Autonomy **Growth** **Complexification** **Adaptation**

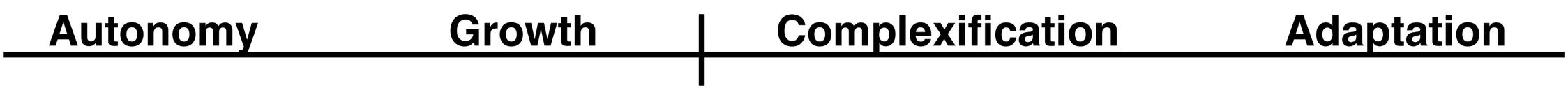
2015

Autonomy **Growth** | **Complexification** **Adaptation**

Now

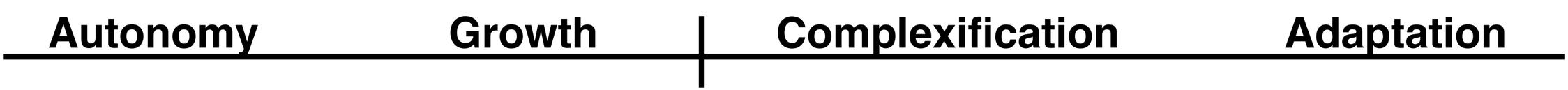
DevOps discovered opportunities to build adaptive capacity to overcome complexity penalties from growth

2015



Now

2015



Now

New waves of complexity penalties threaten, can DevOps create new opportunities to build adaptive capacity?

2015

Autonomy **Growth** | **Complexification** **Adaptation**

Now

Marry computational power w/ new representational power
to see ahead, see around, see anew

Autonomy	Growth	Complexification	Adaptation

Noun-people
Nearly optimal

Stuck on Stuff:
how much, links, counts, linear

Verb-people
Messy, SNAFU

Activities: doing, adapting,
revising, keeping pace,…

Autonomy **Growth** **Complexification** **Adaptation**

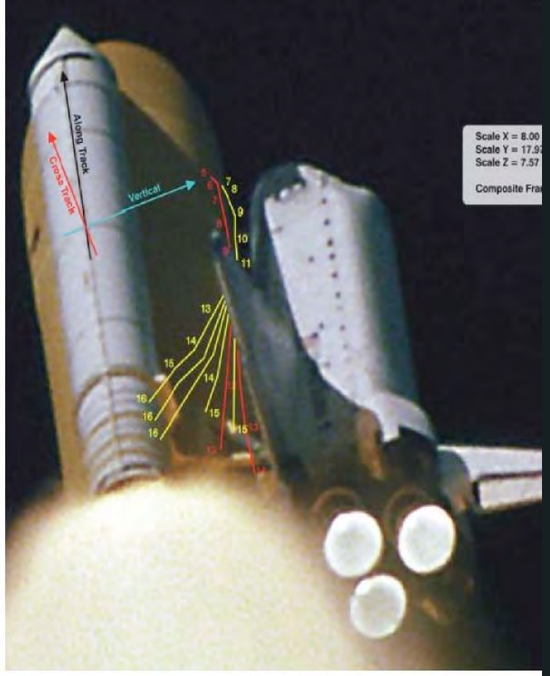
Noun-people
Nearly optimal, if only …

more autonomy
since people are the limit

Verb-people
Messy, endlessly

build future adaptive capacity b/c
brittleness & surprise are inevitable

Operating in Seas of Complexity



places where surprise is tangible

2015

The future is already here & it’s not as advertised

Autonomy **Growth** **Complexification** **Adaptation**

DevOps
continuous adaptability at scale

When Complexity Penalties Grow too

↑ Pace/Tempos, Surprises, Tangles,
↑ Saturation, Lag, Friction,
↑ Congestion, Cascades, Conflicts

Need ↑ Adaptive Capacity when AC under pressure

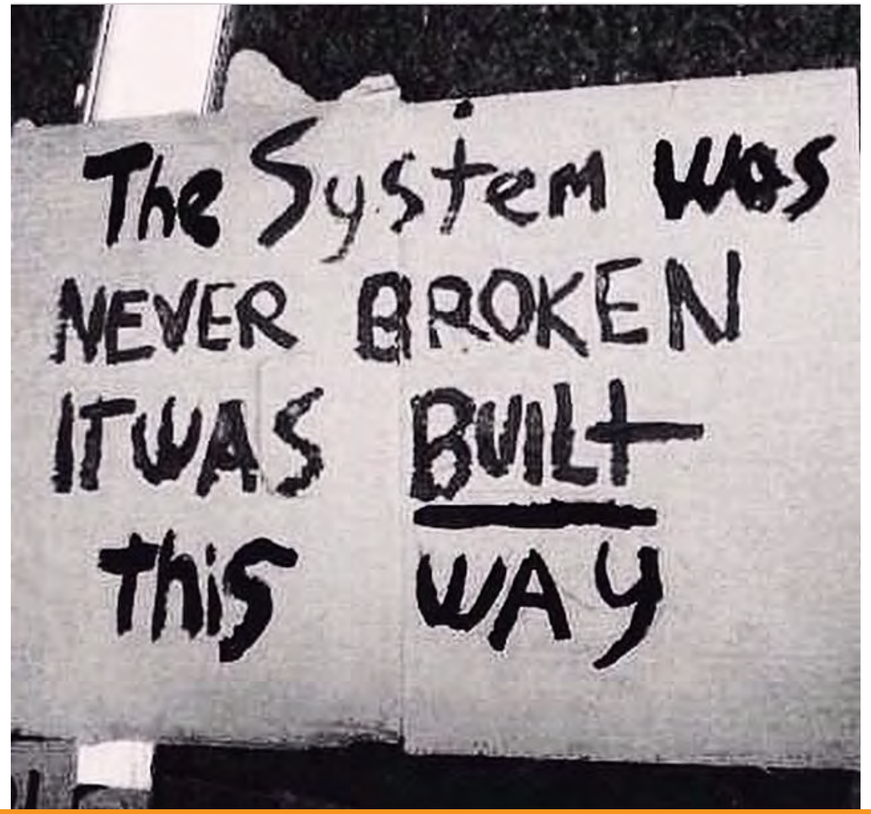
Keep Pace with Change? ↑ Risk Slow, Fragmented and Stale

Revealed during incidents/outages of valued, vital services

Systems are *Messy*

(some) People/Agents provide resilient performance

Resilience-as-extensibility essential for systems to succeed despite their design



Finite Resources/Continuing change inescapable
(regardless of your role, technology, or potential advance)

Pressures are ubiquitous

SNAFU is normal

Poised to Adapt is essential

05

SNAFU CATCHERS

SNAFU is the natural state of systems

Plans and Resilience-as-extensibility

Plans and Resilience-as-extensibility

Plans and Resilience-as-extensibility

SNAFU is normal

SNAFU catching ubiquitous

SNAFU catching becomes invisible

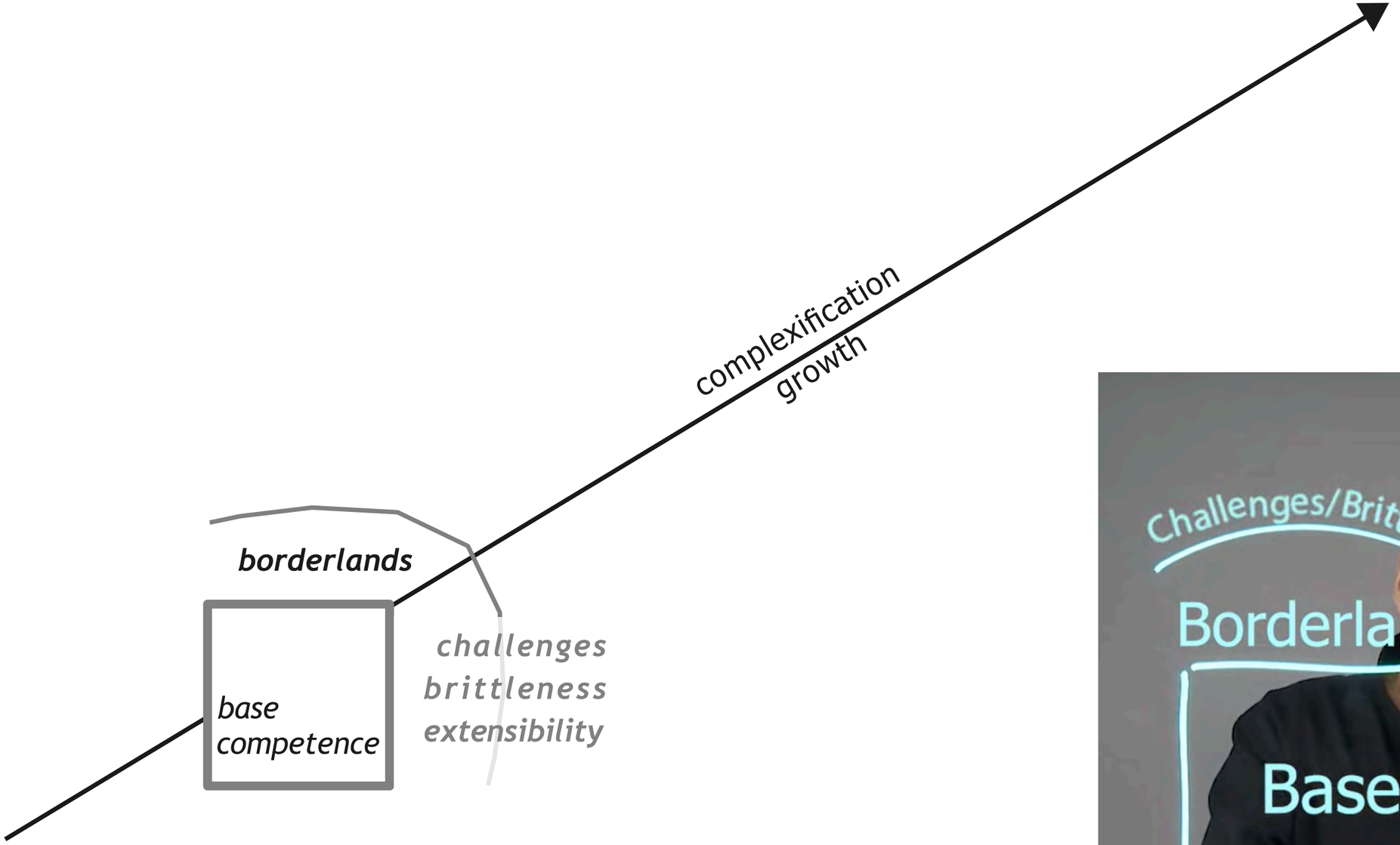
SNAFU is misperceived as rare

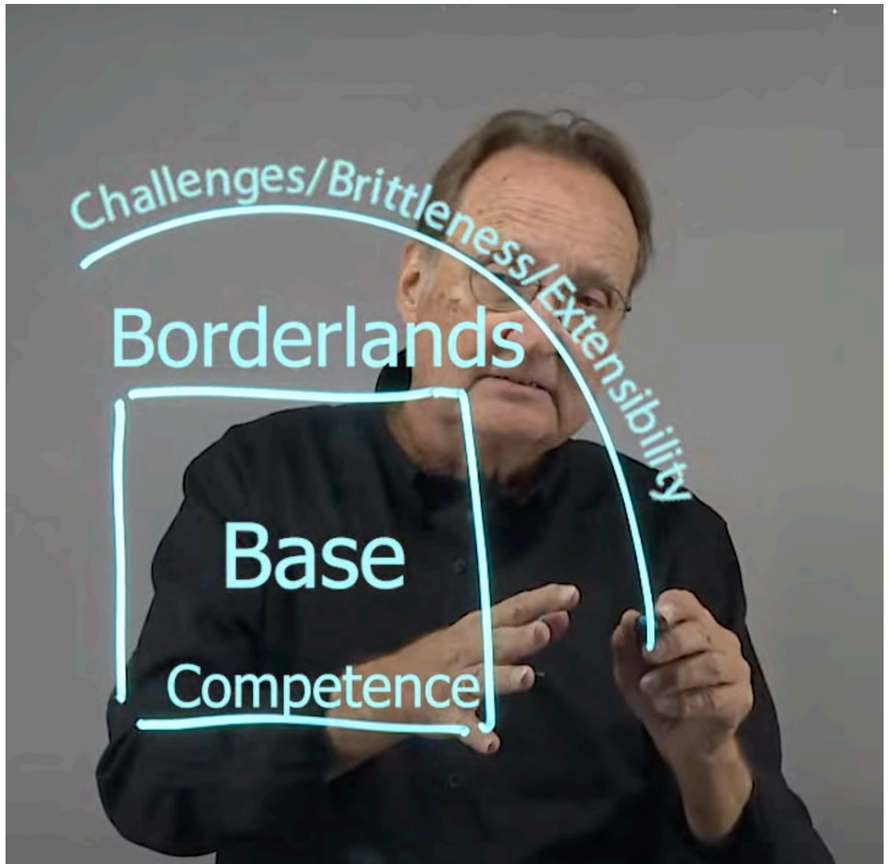
Law of Fluency →"Well"-adapted activity occurs with a facility that belies the difficulty of the demands resolved & the dilemmas balanced

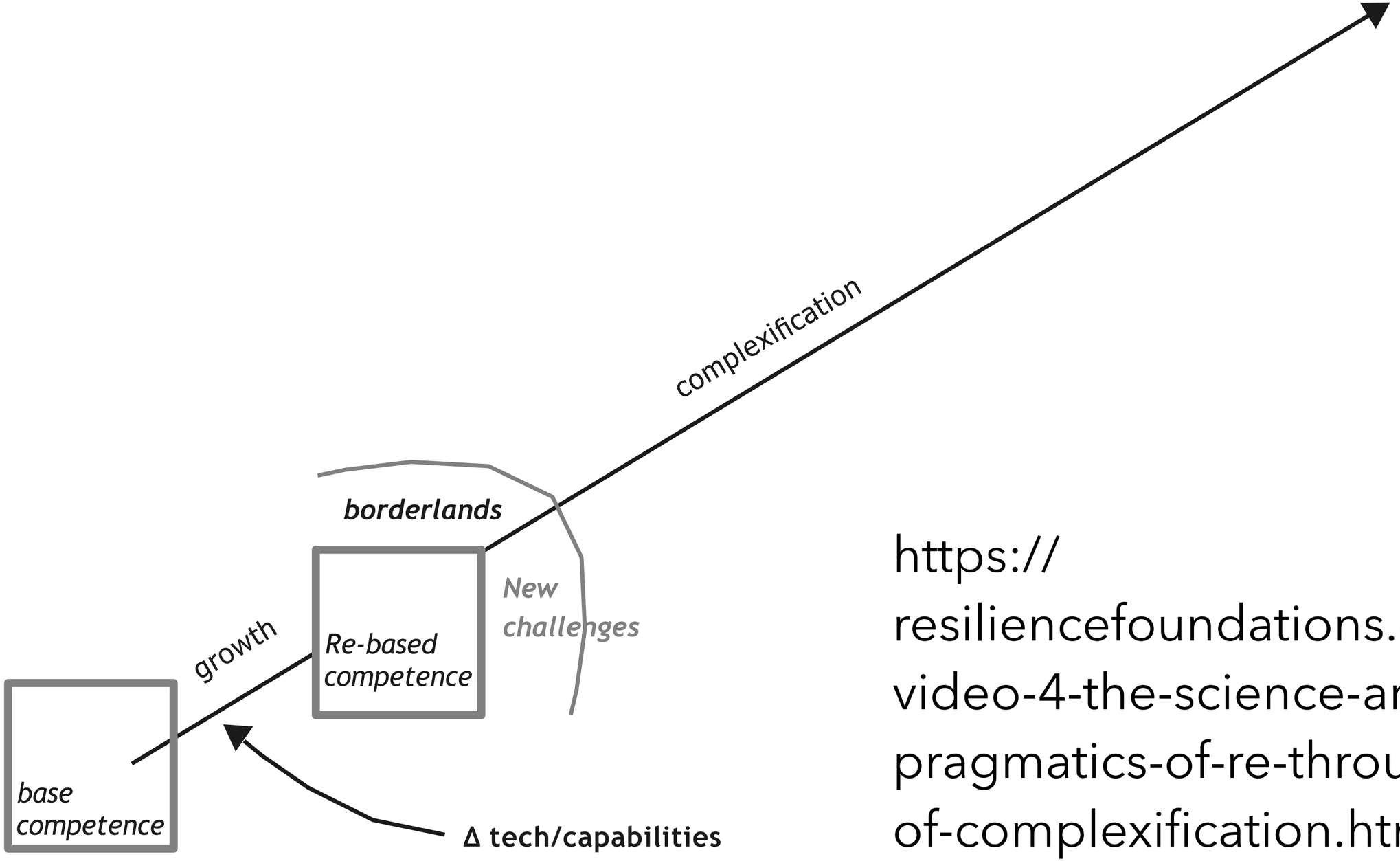
Methods designed to reveal where and how SNAFU catching occurs

Explore the gap between Work as Imagined and Work as Done (WAI-WAD)

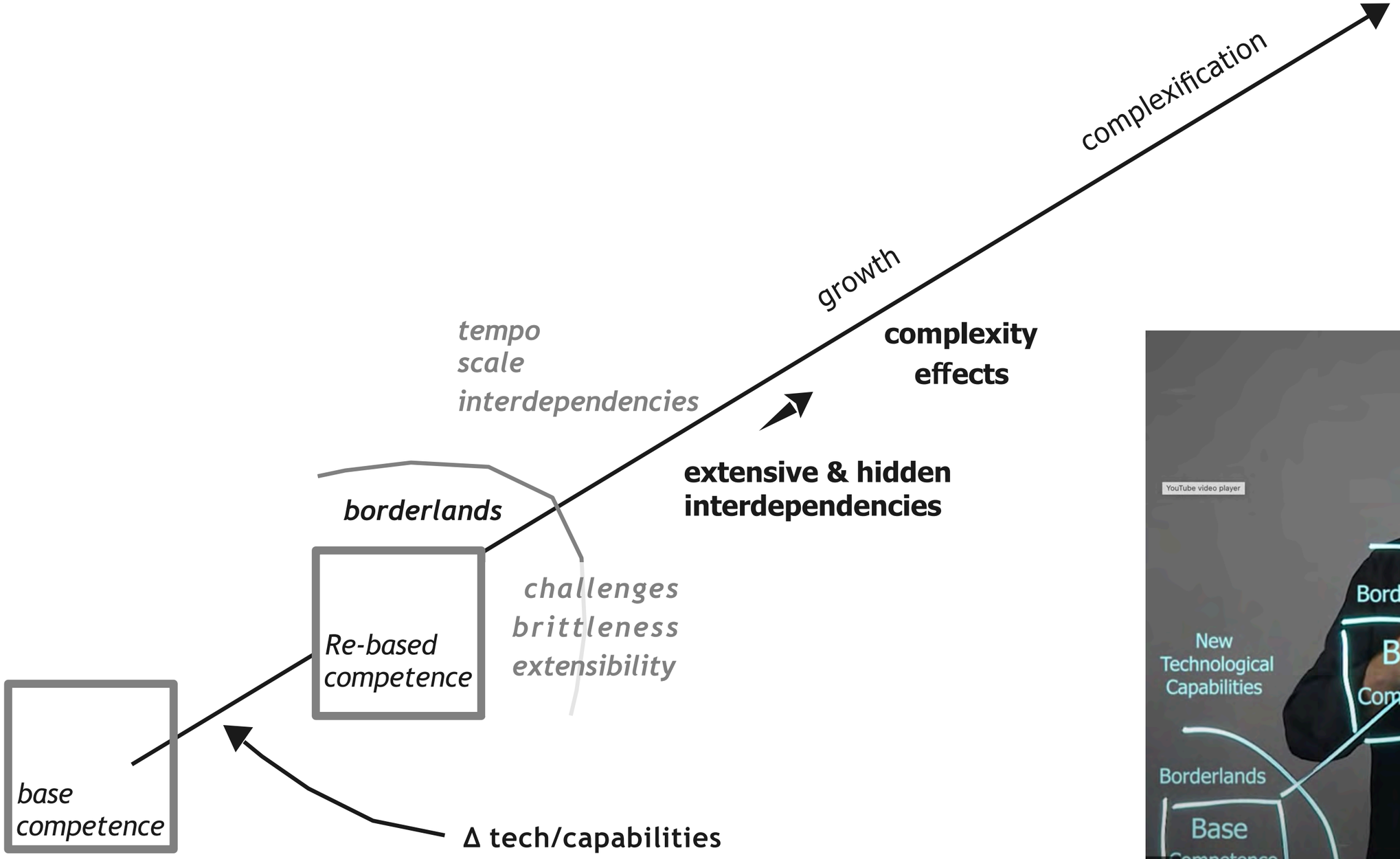
https://resiliencefoundations.github.io/overview.html

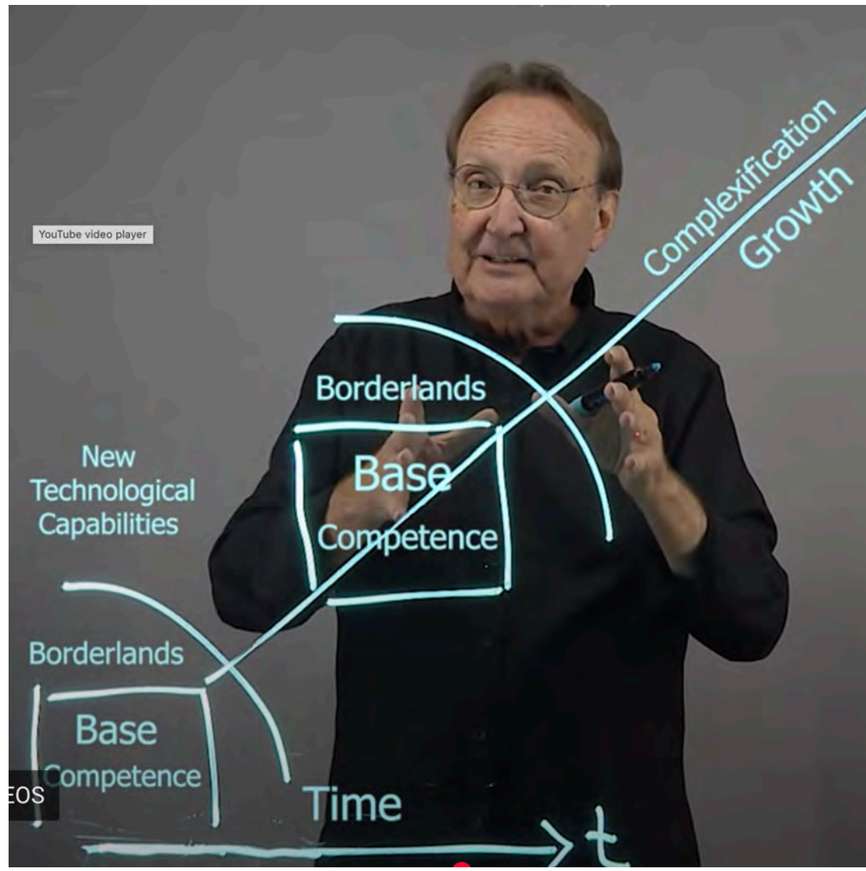

complexification
growth
borderlands
base
competence
challenges
brittleness
extensibility


Challenges/Brittleness/Extensibility
Borderlands
Base
Competence



https://resiliencefoundations.github.io/video-4-the-science-and-pragmatics-of-re-through-the-lens-of-complexification.html


complexification
growth
tempo
scale
interdependencies
complexity
effects
extensive & hidden
interdependencies
borderlands
challenges
brittleness
extensibility
Re-based
competence
base
competence
Δ tech/capabilities


YouTube video player
Complexification
Growth
Borderlands
Base
Competence
New
Technological
Capabilities
Borderlands
Base
Competence
Time
t

Overview

How is everything in resilience engineering connected? Here are two visuals to reference.

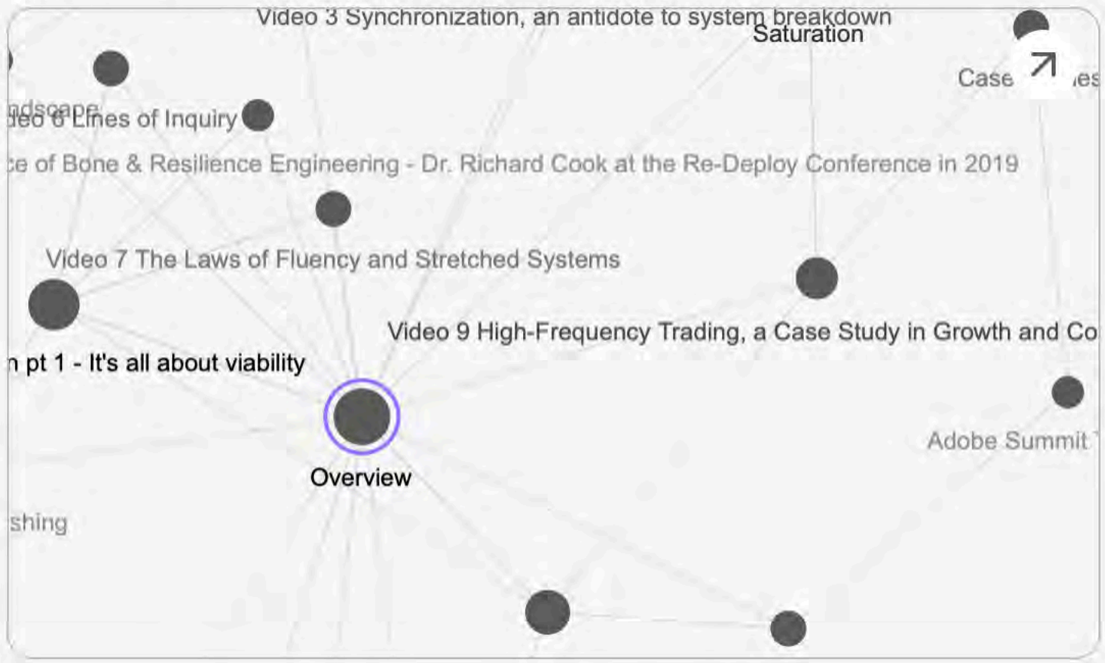
Viability

Video 1 Introduction pt 1 - It's all about viability

Theory and Pragmatics are Complementary

Video 4 The Science and Pragmatics of RE through the lens of Complexification

INTERACTIVE GRAPH



https://resiliencefoundations.github.io/overview.html

Viability is a universal goal

Resources are finite

Conflict is ubiquitous

Systems are always adapting

Change is continuous

Models become stale,
Surprise re-occurs

Seeking Opportunity

Growth in the face of constraints

Handling Challenge

Extensibility in the face of potential brittle collapse

Other units at other layers are adapting too

“Law of Stretched Systems”
any improvement will be exploited to achieve a new intensity and tempo of activity

“Law of Fluency”
hides the effort required to maintain viability

Reference: Woods, D. D. (2018). The Theory of Graceful Extensibility: Basic rules that govern adaptive systems. *Environment Systems and Decisions*, 38(4), 433-457.

Viability is a universal goal

Resources are finite

Conflict is ubiquitous

Change is continuous

Models become stale, Surprise re-occurs

Systems are always adapting

Seeking Opportunity

Growth in the face of constraints

Handling Challenge

Extensibility in the face of potential brittle collapse

Growth

↑ interdependencies, scale, tempos, challenges, surprises

Complexity penalties

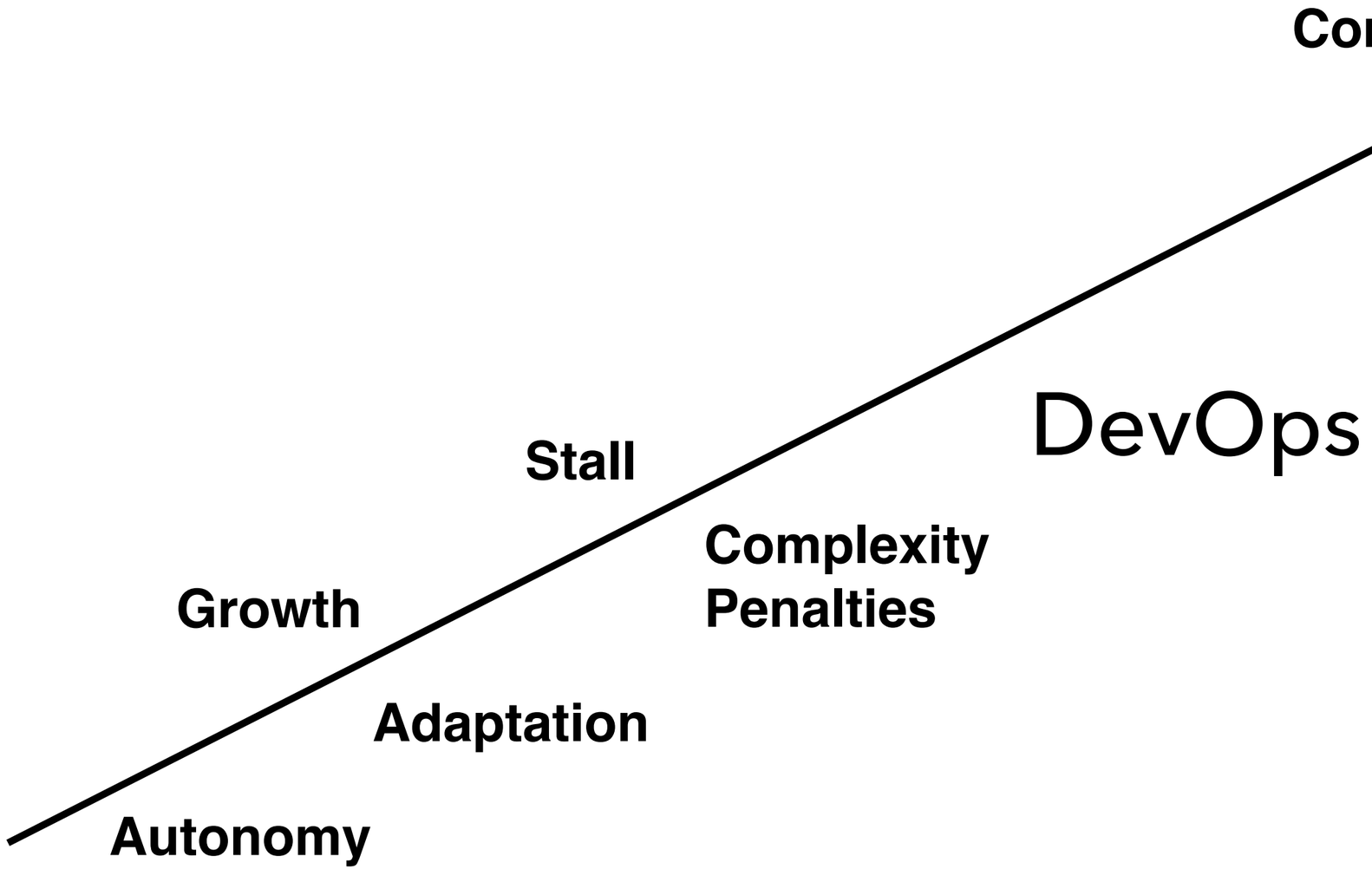
Robust yet Fragile (RyF) & other T/Os

Risks from brittleness are omnipresent

Complexification

Reference: Woods, D. D. (2018). The Theory of Graceful Extensibility: Basic rules that govern adaptive systems. *Environment Systems and Decisions*, 38(4), 433-457.

2015


Complexification
DevOps
Stall
Complexity
Penalties
Growth
Adaptation
Autonomy

to outmaneuver complexity

DevOps

Discovered Opportunities

via underground adaptations

innovate opportunities by reframing, re-synchronizing, anticipating

Stella.report

2025

Autonomy **Growth** **Complexification** **Adaptation**

Complexification and You
Where Nouns and Verbs do Battle

Management

Noun

Neat, if only

Stuff: how much, links, counts, linear

Activities: doing, adapting, revising, pace,…

Ops

Verb

Messy, endlessly

Complexification
Where Nouns and Verbs do Battle

Failure statistics

Noun or Verb?

Complexification
Where Nouns and Verbs do Battle

Noun

Complexification
Where Nouns and Verbs do Battle

Nouns or Verbs capture …

Saturation, Lag, Friction,
Congestion, Cascade, Conflict,
Changing Tempos

Complexification
Where Nouns and Verbs do Battle

Complexification
Where Nouns and Verbs do Battle

MTTR

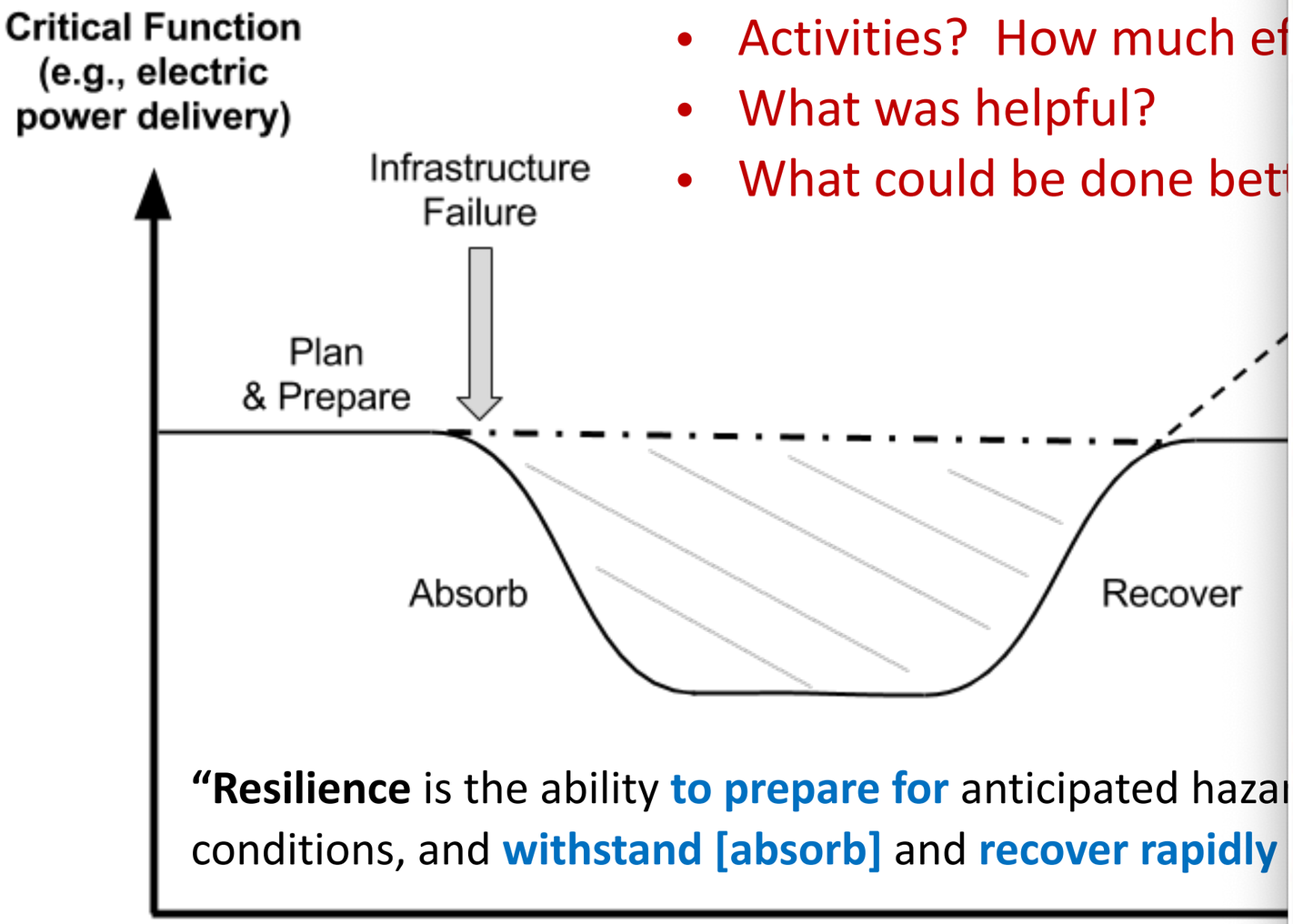
Noun or Verb?

Complexification
Where Nouns and Verbs do Battle

Noun

The “Rebound Curve” is a Poo

Process-Outcome Confusio
- Activities? How much ef
- What was helpful?
- What could be done bett



“Resilience is the ability **to prepare for** anticipated hazar
conditions, and **withstand [absorb]** and **recover rapidly**

Official Definition for Resilience from NIST, DHS, FEMA, etc.

PNAS NEXUS
The National Academy of Sciences of the United States of America

JOURNAL ARTICLE ACCEPTED MANUSCRIPT

The rebound curve is a poor model of resilience

Daniel A Eisenberg, Thomas P Seager, David L Alderson

PNAS Nexus, pgaf052, https://doi.org/10.1093/pnasnexus/pgaf052
Published: 13 February 2025 **Article history**

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Abstract

The *rebound curve* remains the most prevalent model for conceptualizing, measuring, and explaining resilience for engineering and community systems by tracking the functional robustness and recovery of systems over time. (It also goes by many names, including the resilience curve, the resilience triangle, and the system functionality curve, among others.) Despite longstanding recognition that resilience is more than rebound, the curve remains highly used, cited, and taught. In this article, we challenge the efficacy of this model for resilience and identify fundamental shortcomings in how it handles system function, time, dynamics, and decisions — the key elements that make up the curve. These oversimplifications reinforce misconceptions about resilience that are unhelpful for understanding complex systems and are potentially dangerous for guiding decisions. We argue that models of resilience should abandon the use of this curve and instead be reframed to open new lines of inquiry that center on improving adaptive capacity in complex systems rather than functional rebound. We provide a list of questions to help future researchers communicate these limitations and address any implications on recommendations derived from its use.

PDF Help

Keywords: Resilience, Critical Infrastructure, Engineering, Emergency Management

Subject: Civil and Environmental Engineering, Sustainability Science (Physical Sciences and Engineering)

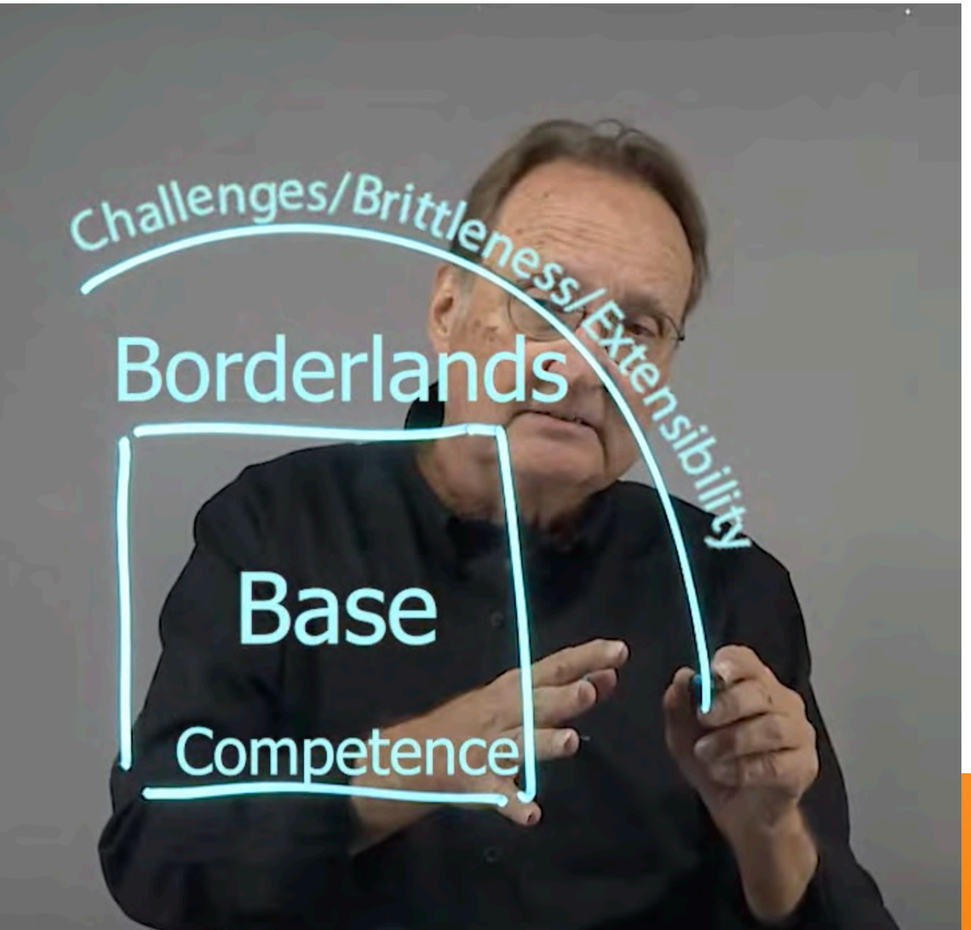
Issue Section: Perspective

Complexification
Where Nouns and Verbs do Battle

Extensibility, graceful or Brittleness

Noun or Verb?

Complexification
Where Nouns and Verbs do Battle



Verb-People

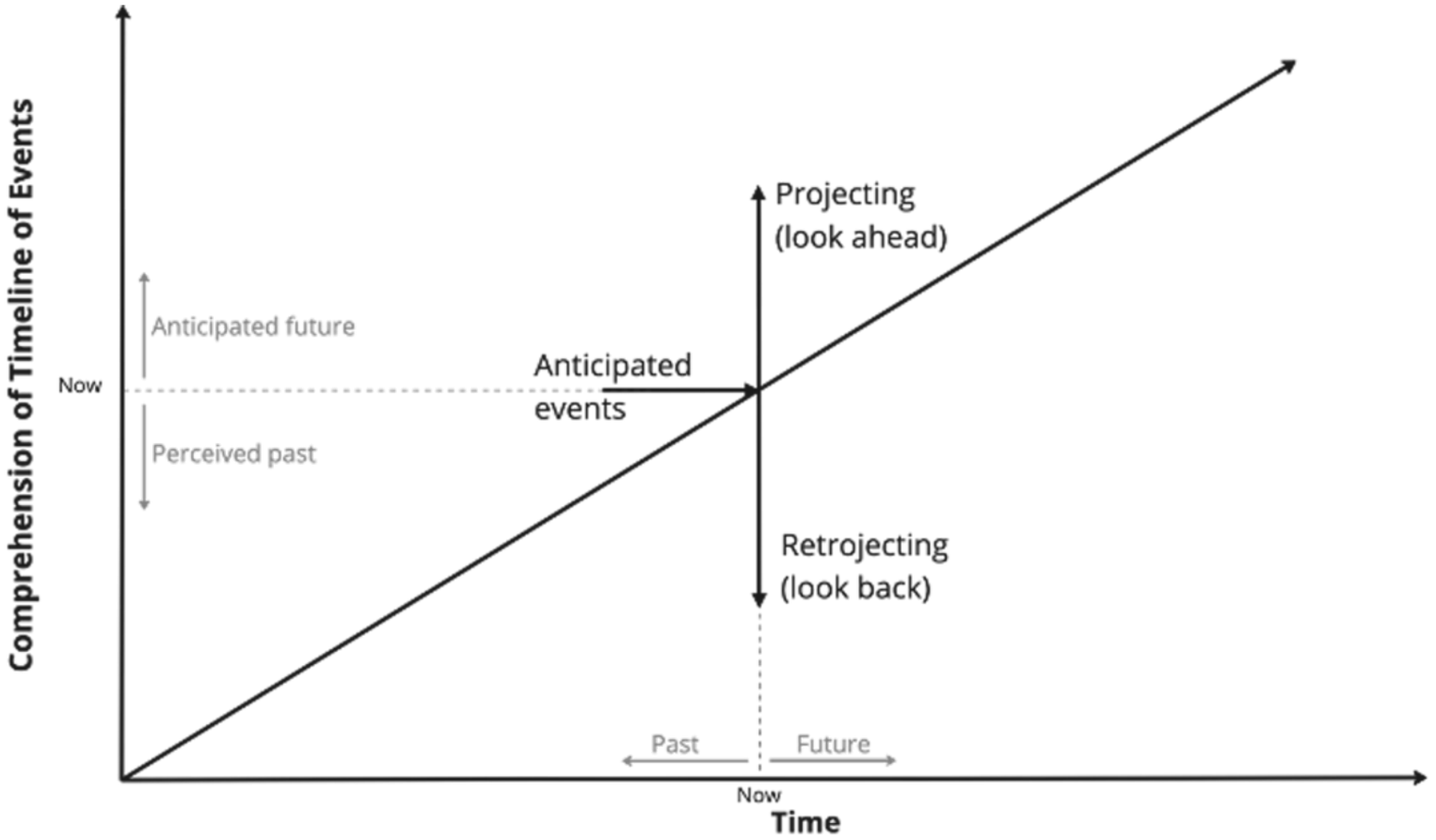
SNAFU CATCHERS

Complexification
Where Nouns and Verbs do Battle

What will this automated sys do next?

Noun or Verb?

Complexification
Where Nouns and Verbs do Battle



Verbs

https://www.researchgate.net/publication/390137523_Determining_What's_Next_Visual_Analytics_for_Evaluating_Human-Automation

Resilience as a verb in the future tense

& adverbs, gerunds, tempo, …

Nouns lose sight of what builds, sustains or constricts adaptive capacities over time

Woods, D. D. (2018).
"Resilience is a verb."
In *IRGC resource guide on resilience (vol. 2):* irgc.epfl.ch and irgc.org.

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journal homepage: www.elsevier.com/locate/jebo

Economics in nouns and verbs

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B59 (Current Heterodox Approaches-Other)
C02 (Mathematical Methods)

Keywords:

ABSTRACT

Standard economic theory uses mathematics as its main means of understanding, and this brings clarity of reasoning and logical power. But there is a drawback: algebraic mathematics restricts economic modeling to what can be expressed only in quantitative nouns, and this forces theory to leave out matters to do with process, formation, adjustment, and creation—matters to do with nonequilibrium. For these we need a different means of understanding, one that allows verbs as well as nouns. Algorithmic expression is such a means. It allows verbs—processes—as well as nouns—objects and quantities. It allows fuller description in economics, and can include heterogeneity of agents, actions as well as objects, and realistic models of behavior in ill-defined situations. The world that algorithms reveal is action-based as well as object-based, organic, possibly ever-changing, and not fully knowable. But it is strangely and wonderfully alive.

Expertise:

• is specialized, not general, tailored to the contexts where it has grown & is expressed (situated).

• grows based on experience w/ variabilities & disruptions that arise in different situations/ contexts & as expertise grows, it becomes flexibly adapted to a wider range of factors/ influences.

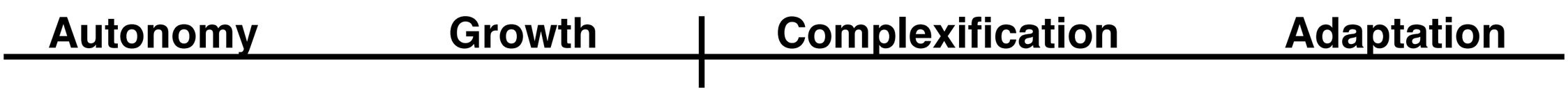
Autonomy Growth Complexification Adaptation

• is sensitive to its limits, noise, uncertainties.

• guides how to act/hedge in the face of uncertainty, trade-offs, and risk.

• is about more than what an individual/role possesses, but incorporates processes of interaction across partial & overlapping areas of specialized expertise.

2015



Now

New waves of complexity penalties threaten, can DevOps create new opportunities to build adaptive capacity?

! S L A M M E D !

AI Gold Rush (2), FBC Pressures,
Growth, Complexity,
Interdependencies, Fragmentation,
...

"When do people adapt?
When they have to."

When people have to adapt, **what direction?**

Re-trenchment? or **Re-vitalization?**

Retreat to cope locally? or Re-prioritize/Reconfigure?

Even when ***Slammed,*** find/innovate opportunities

'SRE' has done this already
SRE now is well-positioned to seize opportunity
window of opportunity won't last

requires reframing, energy when overloaded, reciprocity across roles

face resistance
oversimplification fallacies, stuck entities, retreatists, zombie ideas, & opponents

RE says

Re-prioritize Reconfigure

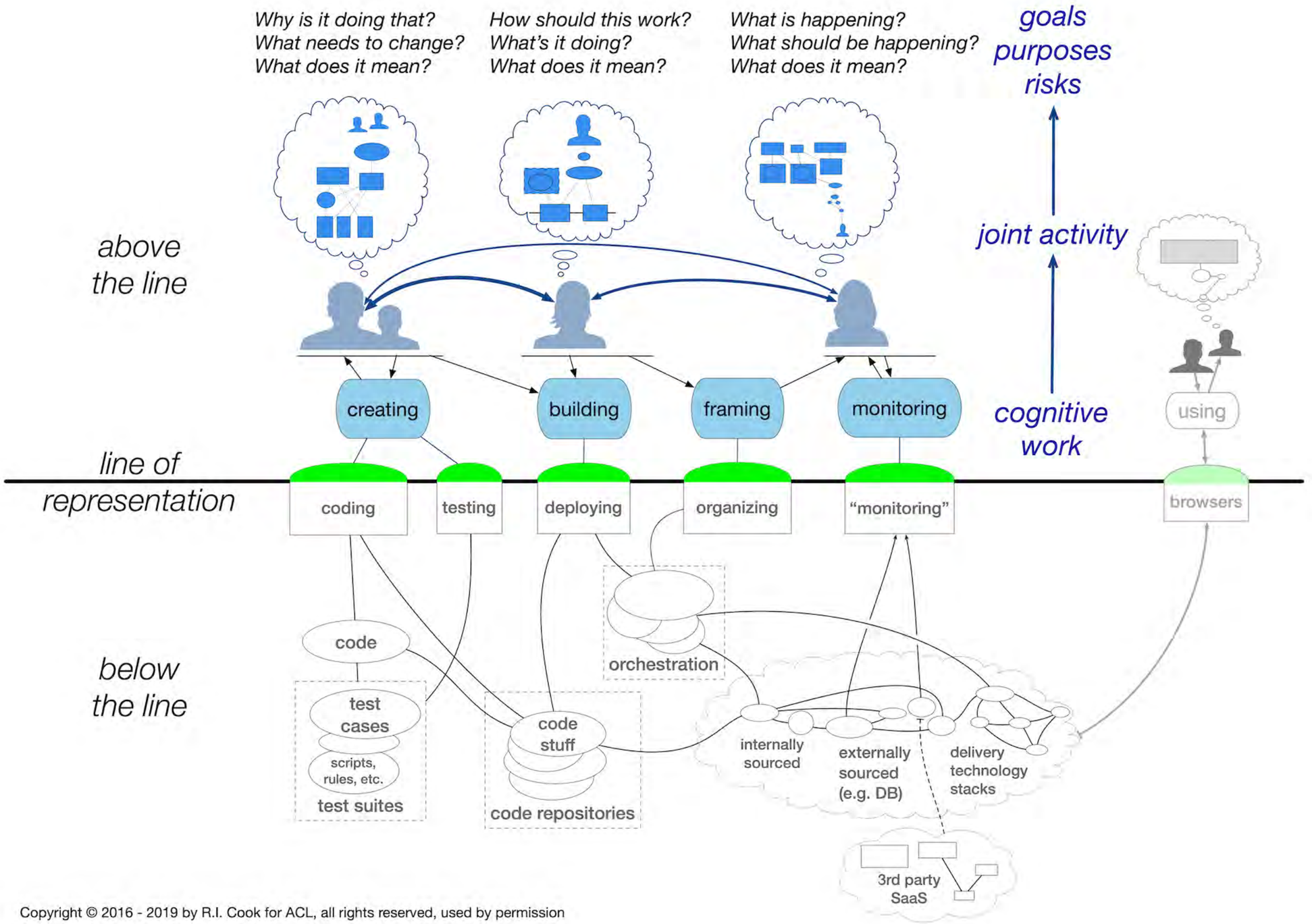
Activate your **readiness to revise/reframe (see anew)**

Build on established **lines of reciprocity** to grow/re-synchronize over role and layers

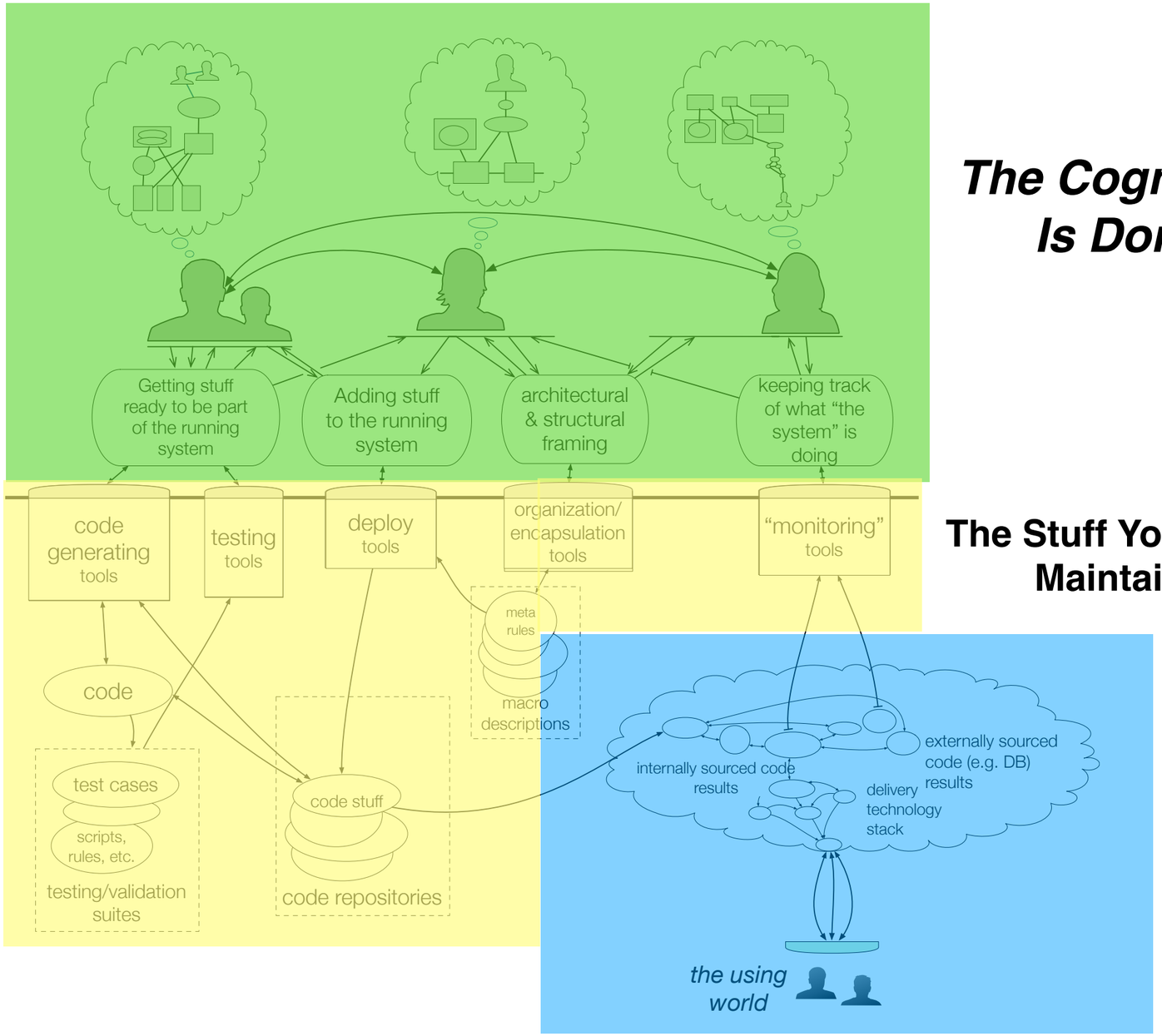
Innovate new forms of **anticipation–**
see ahead, see around

pursue small opportunities for florescence

Line of Representation



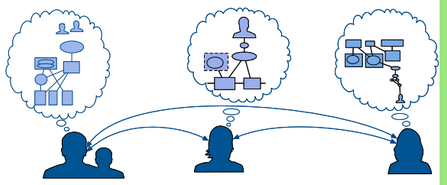
SNAFU CATCHERS



The Cognitive Work Is Done Here

The Stuff You Build and Maintain With

Your Product Or Service



Continuous Deployment

The Cognitive Work /Joint Activity Occurs Here

Only means to ‘see/act’ is through line of representation

Getting stuff ready to be part of the running system

Adding stuff to the running system

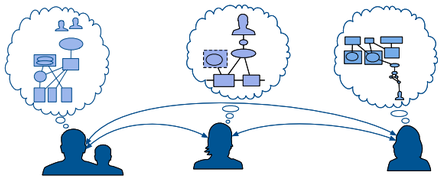
architectural & structural

keeping track of what “the system” is doing

Line of Representation

HMIs HMIs

HMIs HMIs HMIs



Future Using in Context

code generating tools

testing tools

deploy tools

organization/ encapsulation tools

“monitoring” tools

meta rules

macro descriptions

code

test cases

scripts, rules, etc.

testing/validation suites

code stuff

code repositories

internally sourced code results

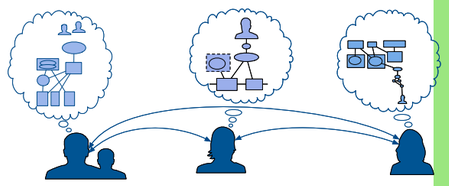
externally sourced code (e.g. DB) results

delivery technology stack

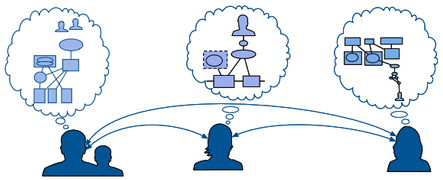
the using world

The Tooling for Continuous Deployment

Infrastructure that Supplies Valued Service



Continuous Deployment



HMIs for Future Using in Context

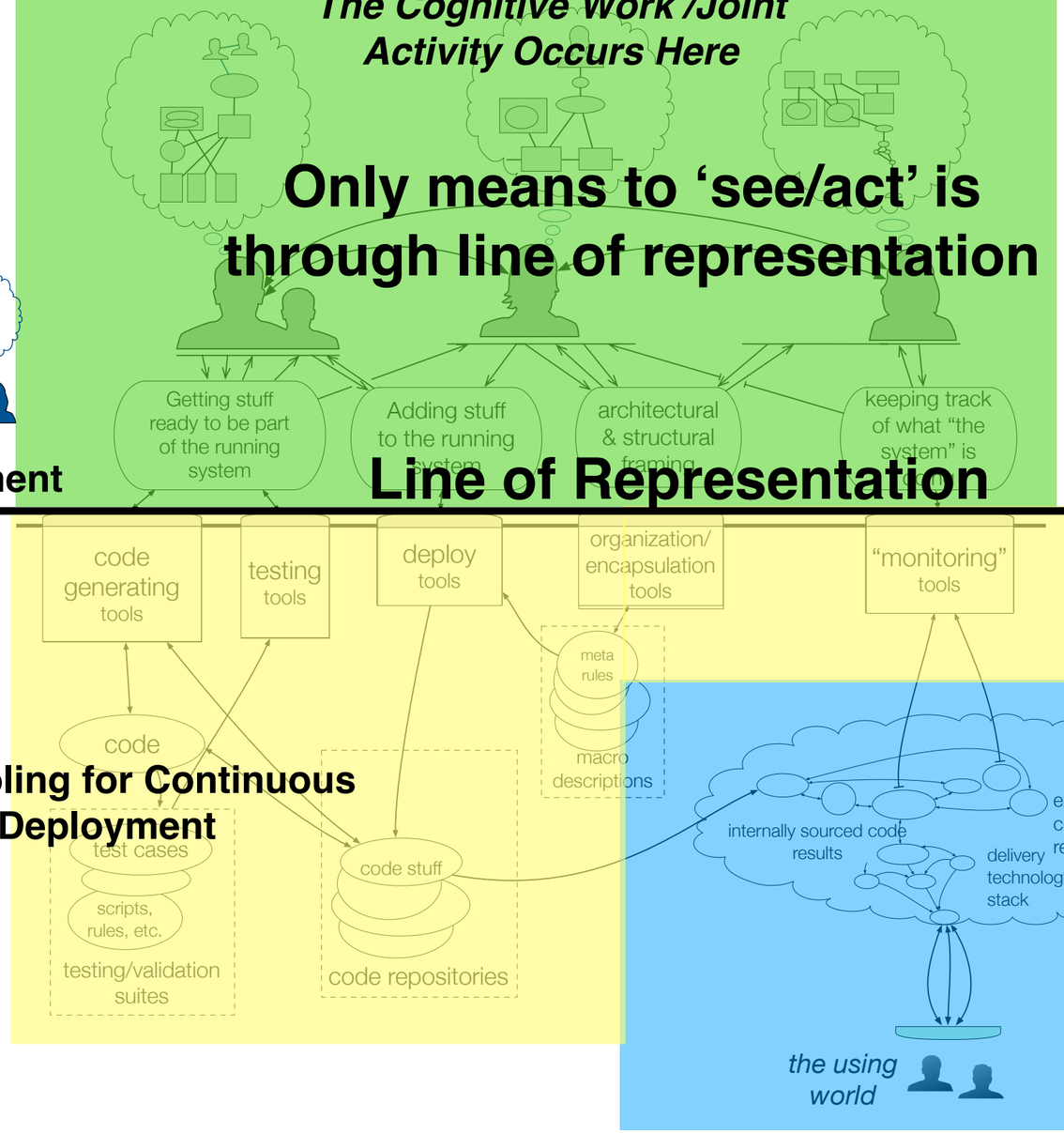
The Cognitive Work /Joint Activity Occurs Here

Only means to ‘see/act’ is through line of representation

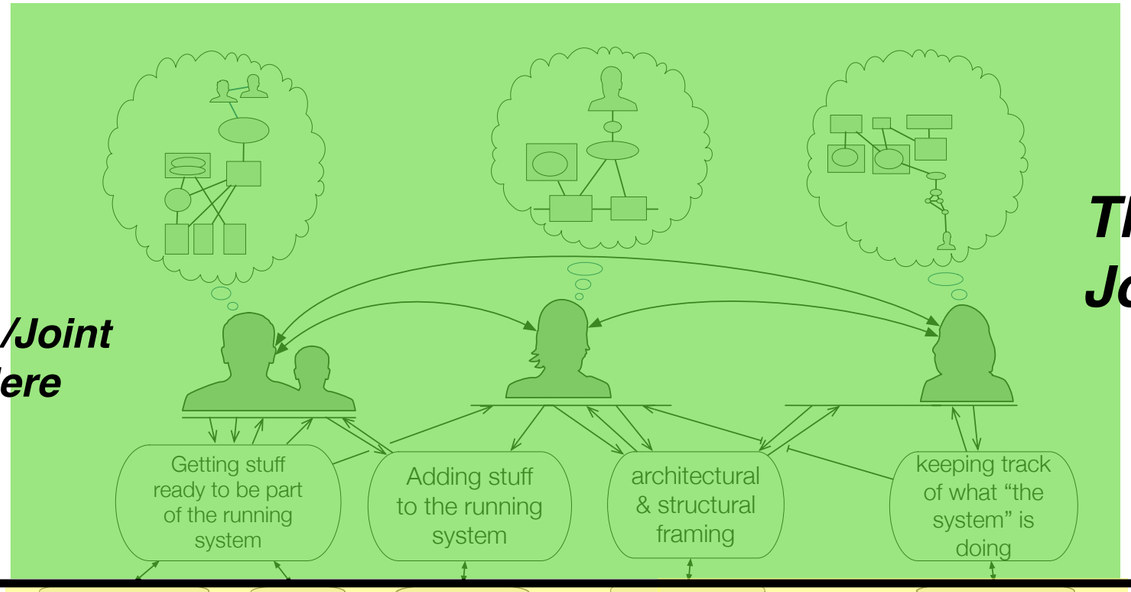
Line of Representation

The Tooling for Continuous Deployment

Infrastructure that Supplies Valued Service



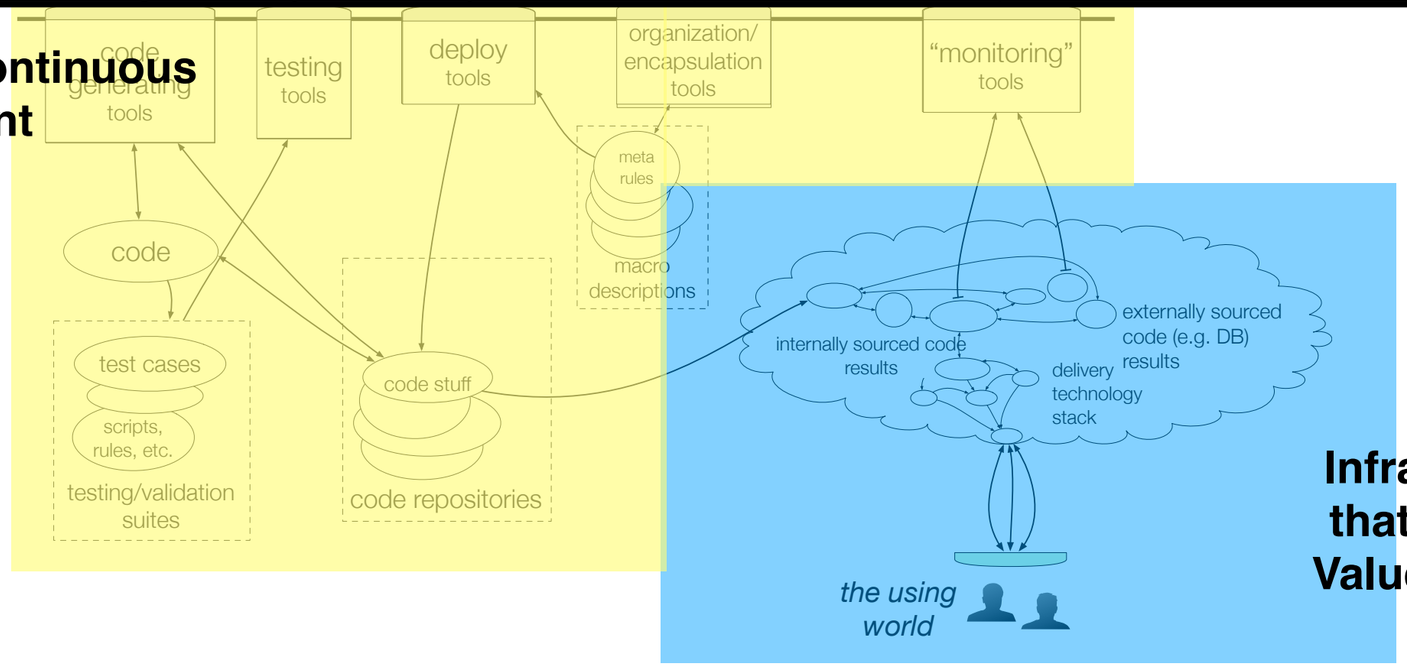
The Cognitive Work /Joint Activity Occurs Here



The Cognitive Work / Joint Activity Occurs Here

HMIs for Future Using in Context

The Tooling for Continuous Deployment



Infrastructure that Supplies Valued Service

Line of Representation

Opportunity—see verbs

Innovate new ways to see ahead, around and anew

Line of Representation

Innovate new tools & tooling to work at scale

See Verbs
Pace, Tempos, Tangles,
↑ Saturation, Lag, Friction,
↑ Congestion, Cascades, Conflicts

Line of Representation

tools/tooling for representing verbs are primitive or crude
Sorry

Discover Opportunities

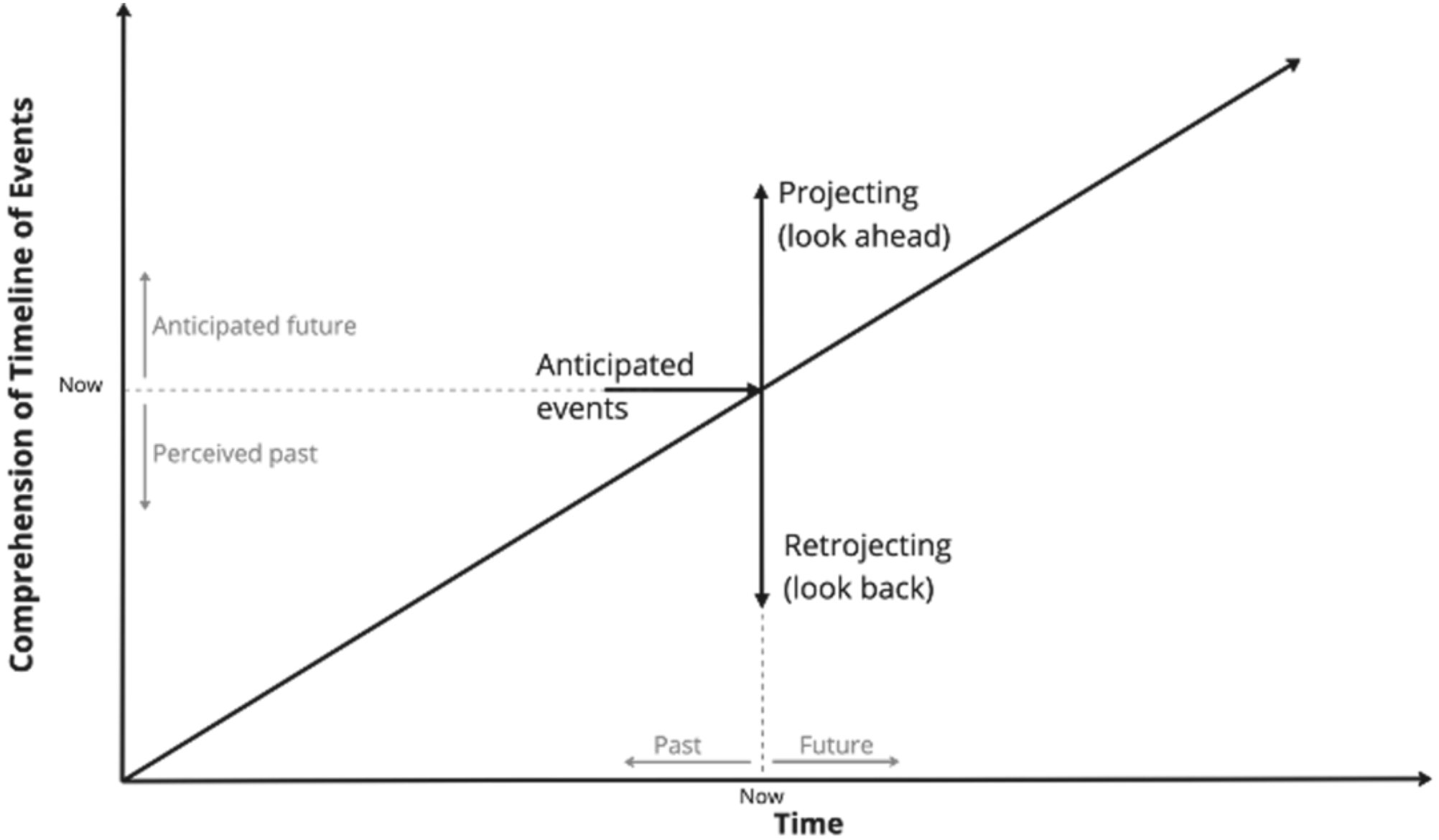
Flip the Frame Heuristic—embrace *Verbs*

See Ahead—What's Next Animations

Together—Middle Out

You have partial control

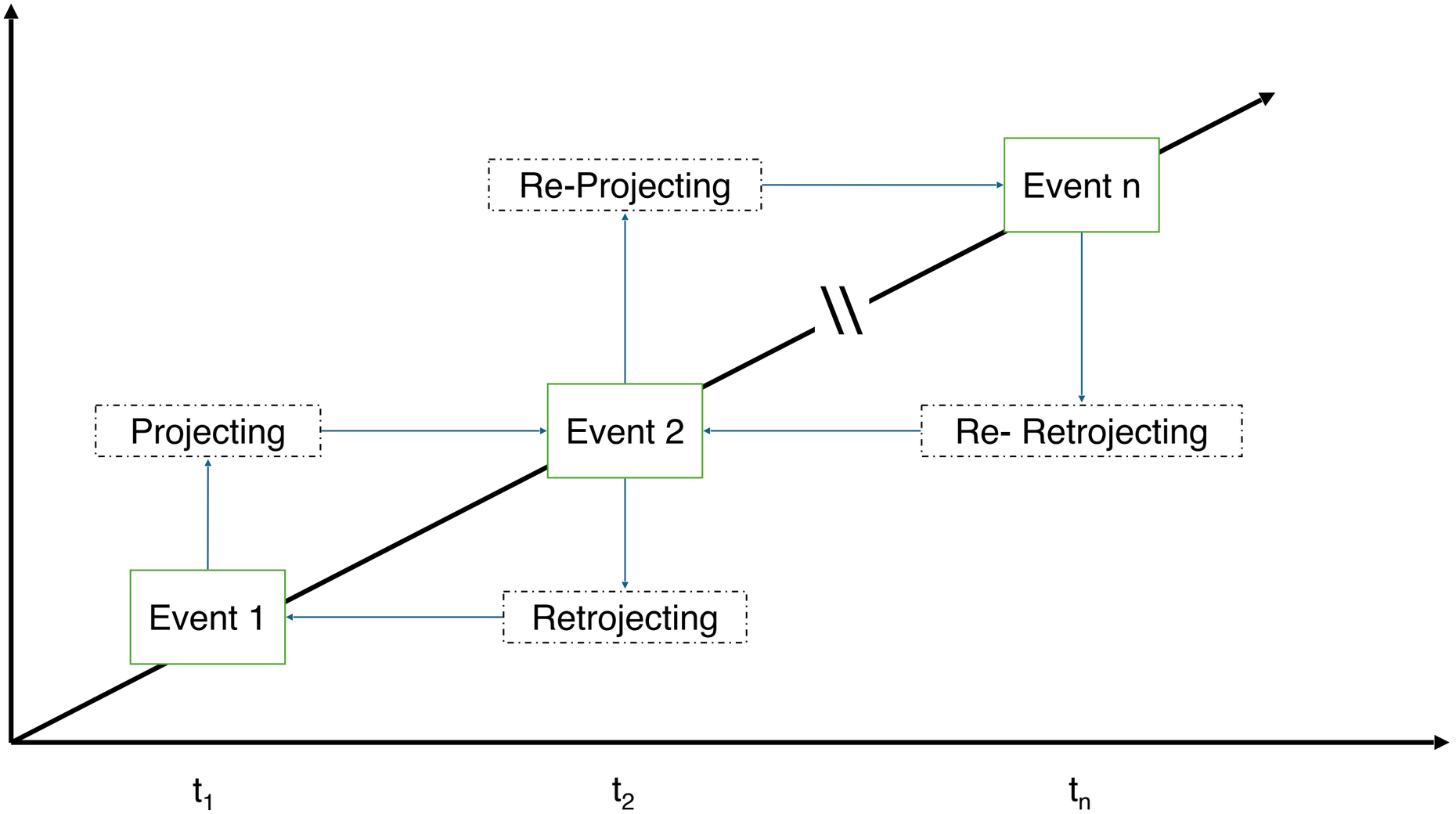
Visual analytics to support designing using verbs.



https://www.researchgate.net/publication/390137523_Determining_What's_Next_Visual_Analytics_for_Evaluating_Human-Automation

At time n, person has frame based on events so far.

Reframing dynamic process situated in time.



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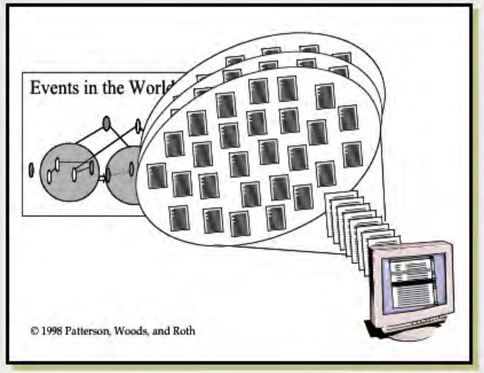
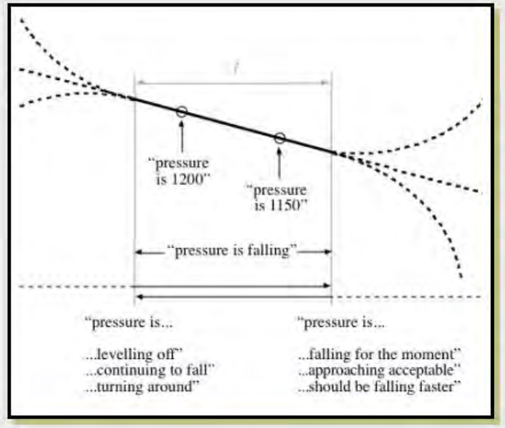


Coordinating Multiple Perspectives – Coordinating shifts and contrasts among different perspectives over task sequences and as situations evolve. Coordination of multiple points of view into the processes of the work domain to create a virtual perceptual field or a workspace in which practitioners carry out their domain activities.



Making Sense of Change – Organize and integrate pattern views around classes of events in the work domain in order to reveal operationally interesting changes. The key is to transform from changes in individual physical characteristics to changes of higher-order semantic properties.

Pattern Views – Organize data to reveal relationships and patterns in the work domain. Integrated representations inter-relate data to provide a coherent view into a process. The key criterion is to help practitioners pick up status at a glance rather than having to read and mentally integrate many individual pieces of data.

build conceptual spaces by depicting relationships in a frame of reference

- discover multiple frames/perspectives
- put data into context
- highlight events/activities - *what will happen next?*
- highlight contrasts - *departures from typical*

Opportunity

Line of Representation

Innovate new ways to see ahead, around and anew

Marry computational power w/ new representational power to see ahead, see around, see anew