TNO

Neth-ER | Netherlands house for Education and Research

April 25th, 13:00 - 17:00

‘Unlock System Transitions’ Workshop

Aarlenstraat 22
1050, Elsene, België

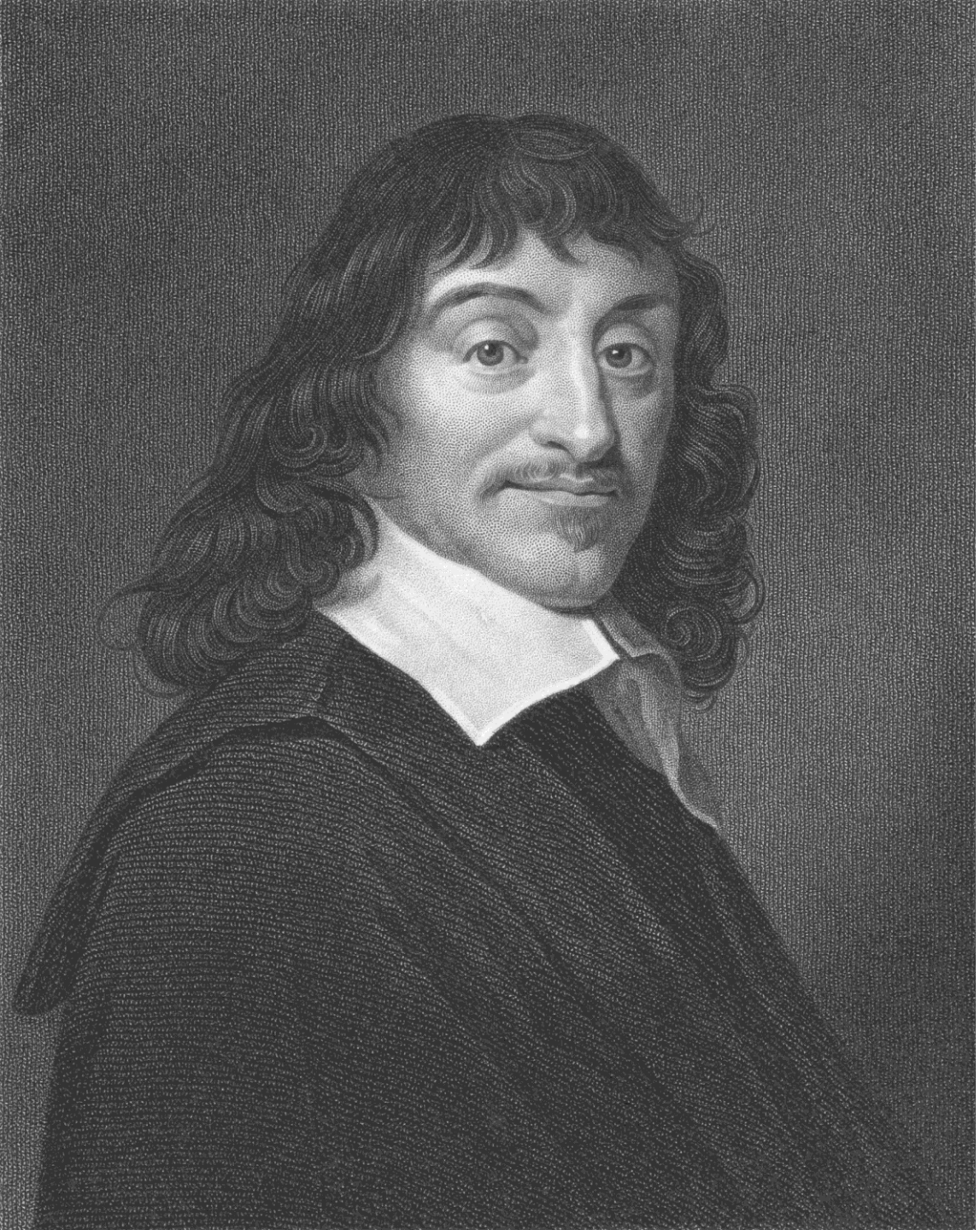
Agenda

- Welcome and introduction – Geraud Guilloud
- Keynote speech: What is system thinking?
  - Mieke van der Bijl-Bouwer
  - Associate professor at TU Delft, Founder of IDE system design lab
- Seizing the potential of systems thinking
  - Bianca Cavicchi
  - Policy officer – DG RTD – European Commission
- 14h15 Coffee break
- 14h30 Workshop

An introduction to systems thinking & system change

Dr.ir. Mieke van der Bijl-Brouwer
TU Delft – Systemic Design Lab – Faculty of Industrial Design Engineering
Meerkat Consultancy

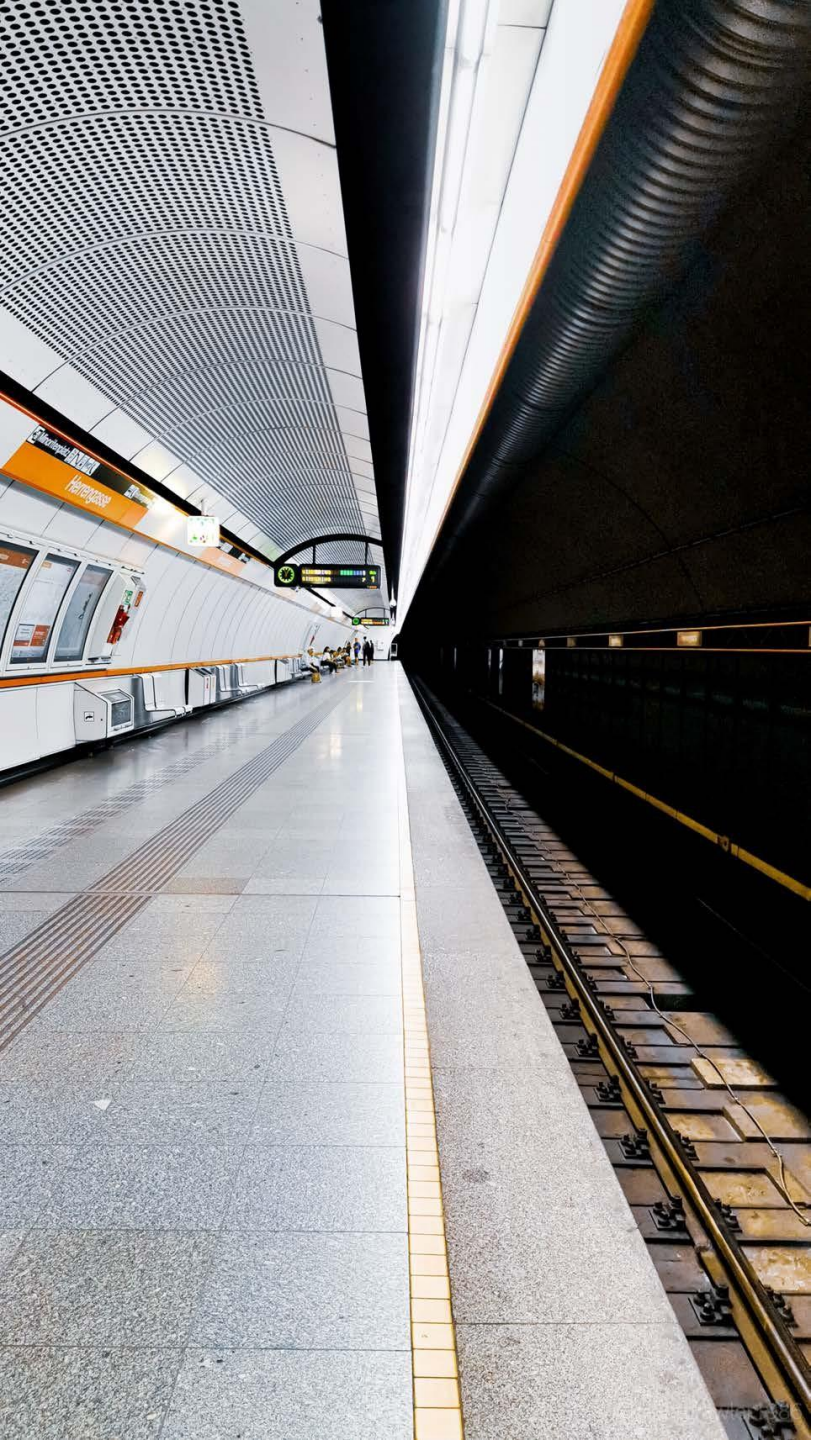

the world as a machine?



reductionism - Descartes

the Cartesian method

- reductionism attempts explanation of entire systems in terms of their individual, constituent parts and their interactions



determinism - Newton

- world operates according to a fixed set of laws
- linear cause effect relations

Photo by John Rodenn Castillo on Unsplash

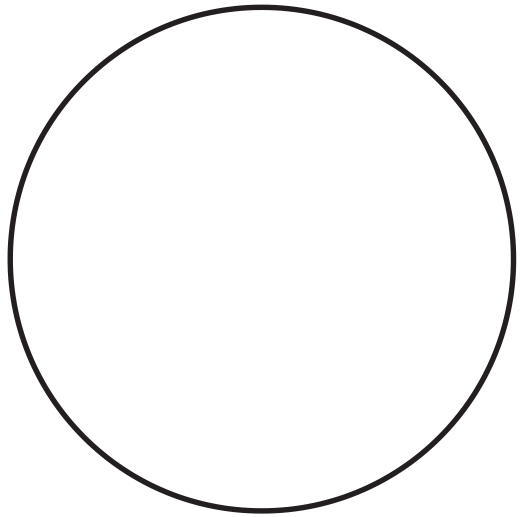
systems thinking

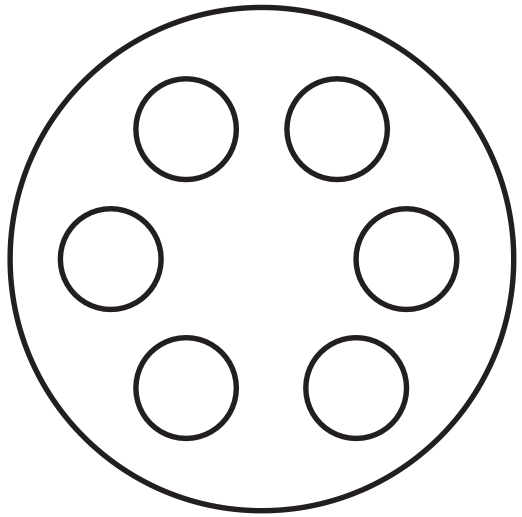
a system is not the sum of the behaviour of its parts, it’s the product of their interactions

systems thinking

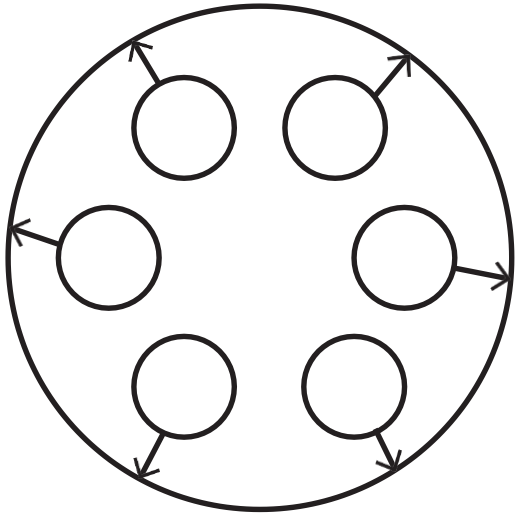
- systems thinking: complements analysis with synthesis
- analysis : reductionism & determinism (linear cause & effect)
- synthesis: expansionism

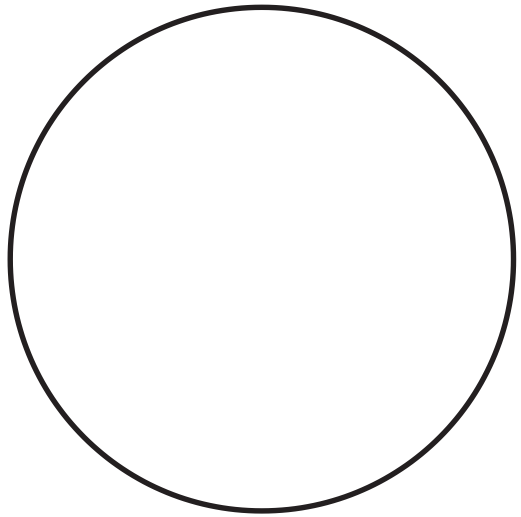
Ackoff, Russell L. *Ackoff's Best.* New York: John Wiley & Sons, 1999.

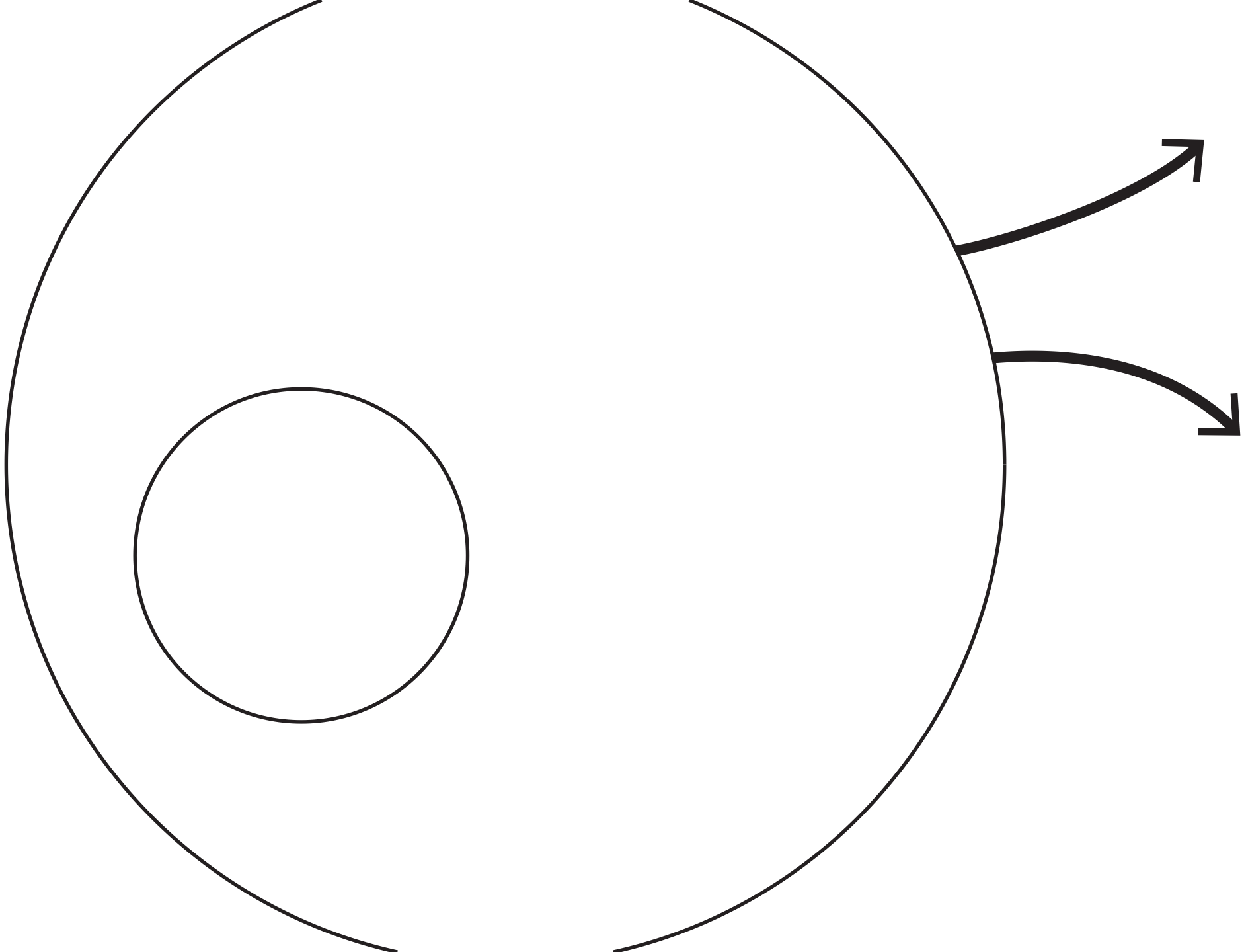


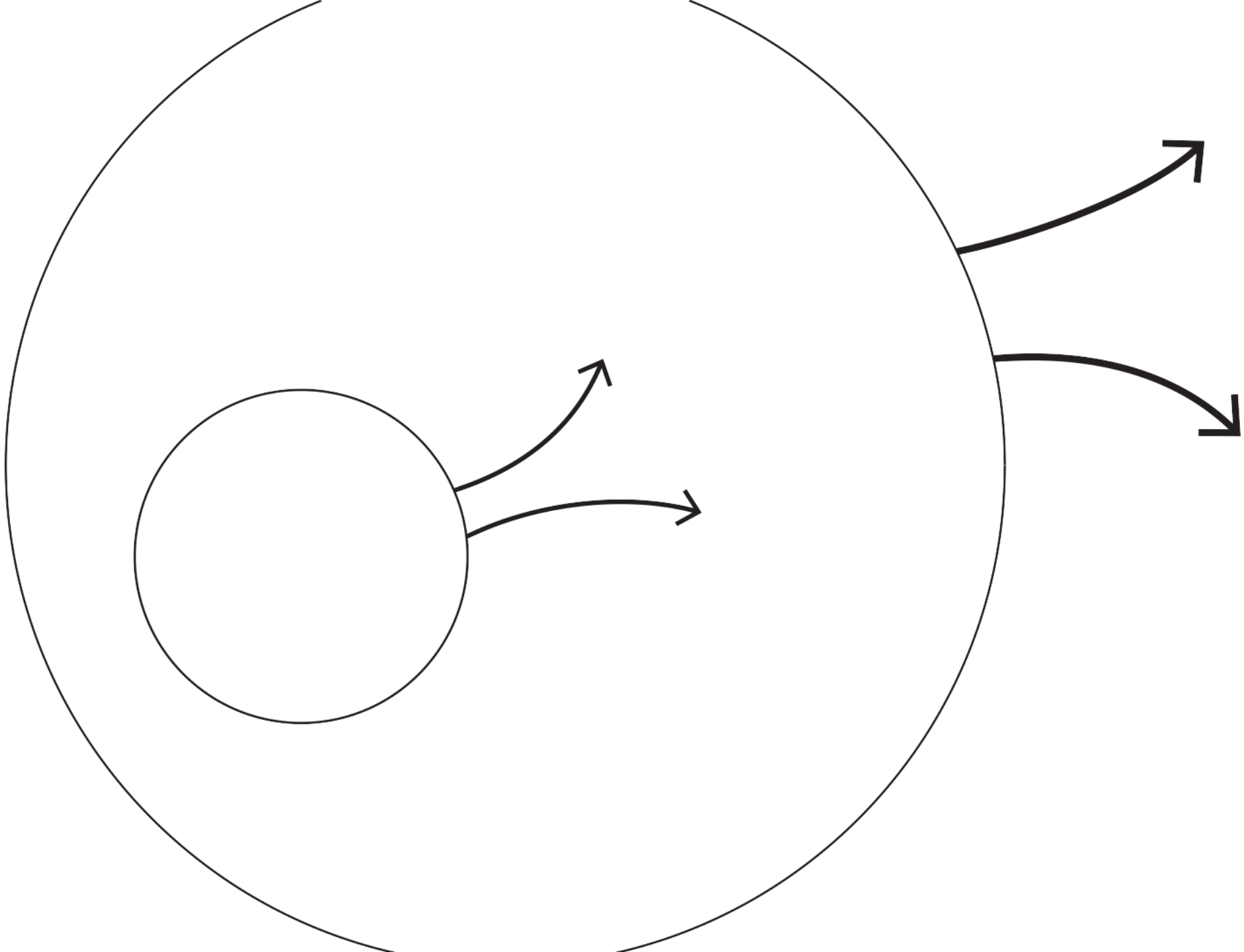


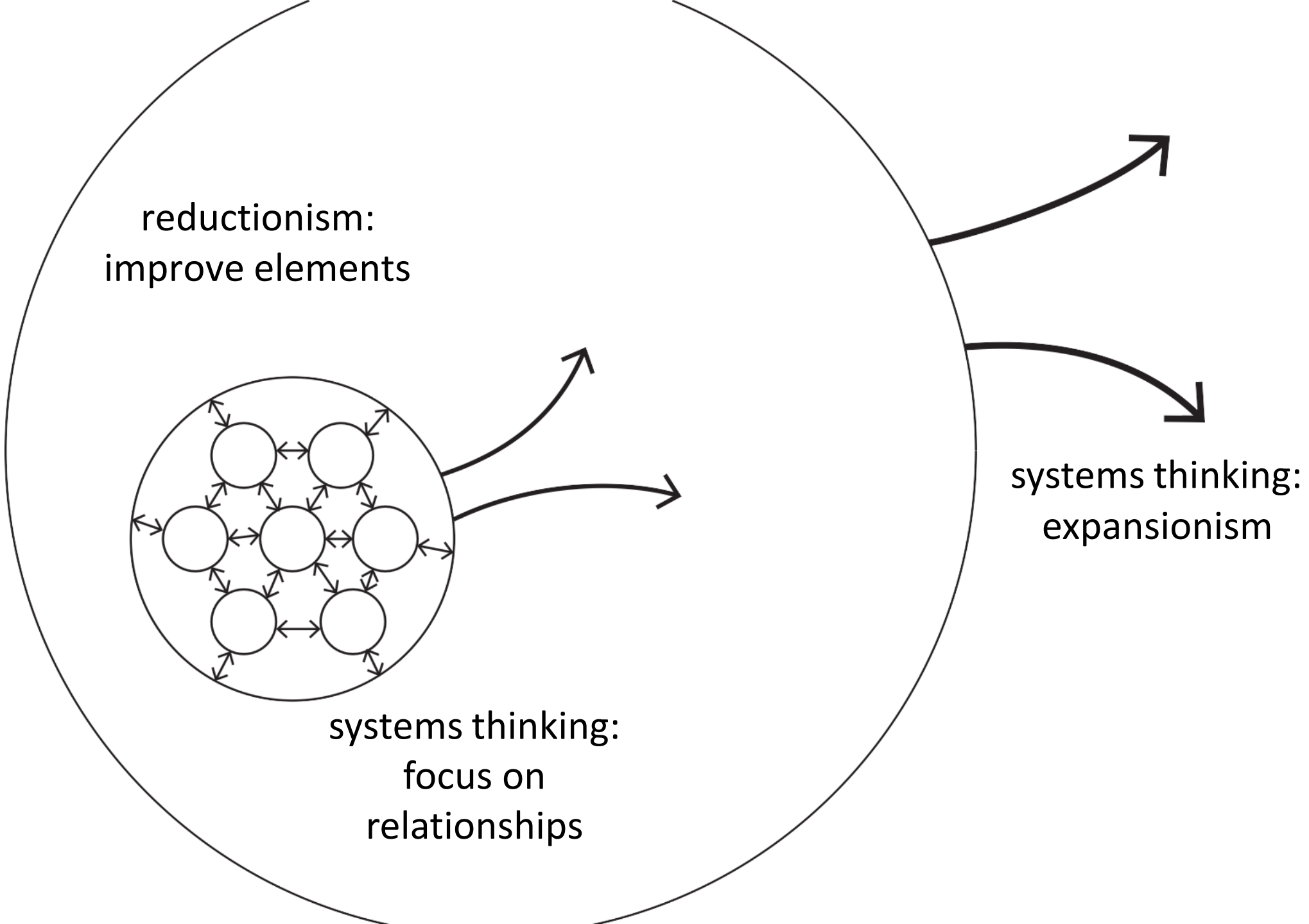
reductionism:
improve elements



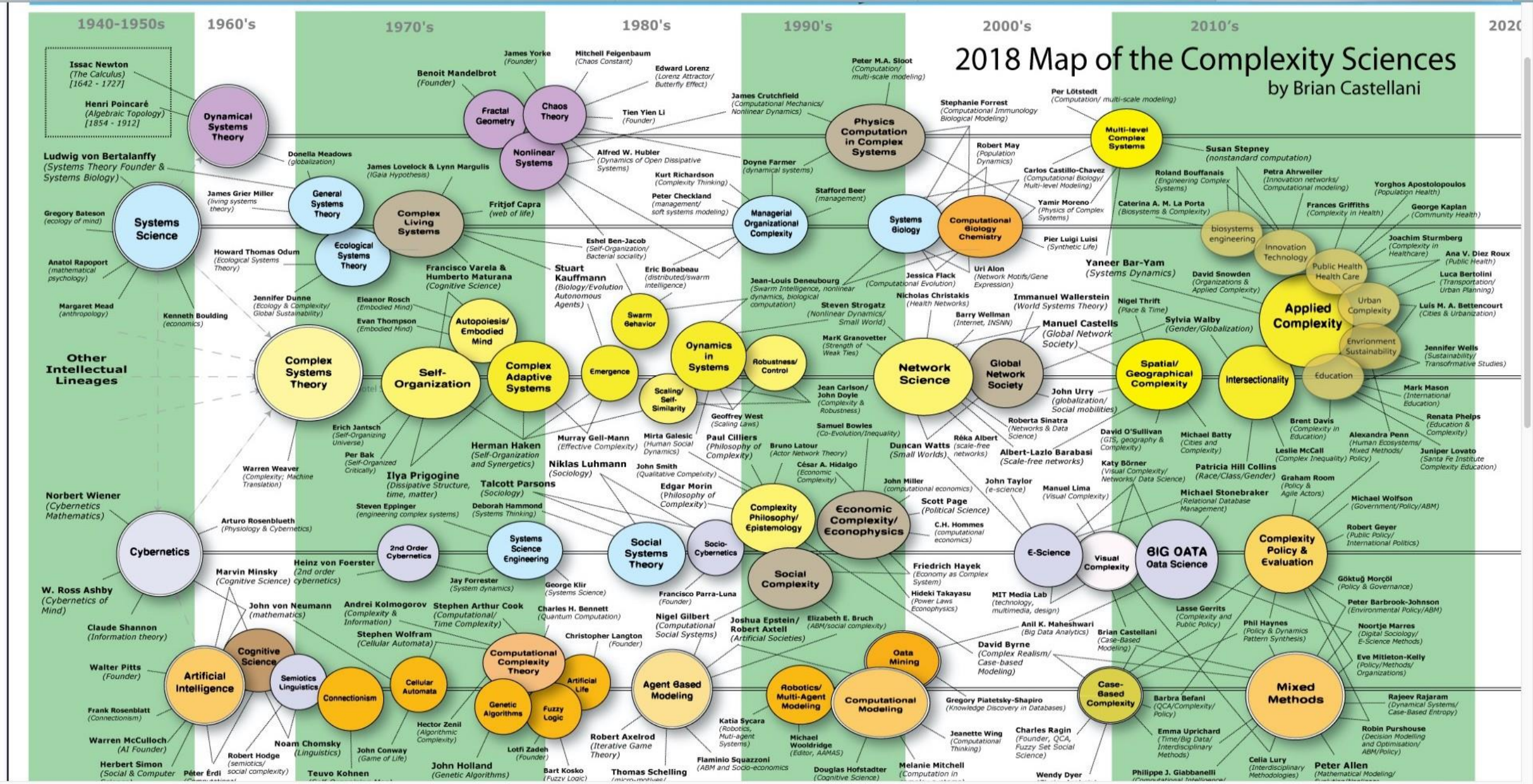







reductionism:
improve elements
systems thinking:
expansionism
systems thinking:
focus on
relationships

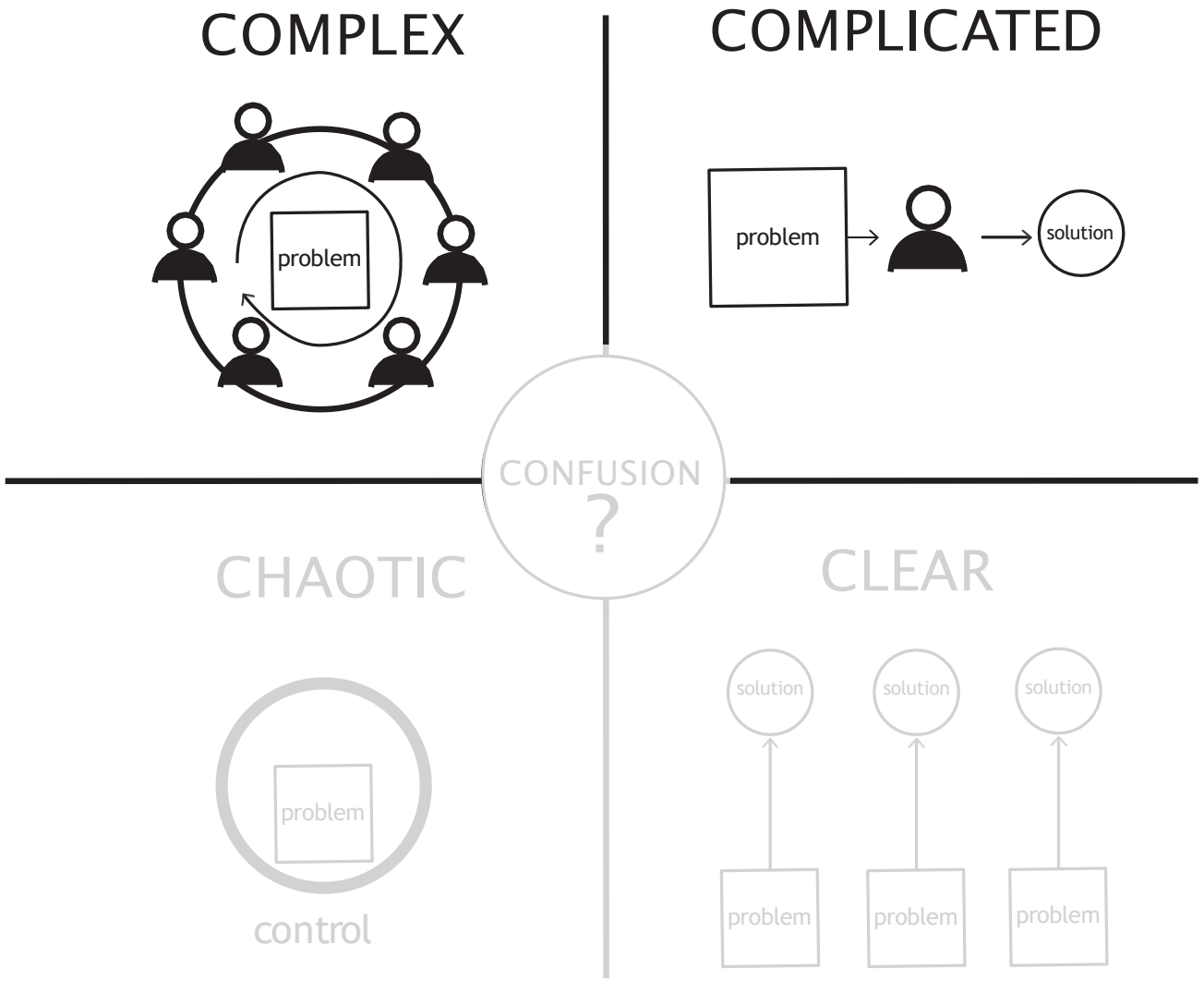
complex systems



Castellani, Brian (2018) “Map of the Complexity Sciences.” Art & Science Factory. https://www.art-sciencefactory.com/complexity-map_feb09.html

Cynefin Framework

Snowden, David J., and Mary E. Boone. "A Leader's Framework for Decision Making." *Harvard Business Review* 85, no. 11 (December 2007): 68-76.



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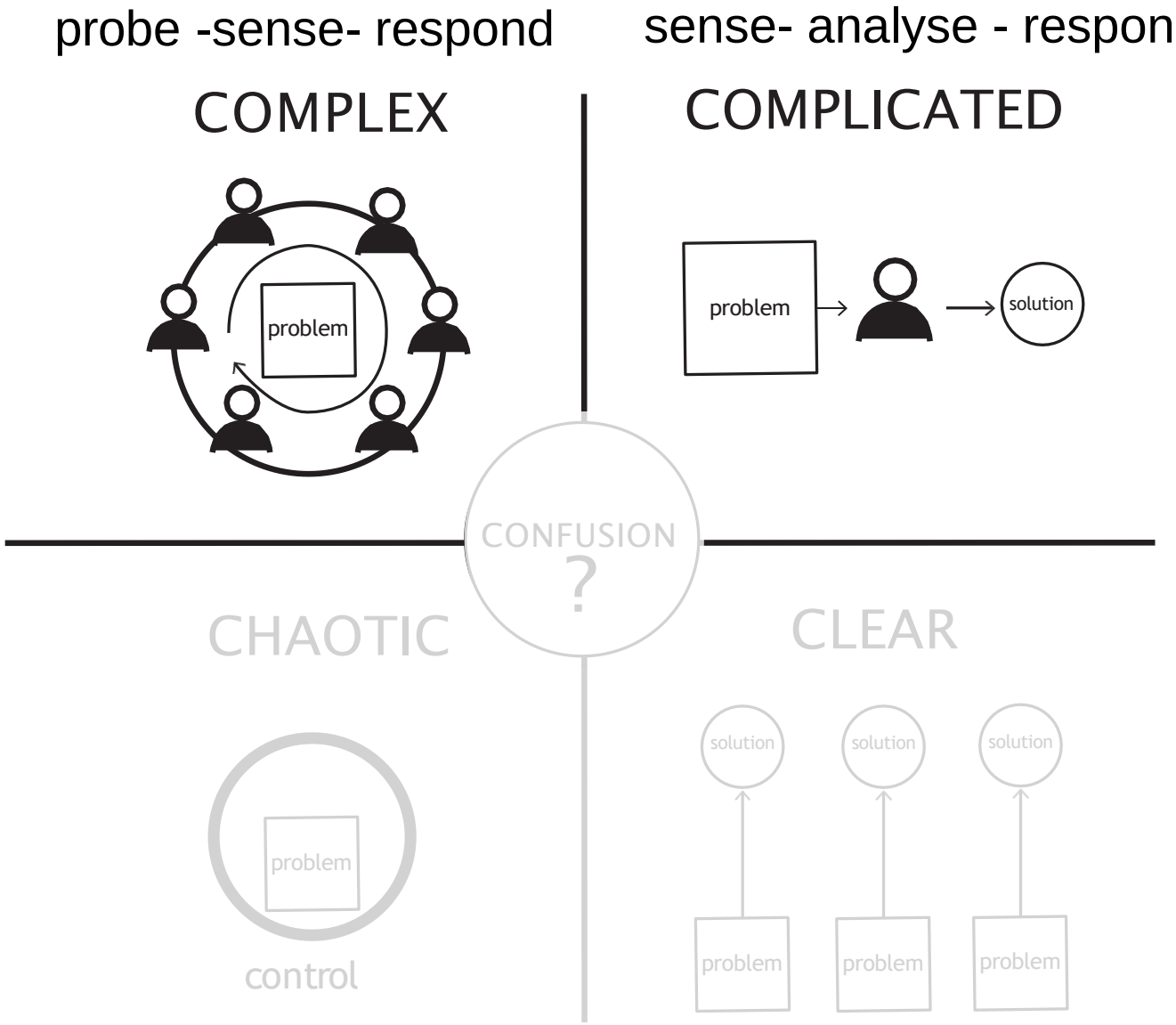
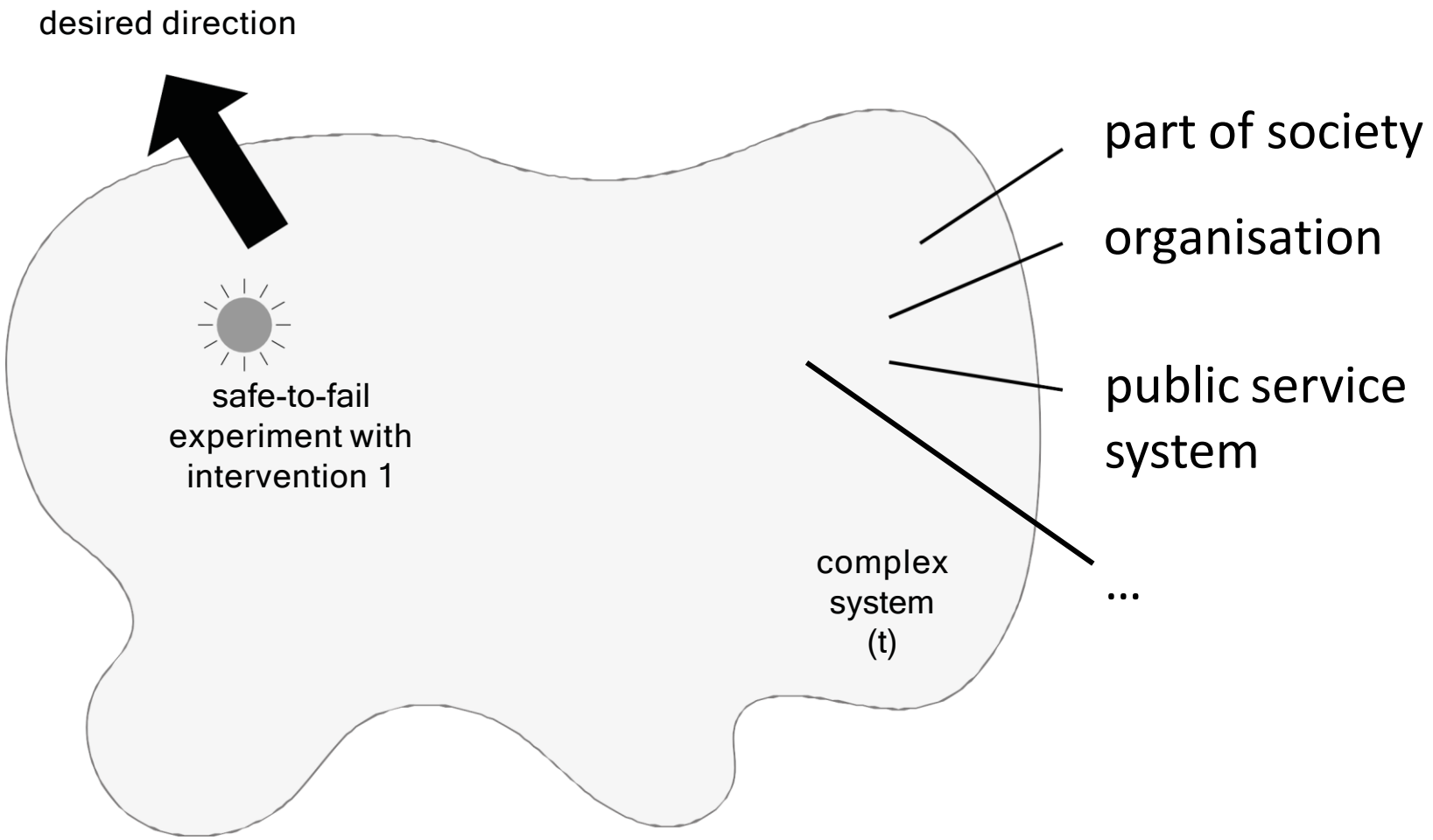


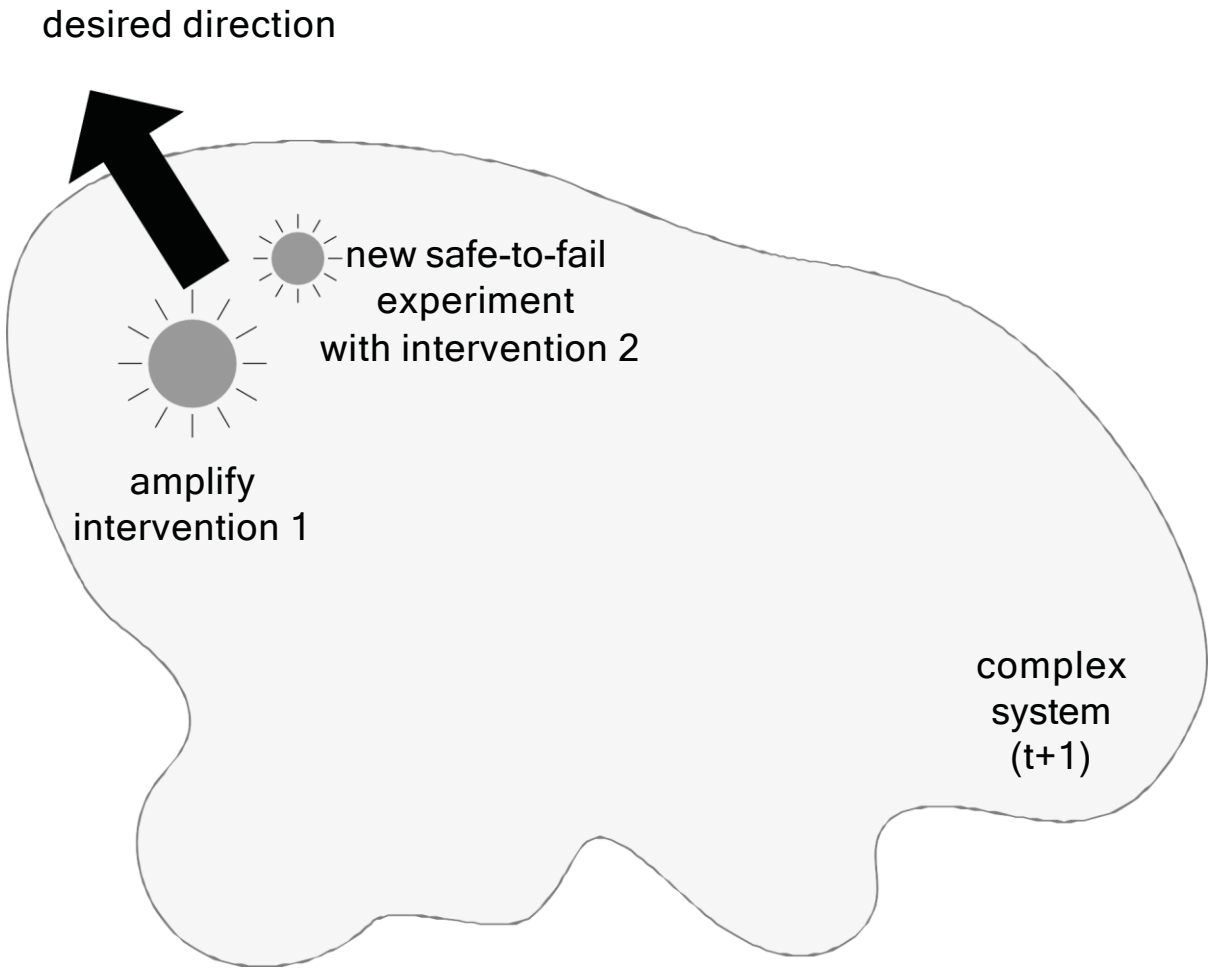
system change



van der Bijl - Brouwer, M., Kligyte, G., & Key, T. (2021). A Co-evolutionary, Transdisciplinary Approach to Innovation in Complex Contexts: Improving University Well-Being, a Case Study. *She ji: The Journal of Design, Economics and Innovation*, *7*(4), 565-588.

Safe-to-fail experiment: Snowden, David J., and Mary E. Boone. "A Leader's Framework for Decision Making." *Harvard Business Review* 85, no. 11 (December 2007): 68-76.

evolutionary approach



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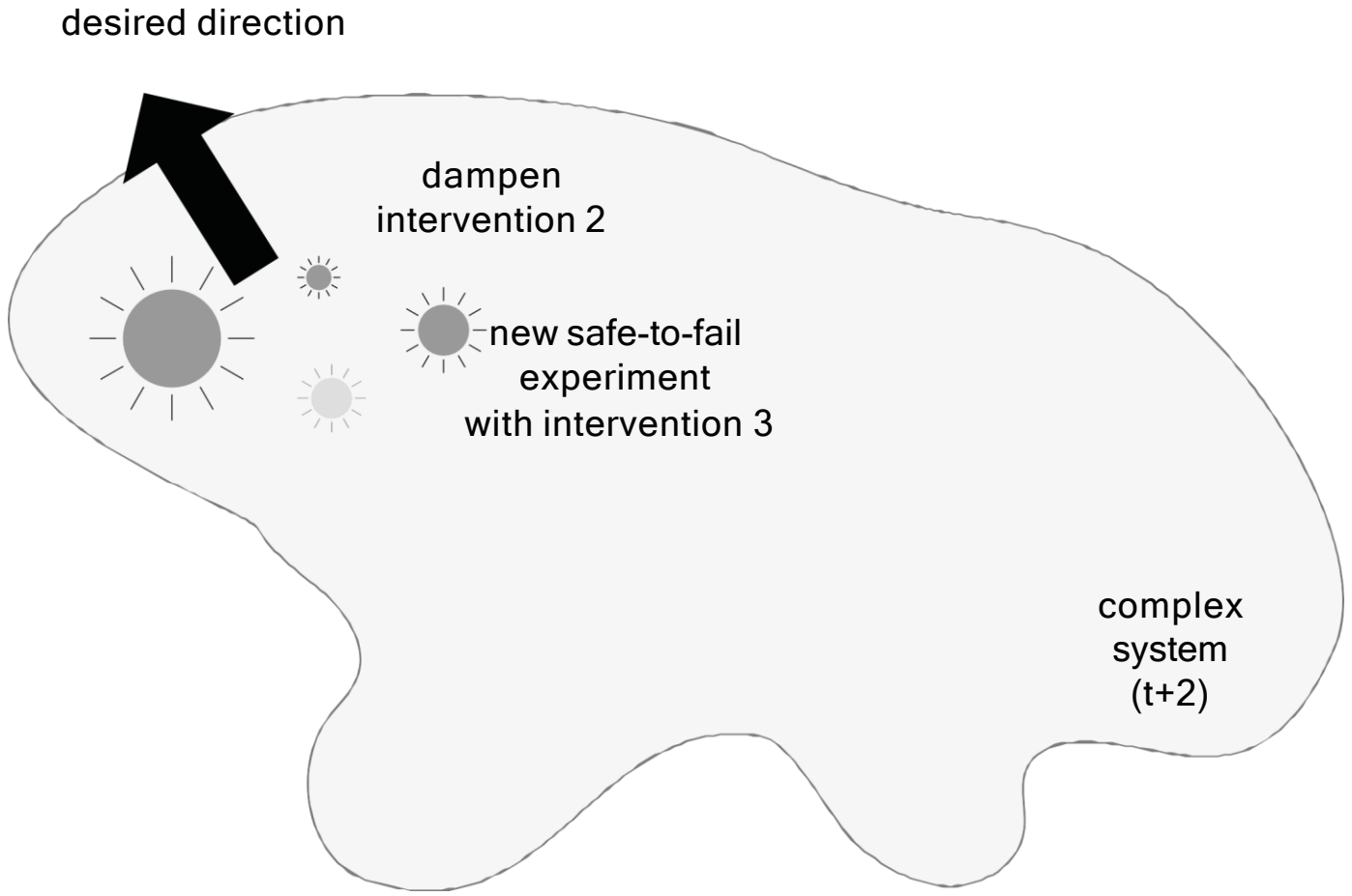
evolutionary approach



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leverage points

leverage points: places in a system where a small change could lead to a large shift in behaviour (Meadows, 1999)

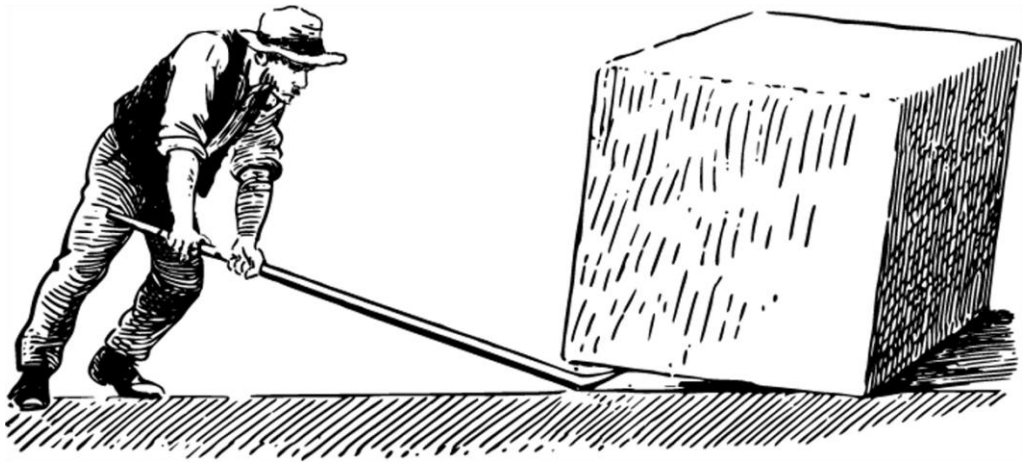

Image source: OpenClipart-Vectors via https://pixabay.com

Meadows, D. H. (1999). *Leverage Points: Places to Intervene in a System*. The Sustainability Institute. http://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

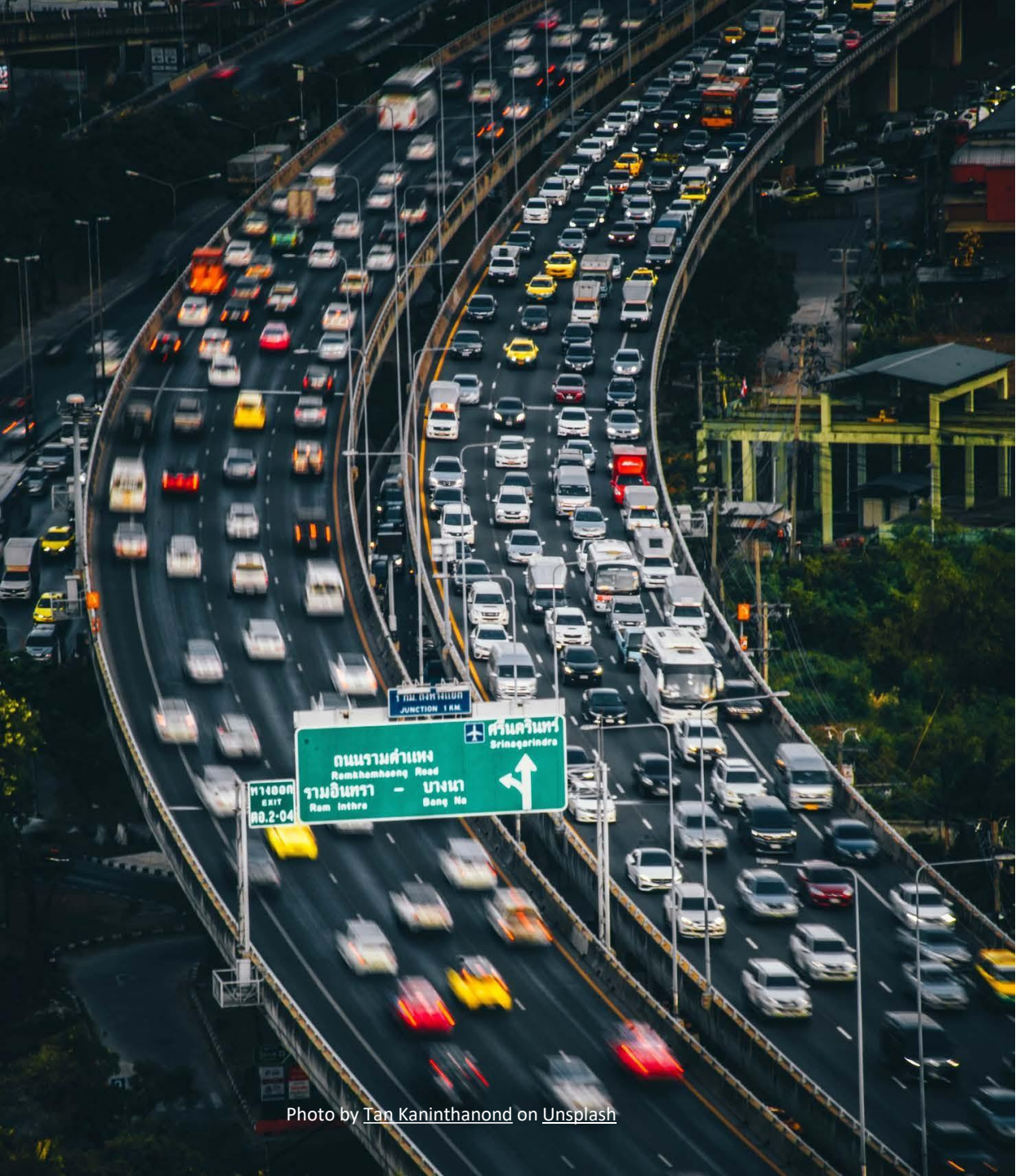

Photo by Tan Kaninthanond on Unsplash

(inincreasingorderofeffectiveness)

12. Constants, parameters, numbers (subsidies, taxes, standards)

11. Buffers – the size of stabilizing stocks relative to their flows

10. Physical systems and their nodes of intersection

9. Delays

8. Regulating negative/balancing feedback loops.

7. Driving reinforcing/ positive feedback loops.

6. Information flows.

5. The rules of the system (incentives, punishments, constraints).

4. Self-organization

3. The goals of the system.

2. The mindset or paradigm out of which the system — its goals, power structure, rules, its culture — arises.

1. Transcending paradigms

(inincreasingorderofeffectiveness)

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1. Transcending paradigms

thank you!

Dr. Mieke van der Bijl-Brouwer
www.miekevanderbijl.com

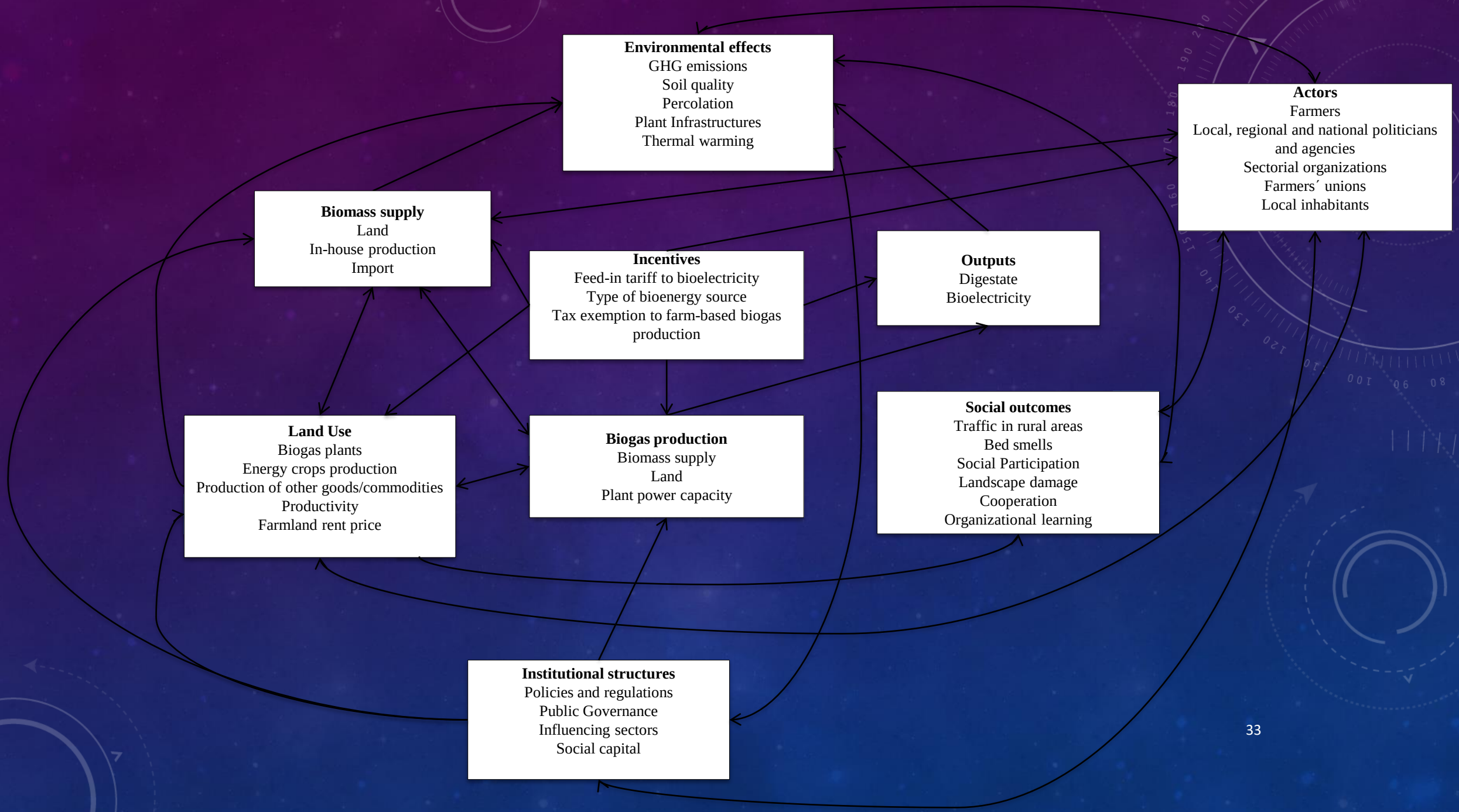
SEIZING THE POTENTIAL OF SYSTEMS THINKING

Concrete examples

Bianca Cavicchi, Policy officer, DG Research and Innovation, Chief Economist Unit

- Systems thinking journey
- Initiatives at DG R&I
- Next steps

SYSTEMS THINKING JOURNEY


Environmental effects
GHG emissions
Soil quality
Percolation
Plant Infrastructures
Thermal warming
Actors
Farmers
Local, regional and national politicians and agencies
Sectorial organizations
Farmers´ unions
Local inhabitants
Biomass supply
Land
In-house production
Import
Incentives
Feed-in tariff to bioelectricity
Type of bioenergy source
Tax exemption to farm-based biogas production
Outputs
Digestate
Bioelectricity
Land Use
Biogas plants
Energy crops production
Production of other goods/commodities
Productivity
Farmland rent price
Biogas production
Biomass supply
Land
Plant power capacity
Social outcomes
Traffic in rural areas
Bed smells
Social Participation
Landscape damage
Cooperation
Organizational learning
Institutional structures
Policies and regulations
Public Governance
Influencing sectors
Social capital

SYSTEMS THINKING IN THE WORK AT DG R&I

EXPERIMENTING WITH POLICY INTERVENTIONS

USEFULLNESS OF SYSTEMS THINKING AND SYSTEM DYNAMICS

Ex-ante impact assessment

Assess relevance and coherence of policy design

Continuous monitoring and evaluation

INITIATIVES AT DG R&I

STUDY ON THE EVOLUTION OF THE FRAMEWORK PROGRAMME FOR R&I

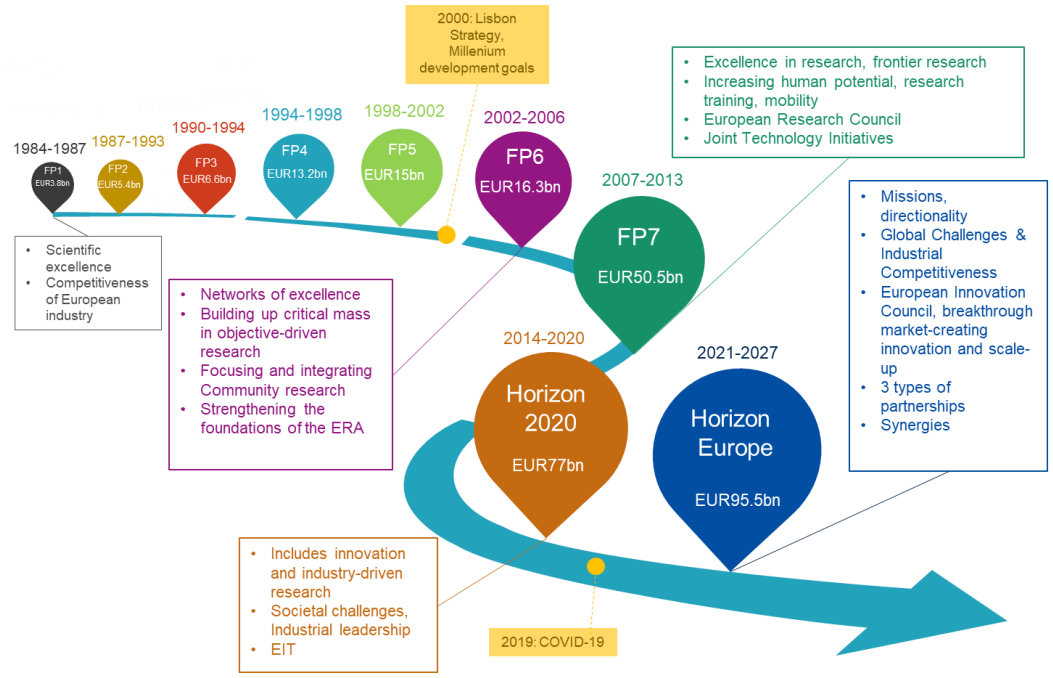
EXPERT STUDY ON SYSTEM-BASED METHODS FOR TRANSFORMATIVE INNOVATION POLICY

TRAINING SYSTEM DYNAMICS SIMULATION

EXPERT STUDY WITH SYSTEM DYNAMICS SIMULATION TO EVALUATE THE IMPACTS OF THE FP ON SOCIETAL CHALLENGES

EVOLUTION OF THE TRANSFORMATIVE NATURE OF THE OF THE FP FOR R&I 2002-2023

BIANCA CAVICCHI, OCEANE PEIFFER-SMADJA, JULIEN RAVET, ALEXANDR HOBZA



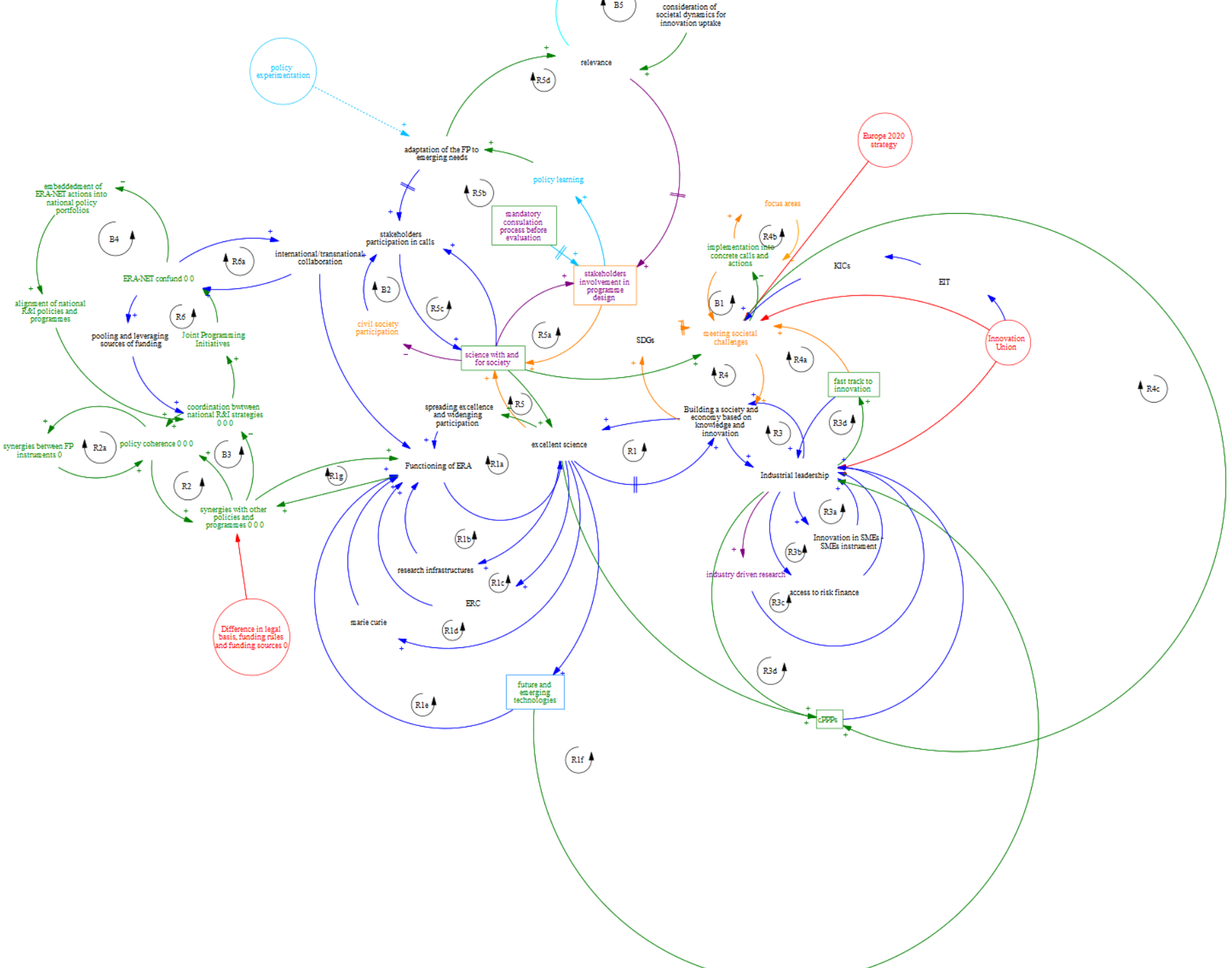
INTERLINKS BETWEEN FP COMPONENTS

Goals and priorities

Portfolio of instruments

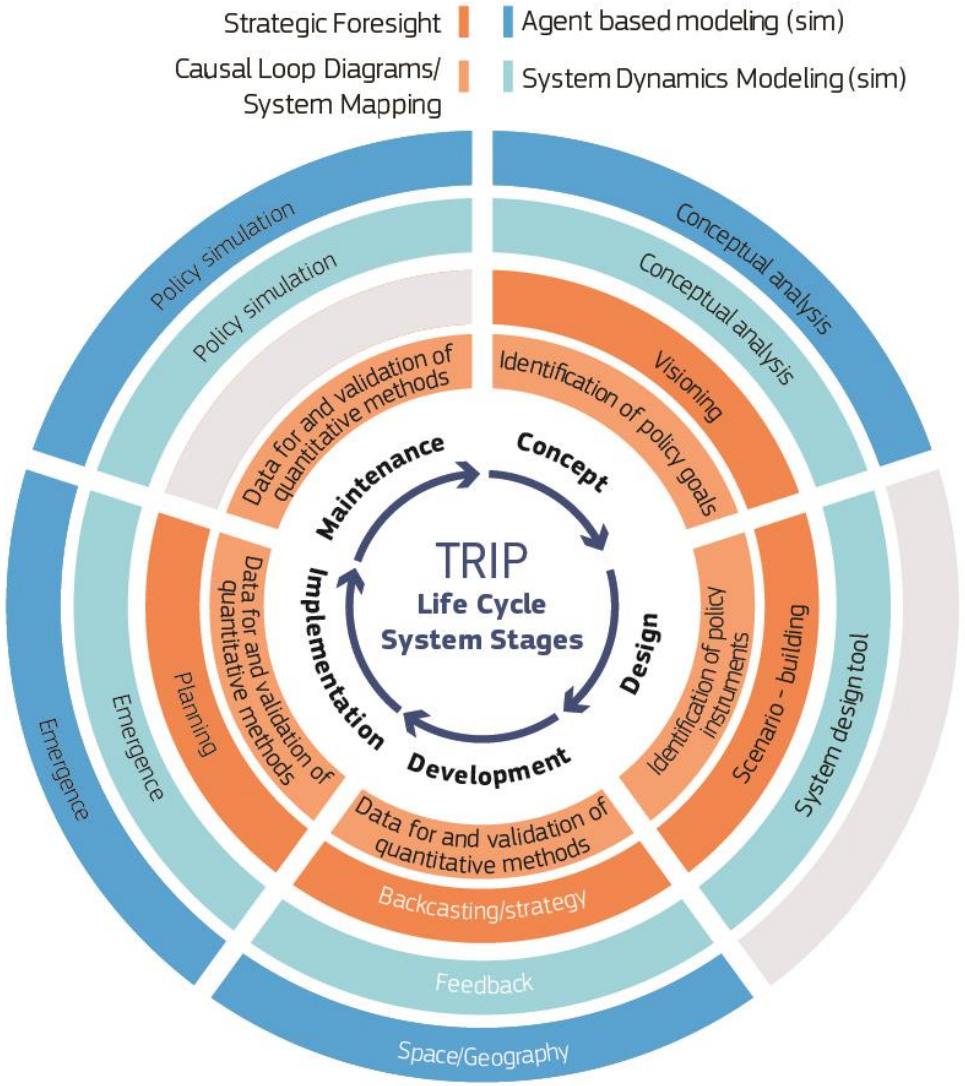
Synergies between instruments

Governance practices


B5
consideration of societal dynamics for innovation uptake
policy experimentation
relevance
R5d
adaptation of the FP to emerging needs
policy learning
R5b
mandatory consulation process before evaluation
stakeholders participation in calls
stakeholders involvement in programme design
Europe 2020 strategy
focus areas
R4b
implementation into concrete calls and actions
KICs
EIT
B1
meeting societal challenges
Innovation Union
R4a
R4
fast track to innovation
R4c
R5a
SDGs
science with and for society
civil society participation
B2
R5c
R5
spreading excellence and widenging participation
excellent science
R1
Building a society and economy based on knowledge and innovation
R3
R3d
Industrial leadership
R3a
Innovation in SMEs - SMEs instrument
R3b
industry driven research
access to risk finance
R3c
R3d
cPPPs
R1f
future and emerging technologies
R1e
R1d
marie curie
ERC
R1c
research infrastructures
R1b
Functioning of ERA
R1a
R1g
international/transnational collaboration
R6a
ERA-NET confund 0 0
B4
embeddedment of ERA-NET actions into national policy portfolios
alignment of national R&I policies and programmes
R6
pooling and leveraging sources of funding
Joint Programming Initiatives
coordination bwtween national R&I strategies 0 0 0
synergies between FP instruments 0
R2a
policy coherence 0 0 0
B3
R2
synergies with other policies and programmes 0 0 0
Difference in legal basis, funding rules and funding sources 0

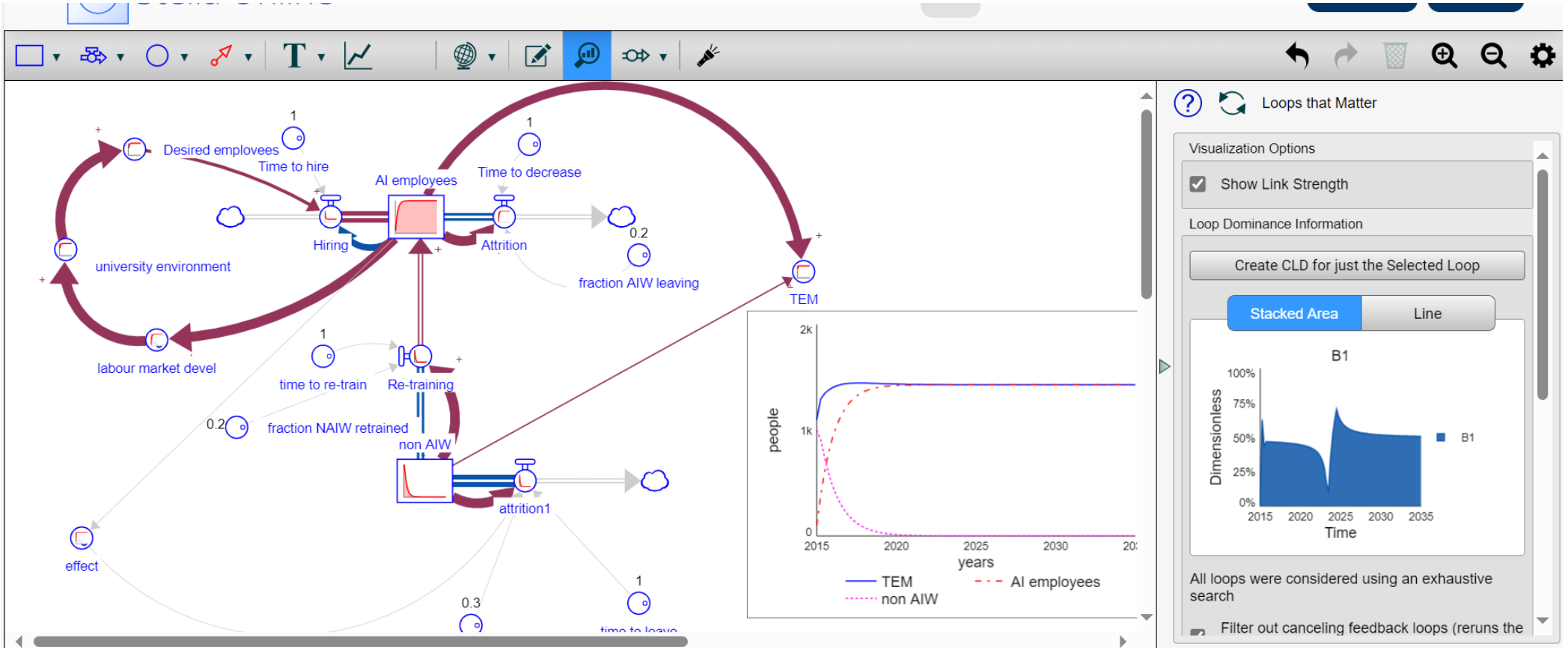
SYSTEM-BASED METHODS FOR TRANSFORMATIVE INNOVATION POLICY

ERIKA PALMER, BIANCA CAVICCHI


Strategic Foresight
Causal Loop Diagrams/ System Mapping
Agent based modeling (sim)
System Dynamics Modeling (sim)
Policy simulation
Policy simulation
Conceptual analysis
Conceptual analysis
Data for and validation of quantitative methods
Identification of policy goals
Visioning
Maintenance
Concept
TRIP
Life Cycle System Stages
Implementation
Design
Development
Data for and validation of quantitative methods
Identification of policy instruments
Scenario - building
Emergence
Emergence
Planning
Data for and validation of quantitative methods
System design tool
Data for and validation of quantitative methods
Backcasting/strategy
Feedback
Space/Geography

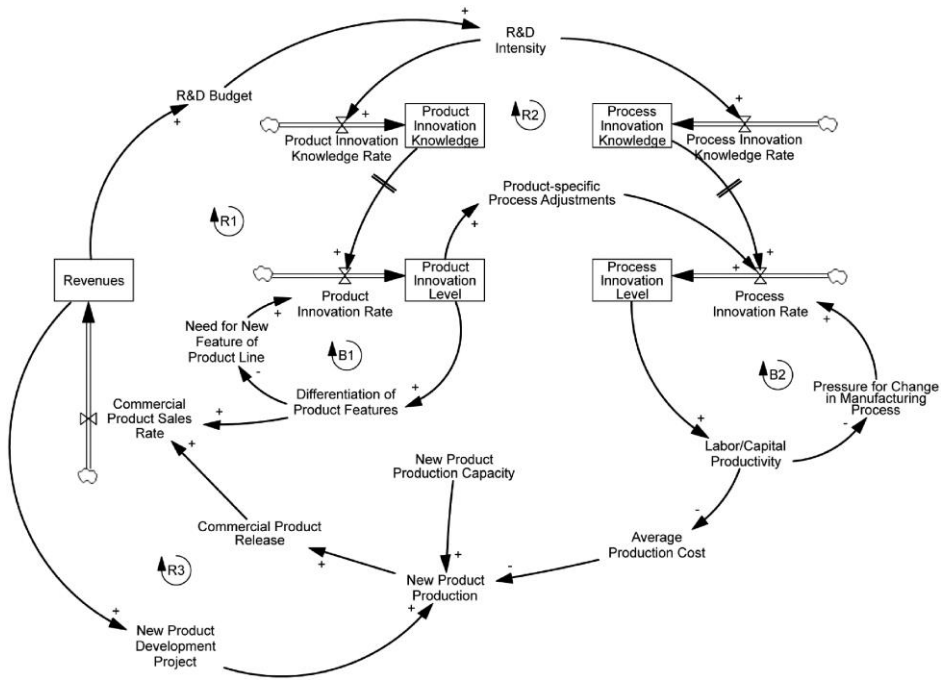
TRAINING: INTRODUCTION TO SYSTEM DYNAMICS SIMULATION

ERIKA PALMER

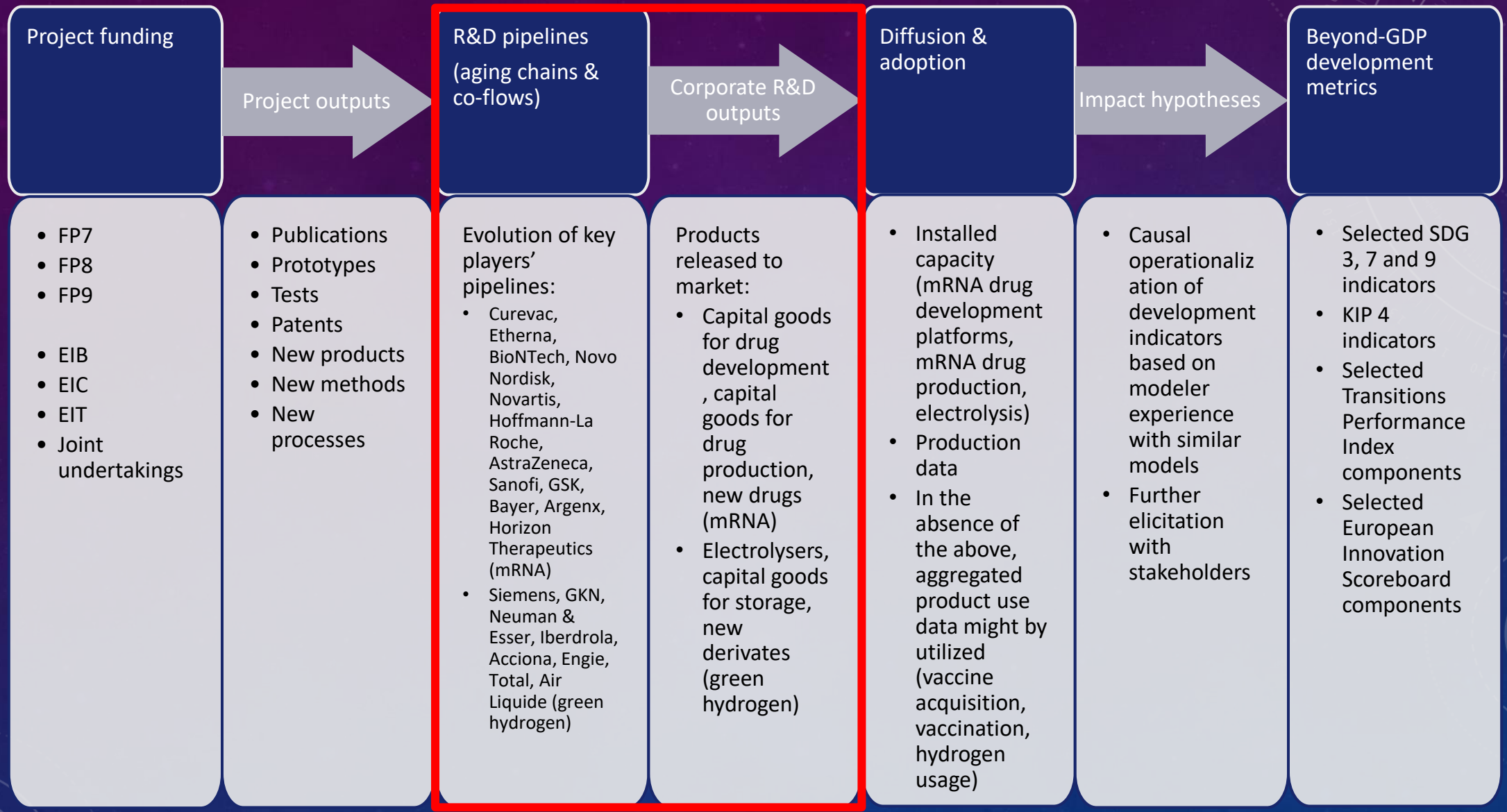

Desired employees
Time to hire
1
AI employees
Time to decrease
1
Hiring
Attrition
0.2
fraction AIW leaving
university environment
TEM
labour market devel
1
time to re-train
Re-training
0.2
fraction NAIW retrained
non AIW
attrition1
effect
0.3
1
people
2k
1k
0
2015
2020
2025
2030
years
TEM
AI employees
non AIW
Loops that Matter
Visualization Options
Show Link Strength
Loop Dominance Information
Create CLD for just the Selected Loop
Stacked Area
Line
B1
100%
75%
50%
25%
0%
Dimensionless
2015
2020
2025
2030
2035
Time
B1
All loops were considered using an exhaustive search
Filter out canceling feedback loops (reruns the

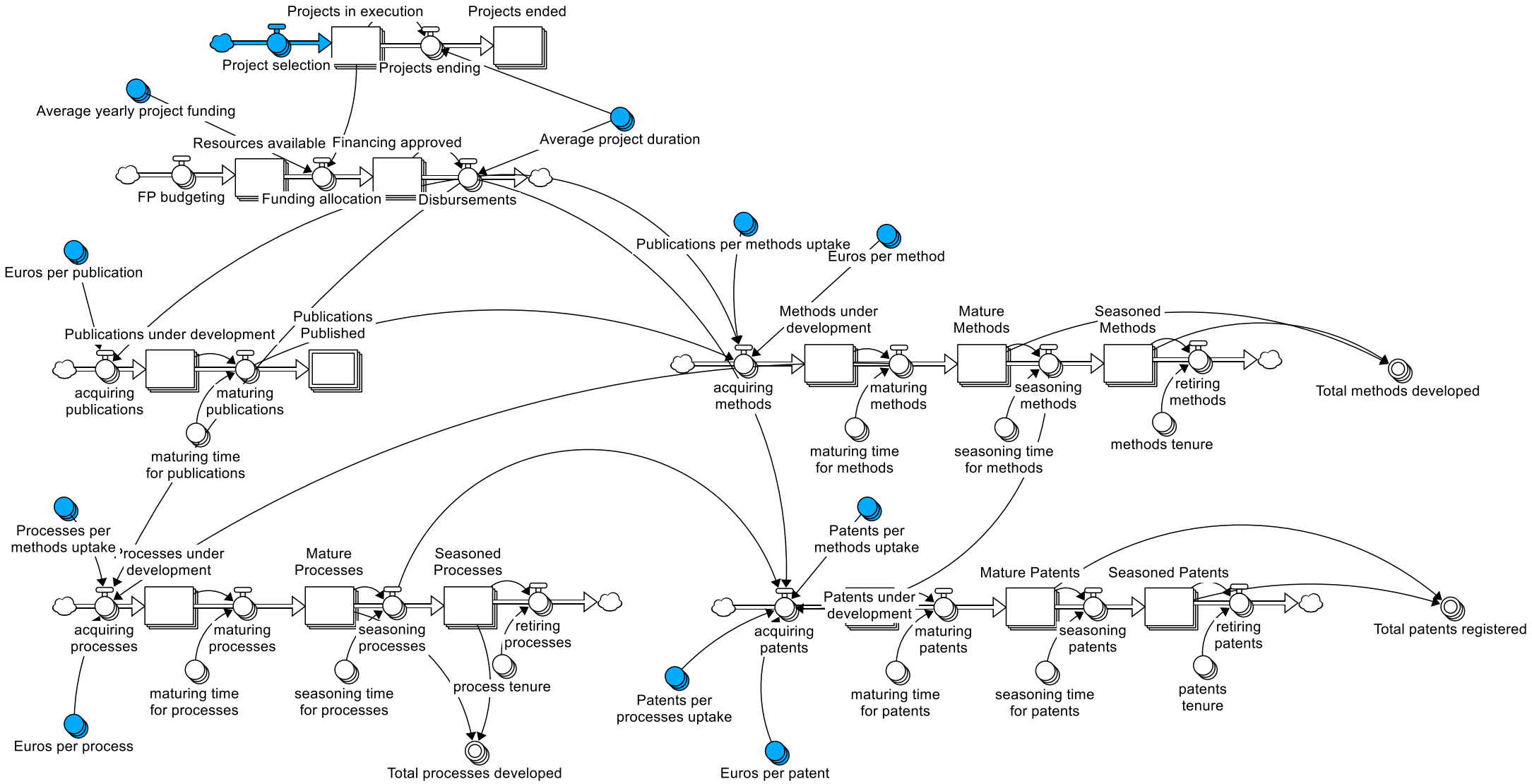
ASSESSING THE IMPACT OF THE FP ON SOCIETAL CHALLENGES

SYSTEM DYNAMICS SIMULATION



- Impacts of Framework Programme for R&I on sustainability/societal challenges
- mRNA vaccines and green hydrogen domains
- Links between R&D pipeline and innovation deployment/diffusion
- Explore data gaps and needs for comprehensive SD modelling


Project funding
Project outputs
R&D pipelines
(aging chains & co-flows)
Corporate R&D outputs
Diffusion & adoption
Impact hypotheses
Beyond-GDP development metrics
• FP7
• FP8
• FP9
• EIB
• EIC
• EIT
• Joint undertakings
• Publications
• Prototypes
• Tests
• Patents
• New products
• New methods
• New processes
Evolution of key players' pipelines:
• Curevac, Etherna, BioNTech, Novo Nordisk, Novartis, Hoffmann-La Roche, AstraZeneca, Sanofi, GSK, Bayer, Argenx, Horizon Therapeutics (mRNA)
• Siemens, GKN, Neuman & Esser, Iberdrola, Acciona, Engie, Total, Air Liquide (green hydrogen)
Products released to market:
• Capital goods for drug development, capital goods for drug production, new drugs (mRNA)
• Electrolysers, capital goods for storage, new derivates (green hydrogen)
• Installed capacity (mRNA drug development platforms, mRNA drug production, electrolysis)
• Production data
• In the absence of the above, aggregated product use data might by utilized (vaccine acquisition, vaccination, hydrogen usage)
• Causal operationalization of development indicators based on modeler experience with similar models
• Further elicitation with stakeholders
• Selected SDG 3, 7 and 9 indicators
• KIP 4 indicators
• Selected Transitions Performance Index components
• Selected European Innovation Scoreboard components


Projects in execution
Projects ended
Project selection
Projects ending
Average yearly project funding
Resources available
Financing approved
Average project duration
FP budgeting
Funding allocation
Disbursements
Euros per publication
Publications per methods uptake
Euros per method
Publications under development
Publications Published
Methods under development
Mature Methods
Seasoned Methods
acquiring publications
maturing publications
maturing time for publications
acquiring methods
maturing methods
maturing time for methods
seasoning methods
seasoning time for methods
retiring methods
methods tenure
Total methods developed
Processes per methods uptake
Patents per methods uptake
Processes under development
Mature Processes
Seasoned Processes
Patents under development
Mature Patents
Seasoned Patents
acquiring processes
maturing processes
seasoning processes
retiring processes
acquiring patents
maturing patents
seasoning patents
retiring patents
Total patents registered
maturing time for processes
seasoning time for processes
process tenure
maturing time for patents
seasoning time for patents
patents tenure
Patents per processes uptake
Euros per process
Total processes developed
Euros per patent

VERY PRELIMINARY EVIDENCE

DATA COVERS R&D

DIFFUSION AND ADOPTION STAGES LESS COVERED

NEED FOR COMPANY DATA

NEXT STEPS

- Results expert contract
- On-going collaboration with JRC Sevilla on system dynamics
- Bigger study to develop the SD tool for impact assessment
- Connect with interested parties in EU institutions, MSs and localities and academic/research organisations to exchange and pull together resources

THANK YOU

Bianca Cavicchi, Policy Officer, DG RTD, G1. bianca.cavicchi@ec.europa.eu

UNLOCK System Transitions

Marjoleine ‘t Hart, Bastiaan van Bloppoel, Josephine Sassen

UNLOCK Neth-ER

Workshop UNLOCK System Transitions

Agenda

Plenary

• UNLOCK System Transitions methodology; what is it?	20 min

Interactive workshop

• Discovering Paradox; a lens on the system	30 min
• CRM case study	10 min
• Developing a paradox mindset - exercises	60 min
Wrap up	5 min

Creating breakthroughs in wicked problems requires:

- A deep understanding of the system
- Transdisciplinary capacity
- Opening pathways to system transitions

TNO's UNLOCK System Transitions

"Don't look at the world, look at your lens."

Edward W. Said in 'Orientalism'

TNO's UNLOCK System Transitions Methodology

UNLOCK Common Purpose

UNLOCK transdisciplinary capacity

UNLOCK Deep System intelligence

UNLOCK Pathways to system transitions

Phase 0

Explore the wicked problem & Hopes for transition

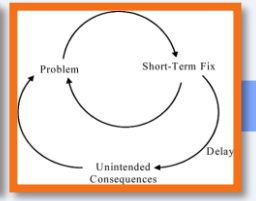
Phase 1

Foundation Transdisciplinary work

Phase 2

Root causes and Biases

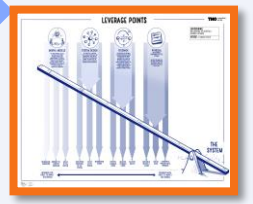
Paradoxical tension fields



Archetypical recuring patterns

Today's workshop

Phase 3

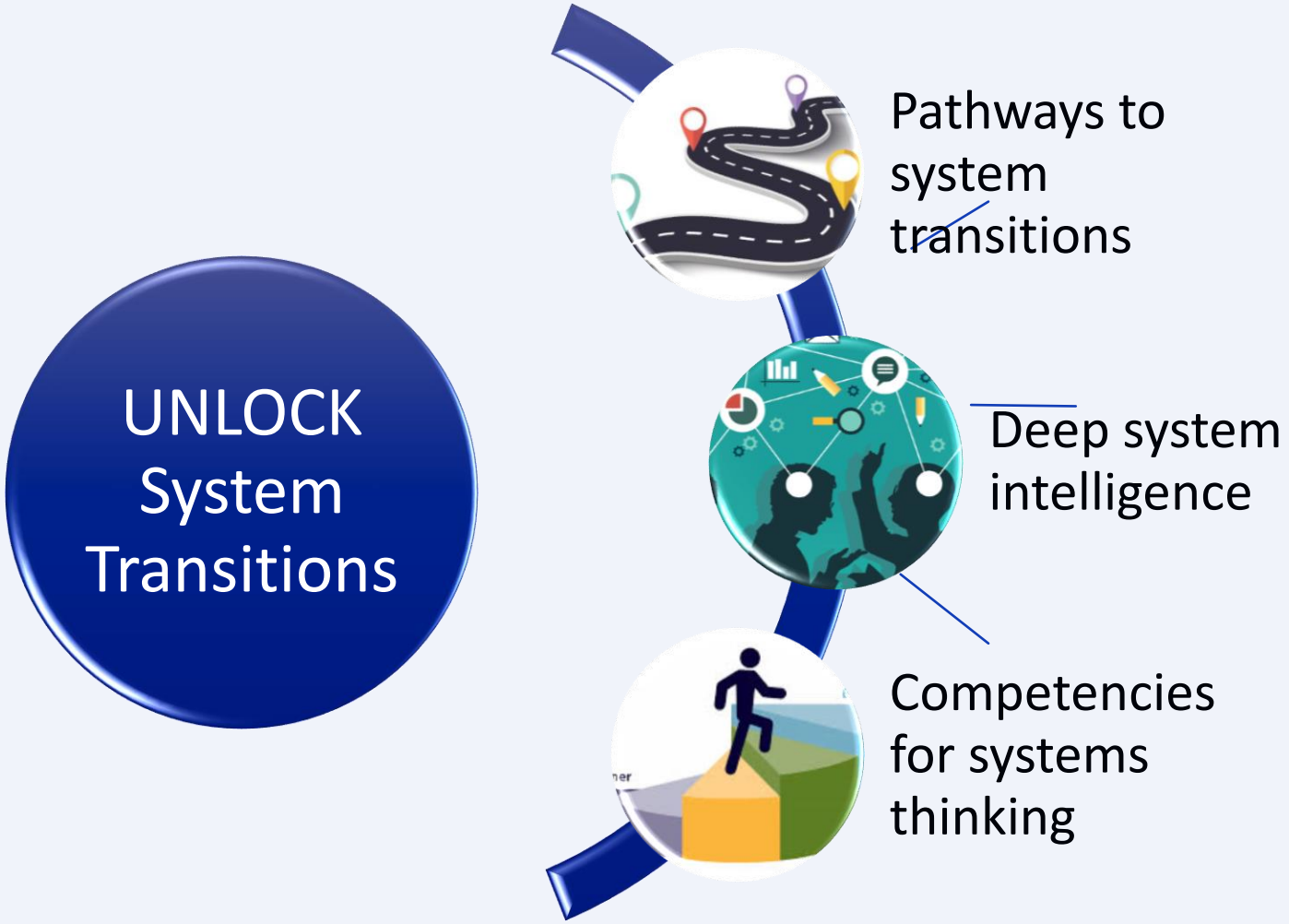


Develop Ecologies of Transformations

Transition Paths

launch

The promise of UNLOCK System Transitions



System tables

- 8-12 experts
- Large diversity of perspectives
- Selection in advance based on profile
- 10 days in 2-3 months
- Systems practitioner & systems coach lead the table
- Content & interaction: transdisciplinary competencies continuously interwoven into the program
- Involvement of the entire ecosystem

TNO innovation for life

EXPLORING PARADOXES IN SYSTEM INNOVATION

RECOGNIZING, APPRECIATING, RECONCILING

Marjoleine t Hart

The paradox lens

What is a paradox?

- An apparent contradiction: Diametrically opposed *while also* inherently connected (two sides of the same coin)
- If you choose, you lose…

Why are paradoxes worth exploring?

- Understanding deeper tension fields in a system
- Prevent *short term reliefs*
- Potential gateway to innovative ideas for transition

The Samurai

Disciplined & methodical

Stable & unwavering

Thoughtful & vigilant

Reliable & trustworthy

Strong moral-ethical framework

Excels through unparalleled mastery of swordsmanship

The Ninja

Fast & flexible

Resourceful & imaginative

Creative out-of-the-box thinking

Takes by surprise

Jack of all trades

Excels through improvisation in unfamiliar territory

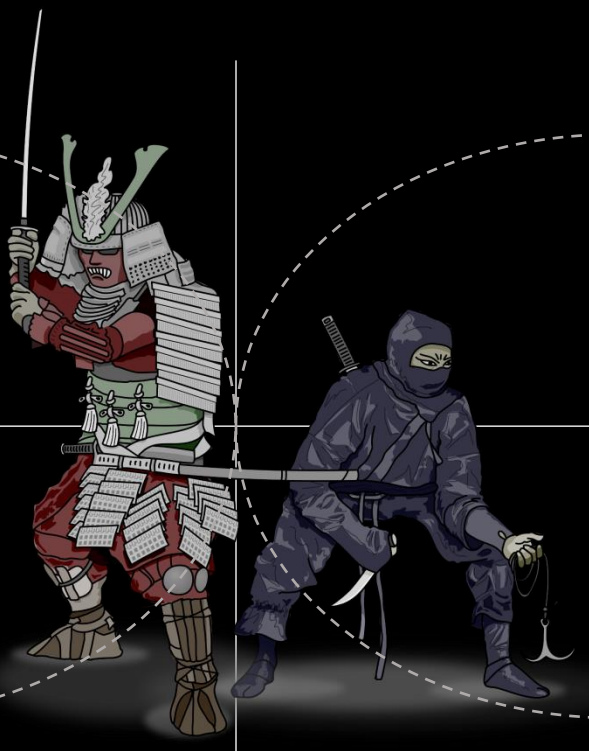
Which power do you feel most connected to?

Robustness
stability

Flexibility,
transformation

Strength

Pitfall

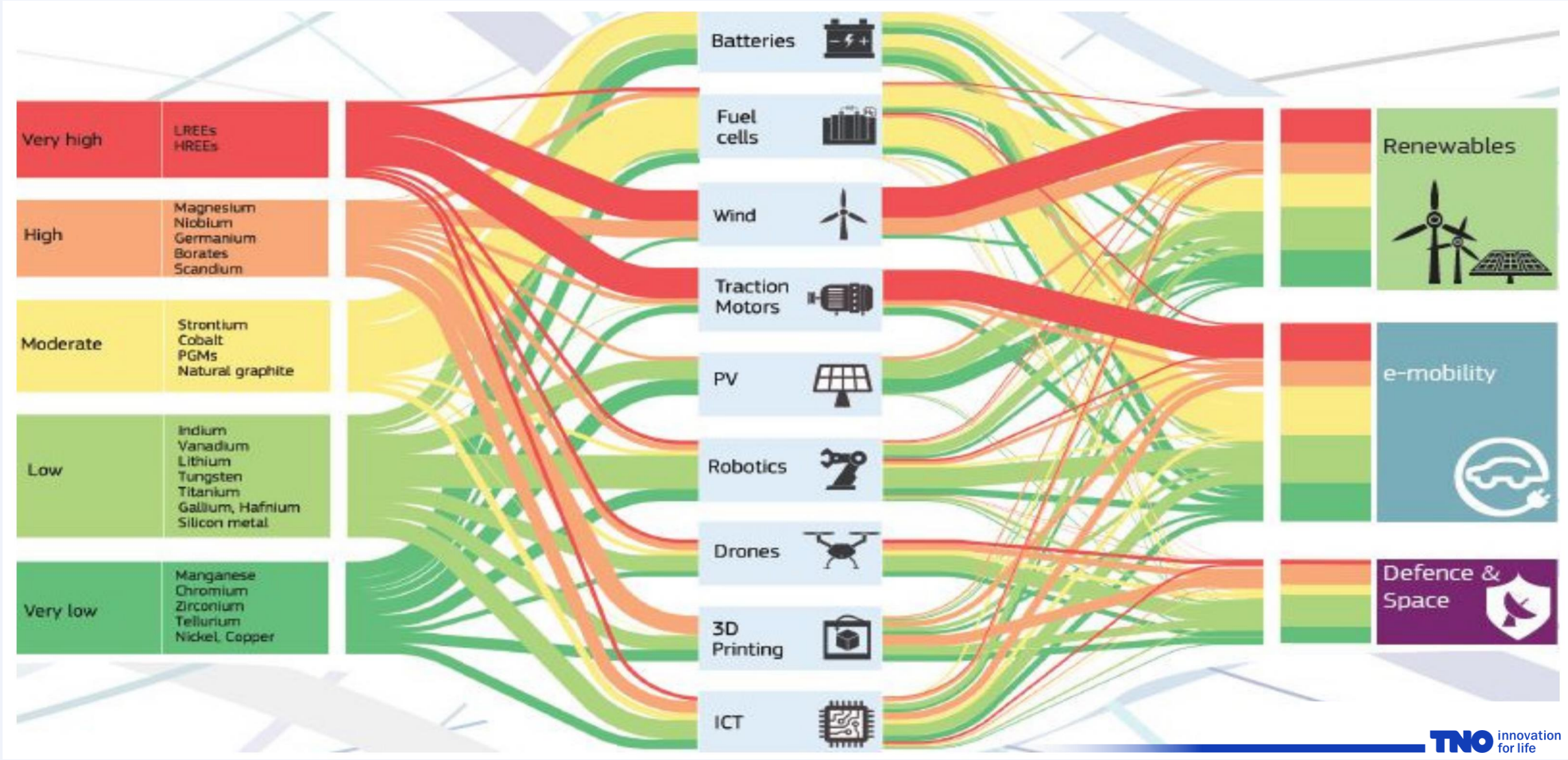


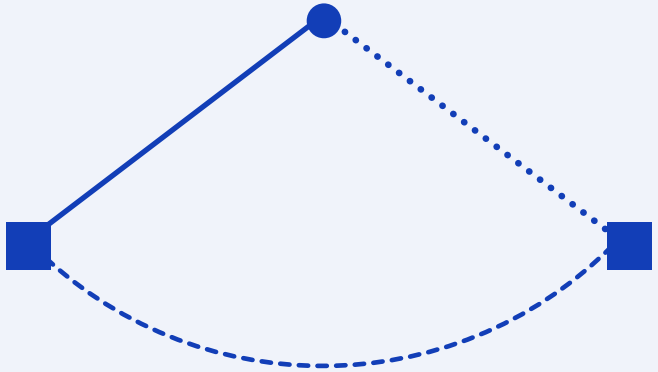
Rigidity

Chaos

Which paradoxes do you experience?

Use case: Critical Raw Materials





Examples of paradoxes in the CRM context

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1. Do we solve this for **ourselves**?
2. **Short term** (now)
3. We want to **keep** CRMs (have our cake)
4. **Self sufficient**
5. **Autonomous behavioural change** (I myself choose to change)

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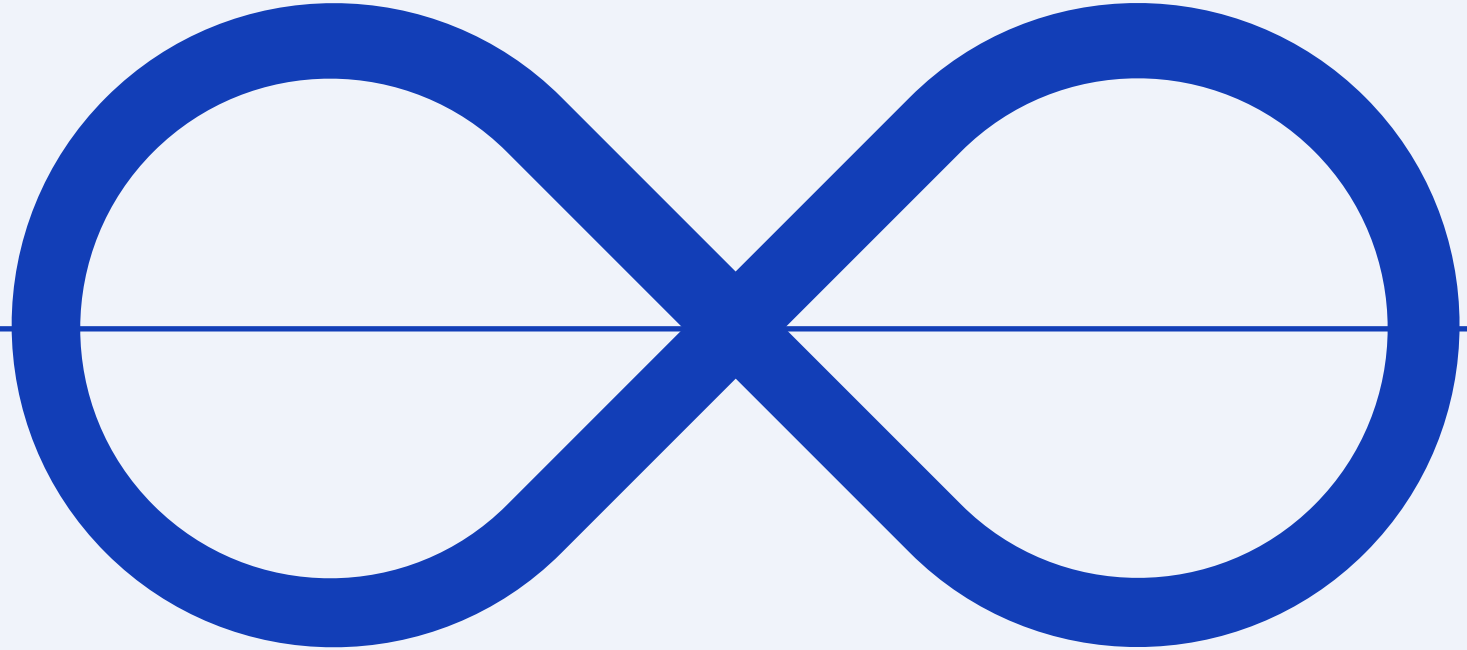

1. Do we solve this for **each other**?
2. **Long term** (later)
3. We want to **use** CRMs (eat our cake)
4. **Dependent**
5. **Heteronomous behavioural change** (The choice to change is made for me)

type of choice

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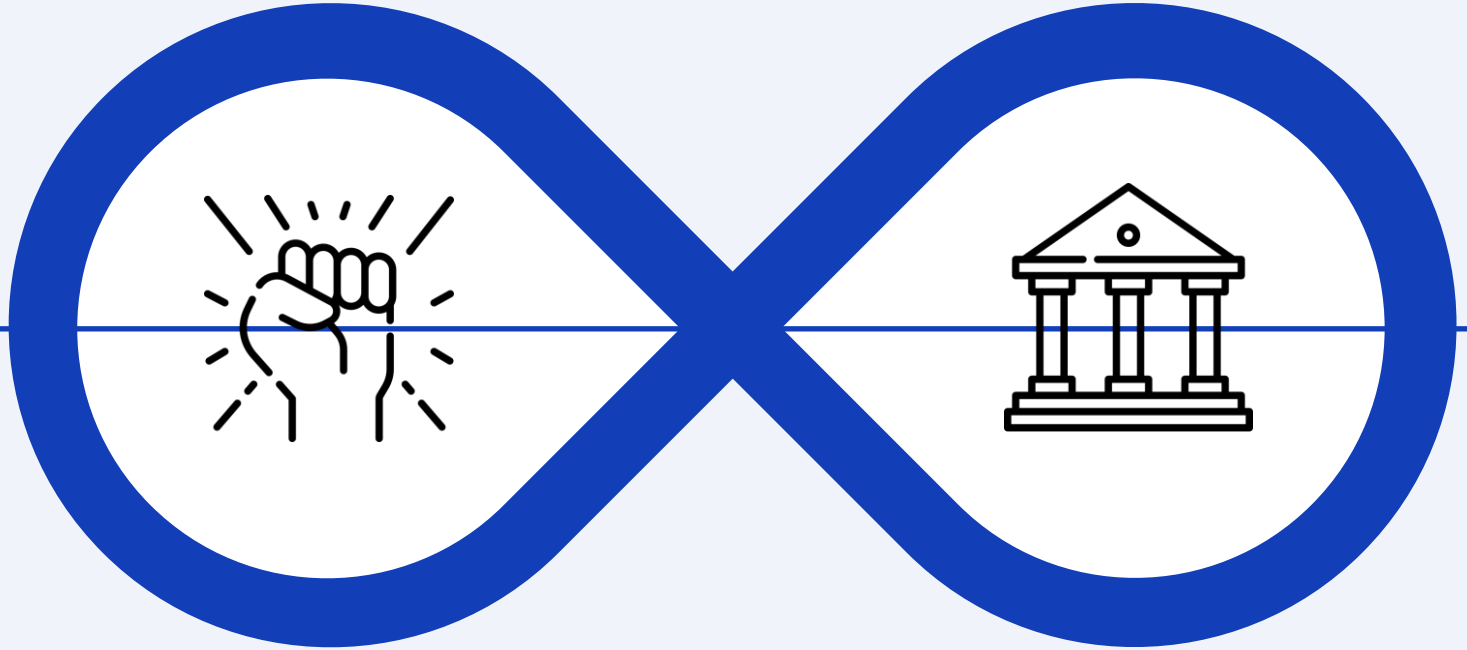

Autonomy

(the ability to

choose independently)

Heteronomy

(following the choice

of others)

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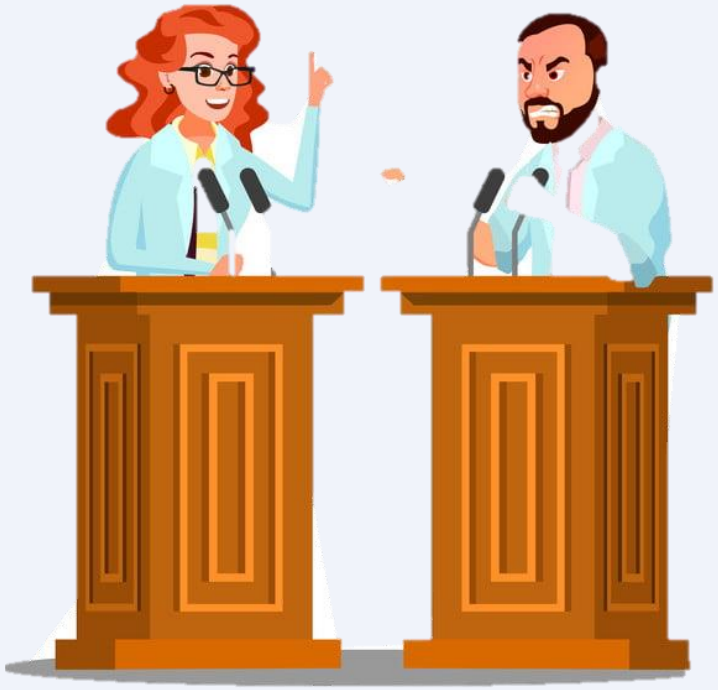
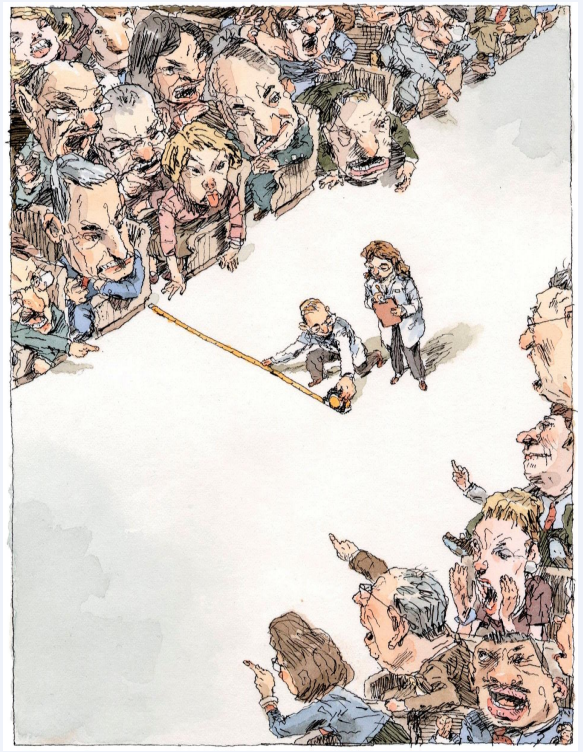
We will divide in 2 groups

1. Exploring the polarities



2. Stretching the polarities



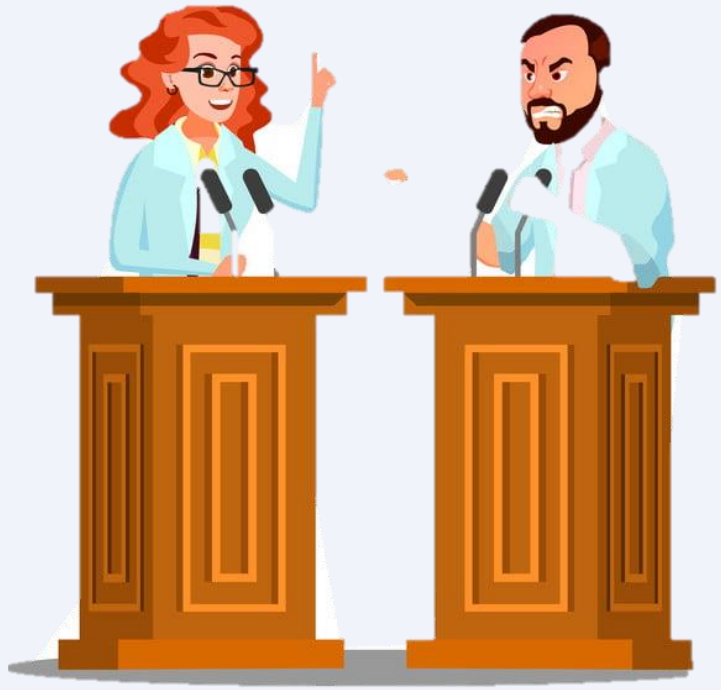
Exploring the polarities – debate preparation

Make teams:

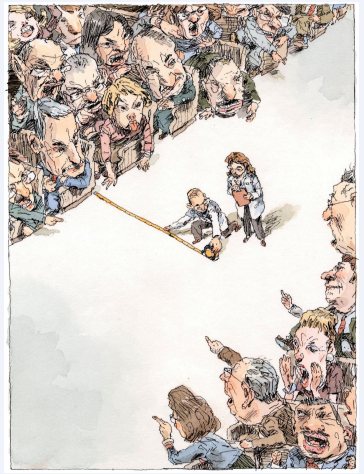
- Four debate teams of 5 participants; team A, B, C and D
- Teams A and B are ‘pro-autonomy’; teams C and D are ‘pro-heteronomy’)

Preparation:

- All teams think of arguments that support their position, and/or that weaken the position of the other opponent.
- Each team decides who will be their spokesperson
- Spokesperson A and C have 2 minutes to speak
- Spokesperson B and D have 1 minute to rebuttal
- All team-members that are not speakers, make notes on the arguments made for both sides and help their speakers



Stretching the polarities - Assignment



In couples:

- Within the CRM context…
- Describe the positive and negative consequences of autonomous choice if it were solely and exclusively implemented, without any consideration or possibility for any other mode of choice.
- Describe the positive and negative consequences of heteronomous choice if it were solely and exclusively implemented, without any consideration or possibility for any other mode of choice.
- Consider both hard (e.g. economic, physical) and soft (e.g. social, psychological) consequences

In groups of 4 (2 couples merge):

- Think of a metaphor, a sketch, a cartoon, a (funny) slogan or an epithet for each of the polarities when implemented to the extreme.
- See if you can show how both polarities will (eventually) suffer damage if only one side gains full passage at the expense of the other side.

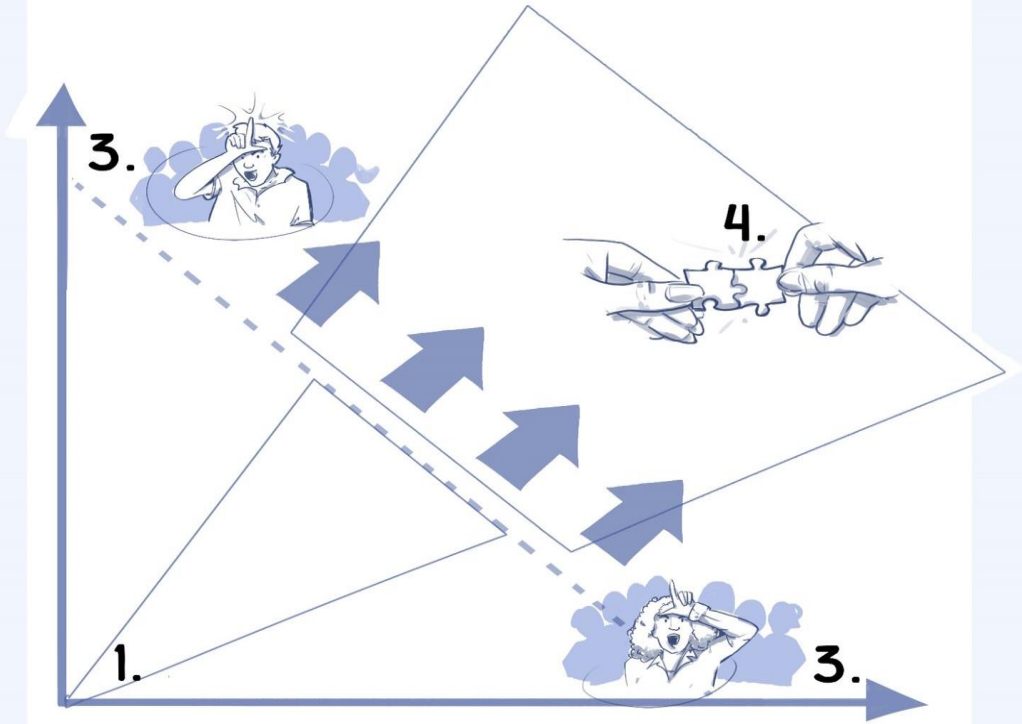
ANALYSING:
PARADOXEN EN DILEMMA'S IN HET SYSTEEM

VERSIE: 23 JANUARI 2022

Stretching the polarities

TNO innovation for life

3. Autonomy



3. Heteronomy

Exploring the polarities – debate

Timeline:

All teams: 10 minutes to prepare your arguments

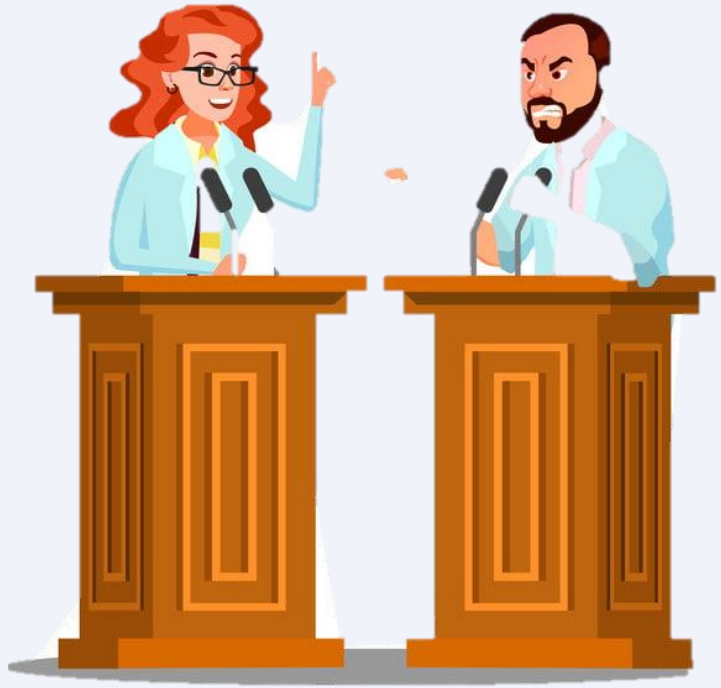
- Speaker team A (2 minutes)
- Speaker team C (2 minutes)

5 minutes huddle team B and D to decide on rebuttal /counter-arguments

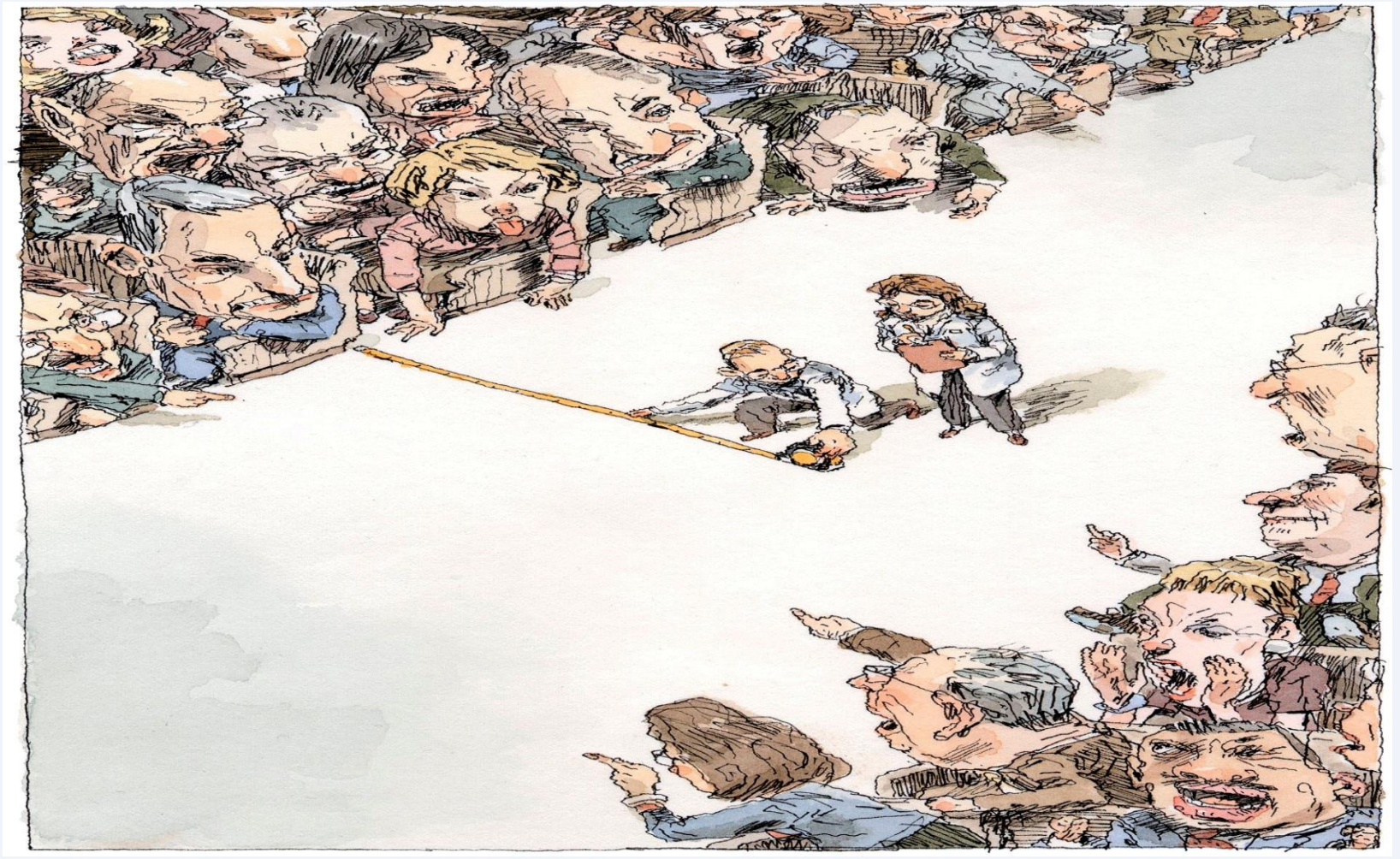
- Speaker team B (1 minute)
- Speaker team D (1 minute)

Audience participation:

- Applaud and/or call out your approval if you agree with an argument



Stretching the polarities – outcomes



TNO's UNLOCK System Transitions Methodology

UNLOCK Common Purpose

UNLOCK transdisciplinary capacity

UNLOCK Deep System intelligence

UNLOCK Pathways to system transitions

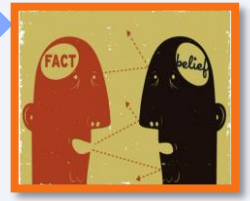
Phase 0

Explore the wicked problem & Hopes for transition

Phase 1

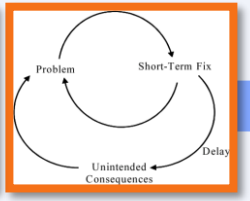
Foundation Transdisciplinary work

Phase 2



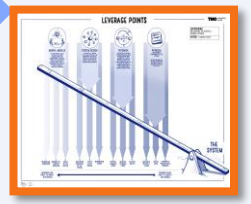
Root causes and Biases

Paradoxical tension fields



Archetypical recuring patterns

Phase 3



Develop Ecologies of Transformations

Transition Paths

launch

Thank you!

Meeting with Oren, R. (Ron)-20240422_094003-Meeting Recording.mp4

- More info?
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- Josephine.sassen@tno.nl