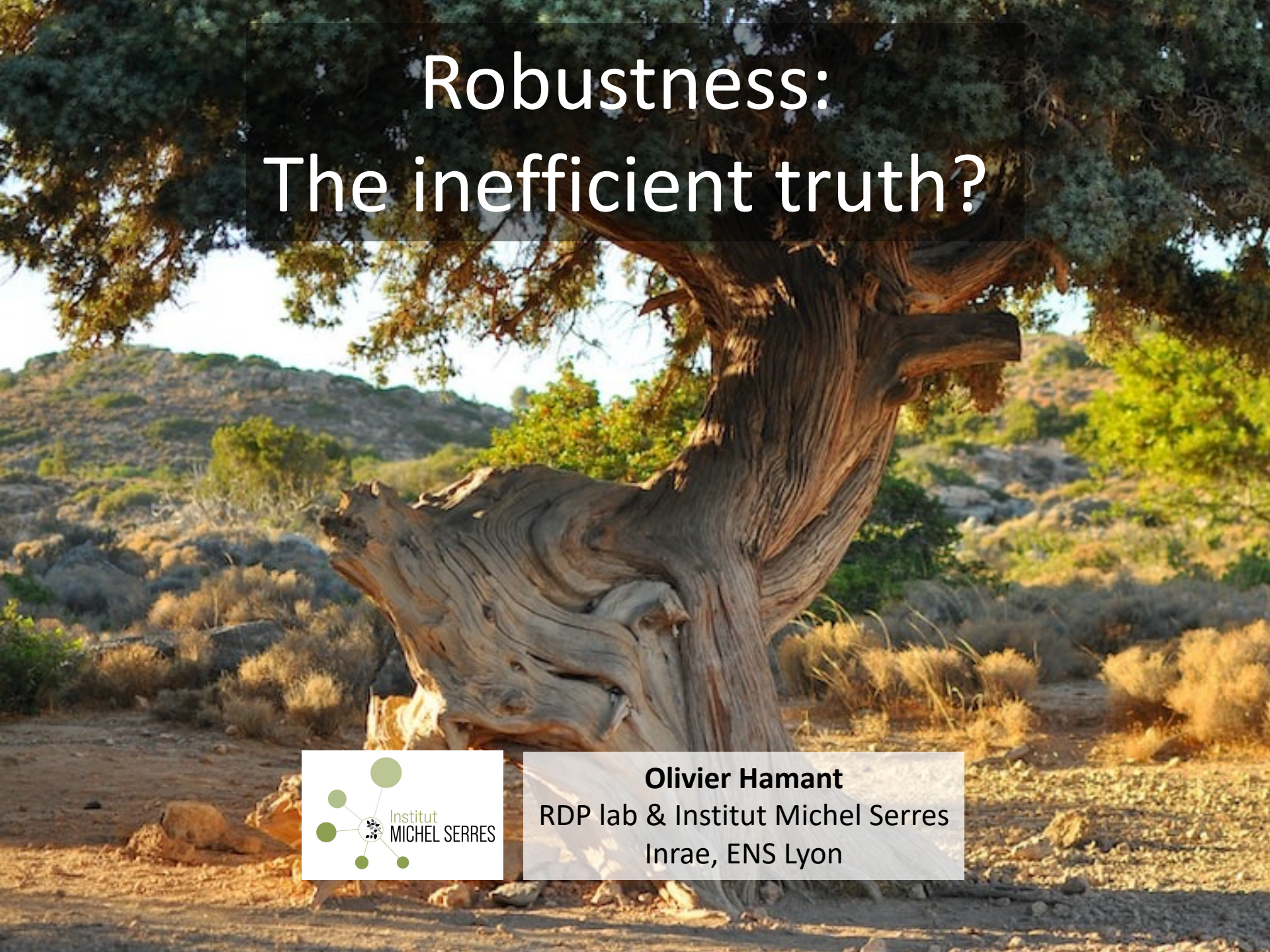
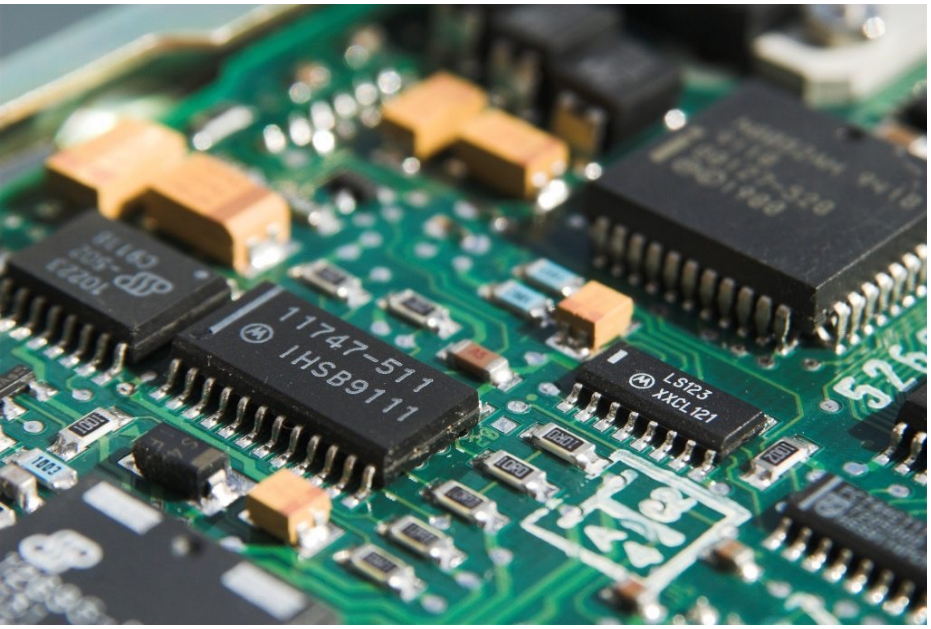
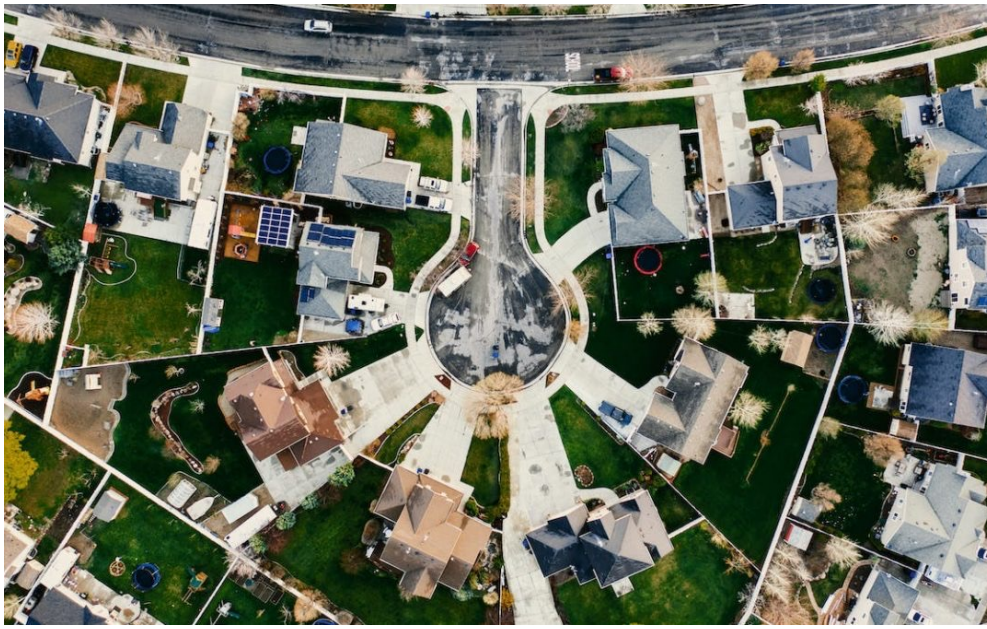
Robustness: The inefficient truth?



Olivier Hamant
RDP lab & Institut Michel Serres
Inrae, ENS Lyon

The era of control and optimization





The era of control and optimization

Quartier de la Part Dieu, Lyon

The era of control and optimization

Elevage industriel de poules

The era of control and optimization

La France vue du ciel, Yann Arthus Bertrand

Defining / questioning performance

Performance = **efficacy** (*to reach one's goal*)

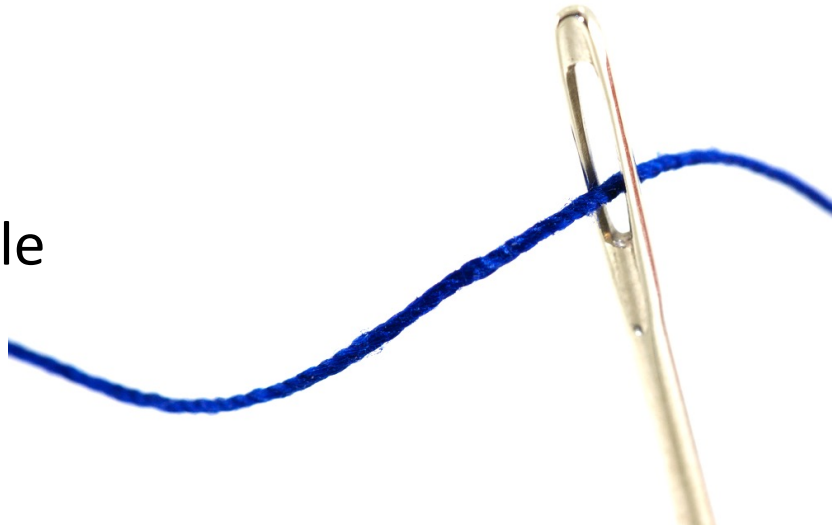
\+

efficiency (*with less means*)

#1 Optimization weakens

Seeing our complex world…

… through the eye of a needle



#1 Optimization weakens

The QR code era

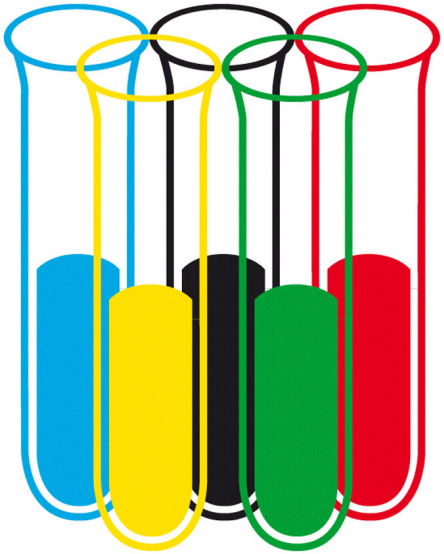
The hacking era

#2 Rebound effect: local efficiency gains do not reduce the global consumption of resources

1960s: Fridges are rare and not energy efficient

Today: Increased efficiency & increased number

#3 Goodhart law: performance can be counterproductive



Doping & burnout
in sports competition

« When a measure becomes a target,
it ceases to be a good measure »

- H index
- Impact factors
- Shanghai ranking

#4 A planetary feedback: the era of **fluctuations**

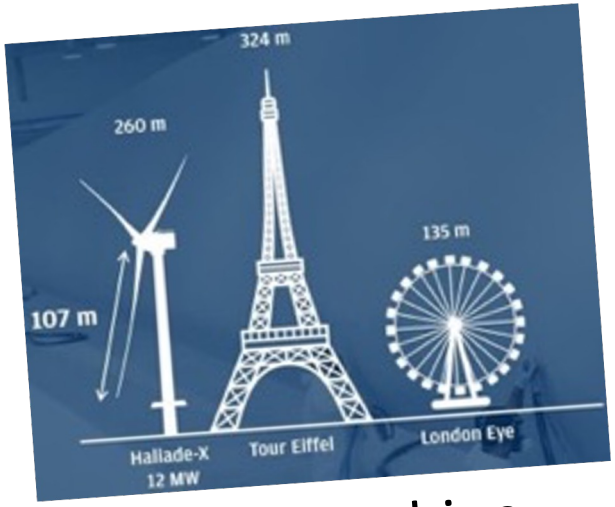
Ressource scarcity

Climate crisis

Biodiversity collapse

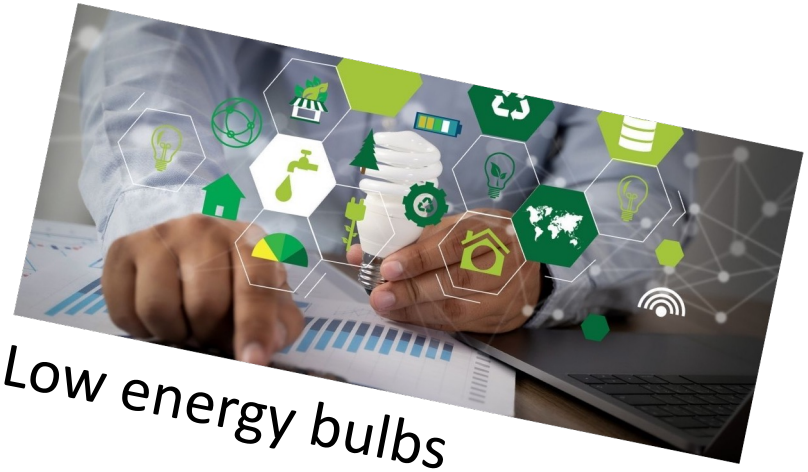
Global pollutions

Solution ? Even more performance !

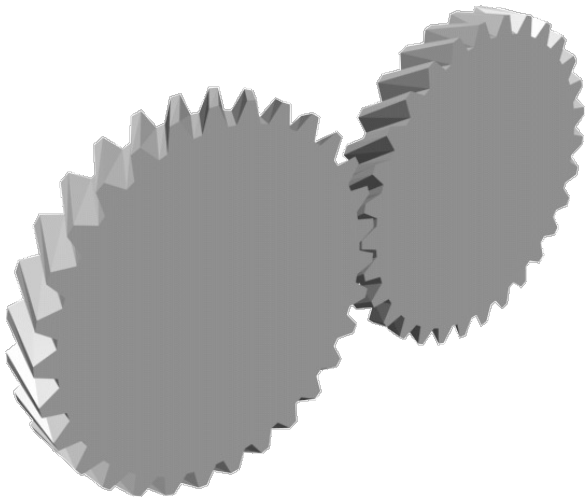


Giant wind turbine

Autonomous vehicle



Low energy bulbs

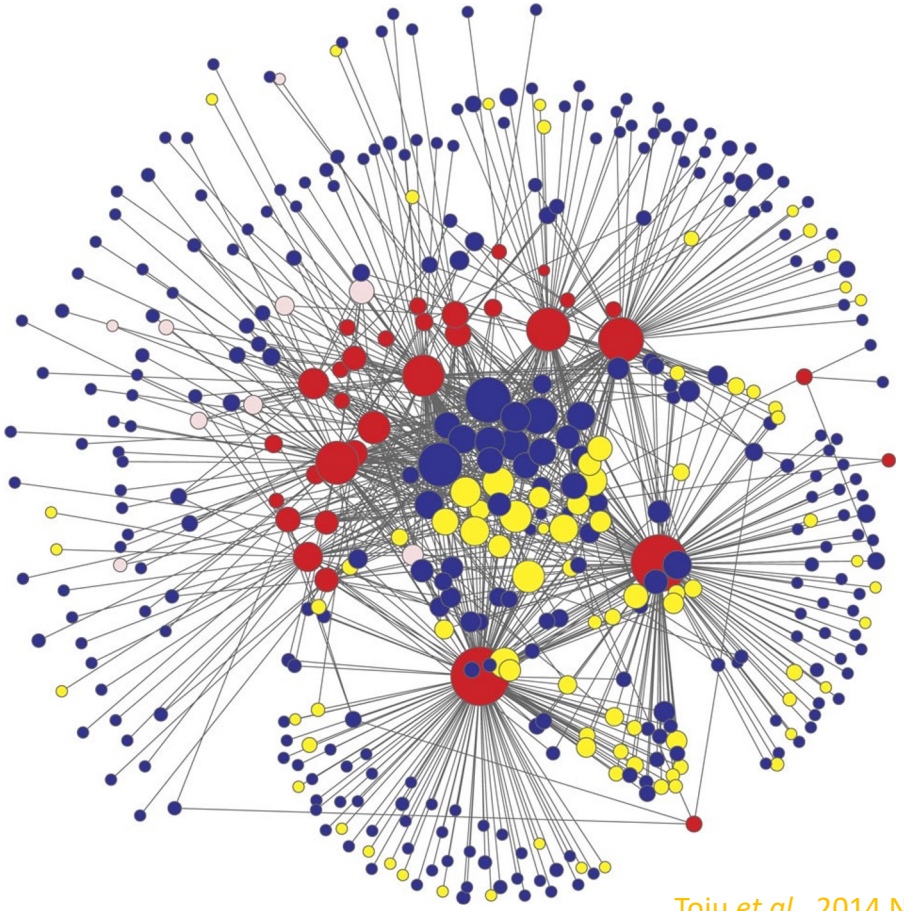


“We cannot solve our problems with the same thinking we used when we created them.”

Albert Einstein

Another way: learning from living systems

Life: Interactions before optimization



Plants

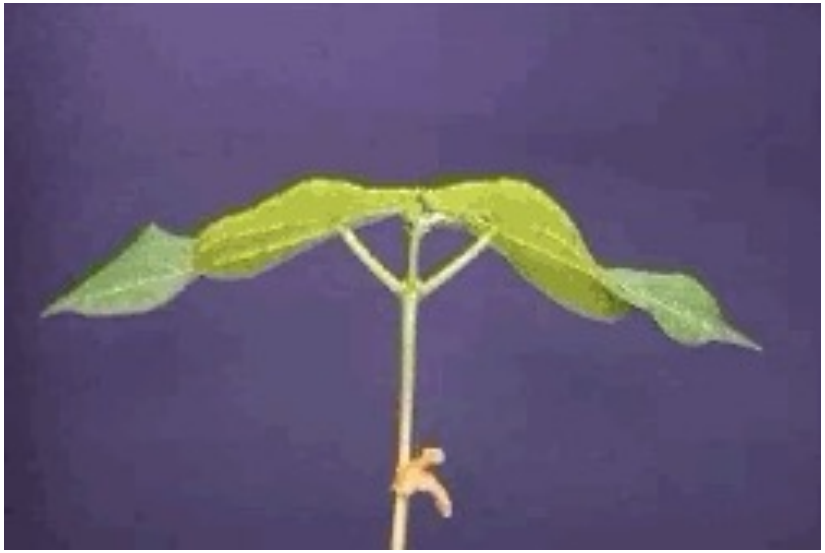
Fungi

Toju *et al.*, 2014 Nat. Com.

Robustness, built *against* performance

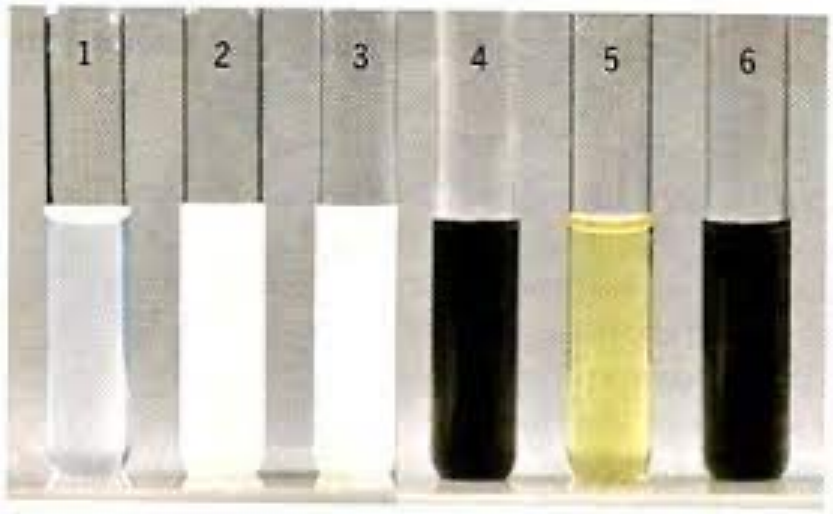
Biological robustness is built on:

- Inefficiency
- Heterogeneity
- Randomness
- Slowness
- Redundancy
- Inconsistency
- Incompleteness
- …



Living systems are sub-optimal

Body temperature: 37°C



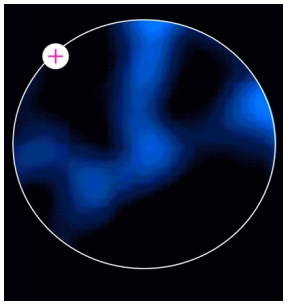
Enzyme optima: 40°C

Photosynthesis: low yield to manage light fluctuations

Solar panels
13-18%

Photosynthesis:
< 1%

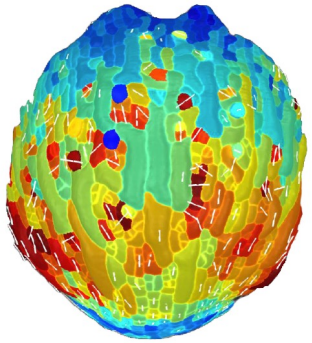
Life generates robustness, against performance



Randomness

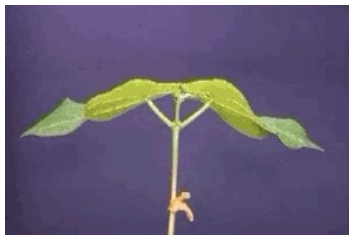
Redundancy

Heterogeneity

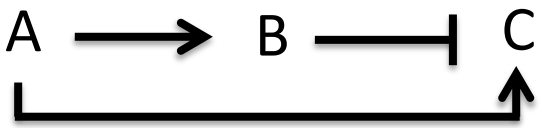


Adaptability

Fluctuations

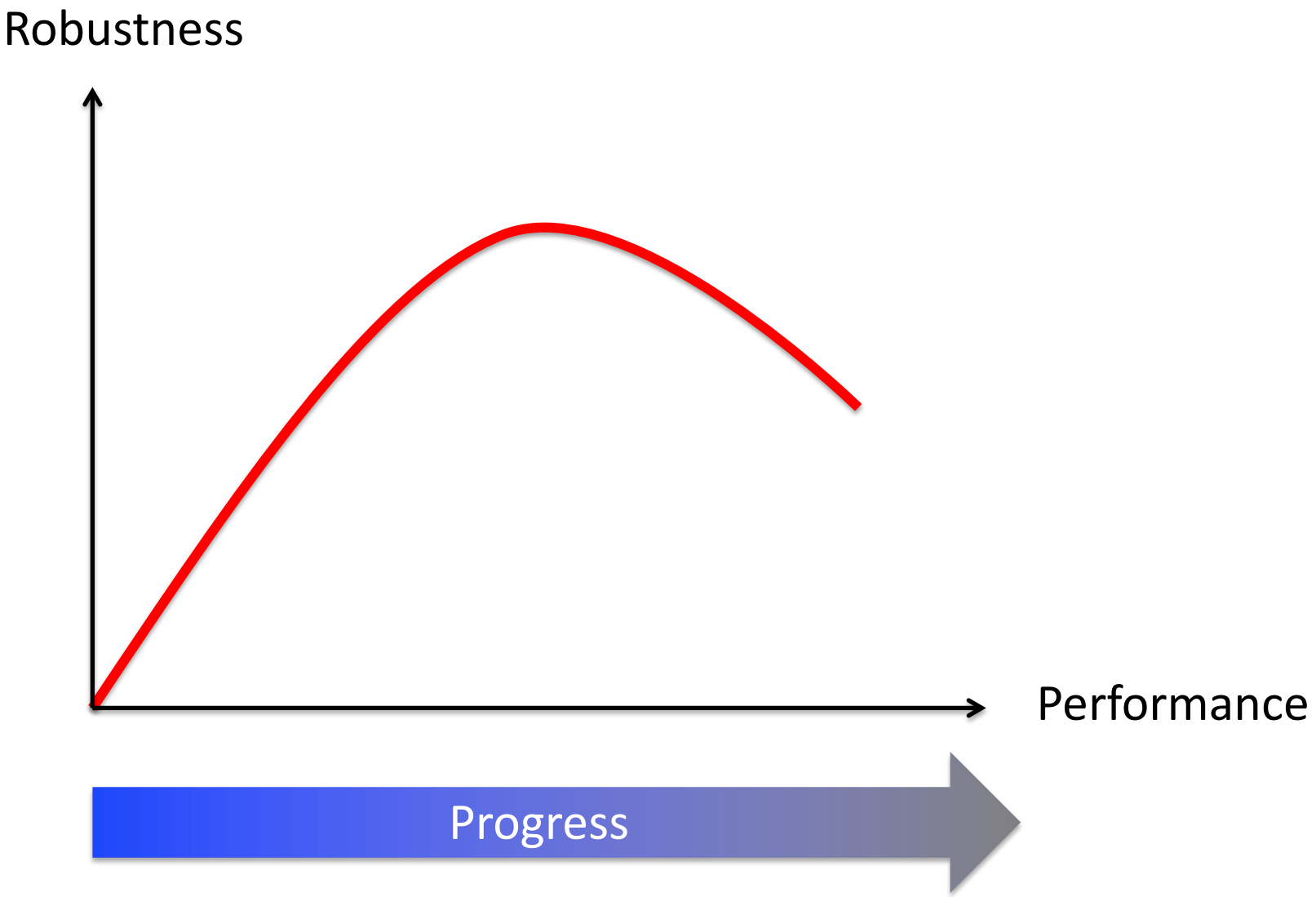


Inconsistency



Mechanical conflicts

Performance gains are counterproductive



Reinventing progress in the 21st century: robustness

From precision agriculture…

https://dataloop.ai/blog/precision-agriculture-challenges/

… to imprecision agriculture
La France agricole

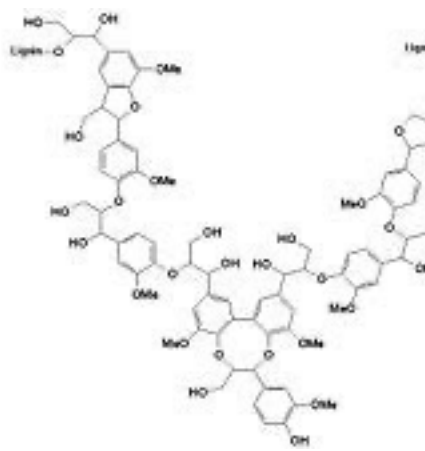
Tipping point #1: Food

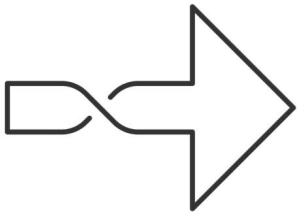
Use ecosystems
to increase production

TOWARDS

How production
can feed ecosystems

Re-carbonization of economy





Lignin-based batteries

LIGNA
ENERGY

Tipping point #2: Time and matter

Use matter to save time

TOWARDS

Use time to save matter

The rise of the all-repairable:
From « smart cities » to « smart citizens »

Wood, earth, straws

Design

FAIRPHONE

Repairable electronics

Breizelec
CONSTRUCTIONS ELECTRONIQUES

Tipping point #3: New engineers

Performance increments
through distant technical delegation

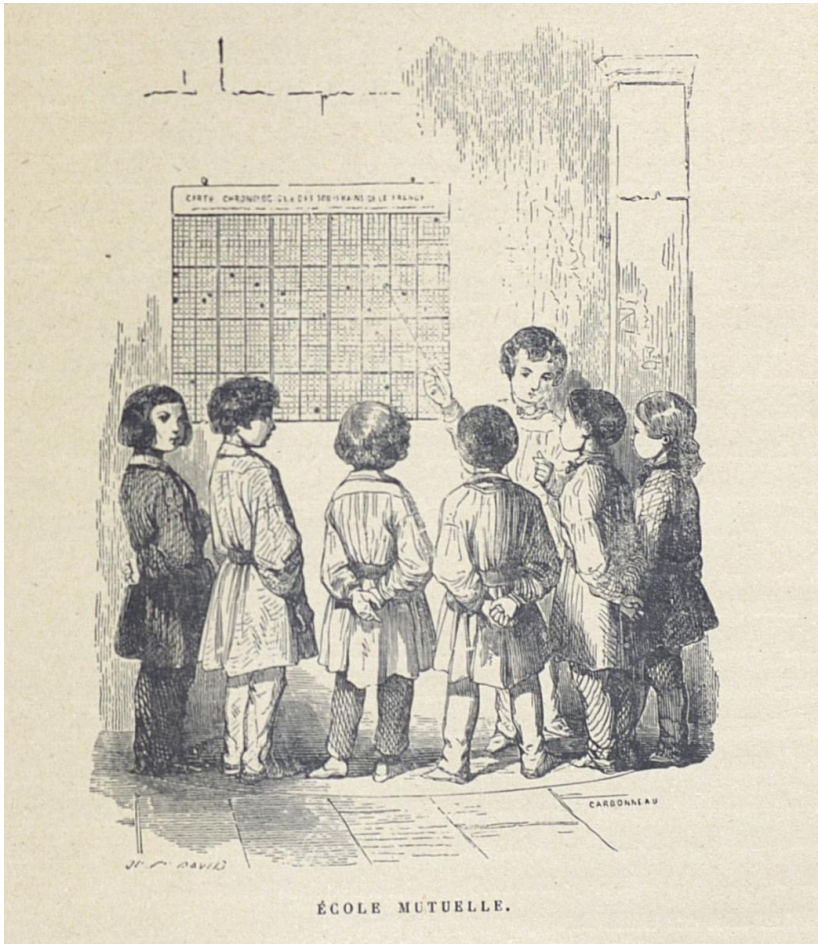
TOWARDS

Robust & techno-diverse solutions,
through the technical autonomy
of citizens

Campus de la transition à Forges 2021 – Le Monde

Education: towards a school of cooperation?

Competition
and performance
(and burnout)



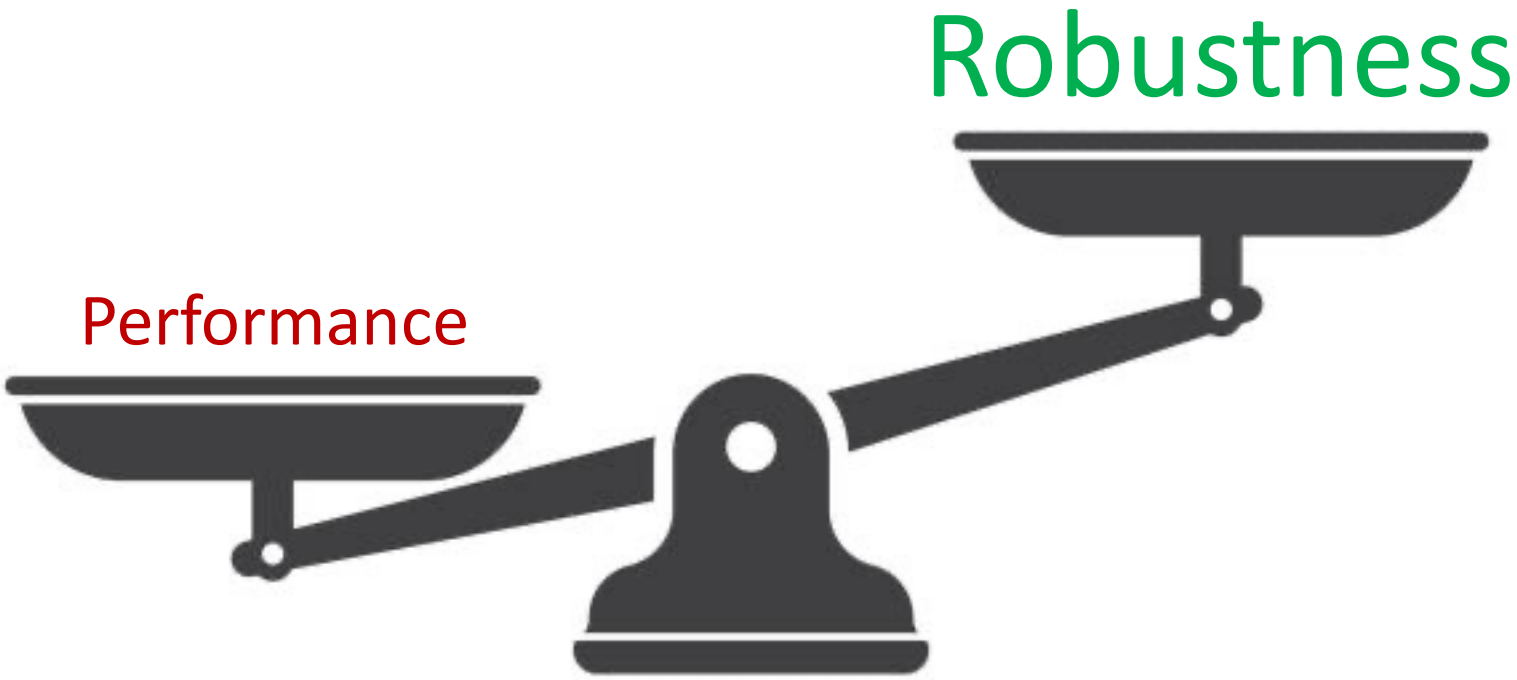
Cooperation
and robust learning

Research: Finding the right question

Citizen science

Atécopols

A new balance



NON À BXL NUMÉRIQUE

MER. 13 DÉCEMBRE 2023

9 h : manifestation virtuelle en 1 clic
(https://www.youtube.com/watch?v=JLzJ4VavUVA)

10 h : manifestation réelle face au parlement
(rue du Lombard 42 - 1000 Bruxelles)

L'humain d'abord !

codedunumerique.be

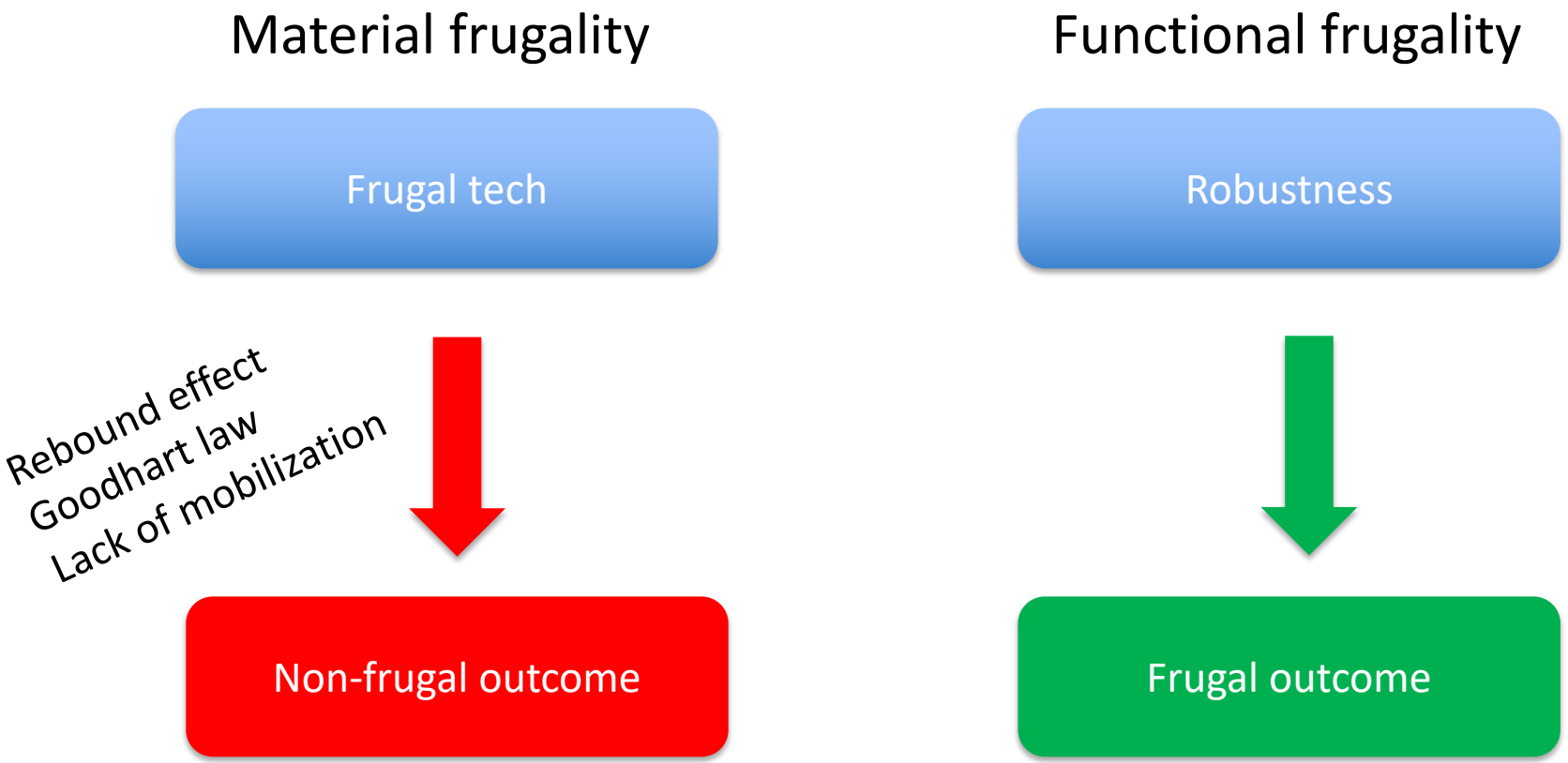
CODE DU NUMÉRIQUE

Pour que le numérique s'adapte à l'humain et non l'inverse

Bienvenue ! Les Actes (tournages) Les Lois discutées + Les Personnages

Increasing resistance:
When efficiency
becomes unacceptable

A method: Robustness before frugality



To be followed…

- Tribunes Le Monde Libération Le Point
- Lectures and MOOC: YouTube SATOR
- Institutmichelserres.fr Institut MICHEL SERRES