Digital Revolution III
- Scale, Complexity and Dynamics

Topics

- Digital Revolution
  - Scale: Numbers Please
  - Disrupting Business
  - Disrupting Jobs
  - Disrupting Politics
  - Disruptive Internet?
  - Platforms
  - Peer-to-Peer strikes back?

- Developments
  - Forces
  - Algorithms
  - Money
  - Jobs

- **Scale, Complexity and Dynamics: Making Sense**
  - **The Big Picture**
  - **Explanations**
  - **Change Factors**
  - **How to think the future**

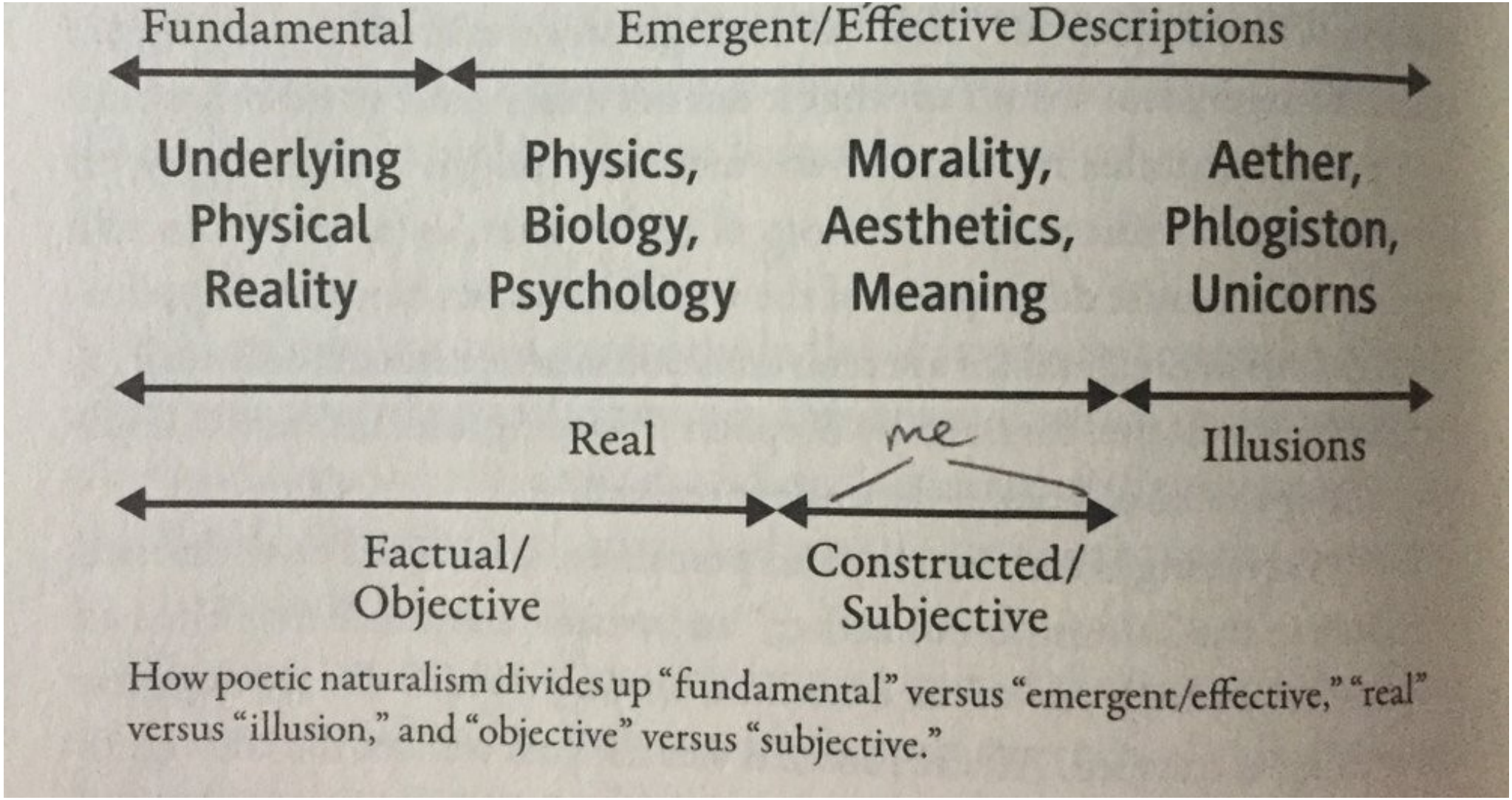
- Strategies
  - Autarkism

Image of large, complex and dynamic things

Prerequisites

- Do you have a theory/model of the world?
- Can you name disrupting and stabilizing forces?
- Can you explain money and its role?
- Do you understand distribution vs. Centralization?
- Do you see trends and developments?
- Can you work interdisciplinary?
- Can you think transdisciplinary?
- Can you design in the ultra-large?
- Can you deal with scale, complexity and dynamics?
- Can you define paradise?

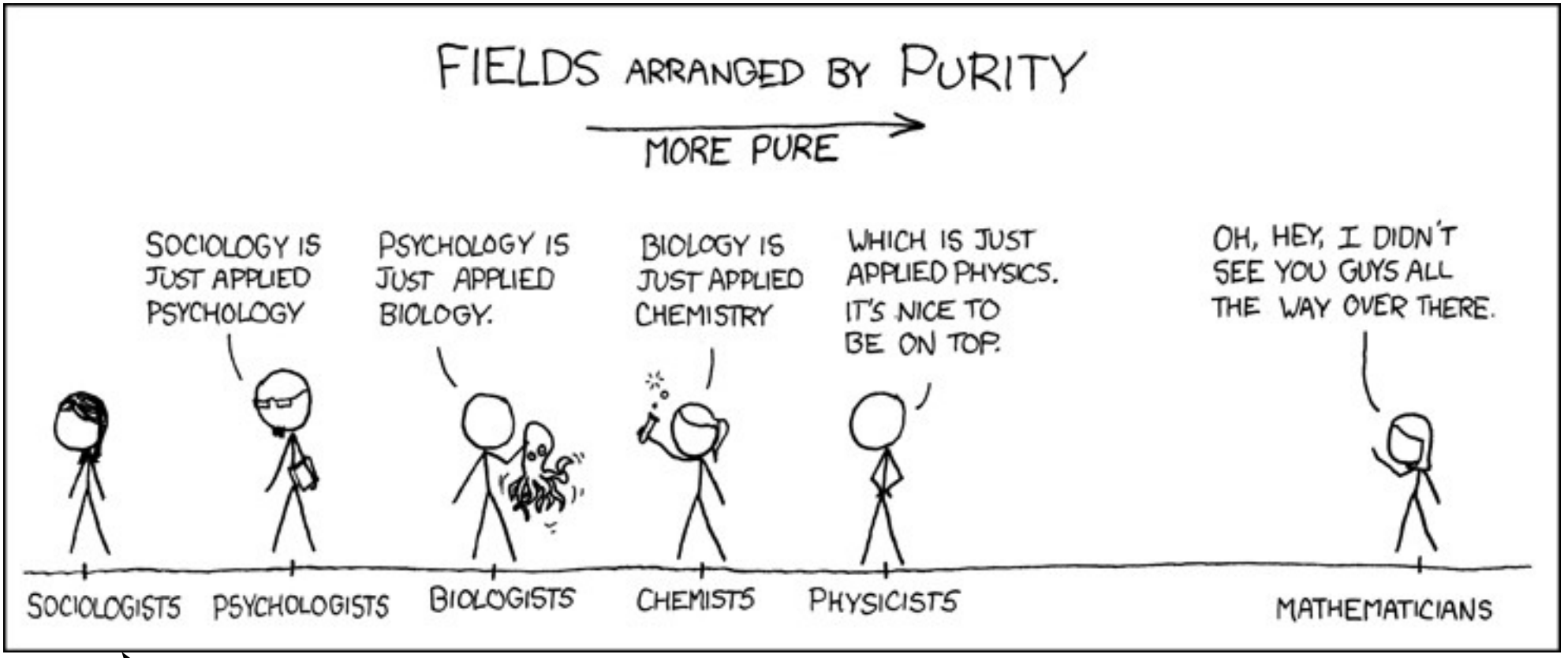
The Big Picture



How poetic naturalism divides up "fundamental" versus "emergent/effective," "real" versus "illusion," and "objective" versus "subjective."

Sean Carroll, The Big Picture

Stack Fallacy



What is he looking at?

Causality: the causal ladder

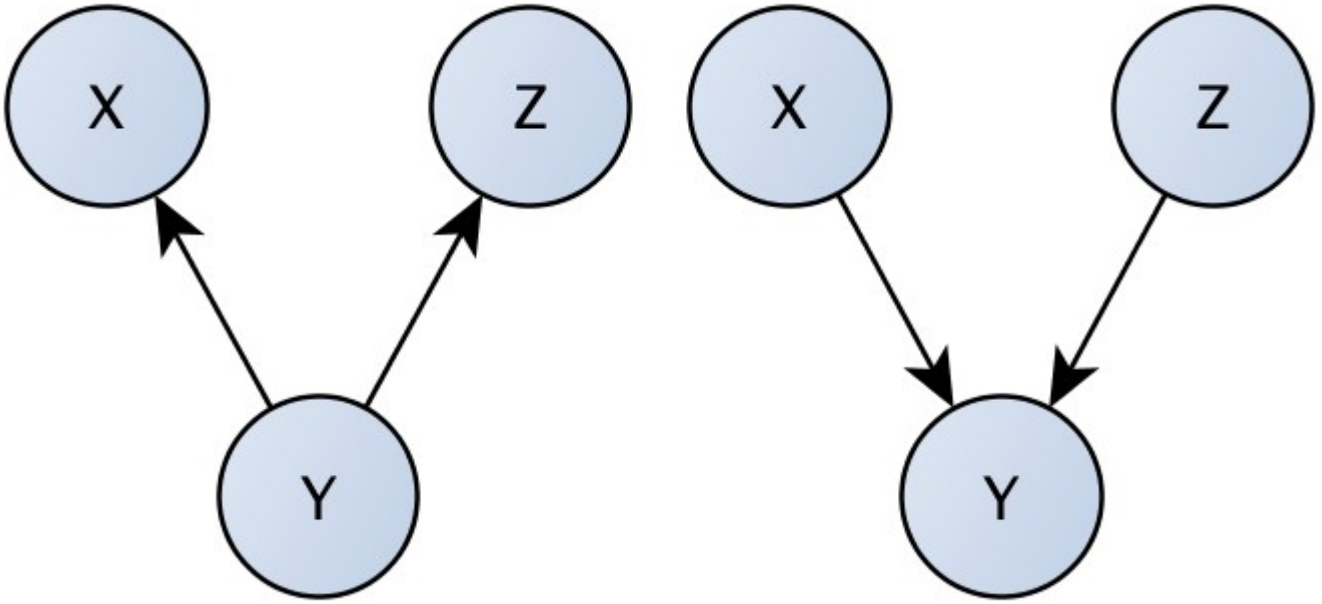
The first level of the causation ladder ist mere association or "seeing". This is where correlations are detected by statistical methods.

The next layer is intervention (the "wiggling") and the

final layer is counter-factual thinking: Calculating with causal results of things that did not really happen (yet).

https://kriha.de/blog16.html

Causal Graphs



You need the RIGHT causal graph. Does this require a theory? And do you want to EXPLAIN or PREDICT?

https://medium.com/@akelleh/a-technical-primer-on-causality-181db2575e41

https://kriha.de/blog16.html

Explanations

System Theory/Dynamics: **equilibrium** through feedback

Sustainability: **non-destructive** resource use

Self-sufficiency: closed, sustainable and controlled input

Cybernetics: dynamic, change, **observer**

Complex Adaptive Systems: **resilience**, buffers

Chaos: detecting patterns, knowledge through **actions**

Dataism, Cellular Automata: universe as a **data processor**

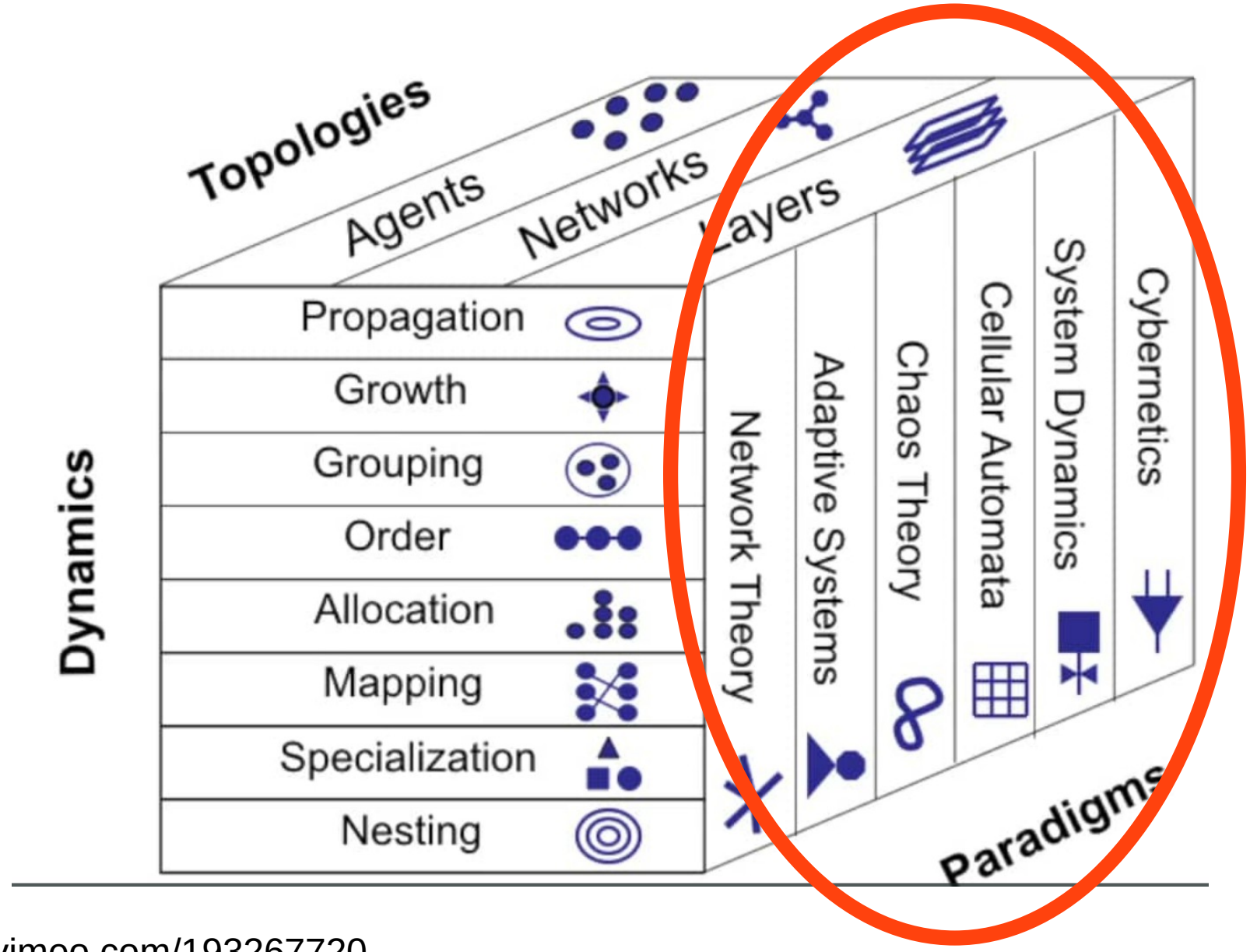
Google/Eric Schmidt: **mobile** plus **free data** flow makes paradise

Quantum-Simulation: **simulate** chaotic dynamical systems

The Grand-Unified Theory

Compare: growth based economic system!

Will Wright, Dynamics for Designers



https://vimeo.com/193267720

Cybernetics

- Negative feedback: control theory
- Positive feedback: change/explosion
- Second Order Cybernetics: observer is part of the system

System Dynamics

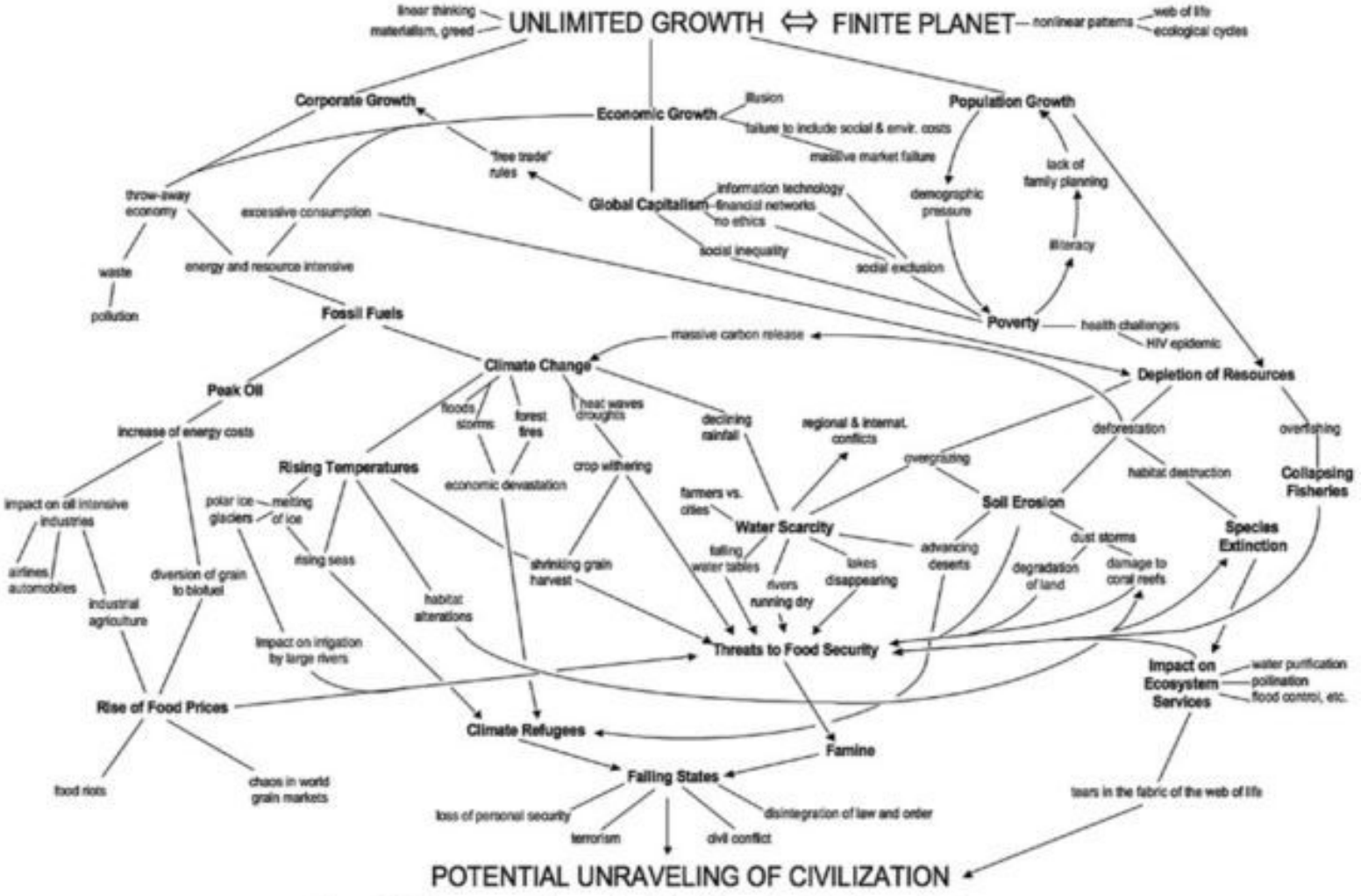


Figure 17.1 Interconnectedness of world problems (based on Brown, 2008).

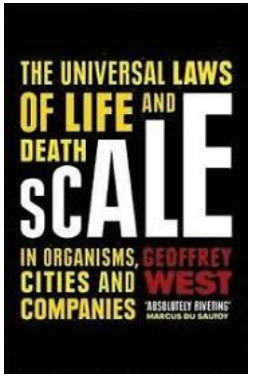
Emergence

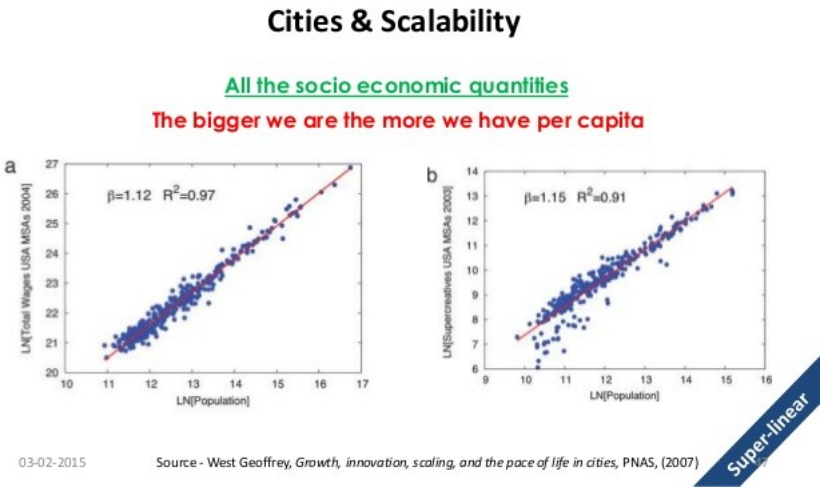
- Cellular automata
- Genetic algorithms
- Ant colony optimizations
- Flocking of birds
- Simple rules create complex things
- No shortcut-algorithms

Network Theory

- Network effects
- City density
- Statistical physics
- Topology: Internet Exchange Points
- Scale free networks
-

Computational Complexity - Power Laws and Scale



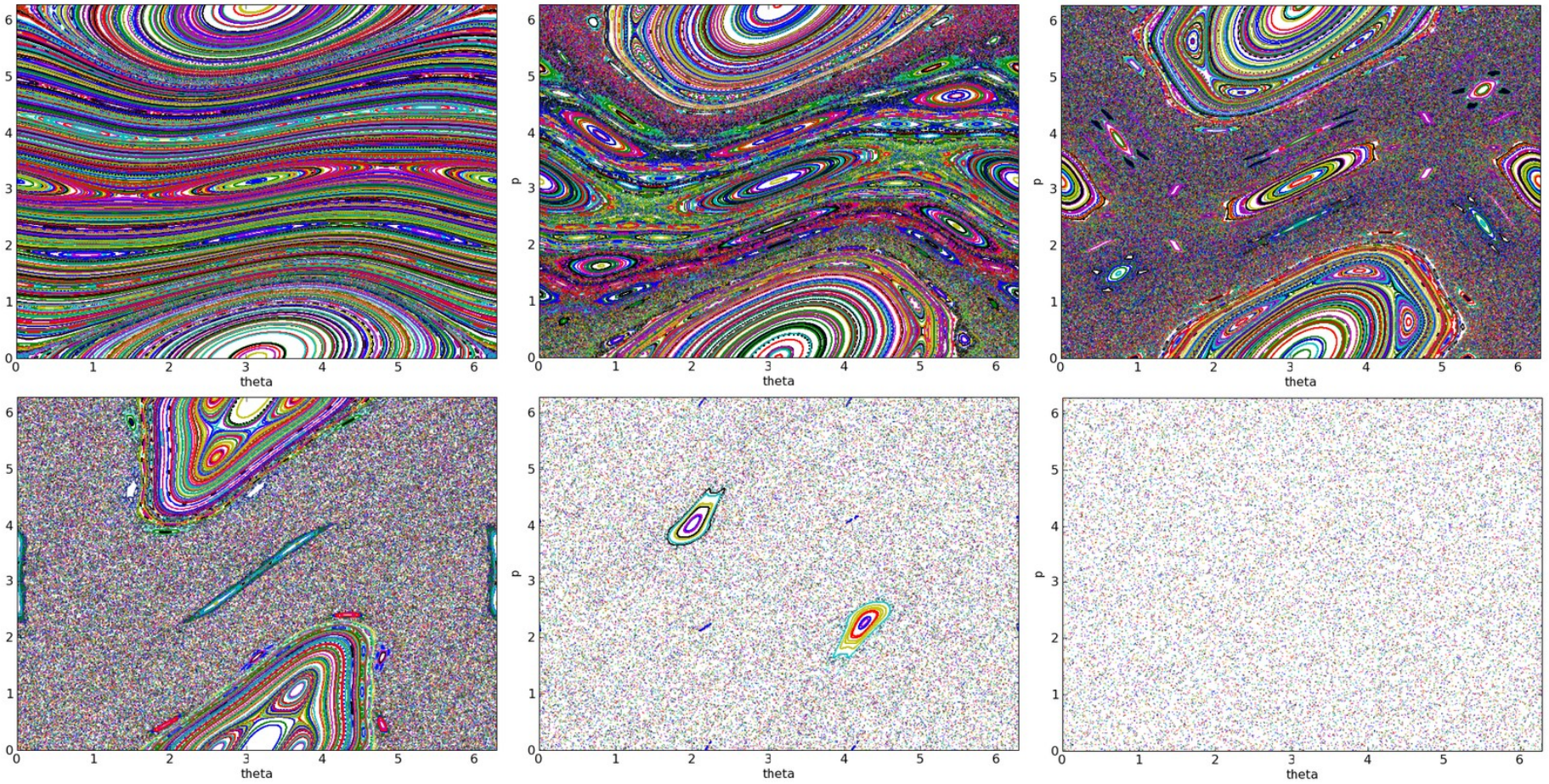


Geoffrey West, The Future of the Planet: Life, Growth and Death in Organisms, Cities and Companies, with Geoffrey West
https://www.youtube.com/watch?v=zyJJPuKF814

„The choice of an imagined future is always a matter of taste. West chooses sustainability as the goal and the Grand Unified Theory as the means to achieve it. My taste is the opposite. I see human freedom as the goal and the creativity of small human societies as the means to achieve it. Freedom is the divine spark that causes human children to rebel against grand unified theories imposed by their parents.“

Freeman Dyson, http://www.nybooks.com/articles/2018/05/10/the-key-to-everything/#fnr-2

Chaos Theory



By Darth Rhombus (Own work) [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

Strange Attractors may give us hints on the aggregate level

The Real Butterfly Effect

The usual butterfly effect says that any small inaccuracy in the knowledge that you have about the initial state of the system will eventually blow up and make a large difference. But if you did precisely know the initial state, then you could precisely predict the outcome, and if only you had good enough data you could make predictions as far ahead as you like. It's chaos, alright, but it's still deterministic.

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You can try to minimize errors by making cells smaller and smaller. But Lorenz said that by decreasing the length by a factor of 2 will only increase prediction time by HALF of the original value. This converges to a limes of 10 effectively limiting our predictive abilities absolutely. But is it physical?

Sabine Hoffenfelder, https://backreaction.blogspot.com/2020/01/the-real-butterfly-effect.html

Complex Adaptive Systems

Complexity

"...Complexity is looking at interacting elements and asking how they form patterns and how the patterns unfold. It's important to point out that the patterns may never be finished. They're open-ended. In standard science this hit some things that most scientists have a negative reaction to. Science doesn't like perpetual novelty."

–BRIAN ARTHUR

Complexity

I love this quote from APJ's fantastic book Design Unbound:

"When we look at problems only as scientific or technical in nature, removed from the context to which they are responding, they may be complicated, but they generally can be solved through straightforward, scientific and engineering design models.

But, when we understand these problems as embedded within human contexts that organize themselves through changing social, political, economic, and cultural belief systems, we are in the realm of complexity".

Design Unbound – Designing for emergence in a white water world

https://www.infoq.com/news/2021/04/cynefin-agile-retrospectives/?utm_source=email&utm_medium=culture-methods&utm_campaign=newsletter&utm_content=04132021

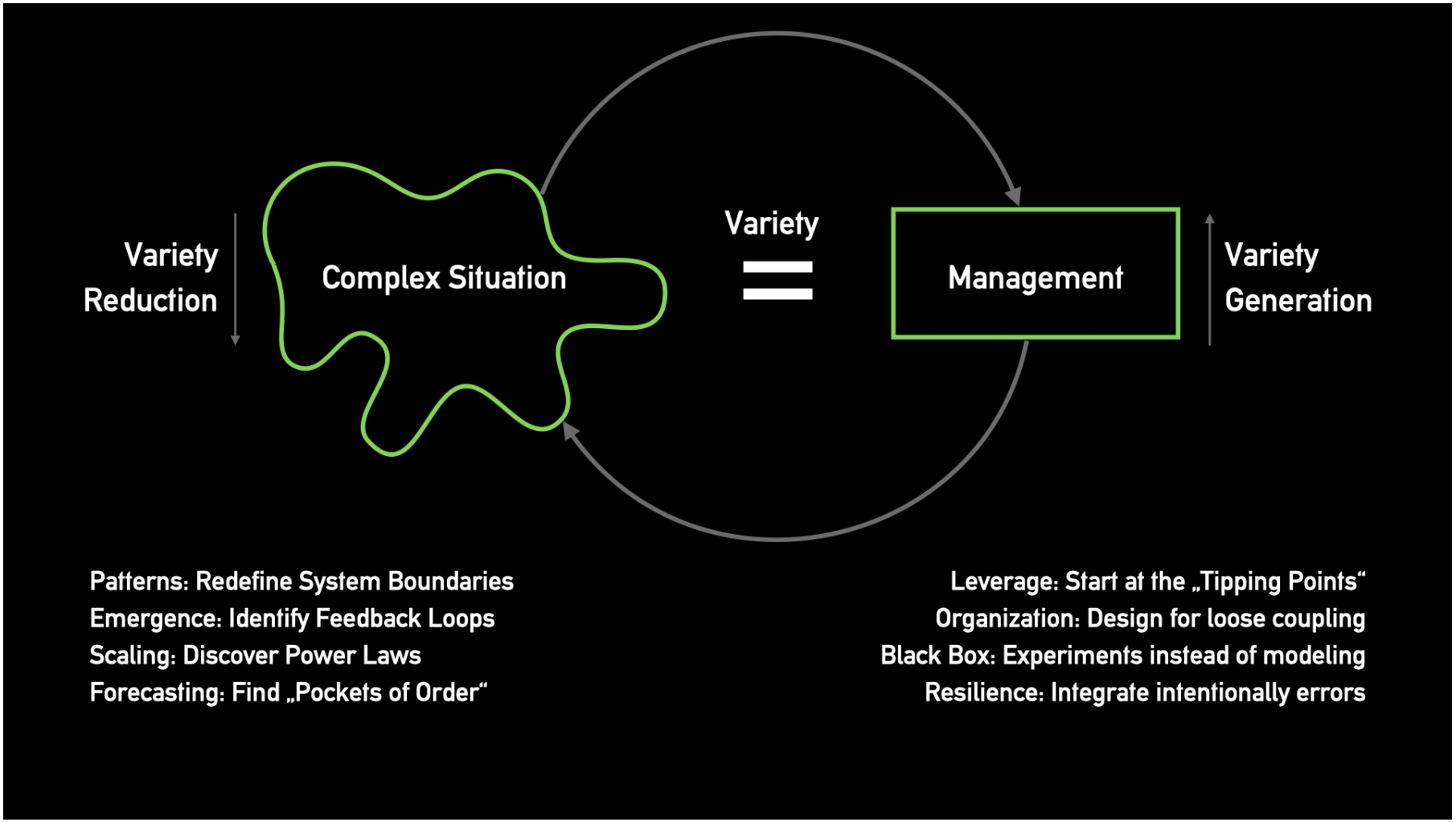
Populismus anyone?

"The larger the variety of **actions** available to a system, the larger variety of the perturbations it is able to compensate."

Ashby's Law of Requisite Variety

Variety, the secret of scale.
https://www.infoq.com/presentations/variety-scale/

Dealing with complex situations



https://intelligente-organisationen.de/ashbys-law-of-requisite-variety#post/0

Interventions

Donella Meadows concluded the following 12 general places to intervene in a system, in increasing order of effectiveness:

Places to intervene in a system

Constants, parameters, numbers (such as subsidies, taxes, standards).

The sizes of buffers and other stabilizing stocks, relative to their flows.

The structure of material stocks and flows (such as transport networks, population age structures).

The lengths of delays, relative to the rate of system change.

The strength of negative feedback loops, relative to the impacts they are trying to correct against.

The gain around driving positive feedback loops.

The structure of information flows (who does and does not have access to information).

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

The power to add, change, evolve, or self-organize system structure.

The goals of the system.

The mindset or paradigm out of which the system — its goals, structure, rules, delays, parameters — arises.

The power to transcend paradigms.

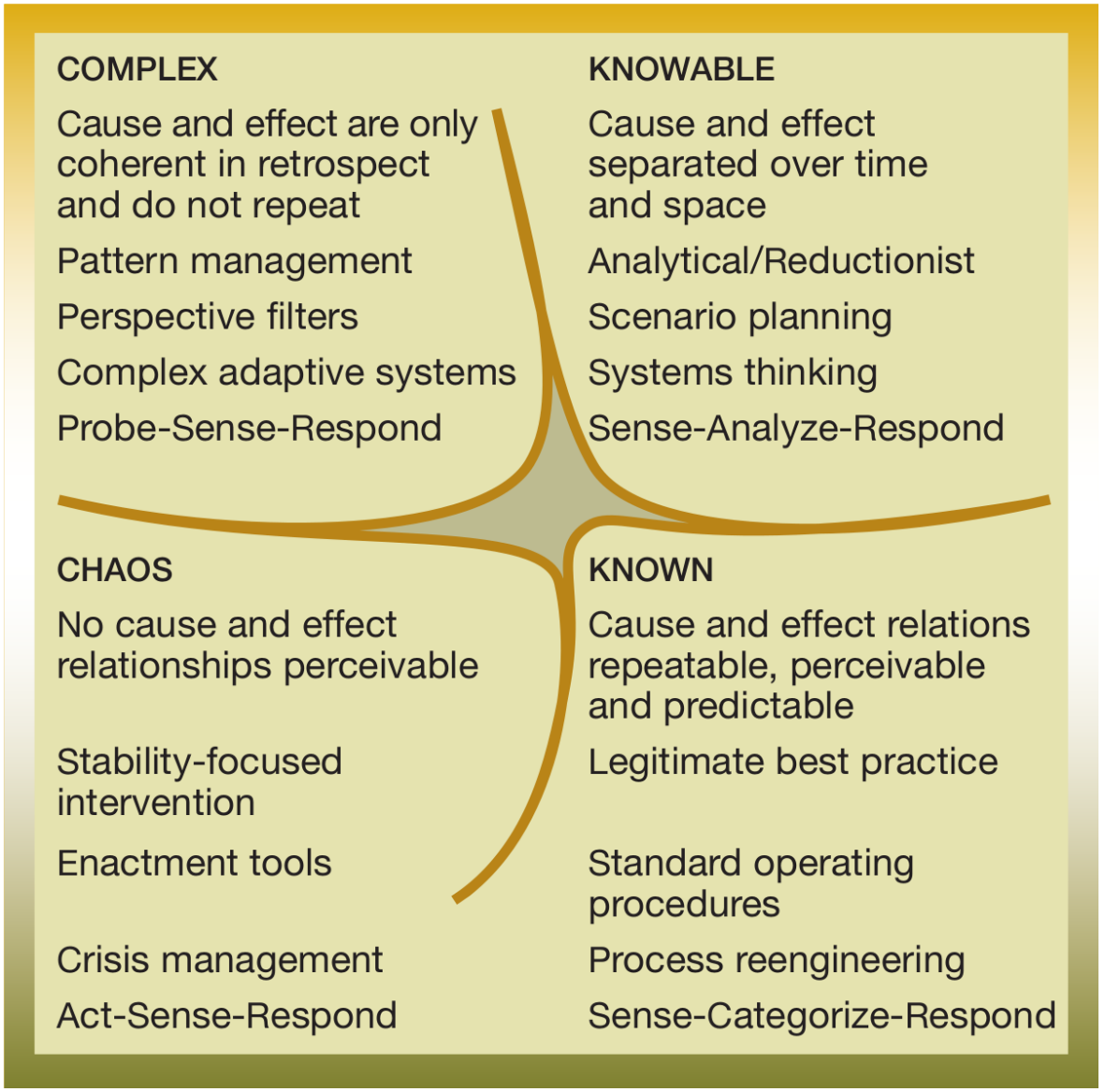
A.Merker, https://blog.mi.hdm-stuttgart.de/index.php/2020/09/04/system-theory-and-introduction-to-complexity/

Properties of CAS

- Non-linear and NL causality
- non ergodic: observed past probabilities do not apply to future processes (Peters, Gell-Mann, Taleb)
- No model of humans
- the only model are humans themselves
- Discovery before delivery architecture
- Kanban-like progress (decomp./recomb)
- Unintended Side-effects are always present

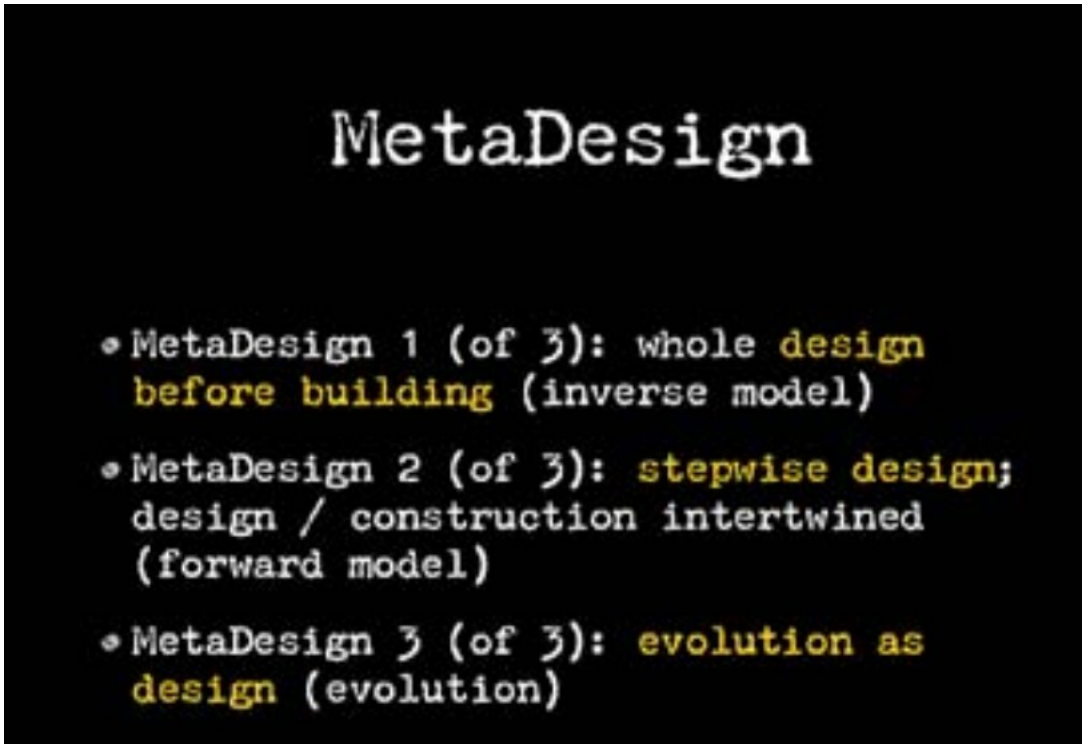
Peter Snowden, Complex Adaptive Systems, Domain-Driven Design Europe 2018, https://www.youtube.com/watch?v=l4-vpegxYPg

Cynefin Framework: order, complexity and chaos



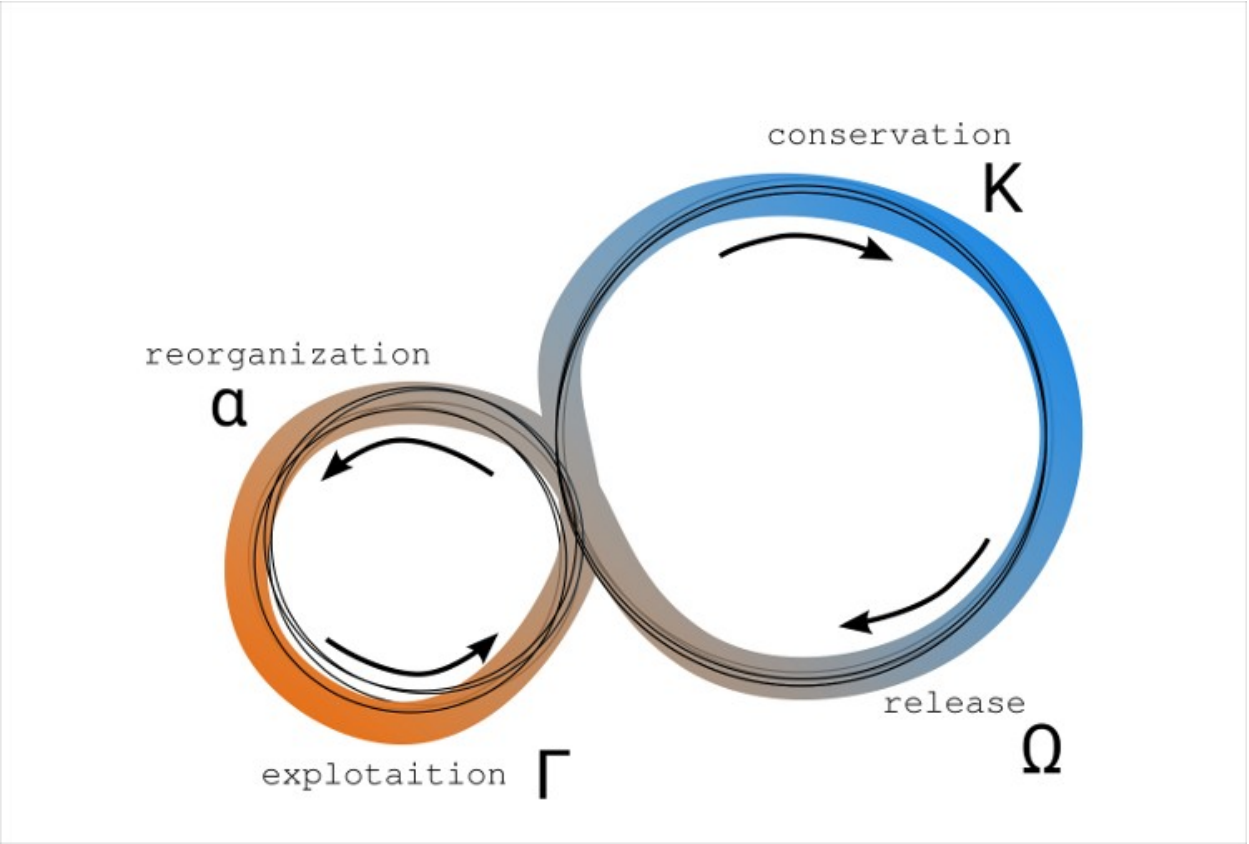
Kurtz and Snowden, IBM SYSTEMS JOURNAL, VOL 42, NO 3, 2003

Design for the Ultra-large



Richard P. Gabriel,
https://www.dreamsongs.com/Files/DesignBeyondHumanAbilitiesSimp.pdf

CAS and Sustainability



https://scientiaplusconscientia.wordpress.com/2015/07/25/environment-sustainability-metaphors-complex-systems-adaptive-cycle/

Disruption vs. Conservation

- Too much slack increases impact of catastrophic change
- Preventing change is not sustainable!
- „Too big to fail“ is not sustainable!
- Subsidizing old economies leads to catastrophic change
- Ecological damage can lead to new environments

From macroresilience.org,

Risk and Power Asymmetries in CAS

- Finance: Investment Banker vs. Citizen
- Politics: Politician/Lobbyist vs. Citizen
- Corporations: CEO vs. Entrepreneur

Those who decide and make the profits have „no skin in the game“ (Nicolas Nassim Taleb): They manage to move the risk to other people.

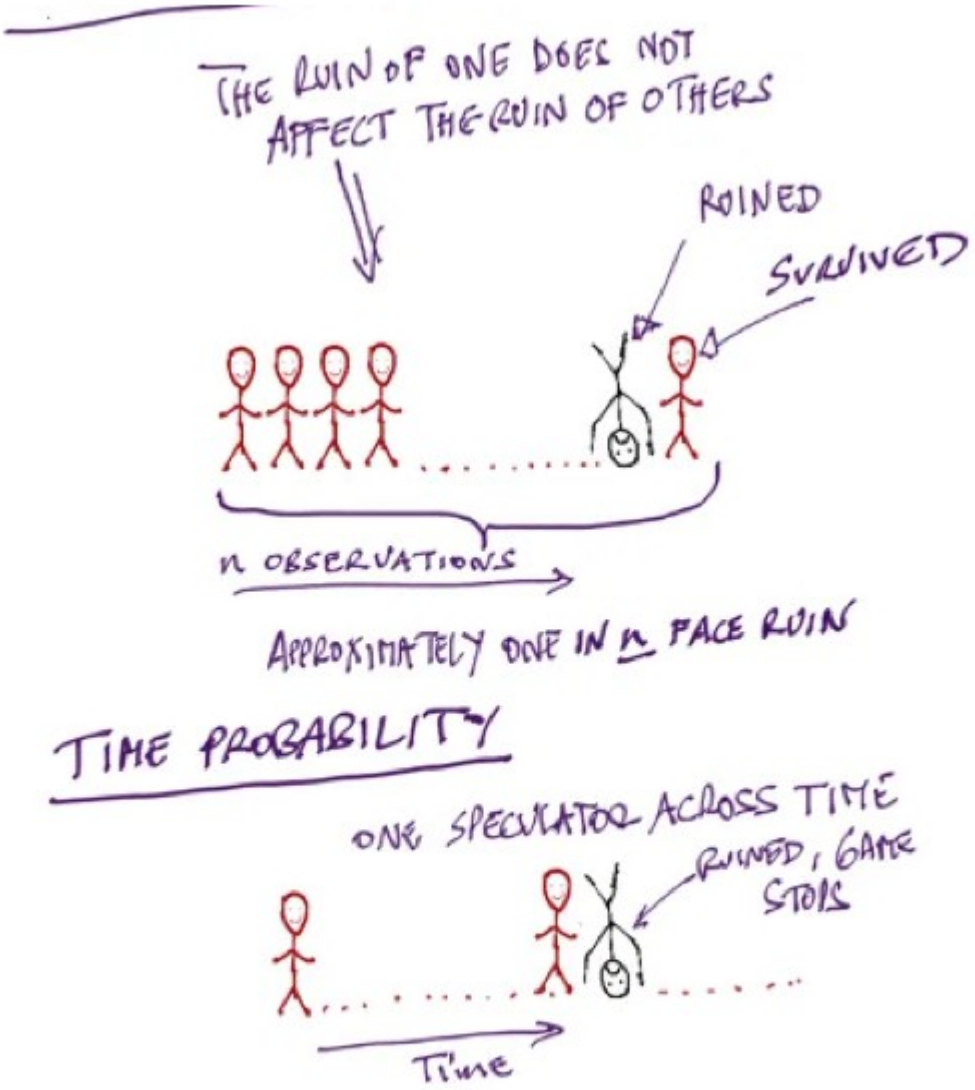
Core Terms

- Ergodicity
- Skin in the Game
- Antifragility
- Optionality
- Black Swans

Those who decide and make the profits have „no skin in the game“ (Nicolas Nassim Taleb): They manage to move the risk to other people.

https://neurabites.com/antifragility/

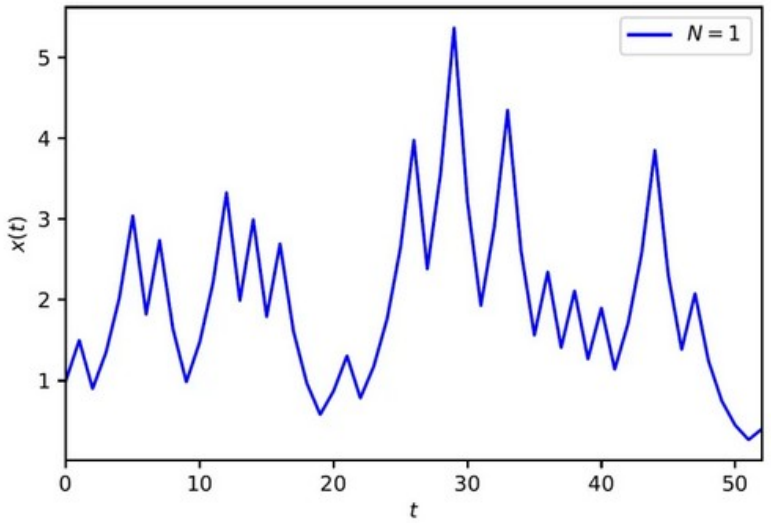
The Ergodic Assumption?



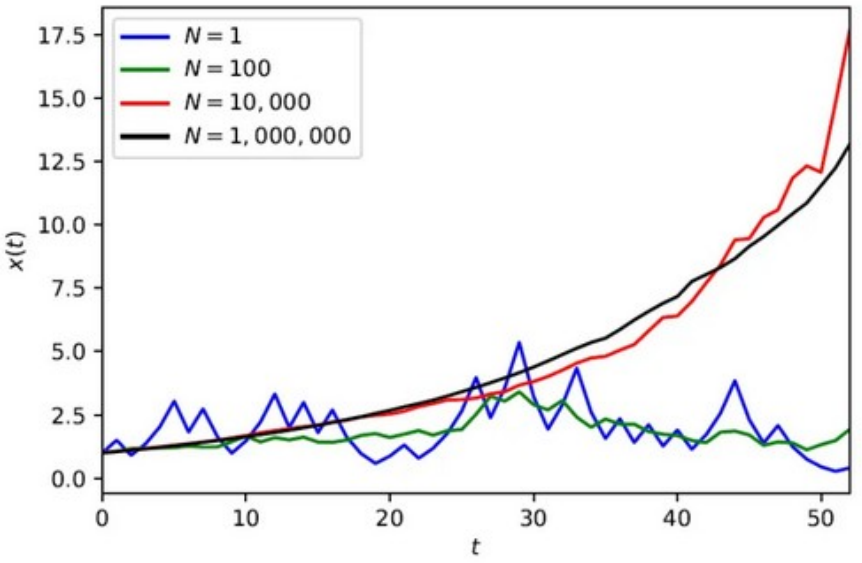
The difference between 100 people going to a casino and one person going to a casino 100 times, i.e. between (path dependent) and conventionally understood probability. The mistake has persisted in economics and psychology since age immemorial. The Logic of Risk Taking, Nassim Taleb

https://neurabites.com/ergodicity/

The Ergodic Assumption?



Ergodicity Economics Lecture Notes, Ole Peters



Ergodicity Economics Lecture Notes, Ole Peters

Which games are non-ergodic? Base Jumping? Nuclear Power Plants? Extreme mountain climbing?

https://neurabites.com/ergodicity/

The Ergodic Assumption?

A process is said to be ergodic if the ensemble-average is equal to the time-average.

Clearly, simulating an individual playing 10,000 rounds gives a drastically different result to simulating 10,000 individuals playing 1 round.

(i) In aggregate, payout is favourable to the players since average wealth is consistently above starting value of $100. This is the ensemble-average.

(ii) But this asymmetric payoff is only favourable on the ensemble dimension (taking the aggregate and dividing it by number of players). The pay-off structure is not favourable to an individual on the temporal (time) dimension. On an individual level, people are actually more likely to lose the longer they play. Gambler's ruin. Thus, looking at ensemble returns is a poor indicator of individual returns.

https://neurabites.com/ergodicity/

Change Factors

- Optimization
- Selection (Subtraction)
- No Selection (Explosion)
- Asymmetries
- Path Dependencies

Equilibrium

„To aspire equilibrium is leading into a trap. What we, what humanity would need – in an evolutionary sense - are survivable disequilibria.“

Translated from: Josef H. Reichholff, eine kurze Naturgeschichte des letzten Jahrtausends, pg. 324

Local Equilibria

The Hayekian argument of dispersed knowledge and its importance in seeking equilibrium is not as important as it seems in explaining why the Soviet project failed. As Joseph Berliner has illustrated, the Soviet economy did not fail to reach local equilibria. Where it failed so spectacularly was in extracting itself out of these equilibria. The dispersed knowledge argument is open to the riposte that better implementation of the control revolution will eventually overcome these problems – indeed much of the current techno-utopian version of the control revolution is based on this assumption. It is a weak argument for free enterprise, a much stronger argument for which is the need to maintain a system that retains the ability to reinvent itself and find a new, hitherto unknown trajectory via the destruction of the incumbents combined with the emergence of the new. Where the Soviet experiment failed is that it eliminated the possibility of failure, that Berliner called the ‘invisible foot’. The success of the free enterprise system has been built not upon the positive incentive of the invisible hand but the negative incentive of the invisible foot to counter the visible hand of the control revolution. It is this threat and occasional realisation of failure and disorder that is the key to maintaining system resilience and evolvability.

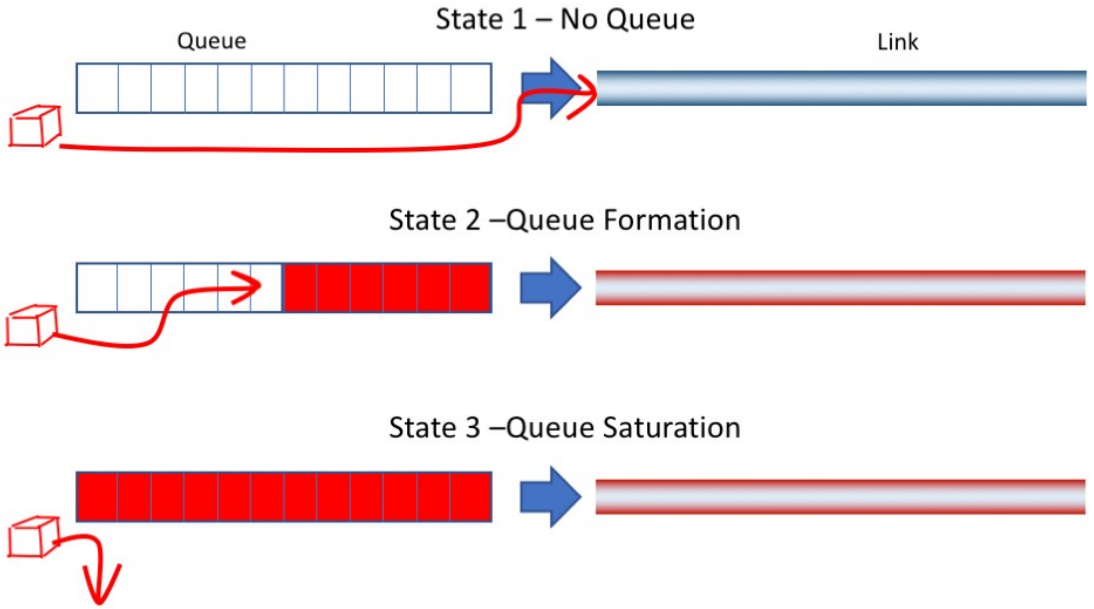
Degeneracy and Complexity

In biological systems, degeneracy is almost invariably accompanied by complexity. A complex system may be considered as one in which smaller parts are functionally segregated or differentiated across a diversity of functions but also as one that shows increasing degrees of integration when more and more of its parts interact. Put otherwise, a complex system may be viewed as one that reveals an interplay between functional specialization and functional integration. Intuitively, it is easy to see that, below a certain level of complexity, there will be very few ways in which structurally different parts can interact to yield the same output or functional result. Accordingly, at low levels of complexity, degeneracy will be low or nonexistent. For a defined function,however, redundancy can still exist even in relatively simple systems.

Degeneracy and complexity in biological systemsGerald M. Edelman* and Joseph A. Gally, The Neurosciences Institute, La Jolla, CA 92121. Contributed by Gerald M. Edelman, September 21, 200

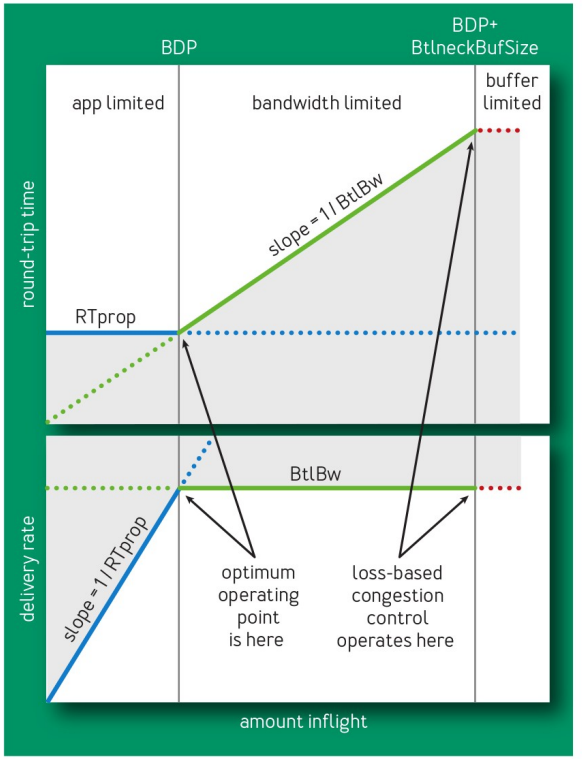
Complexity does not automatically imply fragility!

Slack (Buffering) in TCP



BBR, the new kid on the TCP block, By Geoff Huston on 9 May 2017

FIGURE 1: **DELIVERY RATE AND ROUND-TRIP TIME VS. INFLIGHT**



acmqueue | september-october 2016 22

NEAL CARDWELL
YUCHUNG CHENG
C. STEPHEN GUNN
SOHEIL HASSAS YEGANEH
VAN JACOBSON, congestion based congestion controll

Buffering in complex, adaptive systems is critical and can lead to inferior results if permanently used. Interestingly this explains why increasing memory in NICs due to falling prices did not help latency at all.

Resilience

The Sweet Spot Before the Uncanny Valley: Near-Optimal Yet Resilient

Although it is easy to imagine the characteristics of an inefficient and dramatically sub-optimal system that is robust, complex adaptive systems operate at a near-optimal efficiency that is also resilient. Efficiency is not only important due to the obvious reality that resources are scarce but also because slack at the individual and corporate level is a significant cause of unemployment. Such near-optimal robustness in both natural and economic systems is not achieved with simplistically diverse agent compositions or with significant redundancies or slack at agent level.

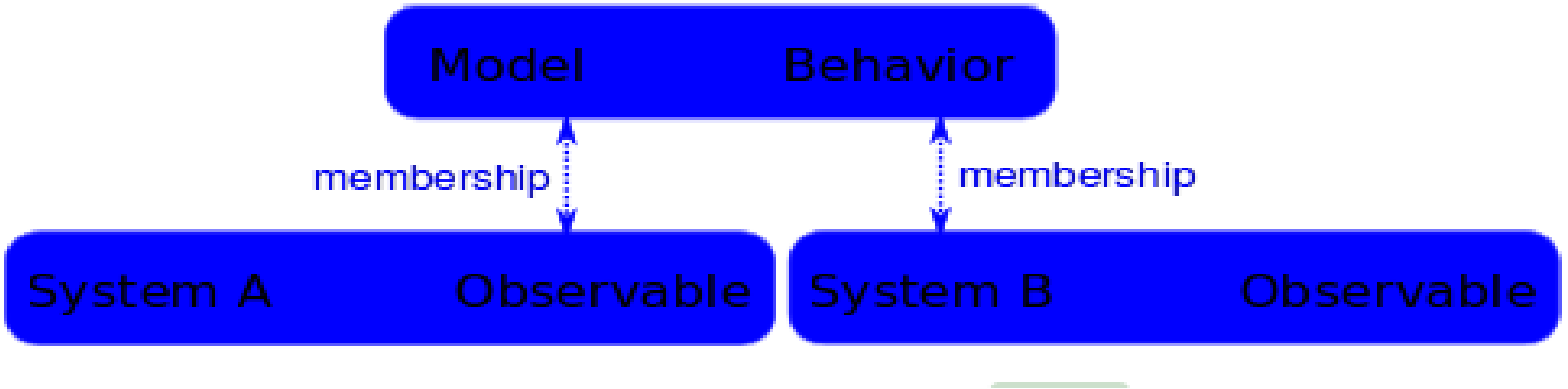
Diversity and redundancy carry a cost in terms of reduced efficiency. Precisely due to this reason, real-world economic systems appear to exhibit nowhere near the diversity that would seem to ensure system resilience. Rick Bookstaber noted recently, that capitalist competition if anything seems to lead to a reduction in diversity. As Youngme Moon's excellent book 'Different' lays out, competition in most markets seems to result in less diversity, not more. We may have a choice of 100 brands of toothpaste but most of us would struggle to meaningfully differentiate between them.

Similarly, almost all biological and ecological complex adaptive systems are a lot less diverse and contain less pure redundancy than conventional wisdom would expect. Resilient biological systems tend to preserve degeneracy rather than simple redundancy and resilient ecological systems tend to contain weak links rather than naive 'law of large numbers' diversity. The key to achieving resilience with near-optimal configurations is to tackle disturbances and generate novelty/innovation with an an emergent systemic response that reconfigures the system rather than simply a localised response. Degeneracy and weak links are key to such a configuration. The equivalent in economic systems is a constant threat of new firm entry.

The viewpoint which emphasises weak links and degeneracy also implies that it is not the keystone species and the large firms that determine resilience but the presence of smaller players ready to reorganise and pick up the slack when an unexpected event occurs. Such a focus is further complicated by the fact that in a stable environment, the system may become less and less resilient with no visible consequences – weak links may be eliminated, barriers to entry may progressively increase etc with no damage done to system performance in the stable equilibrium phase. Yet this loss of resilience can prove fatal when the environment changes and can leave the system unable to generate novelty/disruptive innovation. This highlights the folly of statements such as 'what's good for GM is good for America'. We need to focus not just on the keystone species, but on the fringes of the ecosystem.

http://www.macroresilience.com/2012/02/21/the-control-revolution-and-its-discontents-the-uncanny-valley/

Transdisciplinary: Holistic Models



Holistic models are more focused on similarities between systems and less interested in analogous parts. A holistic approach to modeling often consists of two steps, not necessarily in this order:

- Identify a kind of behavior that appears in a variety of systems.
- Find the simplest model that demonstrates that behavior.

(from: Think Complexity, Allen B. Downey, http://greenteapress.com/complexity/thinkcomplexity.pdf)

Futurism

Matthias Horx, Future Tools – Werkzeuge zum Zukunft denken

Predictions IV

„For the modeling of open processes to be used for scenarios and predictions, all systems need to restrict the degrees of freedom. The programs need to assume „plausible“ conditions. But what if those conditions do not hold? „ (translation WK)

Translated from: Josef H. Reichholff, eine kurze Naturgeschichte des letzten Jahrtausends, pg. 323

Literature

Erik Brynjolfsson, Andrew McAfee: The Second Machine Age. Plassen, Kulmbach 2014. 400 Seiten, Fr. 32.90, E-Book 25.-.

Nick Bostrom: Superintelligenz. Szenarien einer kommenden Revolution. Suhrkamp, Berlin 2014 (erscheint 8.11.). 480 Seiten, Fr. 41.90.

Kevin Kelly, The Inevitable. Understanding 12 Technological Forces That Will Shape Our Future

A Montuori, Systems Approach
California Institute of Integral Studies, San Francisco, CA, USA

A. Maurits van der Veen, The Dutch Tulip Mania: The Social Foundations of a Financial Bubble, October 2012

Scaling Agile @ Spotify
with Tribes, Squads, Chapters & Guilds
Henrik Kniberg & Anders Ivarsson

What Google Learned From Its Quest to Build the Perfect Team
New research reveals surprising truths about why some work groups thrive and others falter.
By CHARLES DUHIGG Illustrations by JAMES GRAHAM FEB. 25, 2016
https://www.nytimes.com/2016/02/28/magazine/what-google-learned-from-its-quest-to-build-the-perfect-team.html?rref=collection%2Fbyline%2Fcharles-duhigg&action=click&contentCollection=undefined&region=stream&module=stream_unit&version=search&contentPlacement=1&pgtype=collection

Peter , Demonetization of everything

The Venus Project – Resource Based Economy

Demonetizing Everything: A Post Capitalism World | Peter Diamandis | Exponential Finance,
https://www.youtube.com/watch?v=3cXPWyP0BBs

http://basicincome.org/research/research-depository/

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