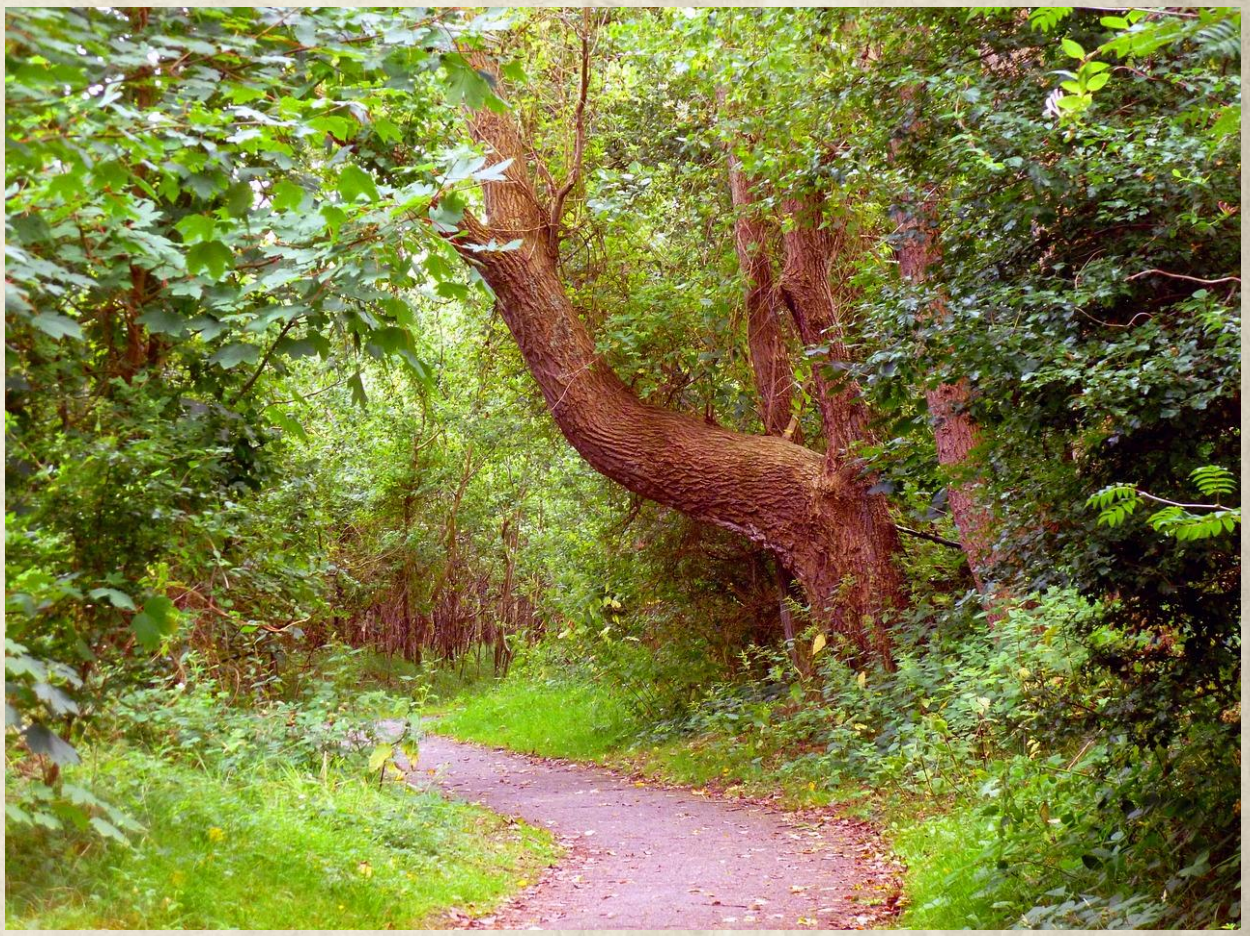
Learning and adaptation is fundamental

The scarcest resource is not oil, metals, clean air, capital, labour, or technology. It is our willingness to listen to each other and learn from each other and to seek the truth rather than seek to be right

— Donella Meadows —







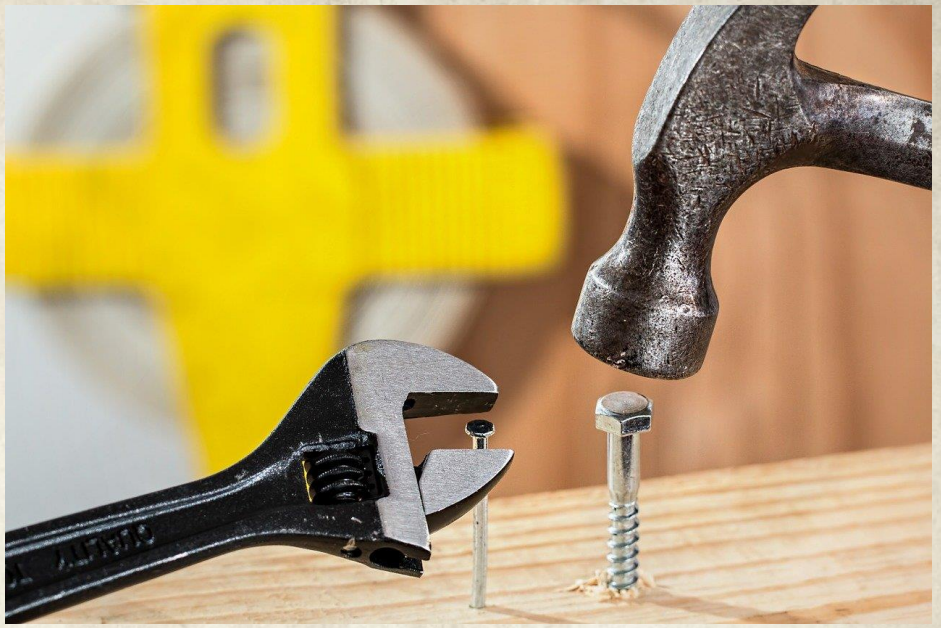
Models

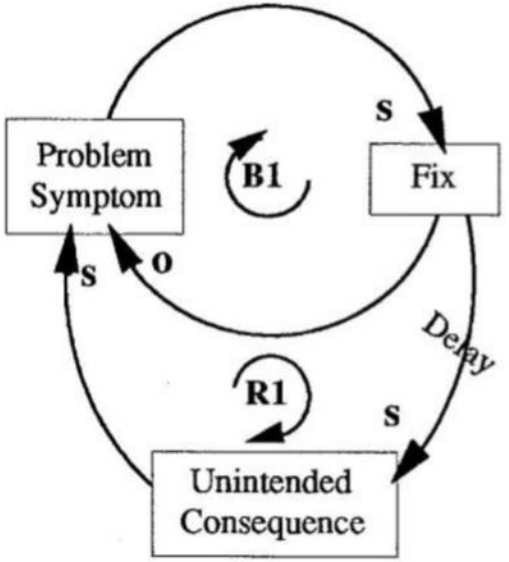
The model can be presented, e.g. using words, picture, or mathematically – the most effective format depending on the context.

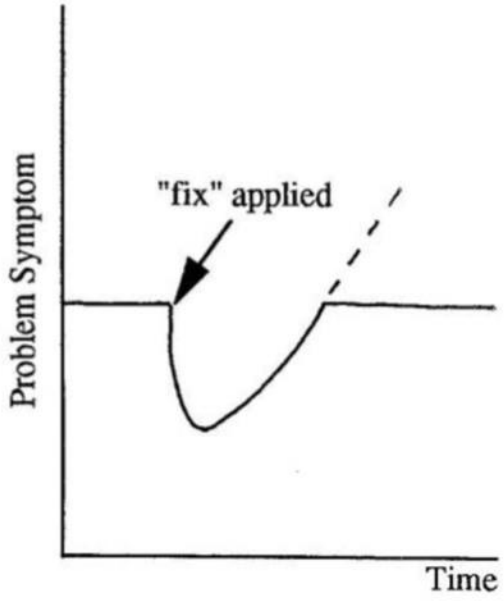
Descriptions or images of the reality, tools for thinking and problem solving

Some of the uses of models include

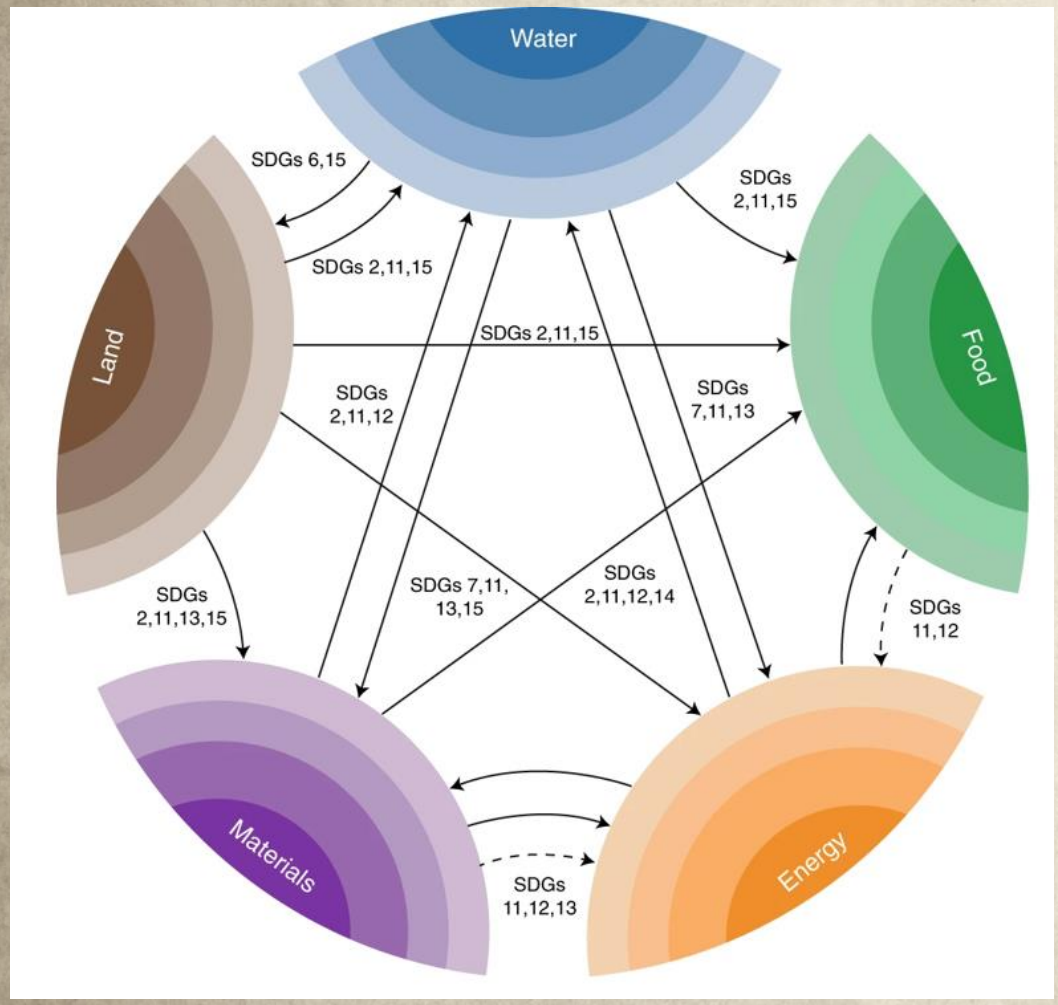
- prediction,
- derivation of decision recommendations,
- generation of alternatives,
- organization of information,
- communication,
- framework for joint problem solving,
- understanding magnitudes,
- integration of perspectives,
- evaluating the consistency of thought,
- fulfillment of regulatory requirements.





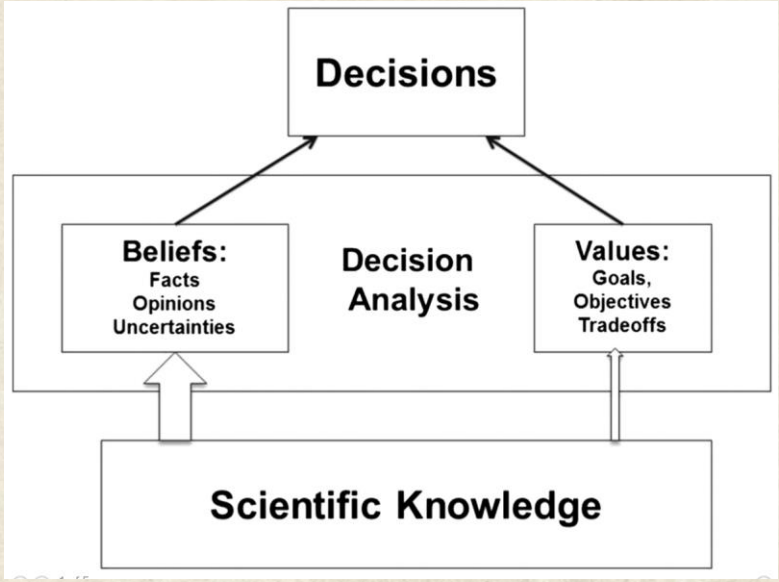


Nexus model

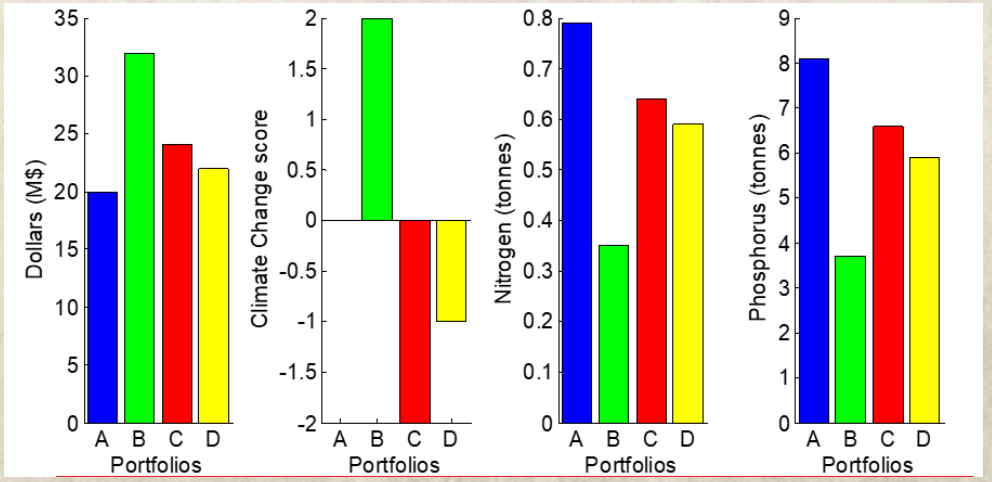


Bleischwitz et al., Resource nexus perspectives towards the United Nations Sustainable Development Goals. Nature Sustainability, 2018.

Decision analysis



von Winterfeldt, Bridging the gap between science and decision making. PNAS, 2013.



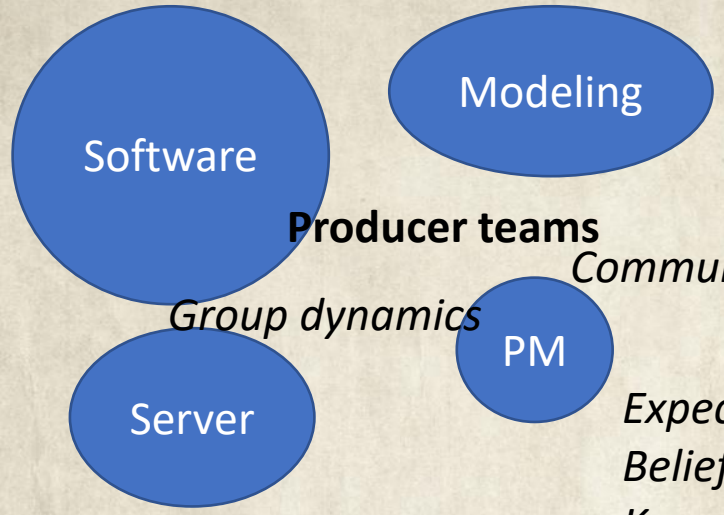
Lahtinen et al. Portfolio Decision Analysis Methods in Environmental Decision Making. Environmental Modelling and Software, 2017.

Software project

Objective: Software solution to address an operational problem

Subsystems
- Producer team
- Client team
- Client organization
- Software
- Processes

Some problems:
- Scoping
- Usability
- Roll-out
- Maintenance
- A mistake happens?
- Specifications change?
- A key person gets sick?

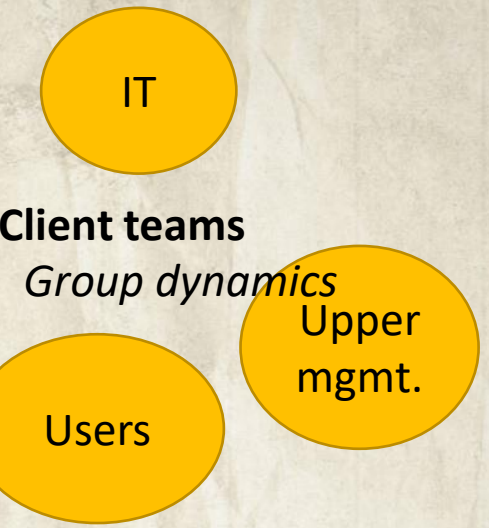


Producer teams

Communication

Group dynamics

Expectations, Beliefs, Knowledge, Trust

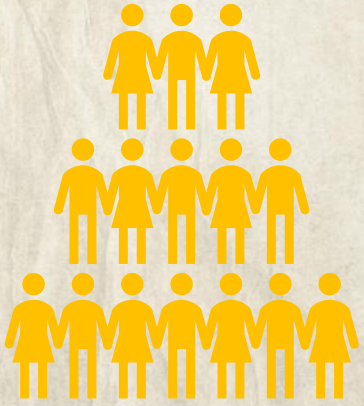


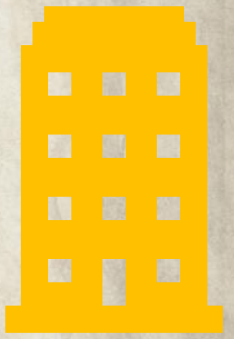
Client teams

Group dynamics

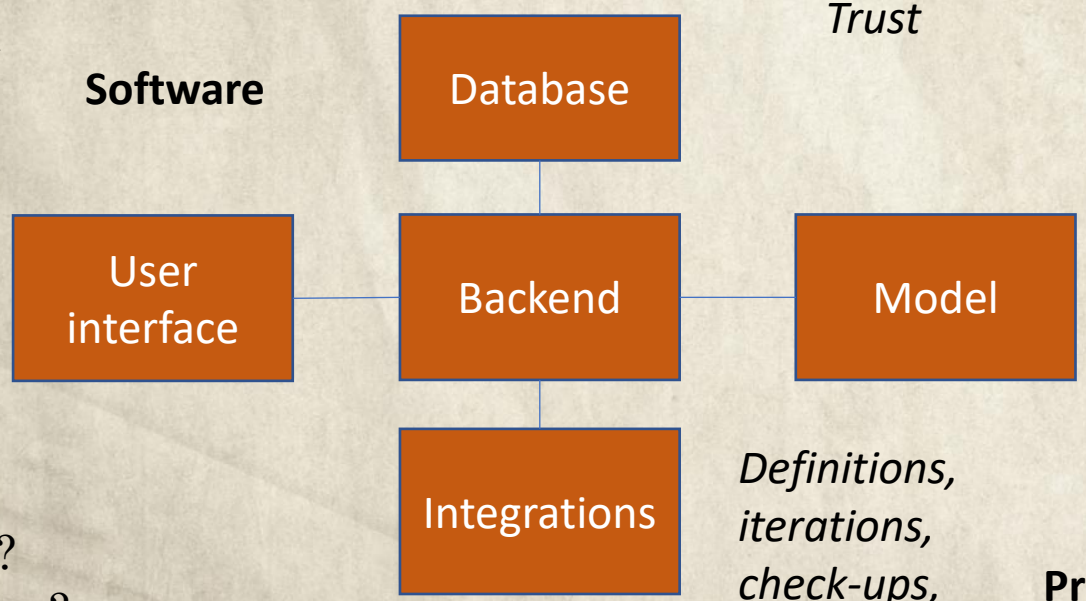
- *Operational pressures*
- *Development needs*
- *Multiple departments*

Client organization





Software



Definitions, iterations, check-ups, requests, reviews, roll-out…

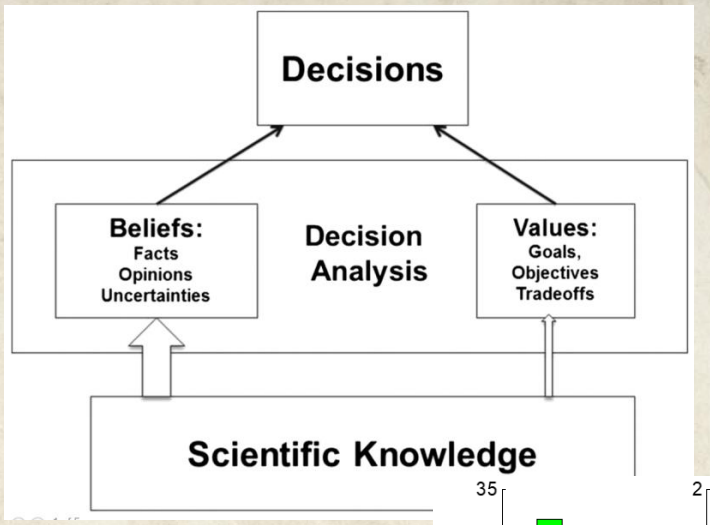
Processes

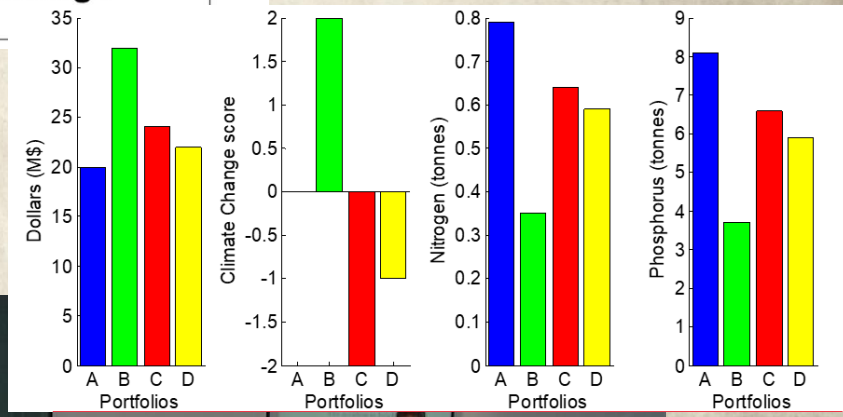
Decision analysis

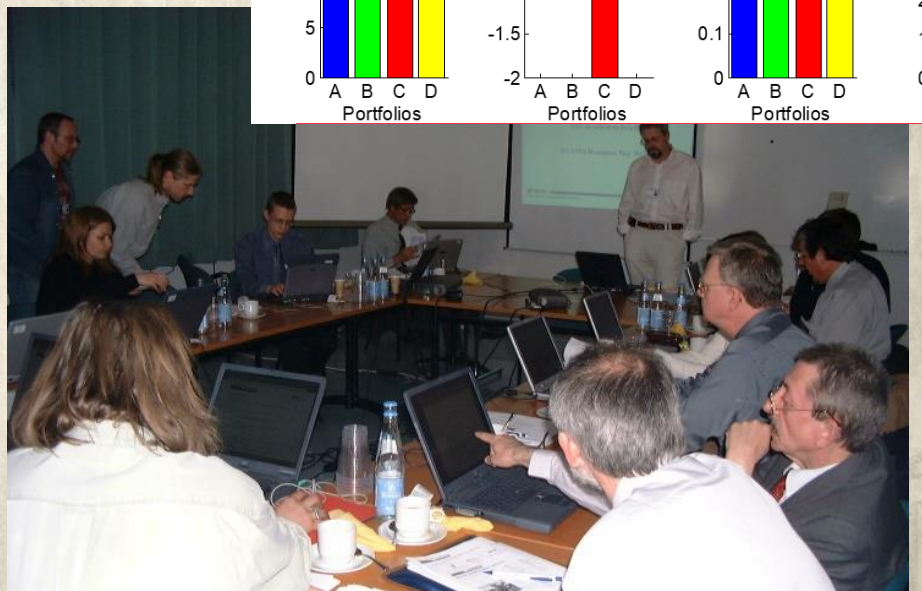
- Processes
- Tools
- Data
- Values
- Physical
  - E.g. table arrangements
- Human behavior
  - Biases
  - Motives
  - Fear and trust generation
  - Groupthink
- Interactions
  - Process parameters and human behavior

Traditional perspective

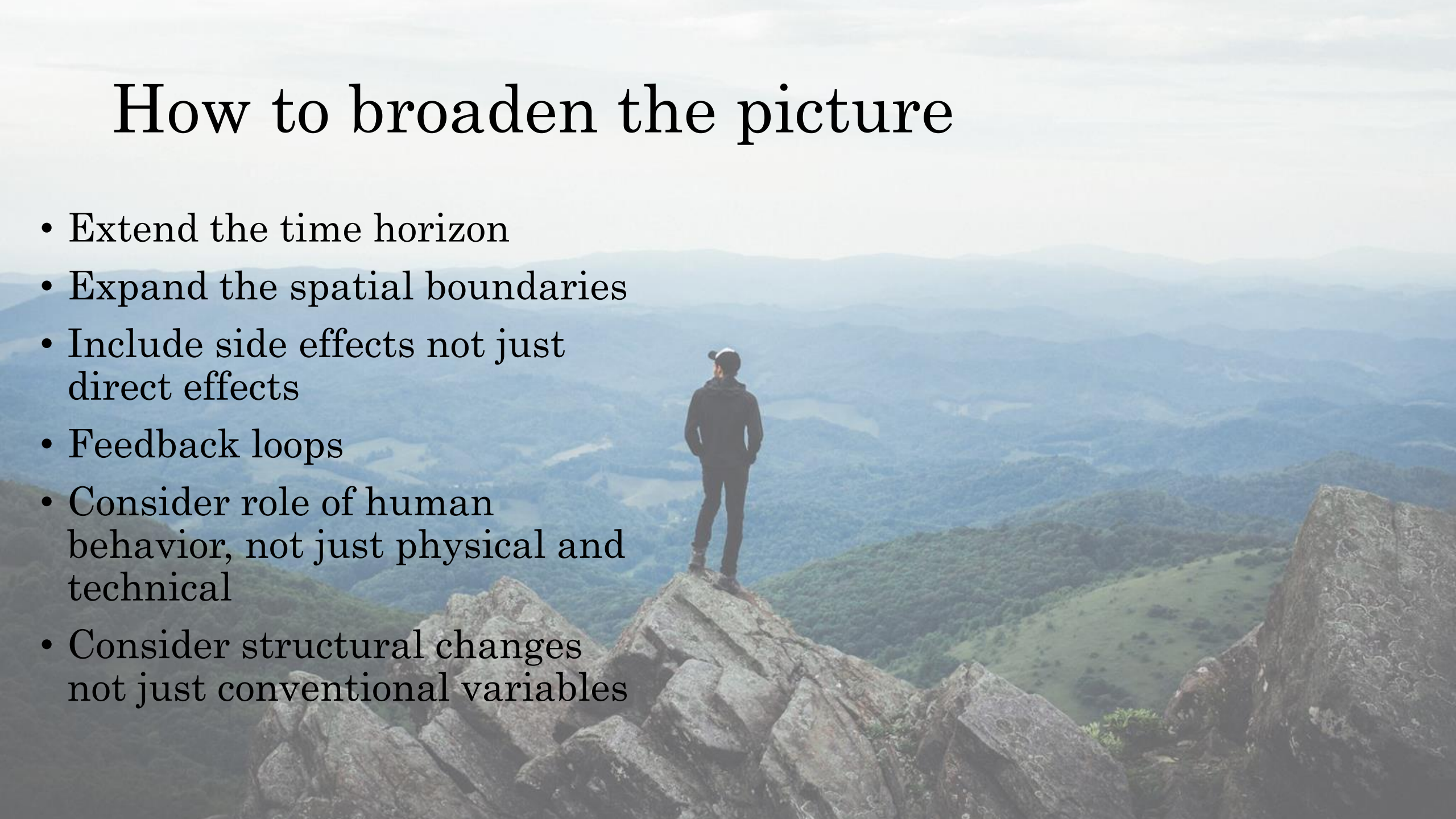
Systems perspective







How to broaden the picture



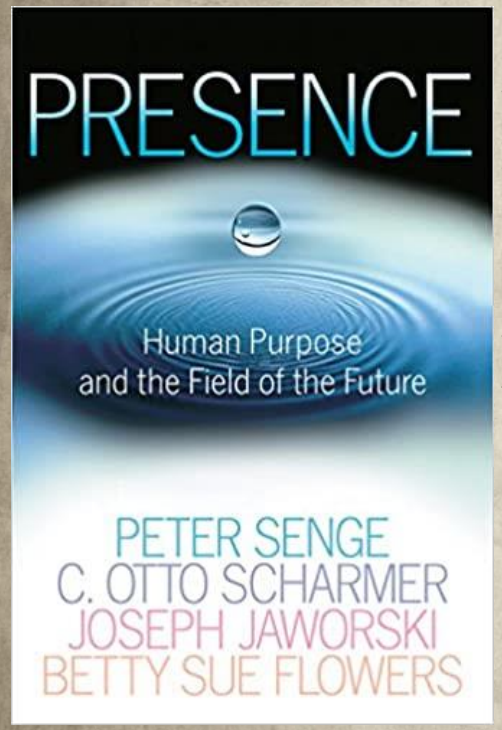
- Extend the time horizon
- Expand the spatial boundaries
- Include side effects not just direct effects
- Feedback loops
- Consider role of human behavior, not just physical and technical
- Consider structural changes not just conventional variables

Places to intervene in a system

12. Constants, parameters, numbers (such as subsidies, taxes, standards).
11. The sizes of buffers and other stabilizing stocks, relative to their flows.
10. The structure of material stocks and flows (such as transport networks, population age structures).
9. The lengths of delays, relative to the rate of system change.
8. The strength of negative feedback loops, relative to the impacts they are trying to correct against.
7. The gain around driving positive feedback loops.
6. The structure of information flows (who does and does not have access to information).
5. The rules of the system (such as incentives, punishments, constraints).
4. The power to add, change, evolve, or self-organize system structure.
3. The goals of the system.
2. The mindset or paradigm out of which the system — its goals, structure, rules, delays, parameters — arises.
1. The power to transcend paradigms.

Meadows, D. (1997). Places to intervene in a system. *Whole Earth*, *91*(1), 78-84.

Some state-of-the-art developments



"Too often, the authors found, we remain stuck in old patterns of seeing and acting. By encouraging deeper levels of learning, we create an awareness of the larger whole, leading to actions that can help to shape its evolution and our future."

"We are always part of systems. We can act intelligently from within those systems."