# Outline

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Interpreting Supply Chains as Engineered Systems

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# The Supply Chain as a "Being"

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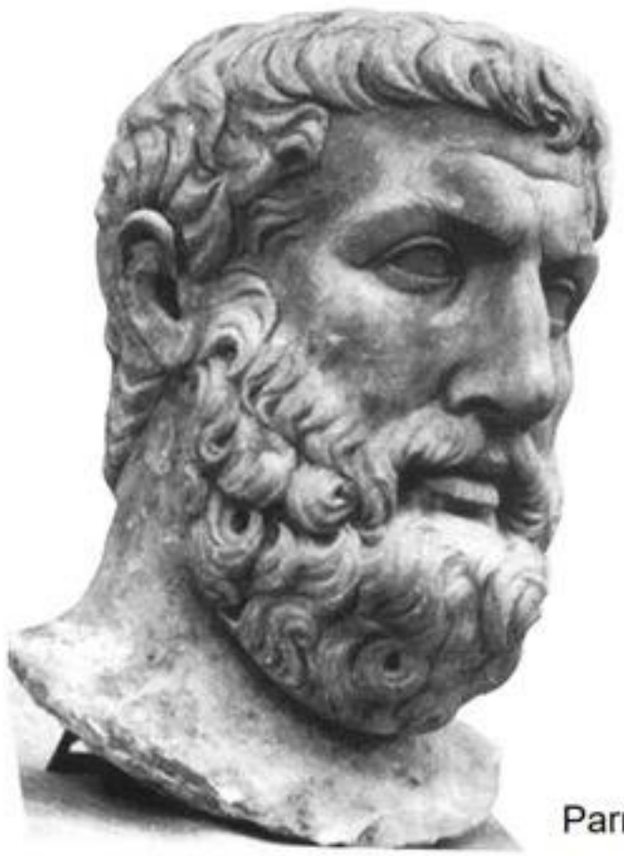

Parmenides of Elea

"There remains, then, but one word by which to express the [true] road: Is. And on this road there are many signs that What Is has no beginning and never will be destroyed: it is whole, still, and without end. It neither was nor will be, it simply is—now, altogether, one, continuous…"

Source: Sawitt (2017), https://plato.stanford.edu/entries/spacetime-bebecome/

# Traditional Supply Chain Definitions

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Supply Chain

*"A network of connected and interdependent organisations mutually and co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end users."*

Christopher (2016), p. 3, ISBN 9781292083797

Supply Chain

*"a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer."*

Mentzer et al. (2001), https://doi.org/10.1002/j.2158-1592.2001.tb00001.x

# Supply Chains as Closed Systems

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## Direct Supply Chain

SUPPLIER ⟷ ORGANIZATION ⟷ CUSTOMER

Source: Mentzer et al (2001), https://doi.org/10.1002/j.2158-1592.2001.tb00001.x

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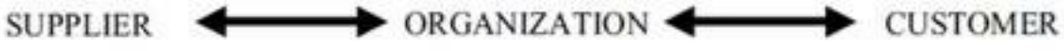
## Direct Supply Chain




## Extended Supply Chain


## Ultimate Supply Chain


Source: Mentzer et al (2001), https://doi.org/10.1002/j.2158-1592.2001.tb00001.x

# Global Automotive Supply Network

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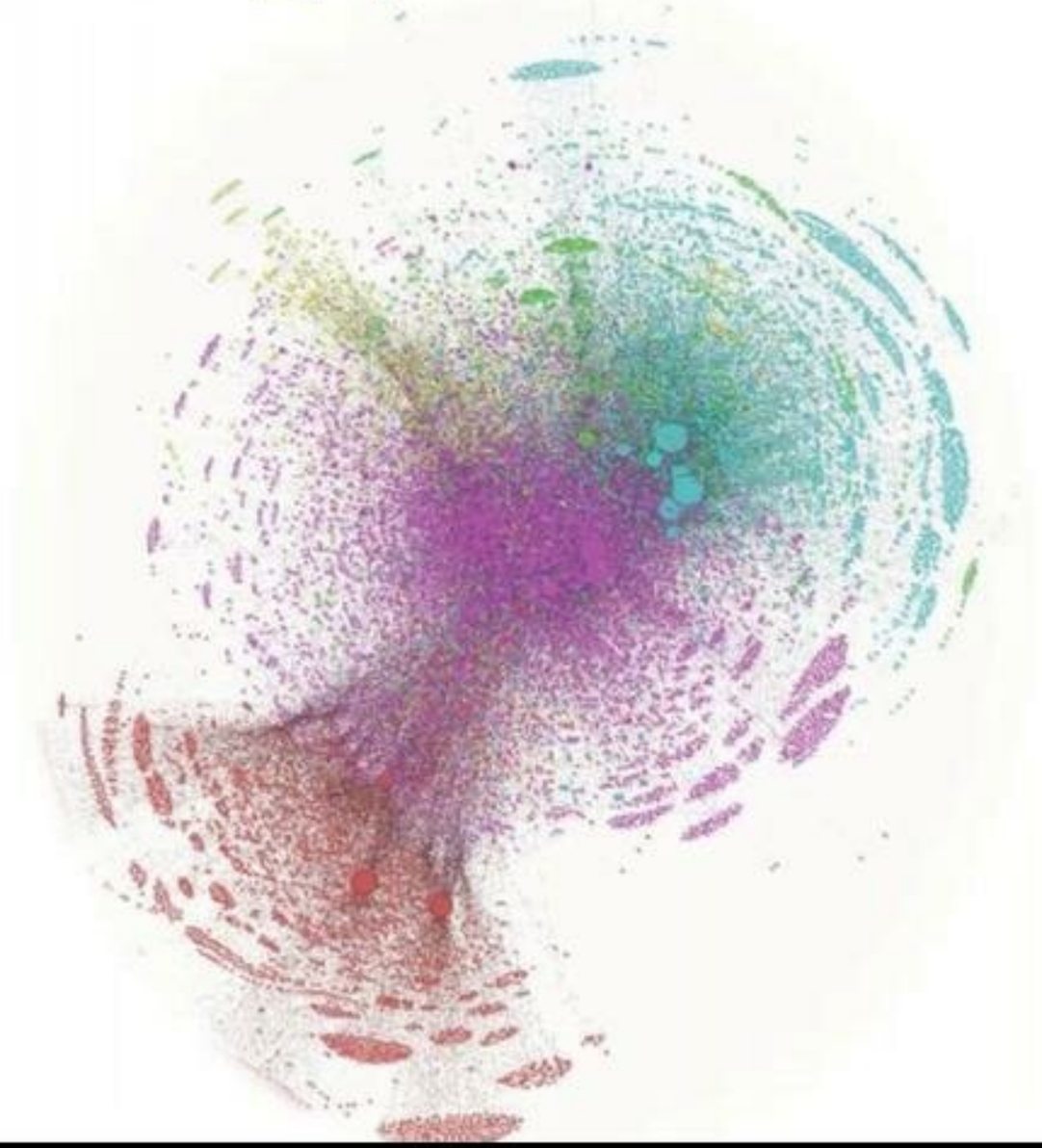

Source: Chauhan et al. (2020), https://doi.org/10.1080/00207543.2020.1831096

# Moving from Engineering to Social Sciences

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> “
> The time has come to take the potential contribution of the social sciences to climate change mitigation seriously. We can not afford to pursue engineered optimality while ignoring the social systems underpinning the transition.
>
> Creutzig et al. (2022), https://doi.org/10.31234/osf.io/ubcz6

→ Social trust, structured decision processes, and impartial rules

→ Bottom-up and top-down management systems

→ ‘Social’ tipping points (e.g., Otto et al., https://doi.org/10.1073/pnas.1900577117 and Winkelmann et al., https://doi.org/10.1016/j.ecolecon.2021.107242)

# The Supply Chain as a "Becoming"

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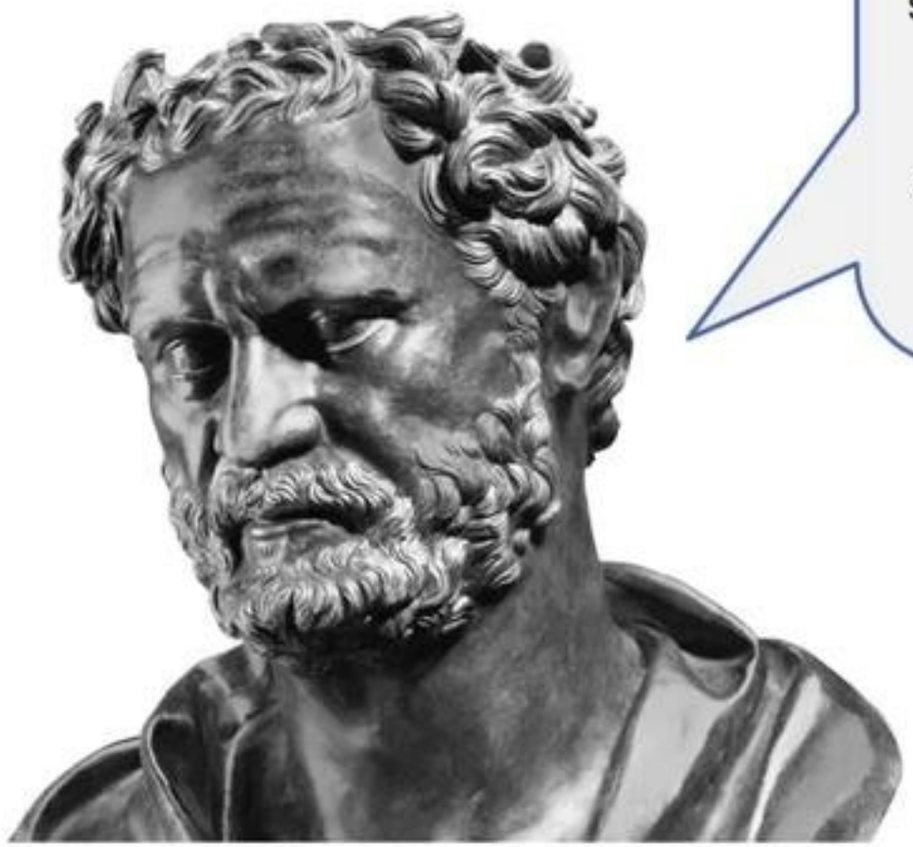

"Everything flows and nothing abides; everything gives way and nothing stays fixed. You cannot step twice into the same river, for other waters and yet others, go flowing on. Time is a child, moving counters in a game; the royal power is a child's."

Heraclitus of Ephesus

Source: Sawitt (2017), https://plato.stanford.edu/entries/spacetime-bebecome/

# Engineering and Ecology Differ in How They Interpret Systems

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# Ecological System: Management as “Evolution”

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# Social-Ecological System: Management as "Dancing"

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# Defining Supply Chain Resilience

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Supply Chain Resilience

*"Supply chain resilience is the capacity of a supply chain to persist, adapt, or transform in the face of change."* Wieland & Durach (2021)

Source: Wieland & Durach (2021), https://doi.org/10.1111/jbl.12271

# Defining Supply Chain Resilience

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**Supply Chain Resilience**

*"Supply chain resilience is the capacity of a supply chain to persist, adapt, or transform in the face of change."* Wieland & Durach (2021)

| Persist | Adapt | Transform |
|---|---|---|
| ▪ Assumes that the supply chain is an engineered system<br>▪ Aims to conserve the status quo<br>→ Solve a deviation from normal quickly | ▪ Assumes that the supply chain is an ecological system<br>▪ Acknowledges external change<br>→ Move the system to a new state | ▪ Assumes that the supply chain is an social–ecol. System<br>▪ Guide external change on a desirable trajectory<br>→ Imagine how the future should look like |

Source: Wieland & Durach (2021), https://doi.org/10.1111/jbl.12271

# Resilience of the Car Industry

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*"When politicians are out there saying, 'Let's get rid of all cars using gasoline,' do they understand this? […] The current business model of the car industry is going to collapse."* Akio Toyoda, President Toyota (2020)

*"Nokia is probably a good example of how such a change can happen—if you're not fast enough, you're not going to survive. I'm always telling our people this example."* Herbert Diess, CEO Volkswagen (2020)

*"The fundamental message that consumers should be taking today, it is financially insane to buy anything other than a Tesla. It will be like owning a horse in three years."* Elon Musk, CEO Tesla (2019)

# Three Stages of Resilience Related to Short-, Medium- and Long-term Perspectives

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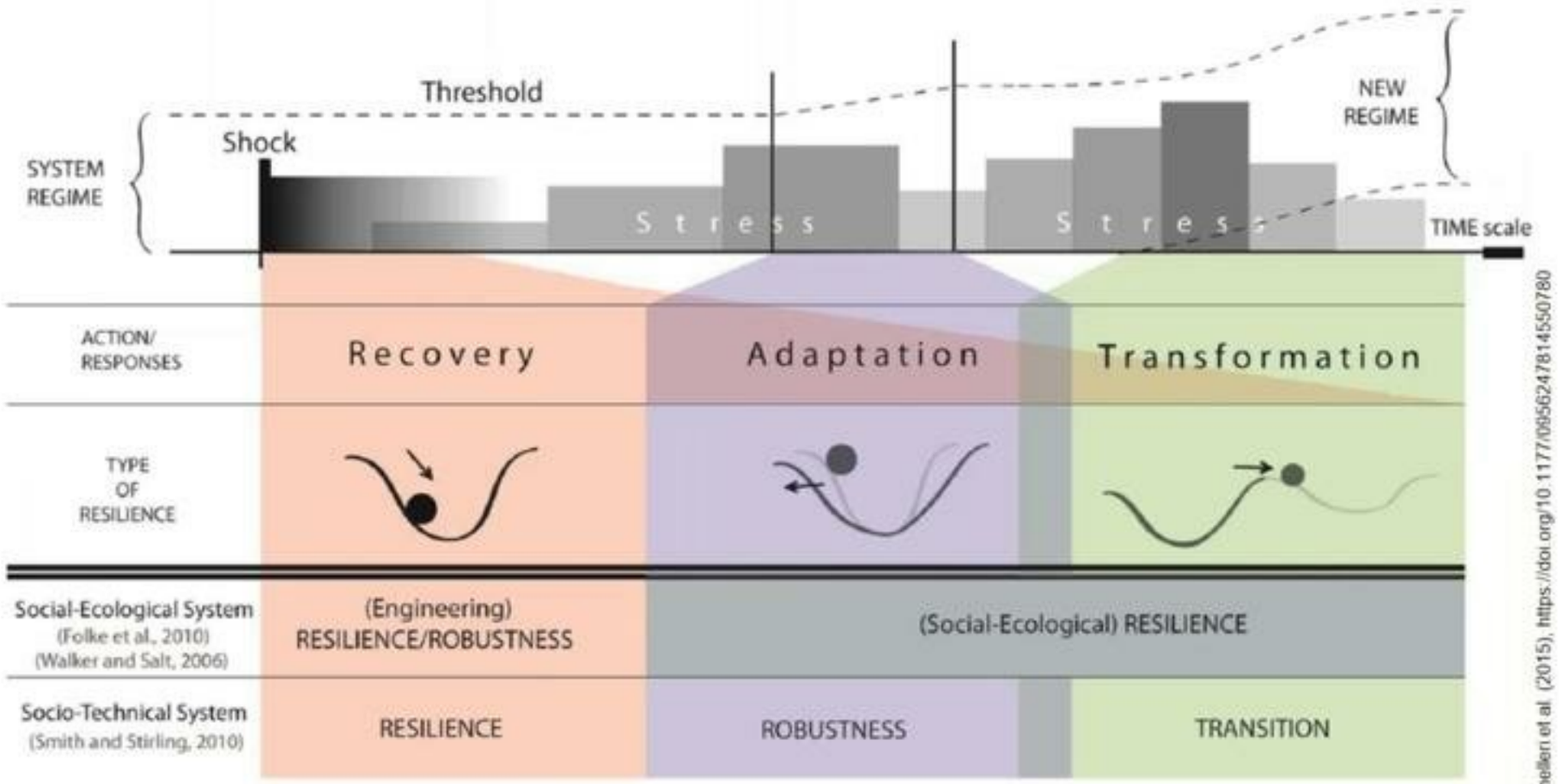
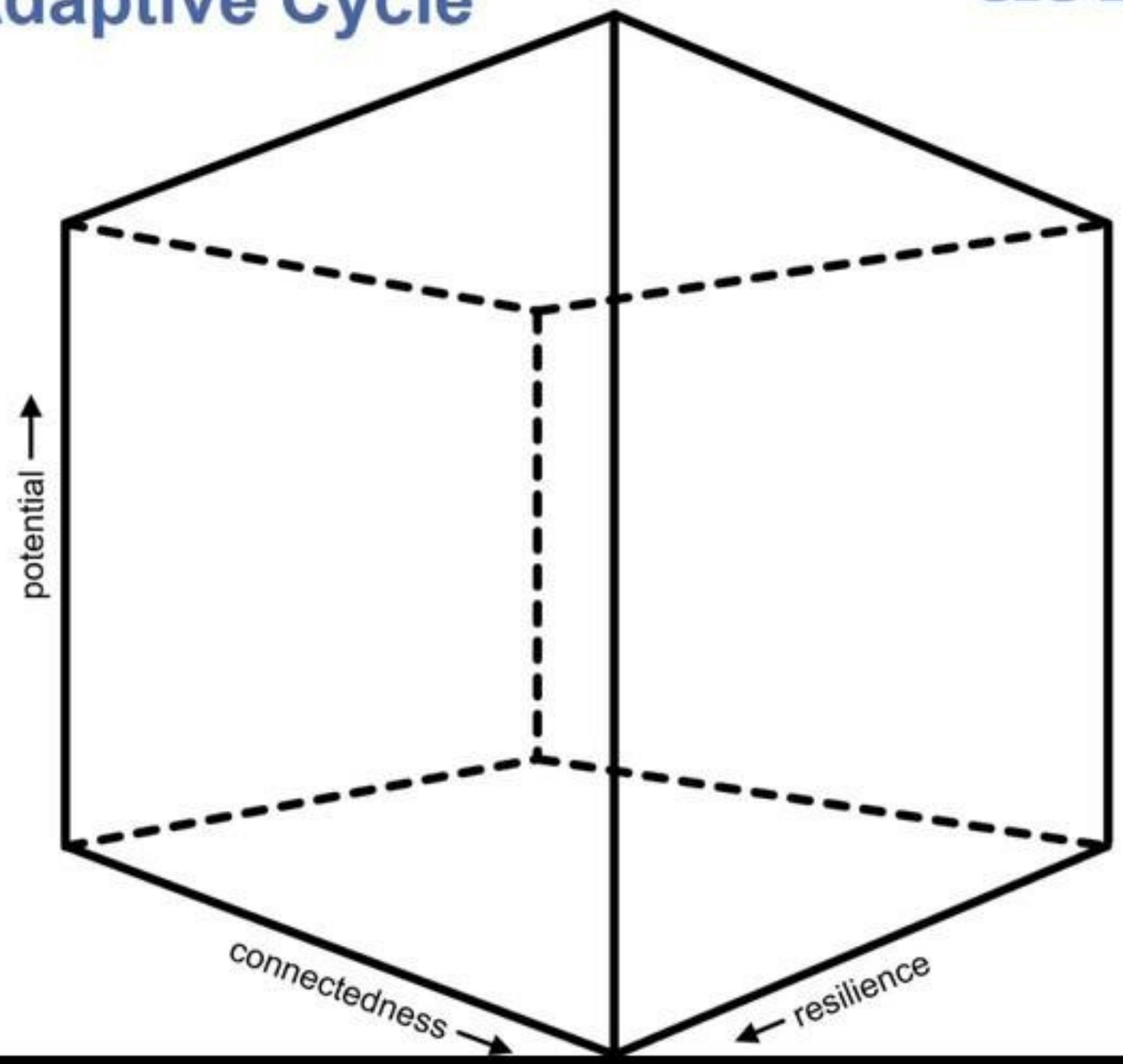



Source: Chelleri et al. (2015), https://doi.org/10.1177/0956247814550780

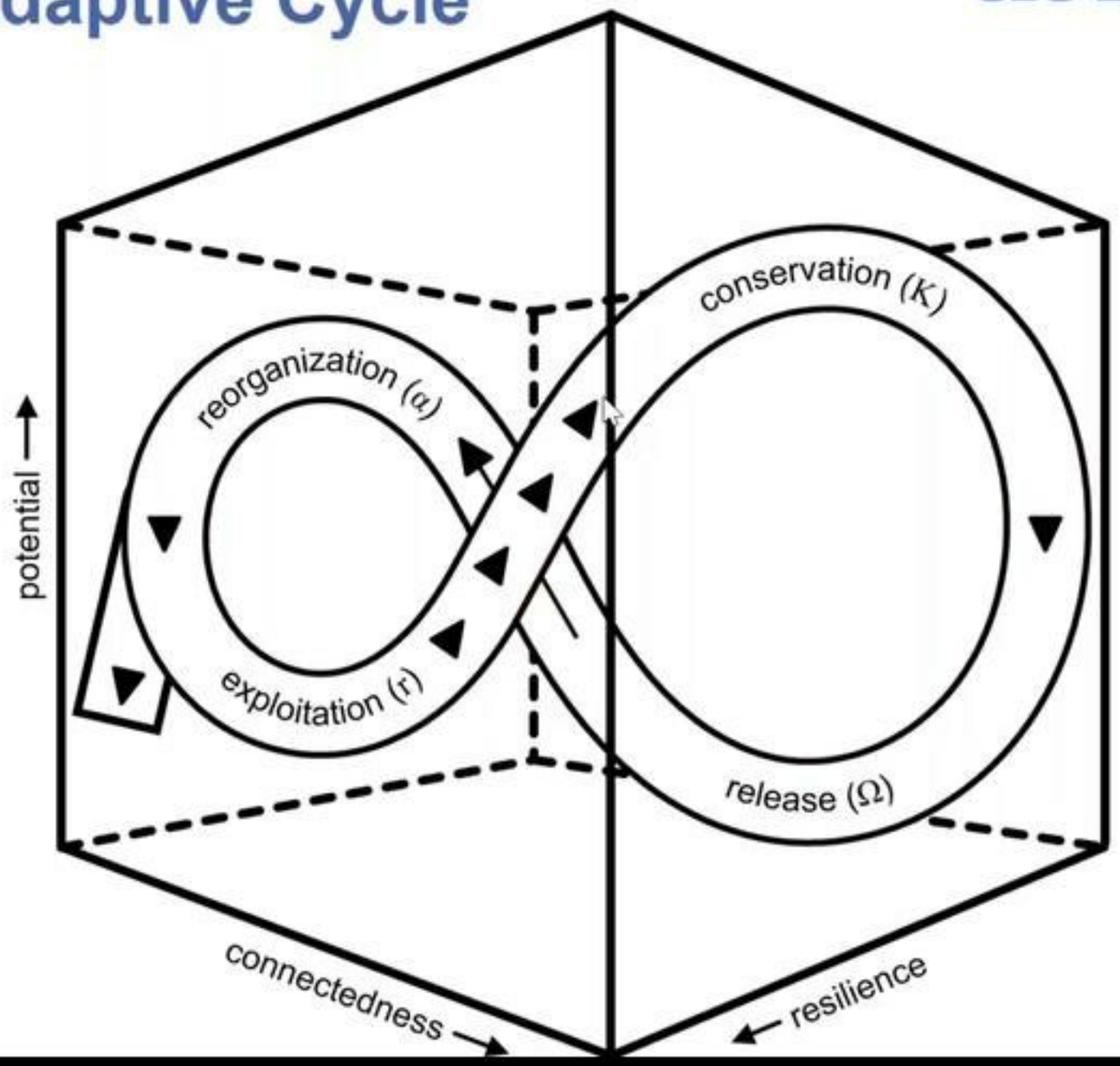
# The Adaptive Cycle






Source: Weiland (2021), based on Holling (2001)

# The Adaptive Cycle




Source: Wieland (2021), based on Holling (2001)

# Reductionism: Isolating a System From Its Environment

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# Simultaneously Studying Systems on Different Levels of Space and Time

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*"[A terrestrial ecosystem] can be described at a leaf or needle scale range (centimeters to meters in space and months to years in time); a tree scale range (multiple meters and decades); to a forest scale range (kilometers and centuries)."* Allen et al. (2014)

Leaf

Tree

Forest

# A Scale of Meaning Relates to Different Narratives Being Told on Different Levels

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# The Problem with Growth when there Are Capacity Boundaries

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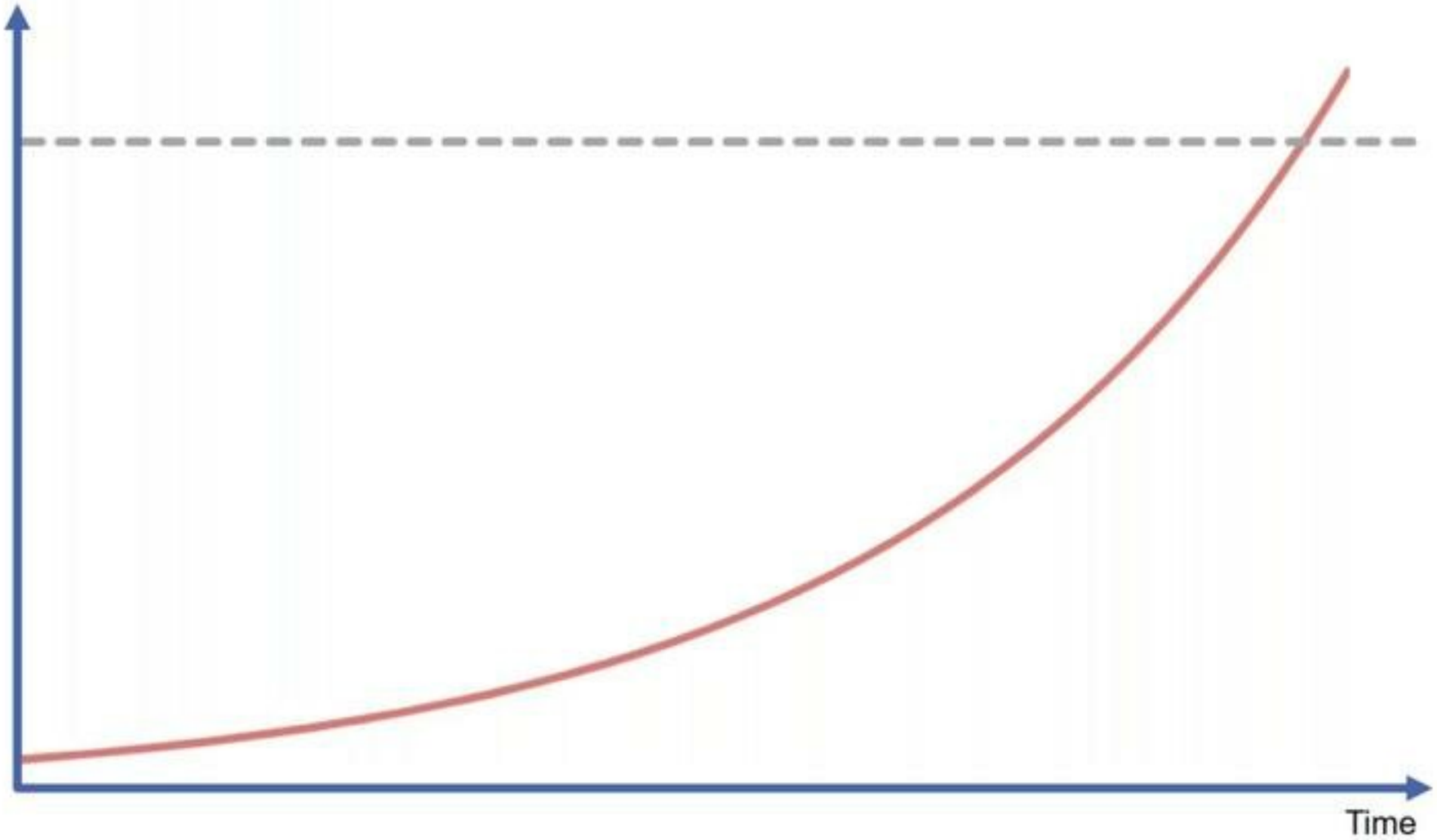

# The Problem with Growth when there Are Capacity Boundaries

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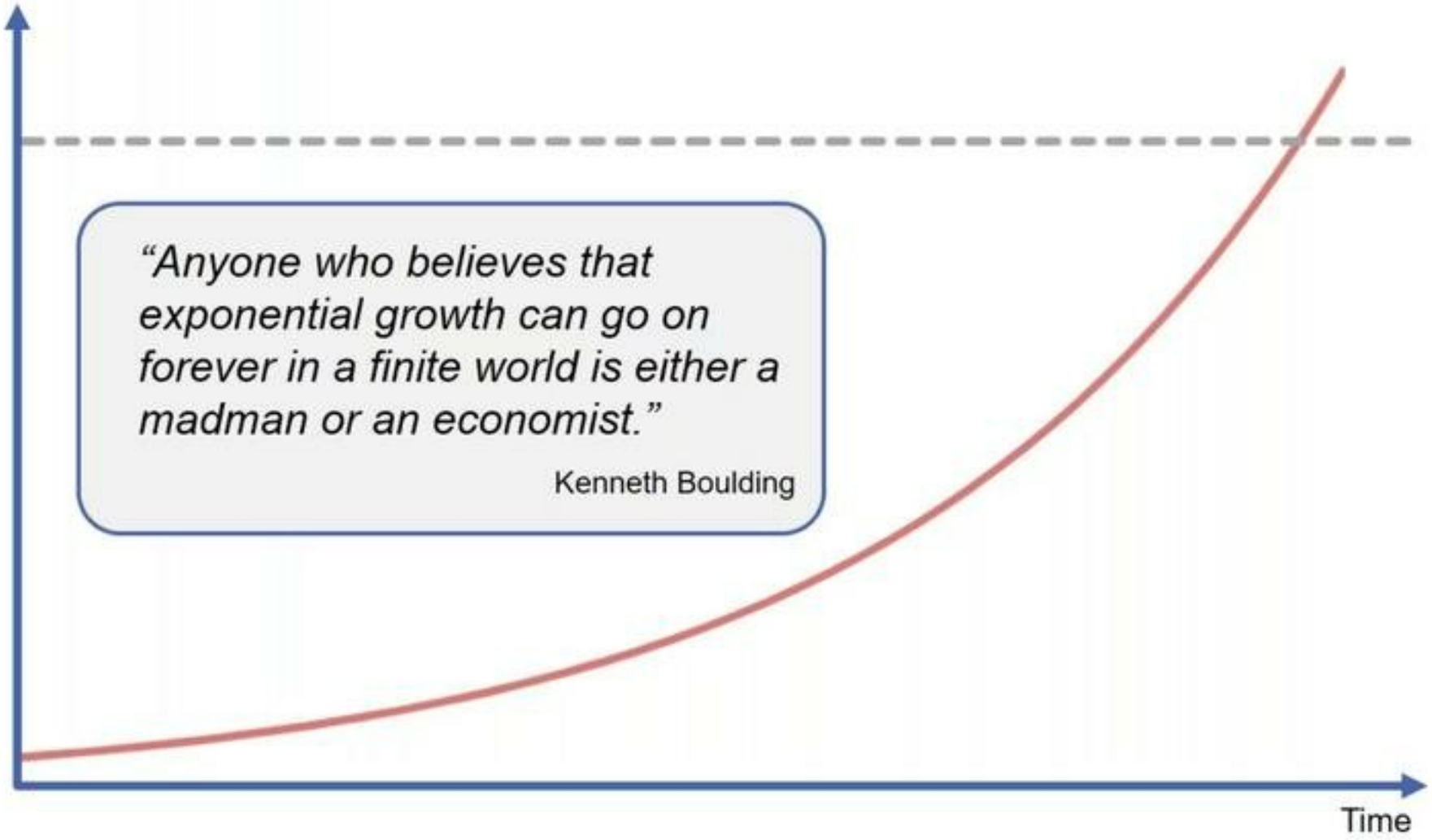

# Economic Growth vs. Planetary Boundaries

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## Economic Growth

- A quantity that has been increasing in the world even faster than human population is industrial output.
- Industrial output has been growing exponentially in the last decades.

Source: Steffen et al. (2015), https://doi.org/10.1126/science.1259855; image: Andrew Rae, NY Times (2018)

# Economic Growth vs. Planetary Boundaries

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## Economic Growth

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## Planetary Boundaries

- The human enterprise has grown so dramatically since the mid-20th century that the relatively stable, 11,700-year long Holocene epoch is now being destabilized.
- A continuing trajectory away from the Holocene could lead to a very different state of the Earth System, one that is likely to be much less hospitable to the development of societies.

Source: Steffen et al. (2015), https://doi.org/10.1126/science.1259855; image: Andrew Rae, NY Times (2018)

# Current Status of the Control Variables for Seven of the Planetary Boundaries

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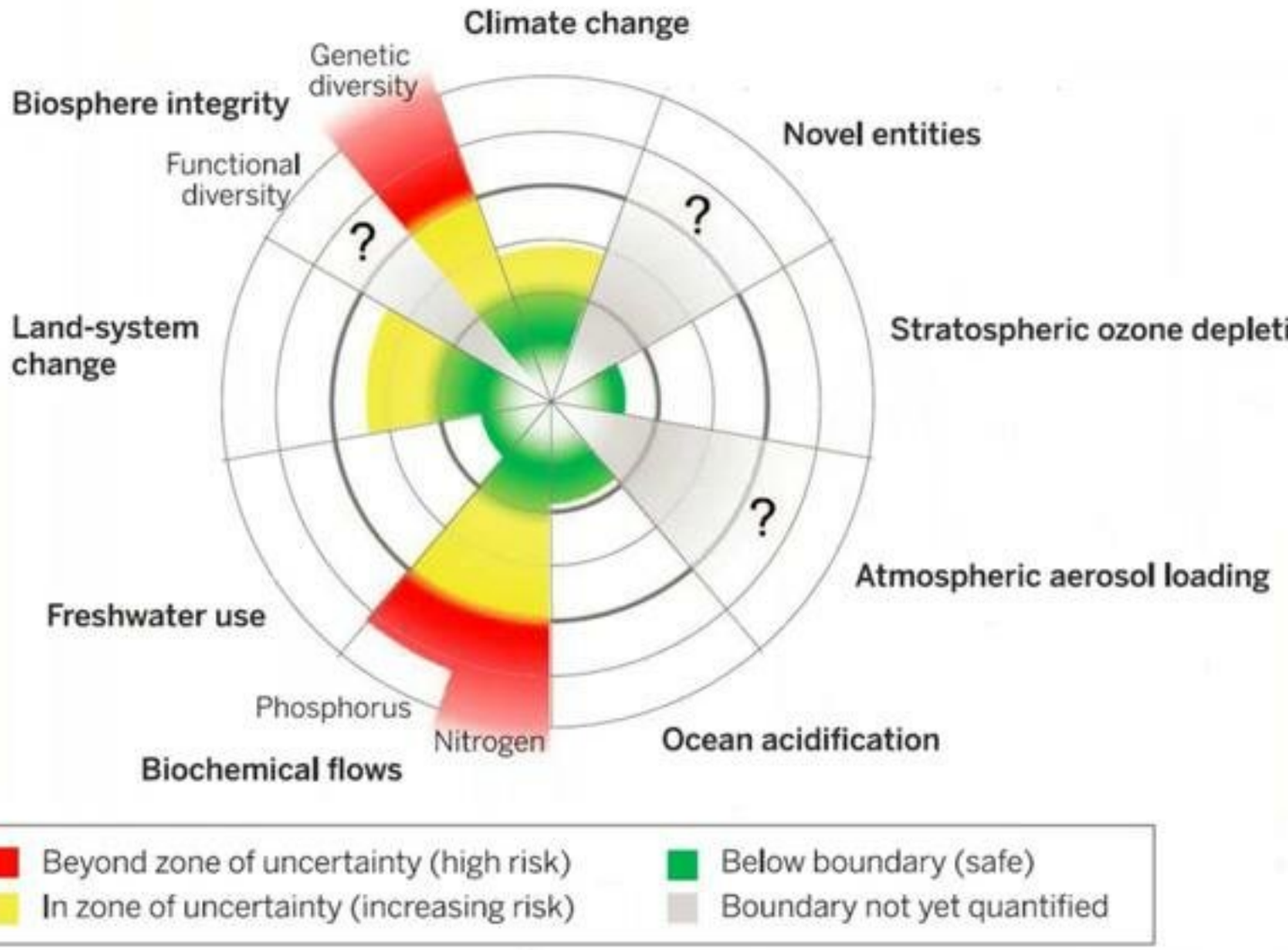


Source: Steffen et al. (2015), https://doi.org/10.1126/science.1259855

# Largely Ignored by Our Theories, Supply Chains Are Vulnerable and Harmful Systems

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# Levels of Space, Time and Meaning in Supply Chain Management

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*A supply chain can be observed at a supply chain scale range (e.g., about one year in time for each new product generation; a relatively small number of people being involved ), a more abstract political-economic scale range (decades in time; larger numbers of people), and a planetary scale range (tens of thousands of years; the entire world population involved).*

Supply Chain

Polit.-Econ. System


Planet

Source: Wieland (2021), https://doi.org/10.1111/jscm.12248

# The Panarchy as a Structure of Nested Systems

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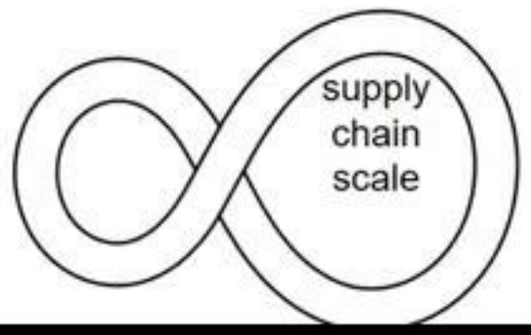


Source: Weiland (2021), https://doi.org/10.1111/jscm.12248

# The Panarchy as a Structure of Nested Systems

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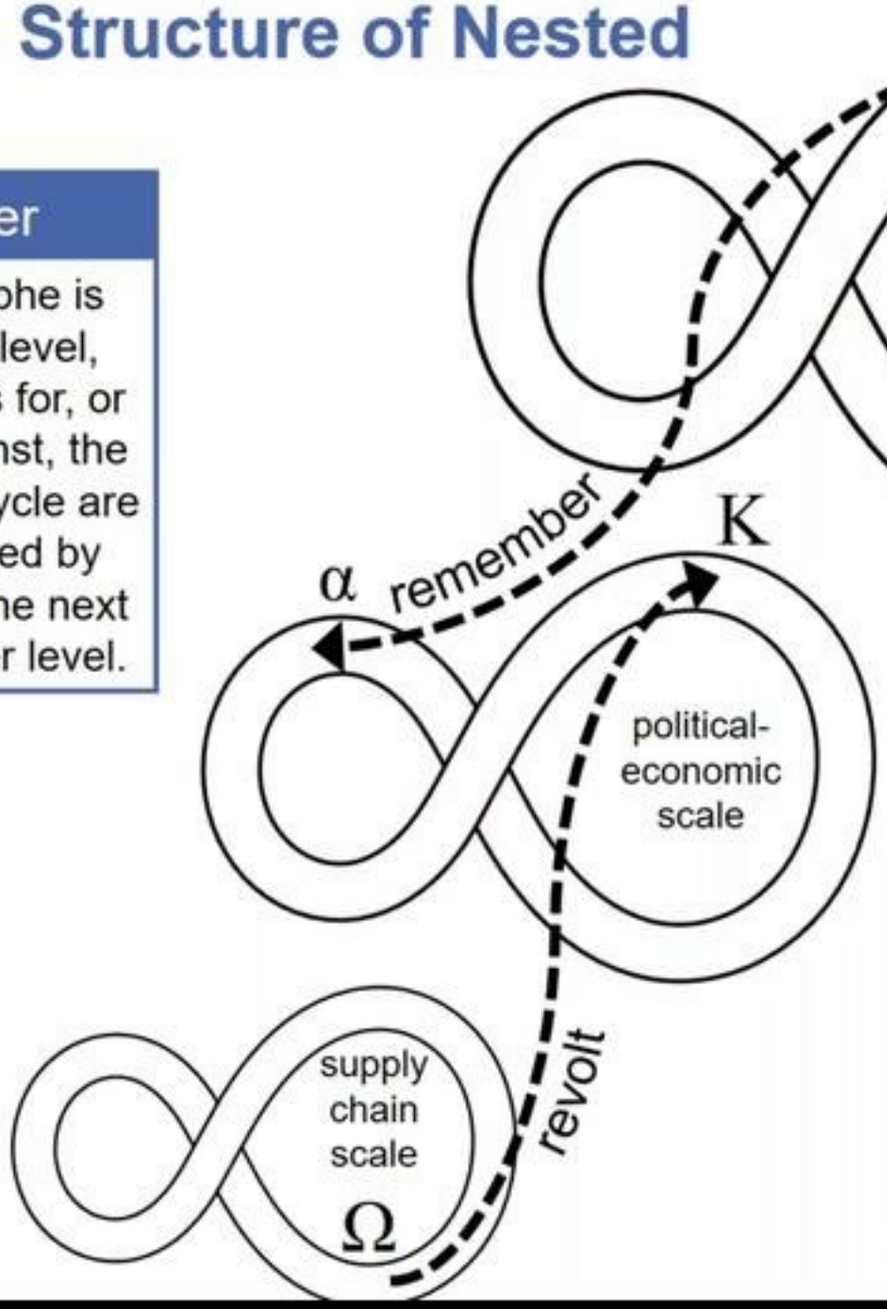
**Remember**

Once a catastrophe is triggered at one level, the opportunities for, or constraints against, the renewal of the cycle are strongly influenced by the K phase of the next slower and larger level.




**Revolt**

When a system enters its Ω phase the collapse can cascade to the next larger level by triggering a crisis (e.g. via larger societal revolts or stakeholder revolts).

Source: Wieland (2021), https://doi.org/10.1111/jscm.12248

# Characteristics of Traditional and Panarchical Supply Chain Management

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| | Traditional supply chain management | Panarchical supply chain management |
|---|---|---|
| Assumptions | Static; reductionist | Dynamic; holistic |
| Discourses | Modernism; positivism | Holism; interpretivism |
| Supply chain | Closed, engineered system ("being") | Open, social–ecological system ("becoming") |
| Management | Command and control; optimization; scientific | Dancing; navigation; experimental |
| Integration | Cross-functional; cross-organizational | Cross-level |
| Goals of management | Growth; stability | Transformation; variety |
| Decision-making | Objective | Subjective |

Source: Weiland (2021), https://doi.org/10.1111/jscm.12248

# Transformative Governance

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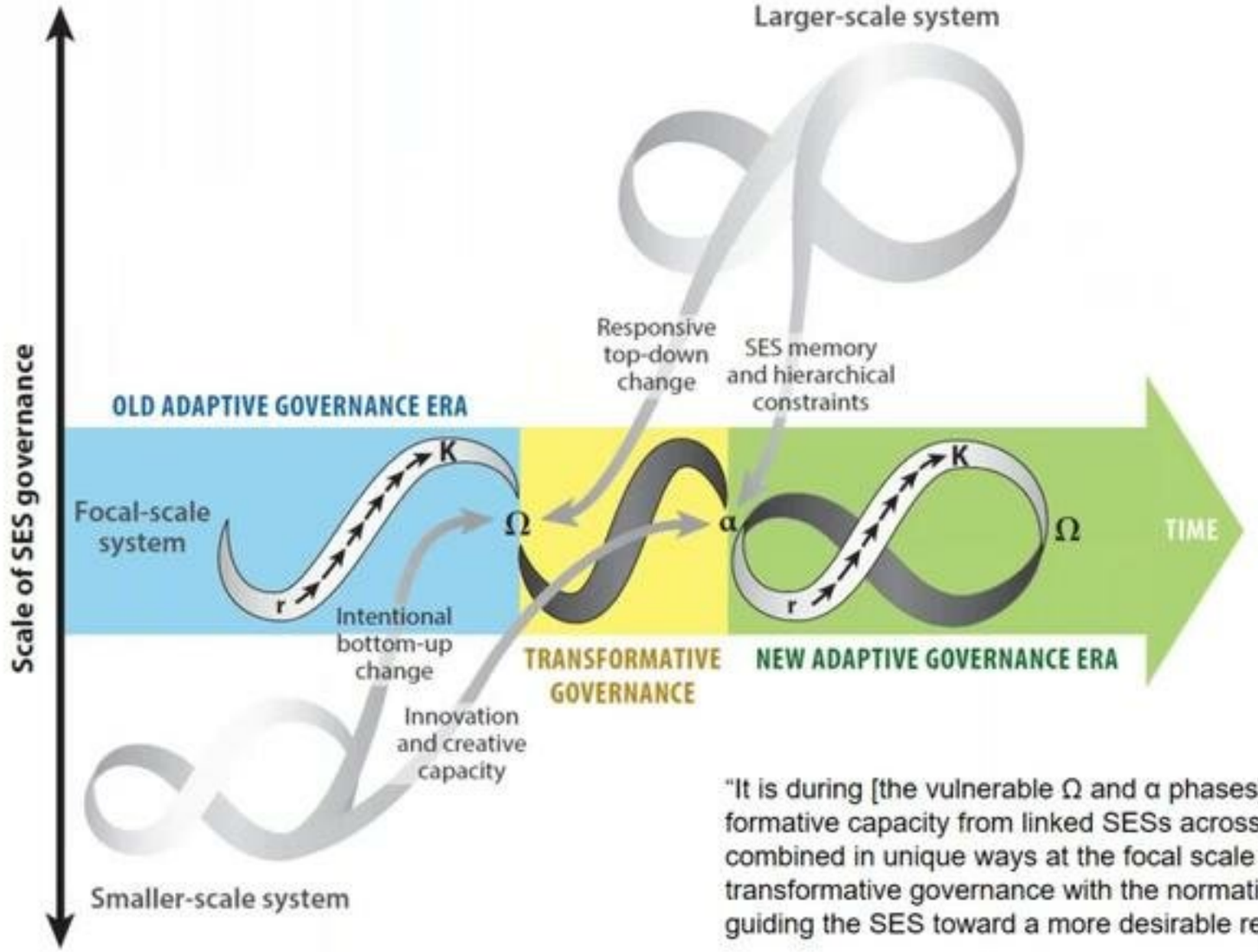


"It is during [the vulnerable Ω and α phases] that transformative capacity from linked SESs across scales […] is combined in unique ways at the focal scale to culminate in transformative governance with the normative goal of guiding the SES toward a more desirable regime."

Source: Chaffin et al. (2016), https://doi.org/10.1146/annurev-environ-110615-085817

# A Panarchical Research Agenda

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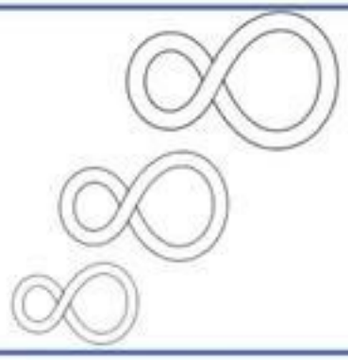
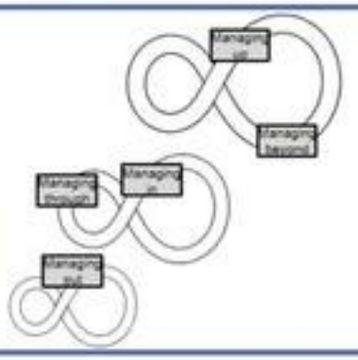
**Theme 1**

Extending the unit of analysis from the supply chain to a nested system on the group, functional, organizational, supply chain, political-economic, socio-cultural, and planetary levels.



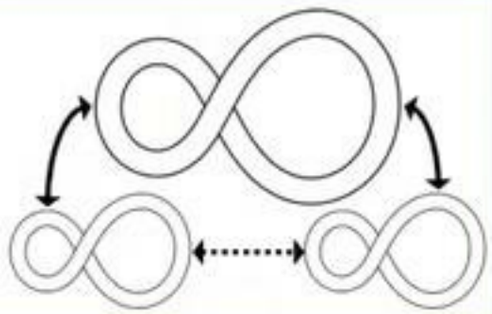
**Theme 2**

Interpreting supply chain management as an adaptive and trans-formative type of management, as managing *in*, *through*, *out*, *up*, and *beyond*.



**Theme 3**

Discovering new relationships, not relationships *within* the supply chain, but between seemingly unrelated and distant supply chain actors in terms of their "teleconnection" via larger levels.



Source: Wieland (2021), https://doi.org/10.1111/jscm.12248

# Distant Communities Are Teleconnected via the Supply Chain

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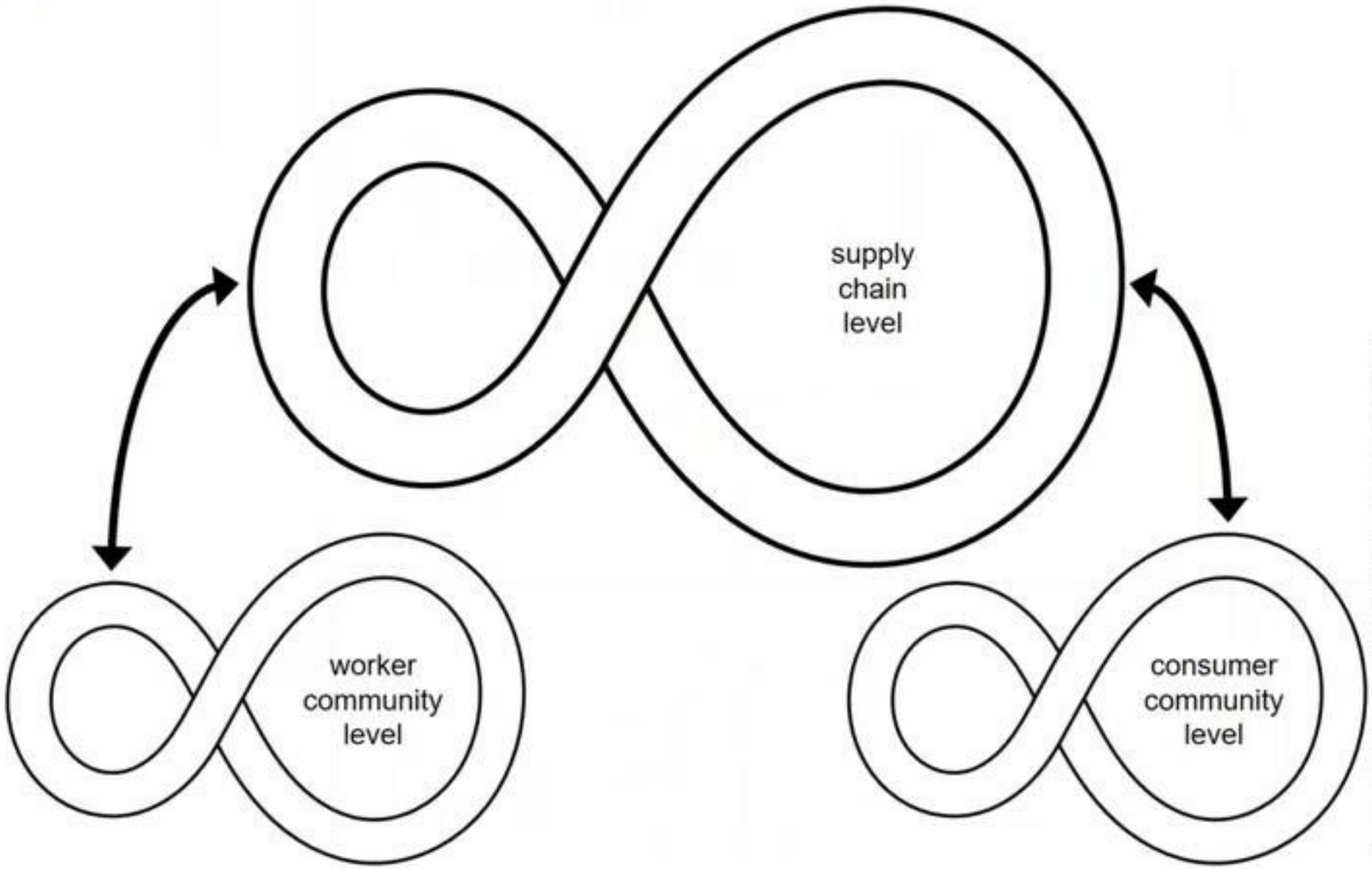


Source: inspired by Adger et al (2009), https://doi.org/10.1890/070148

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