

Dissecting a Complex-Risk Management Framework



THE UNIVERSITY
of ADELAIDE

Ben Luther

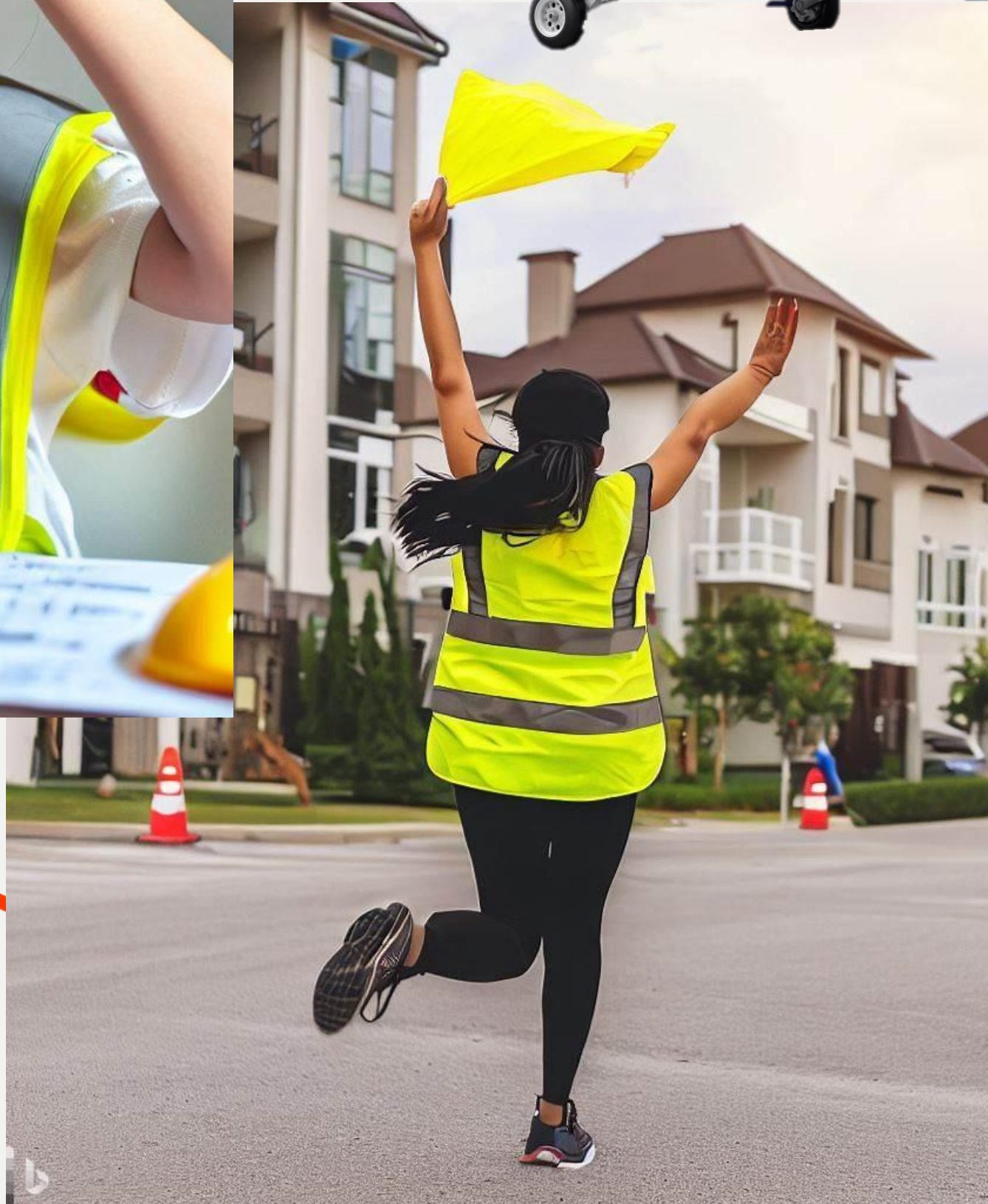
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Why?



		Sequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	5 Almost certain	Moderate 5	High 10	Extreme 15	Extreme 20	Extreme 25
	4 Likely	Moderate 4	High 8	High 12	Extreme 16	Extreme 20
	3 Possible	Low 3	Moderate 6	High 9	High 12	Extreme 15
	2 Unlikely	Low 2	Moderate 4	Moderate 6	High 8	High 10
	1 Rare	Low 1	Low 2	Low 3	Moderate 4	Moderate 5

The Research

Qualitative

- Observation
- Survey
- Interview

Ethnographic Study – case study

Ontological Framework
- Cynefin

Empirically Grounded Analysis

Validated

Test pilots

- survey, n=49
- interview, n=9

<https://data.mendeley.com/datasets/5n2s4fkhz6/2>

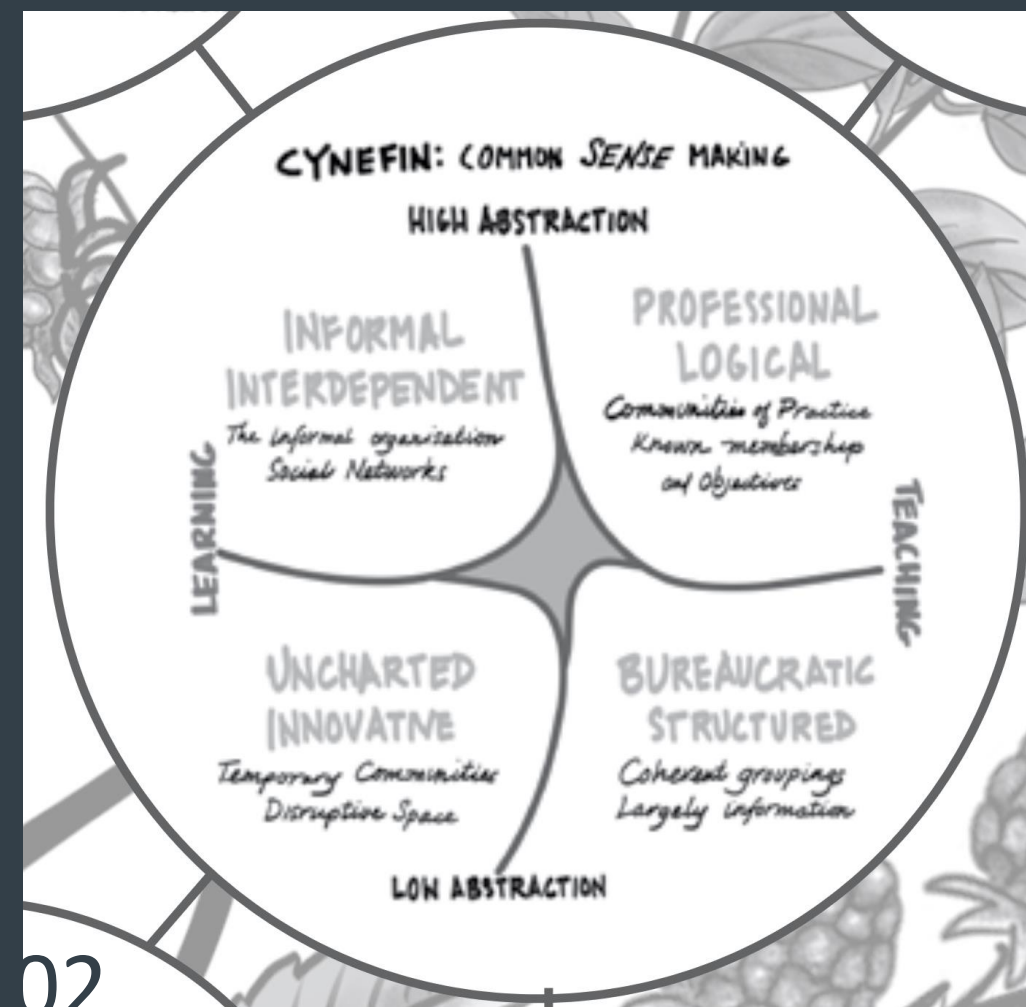
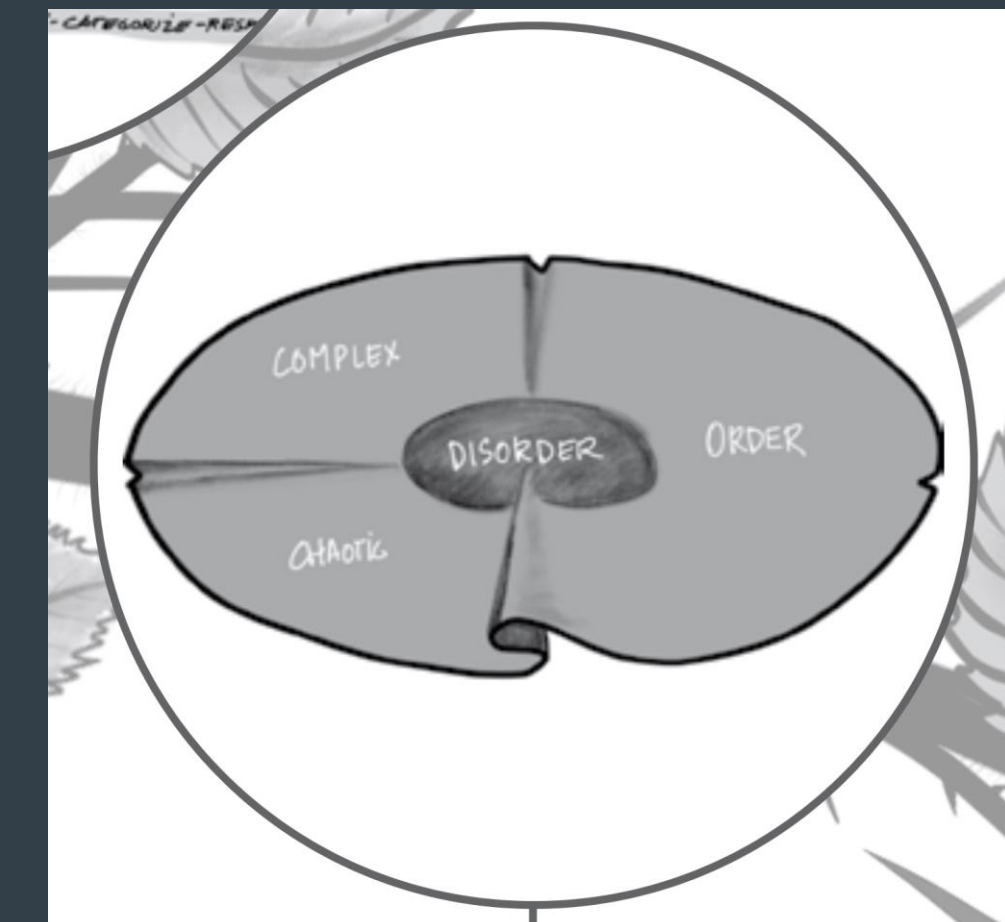
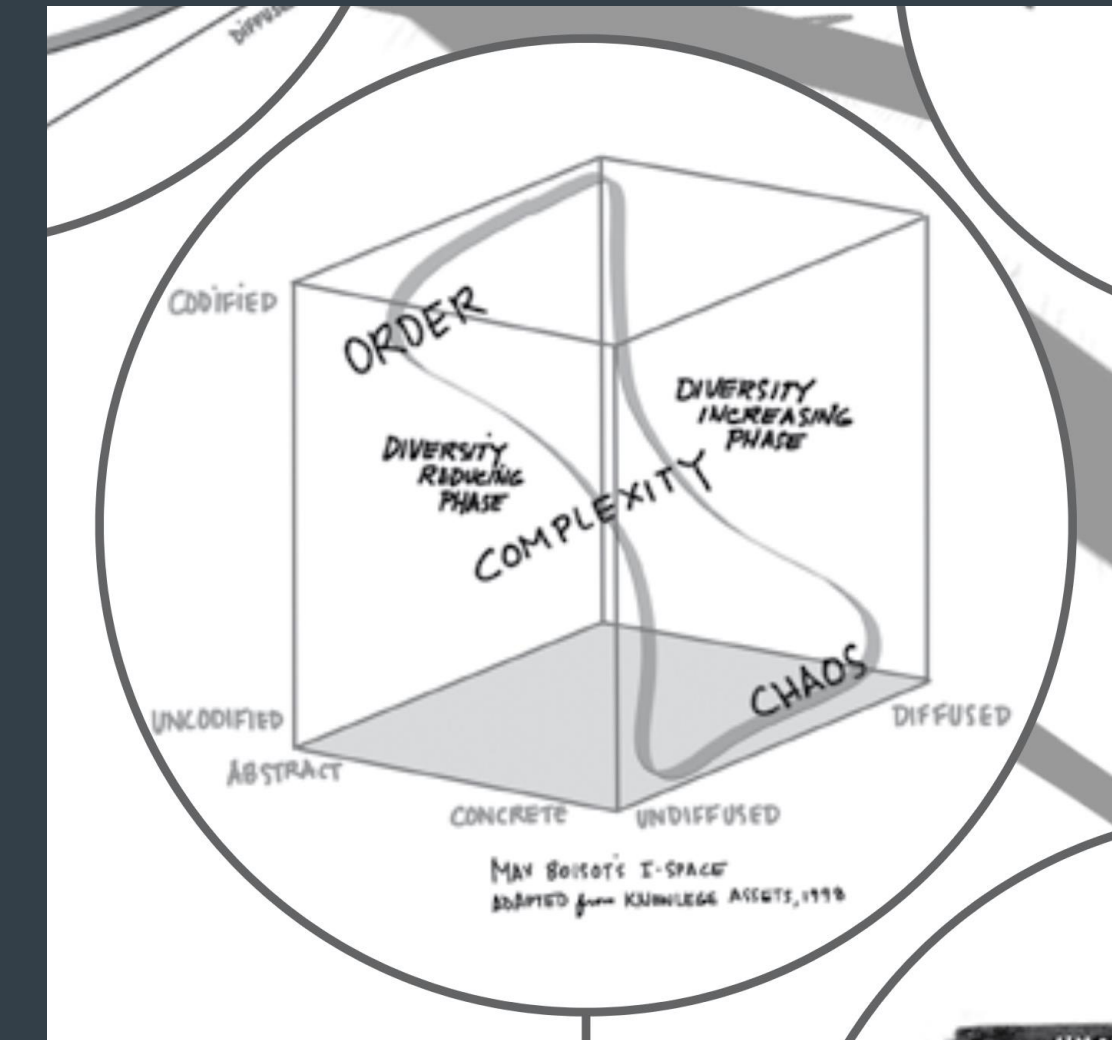
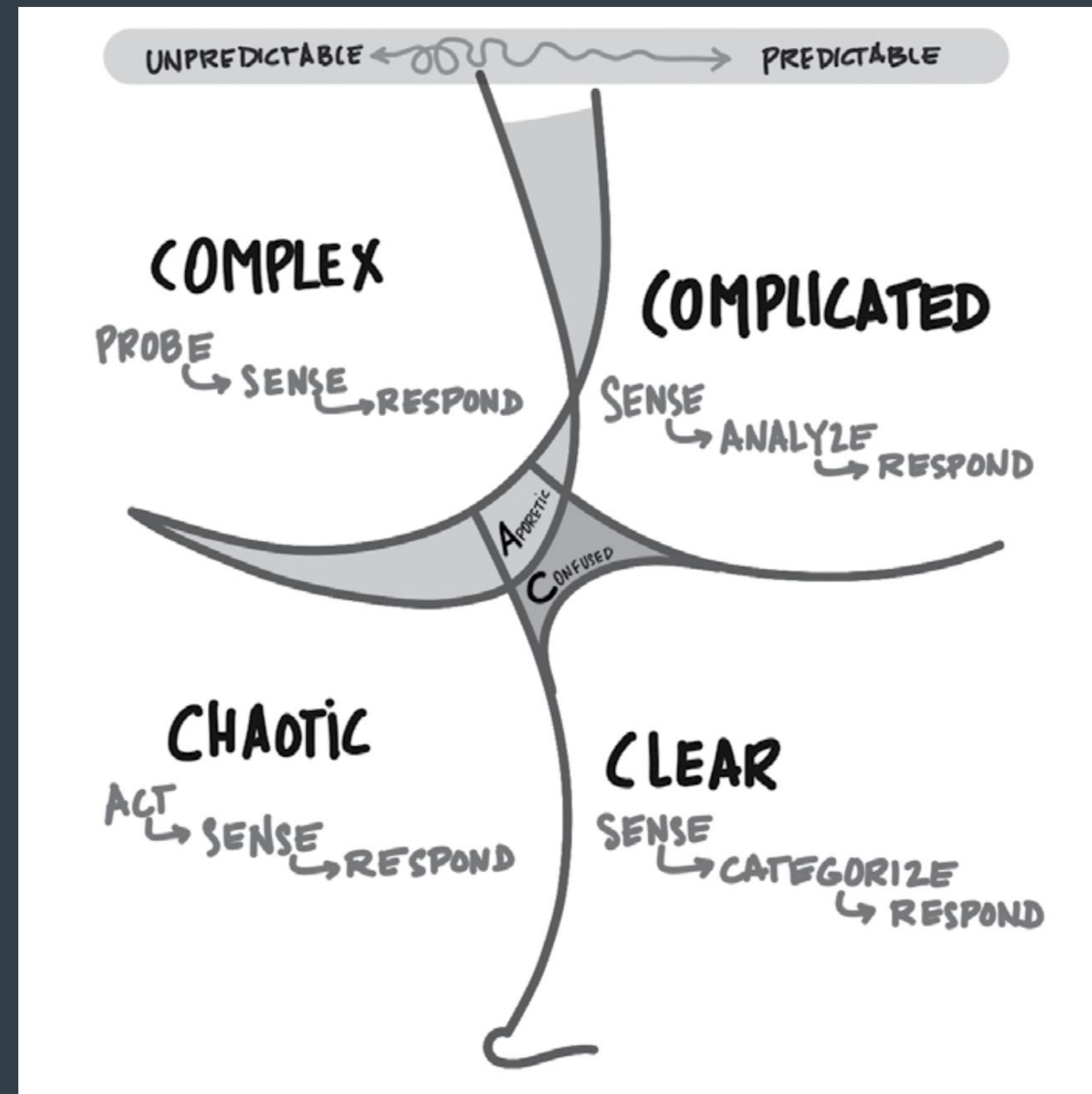
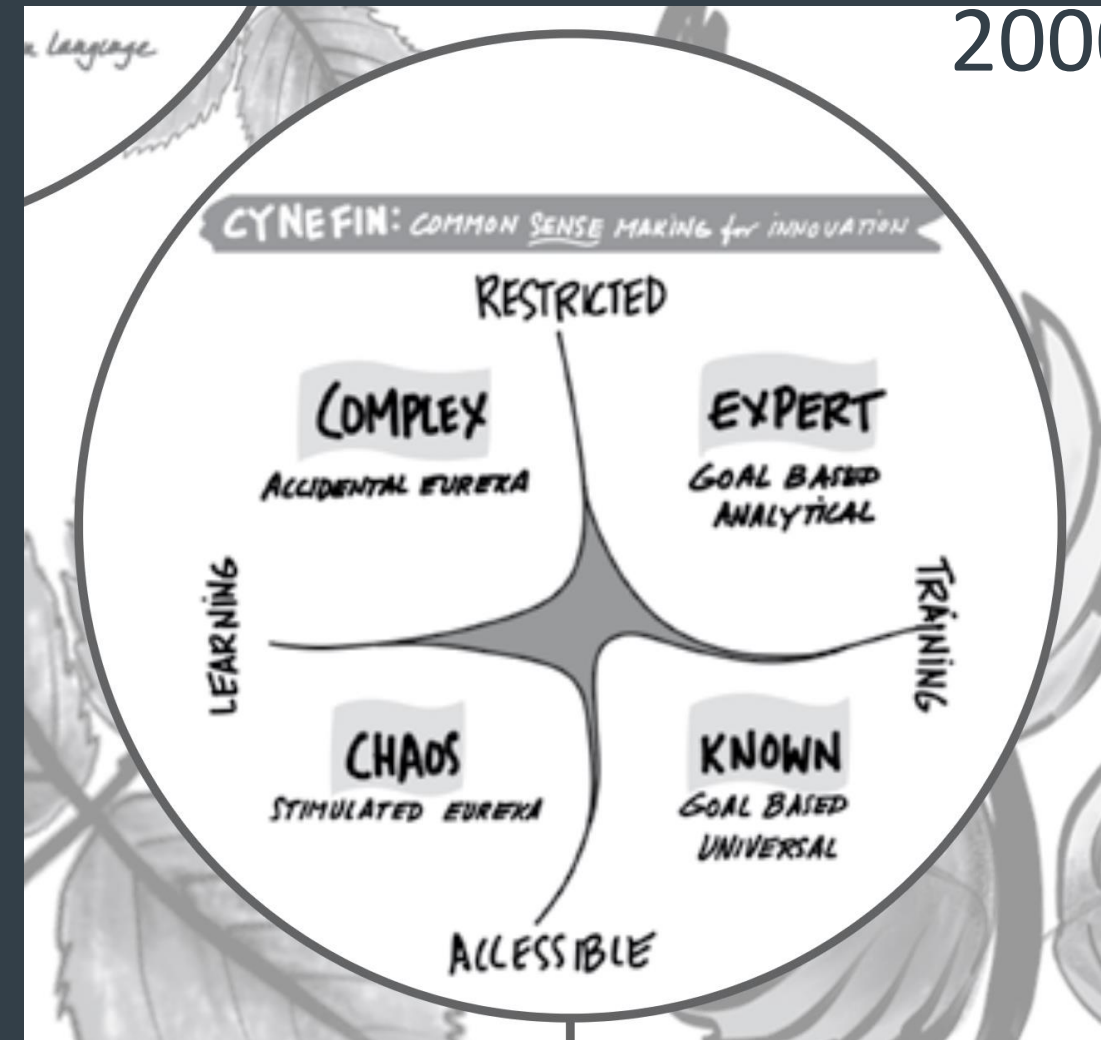
De-identified data



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Cynefin Framework



Test Pilot Risk Management

Different - Uniquely across 3 domains

Unknowable: $n=1$, configuration change

- Complex



Inside the system

Catastrophic:

- no resilience
- no redundancy
- no averages (central tendency)

Capt Charles Yeager, Bell X-1, Muroc Air Force Base, May 1948

<https://unwritten-record.blogs.archives.gov/2022/10/13/captain-chuck-yeager-breaking-the-sound-barrier/>



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Test Pilot Risk Management

Need for different tools

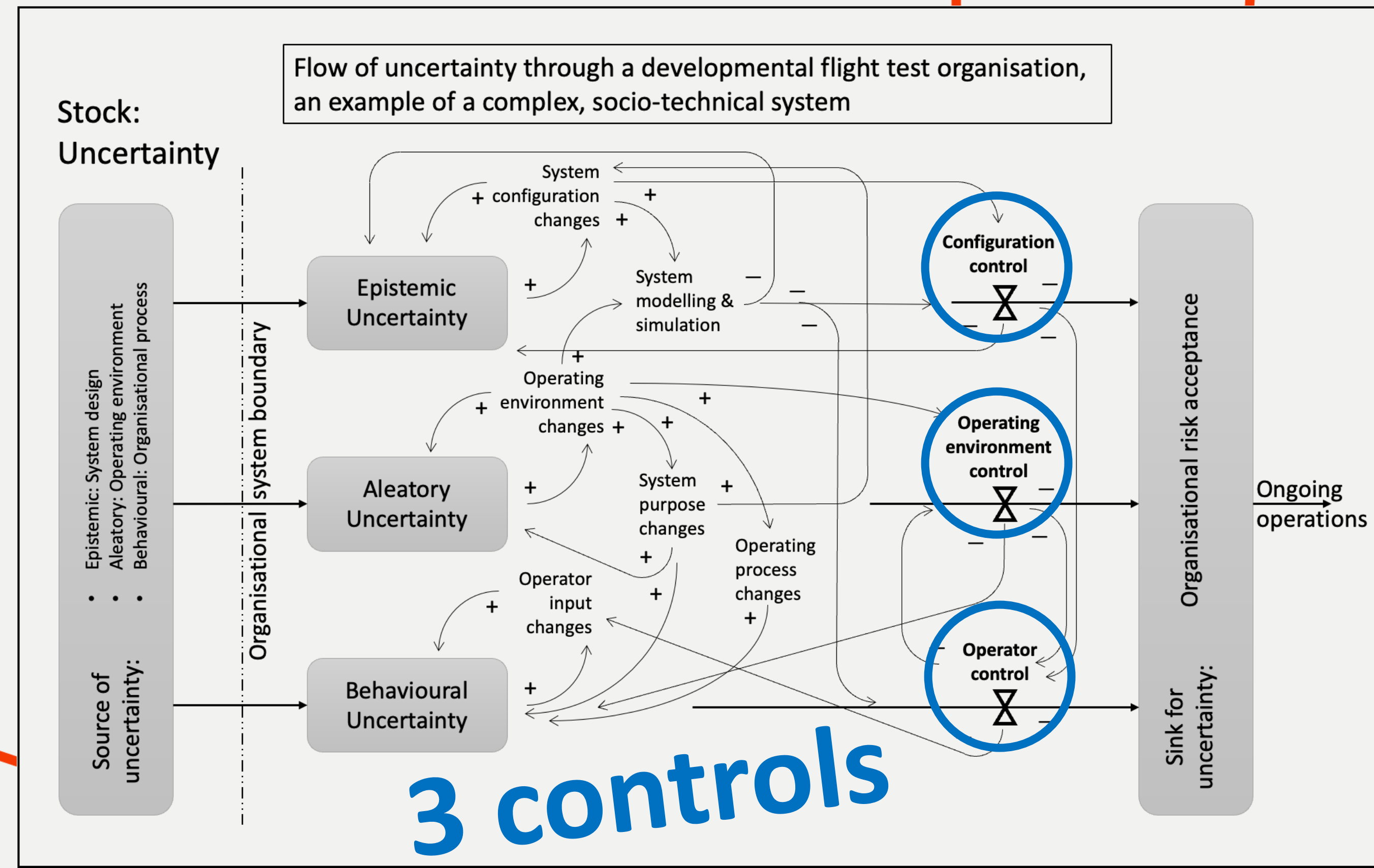
- *infers different types of risk*

Parallel approaches

- *all the tools to all the risks*

Inefficient
- but effective

Systems Dynamics



Unique

Repetitive

Determinism

Extended

Latency

Instantaneous

COMPLEX
Enabling constraints
Loosely coupled

probe-sense-respond

**EMERGENT
PRACTICE**

COMPLICATED
Governing constraints
Tightly coupled

sense-analyze-respond

**GOOD
PRACTICE**

CHAOTIC
Lacking constraint
De-coupled

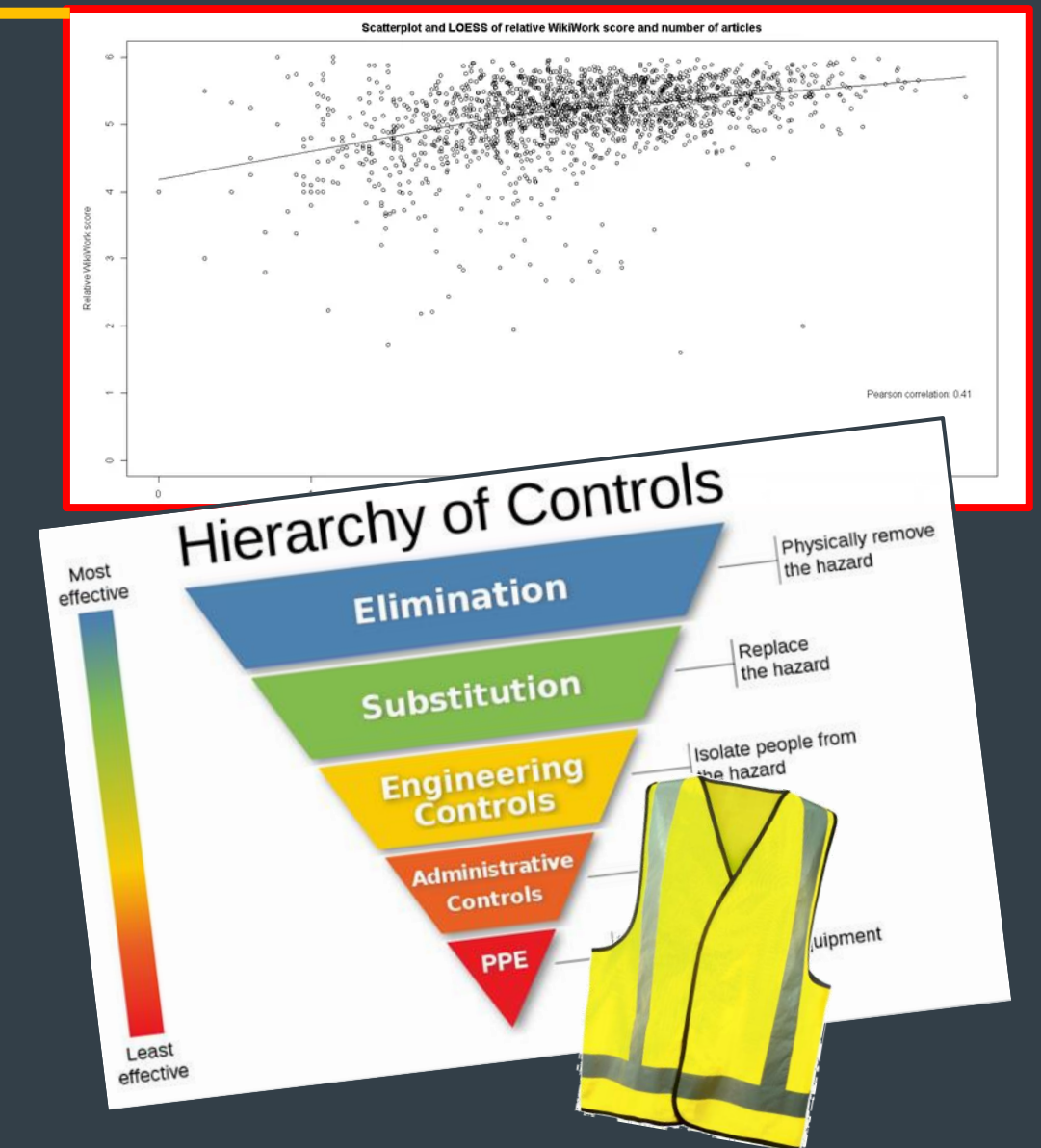
act-sense-respond

**NOVEL
PRACTICE**

CLEAR
Tightly constrained
No degrees of freedom

sense-categorize-respond

**BEST
PRACTICE**



Crisis leadership

State changes

Outcomes

As per ASSC 2023

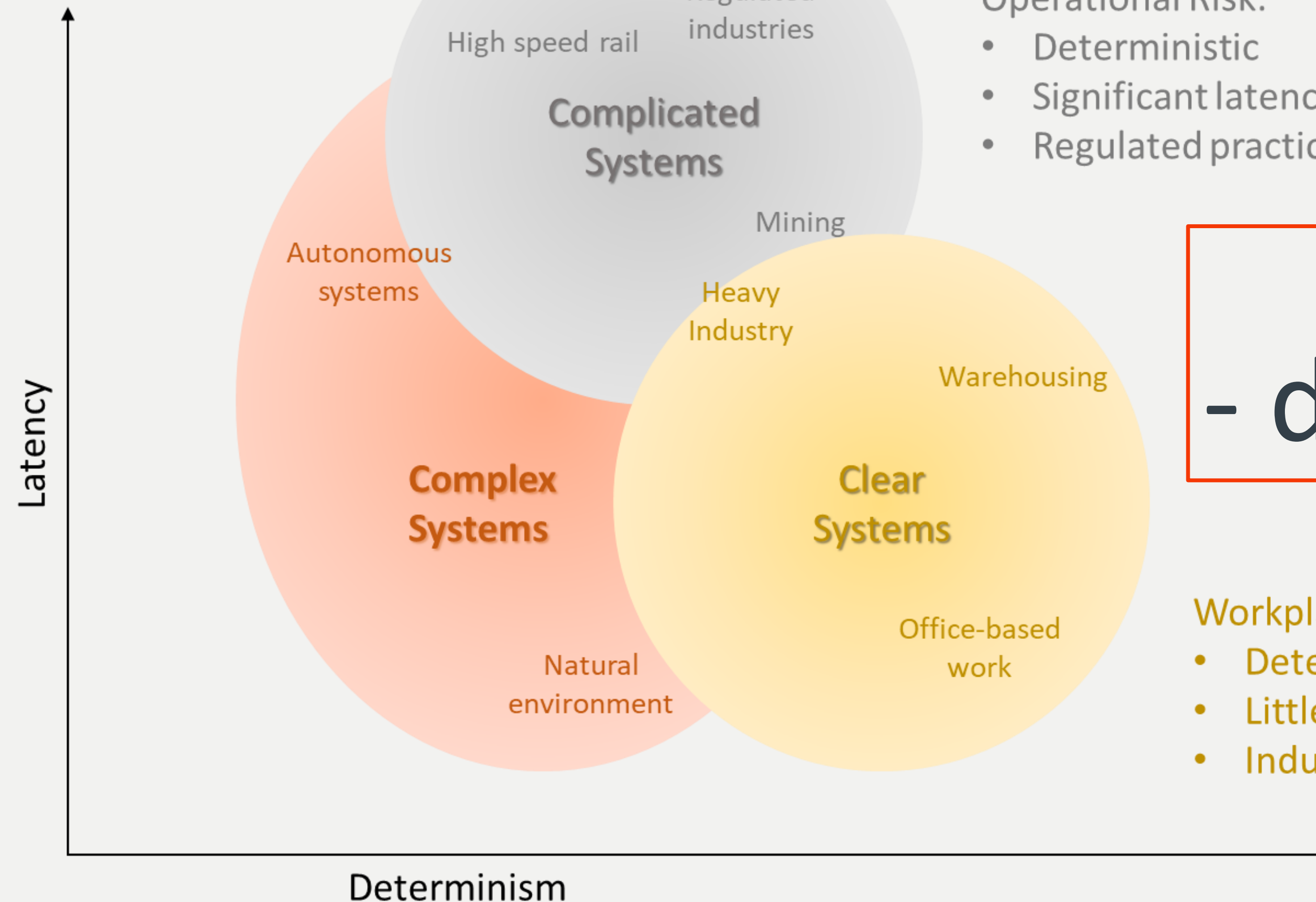
Socio-technical system Risk:

- Non-deterministic
- Variable latency
- Emergent system behaviour
- Not currently regulated

Identifying the underlying system intricacy domain

Operational Risk:

- Deterministic
- Significant latency
- Regulated practices



3 types of systems
- different attributes

Workplace Risk:

- Deterministic
- Little to no latency
- Industrial legislation



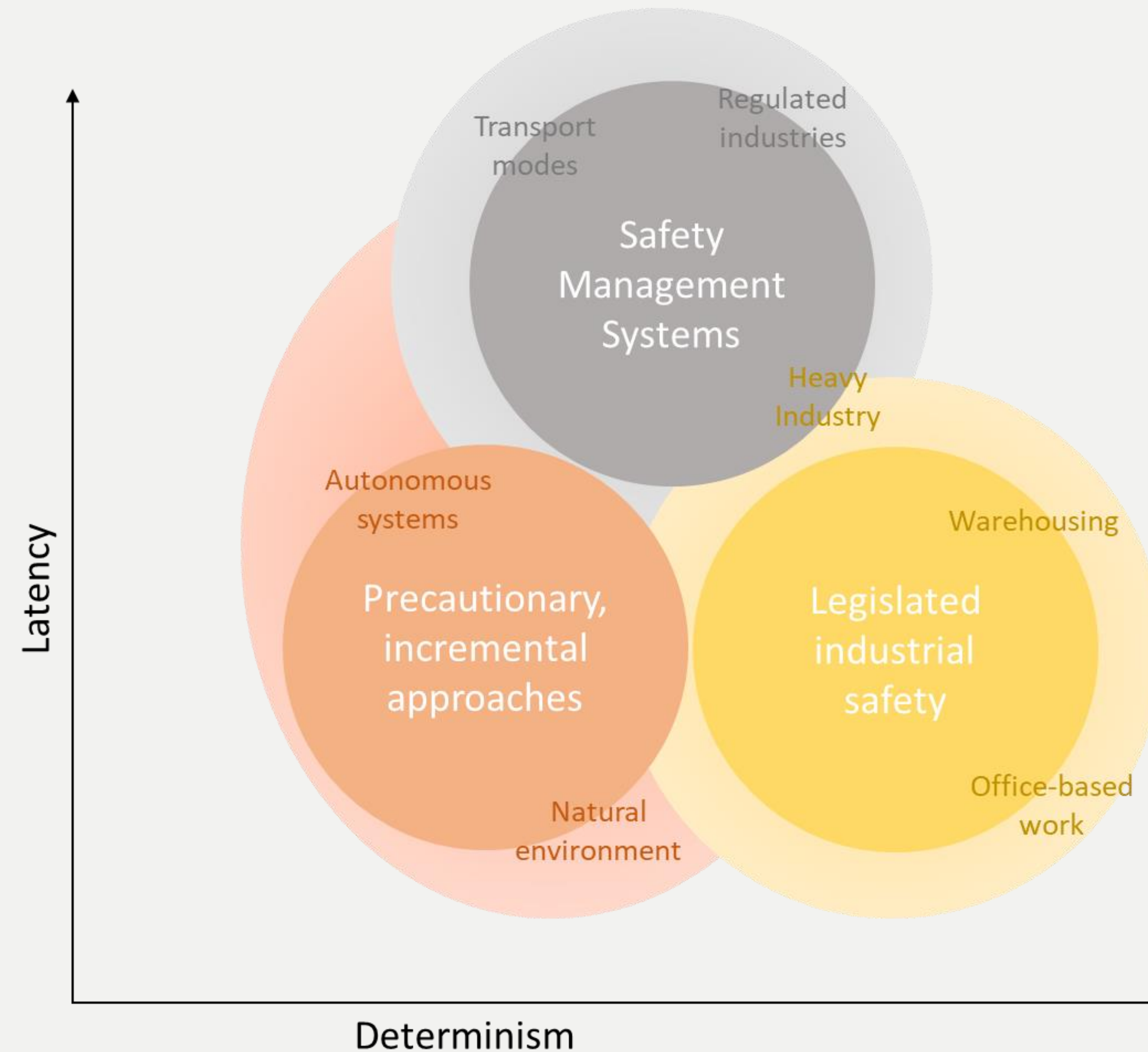
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Outcomes

As per ASSC 2023

Effectiveness of risk management tools across system intricacy domains



One size
does not fit all

3 types of systems
- different tools



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Risk Theory

No grand theory

Established

Probability Theory

- Calculated or
- Subjective

Economic Utility Theory

		Consequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	5 Almost certain	Moderate 5	High 10	Extreme 15	Extreme 20	Extreme 25
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Alternative



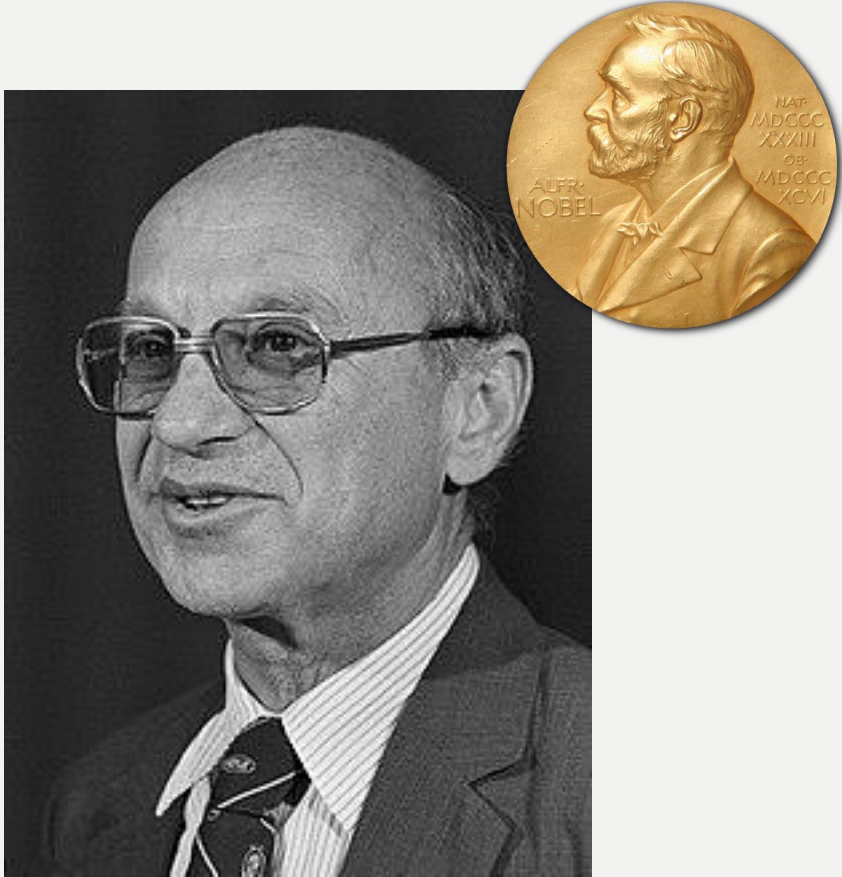
Economic Theory

Extant **Risk theory**

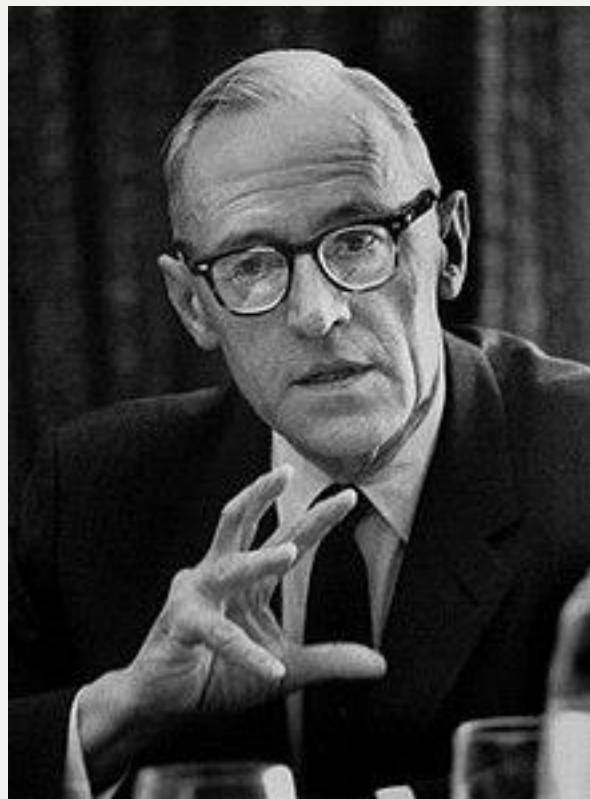
Safety Science

Morgenstern

Friedman



von
Neumann



Utility Theory
Probability Theory

Subjective
Probability

$r = c . p$

		Consequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
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System Safety

$\frac{1}{reliabilty} = failure\ rate$

Probability

Empirical observation

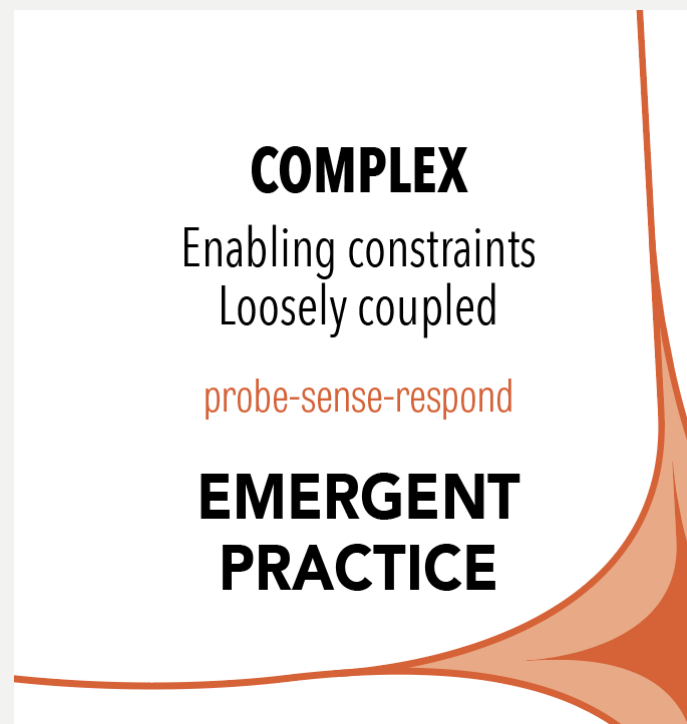
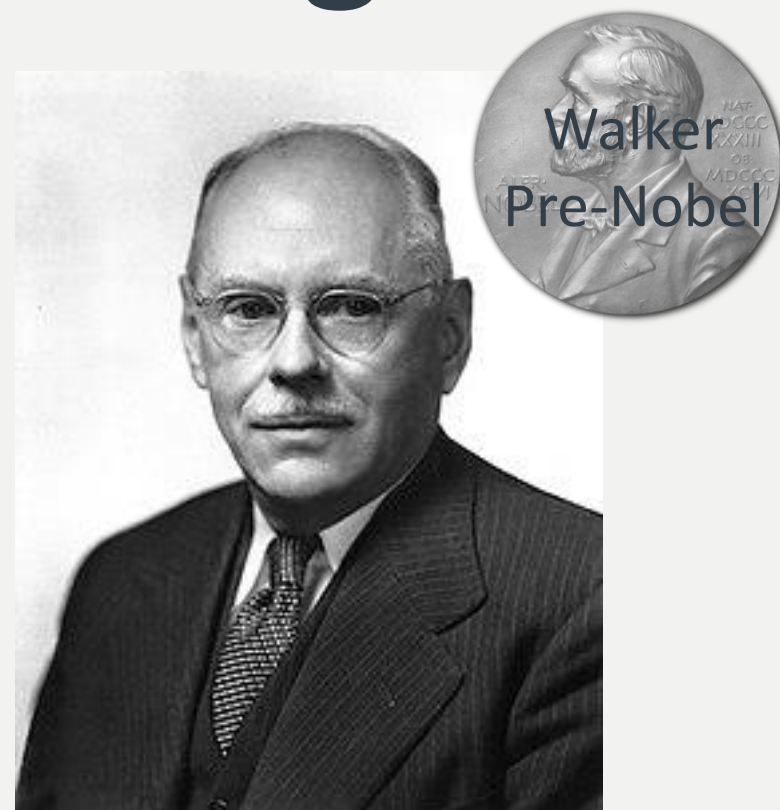
$\frac{1}{frequency} = rate$

Economic Theory Evolved **Risk theory**

Knight

Keynes

Cynefin
framework



Safety Science

$$\frac{1}{\text{Reliability}} = \text{Failure rate}$$

Probability

$$\frac{1}{\text{frequency}} = \text{rate}$$

$$r = c . p$$

		Consequence				
		Negligible 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	5 Almost certain	Moderate 5	High 10	Catastrophic 25	Catastrophic 25	Catastrophic 25
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Utility Theory
Probability Theory

Uncertainty

Shiller



Nuance in complexity



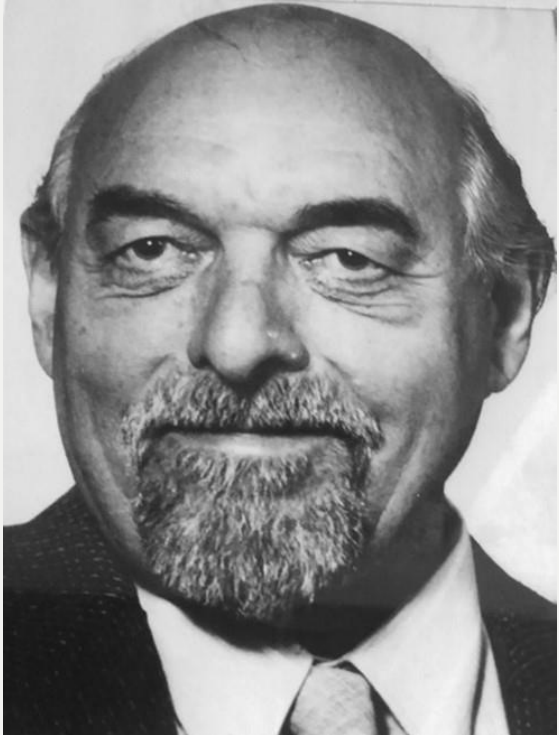
Rasmussen

Friedman

Risk theory

Toward a Grand Theory of Risk

Rasmussen



Drift

Dynamic

Sterman



Latency

Dekker

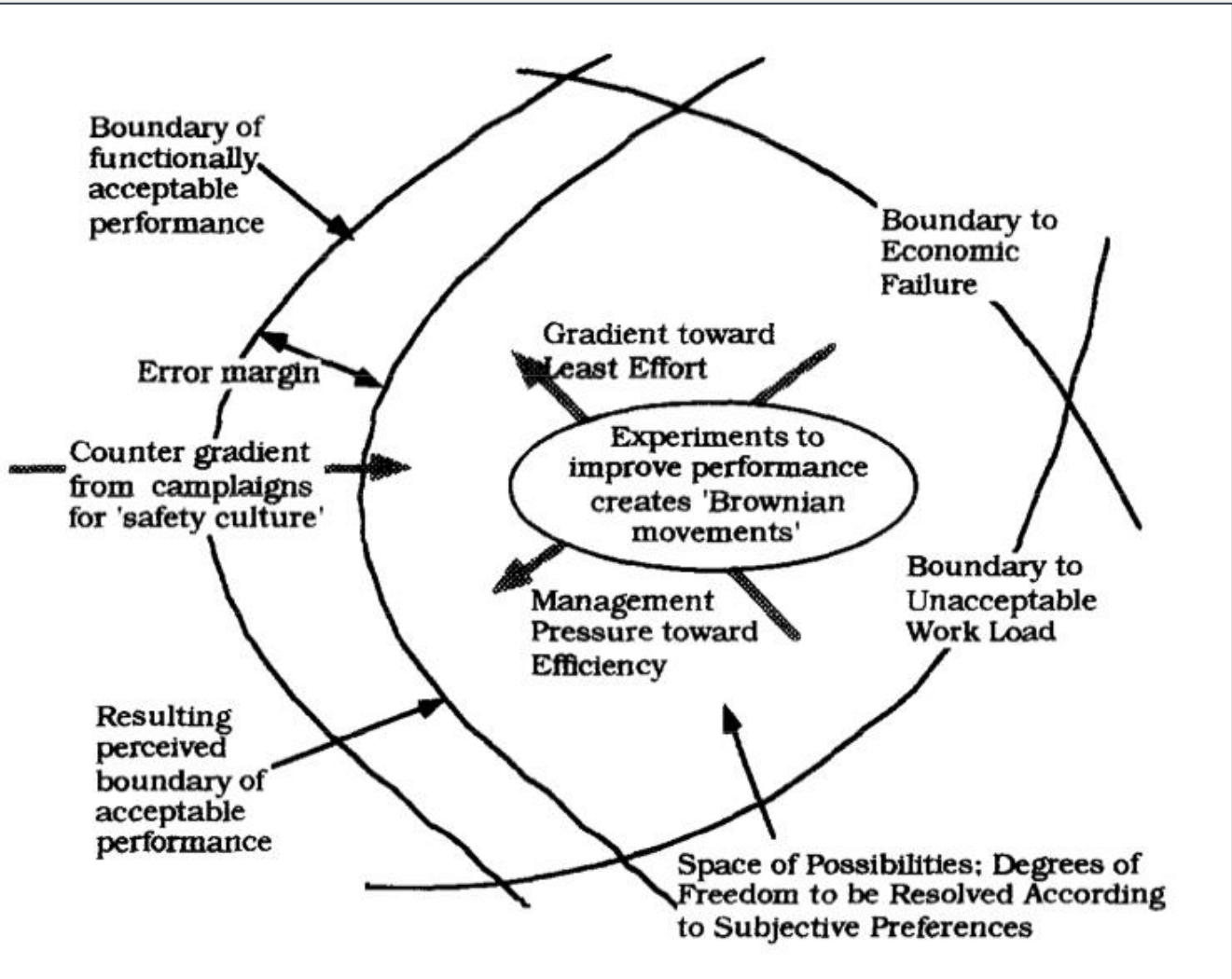


Incubation
Period

Time
Dependency

Complicated
Complex

Combinatorial complexity
vs
Dynamic complexity



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Risk theory

Toward a Grand Theory of Risk

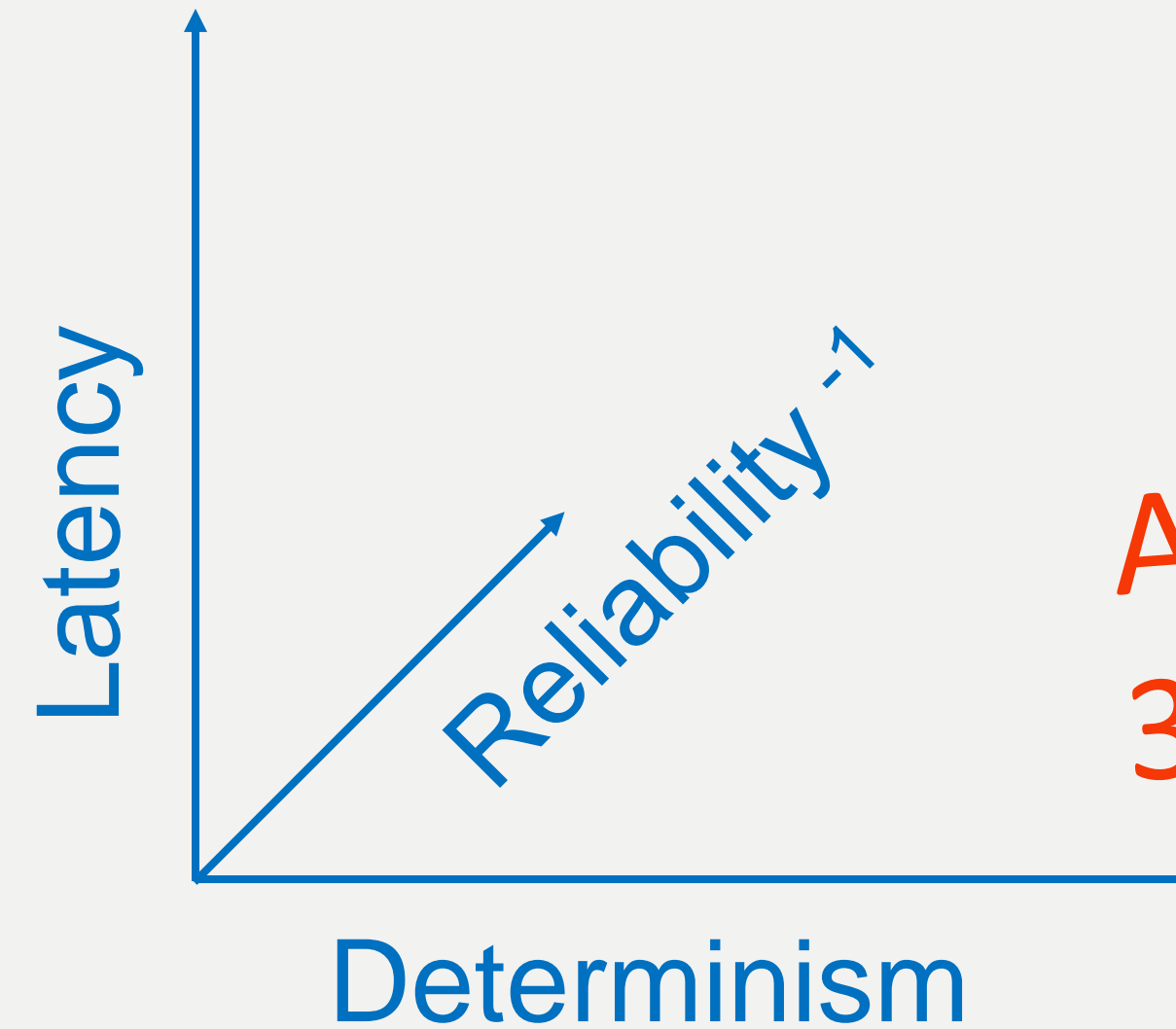
Not yet resolved

Functions
of time?

Underlying system attributes

Sterman's
time
dependency?

risk



Are we in a
3D space?

Dekker's
incubation
period?

certainty

Rasmussen's
drift?



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What to do with this?

Continue to abide by the rules

Critical thinking

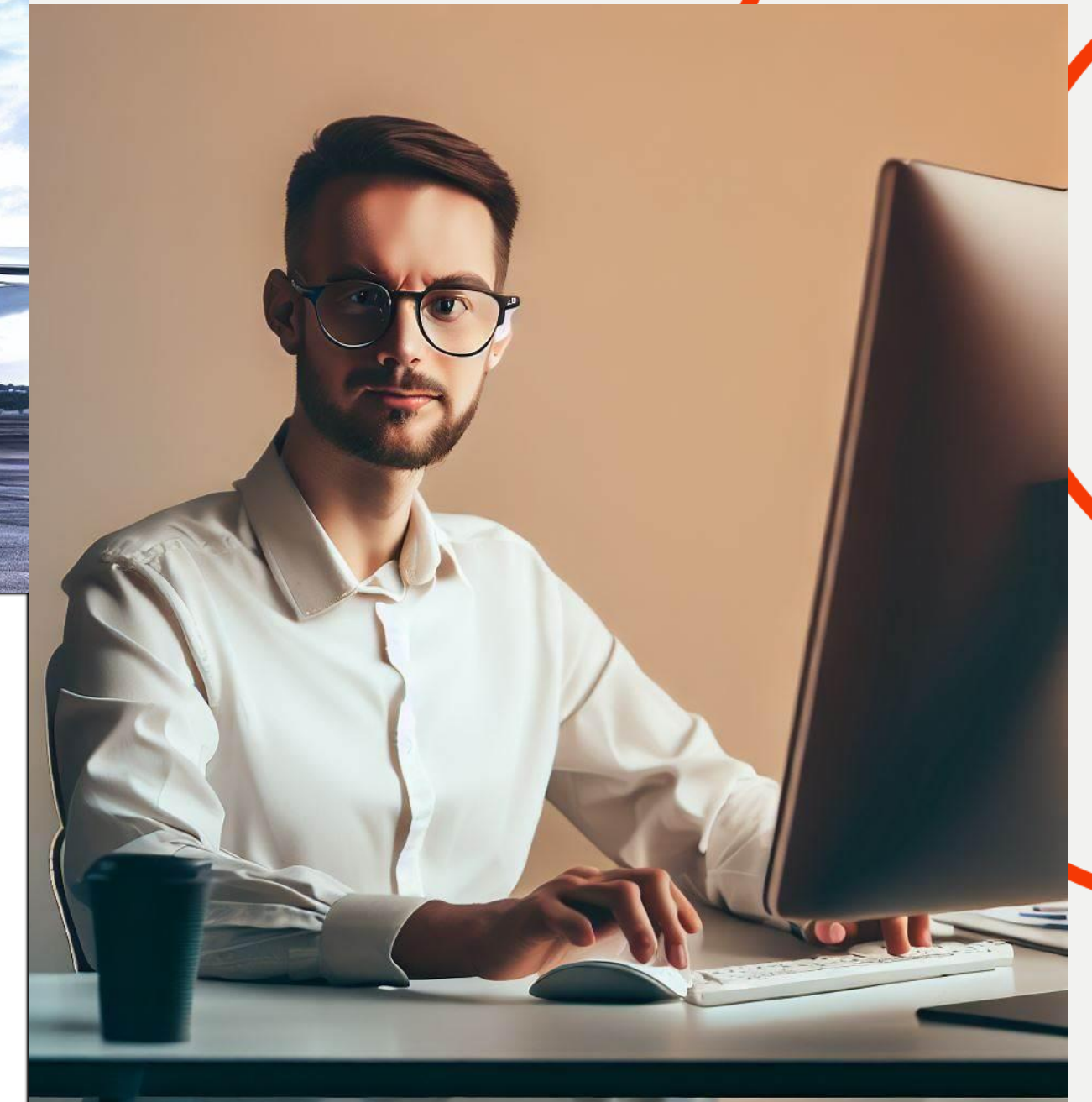
- right tool for the job
- do you really know the probability?

Understanding

- risk acceptance
- empathy



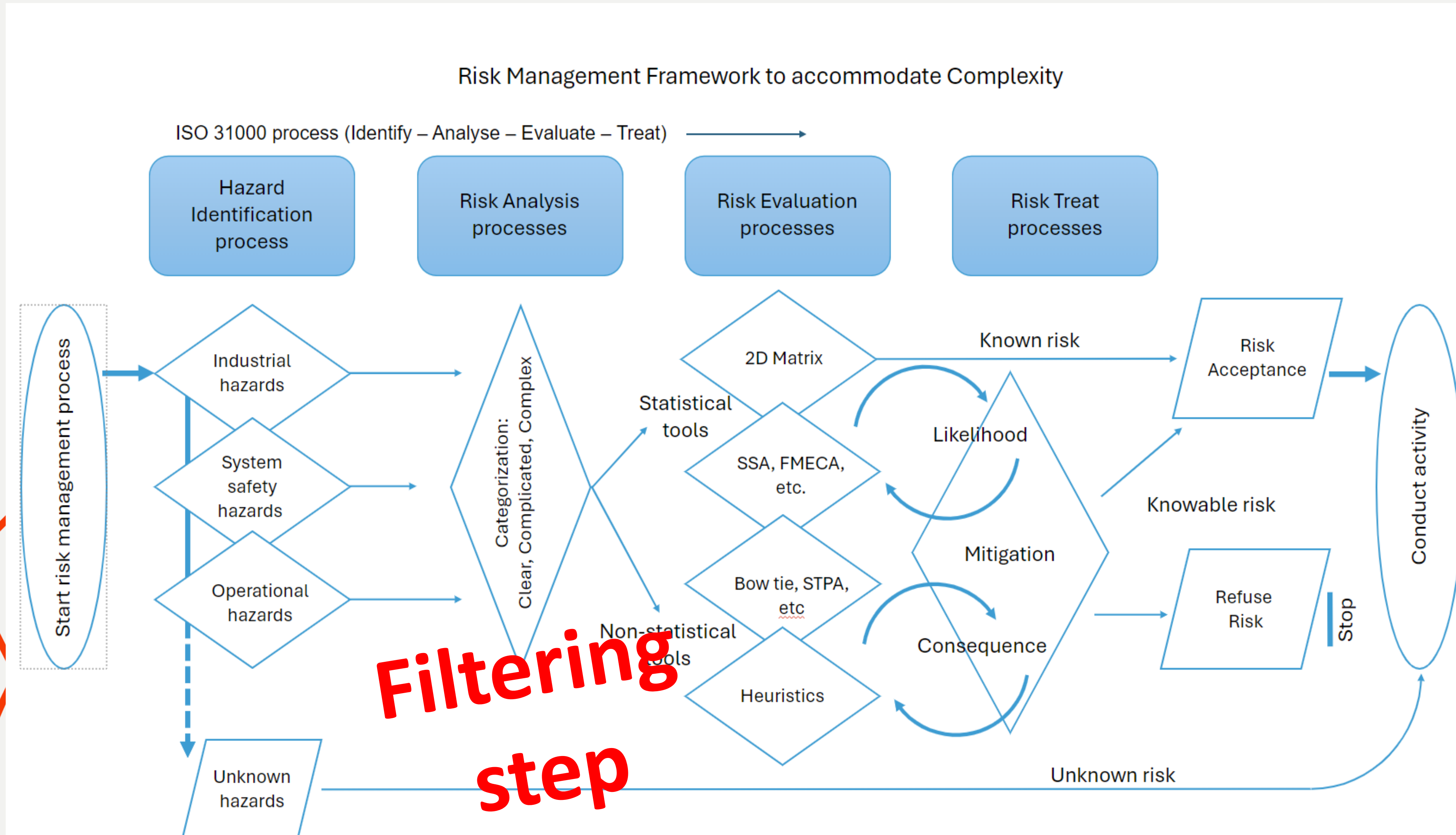
RISK ASSESSMENT MATRIX				
SEVERITY PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			



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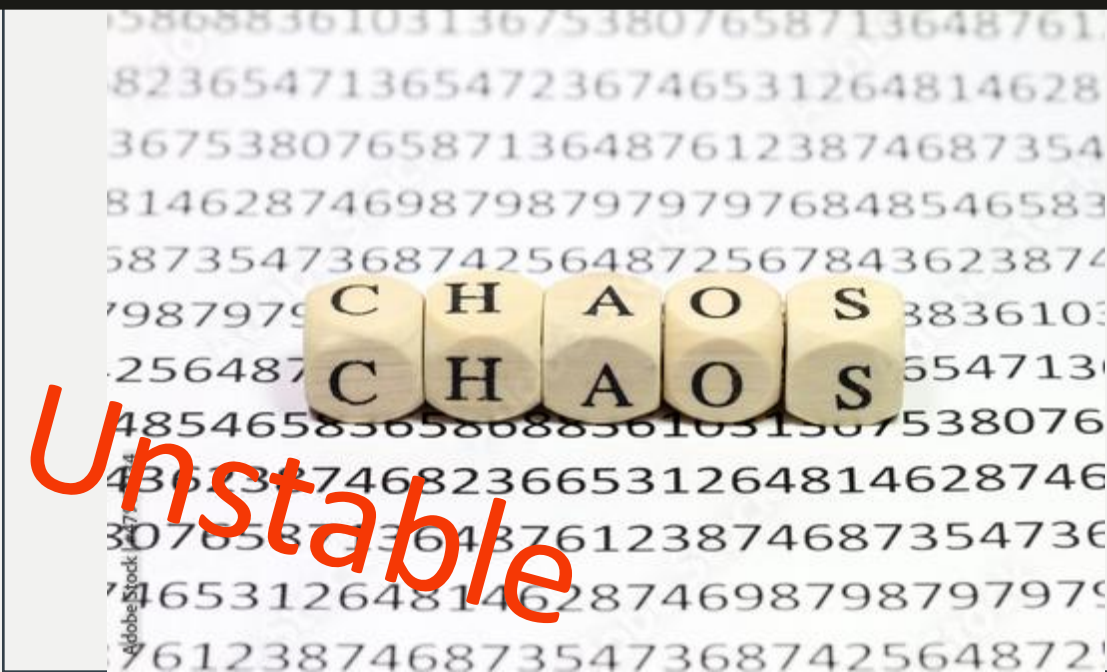
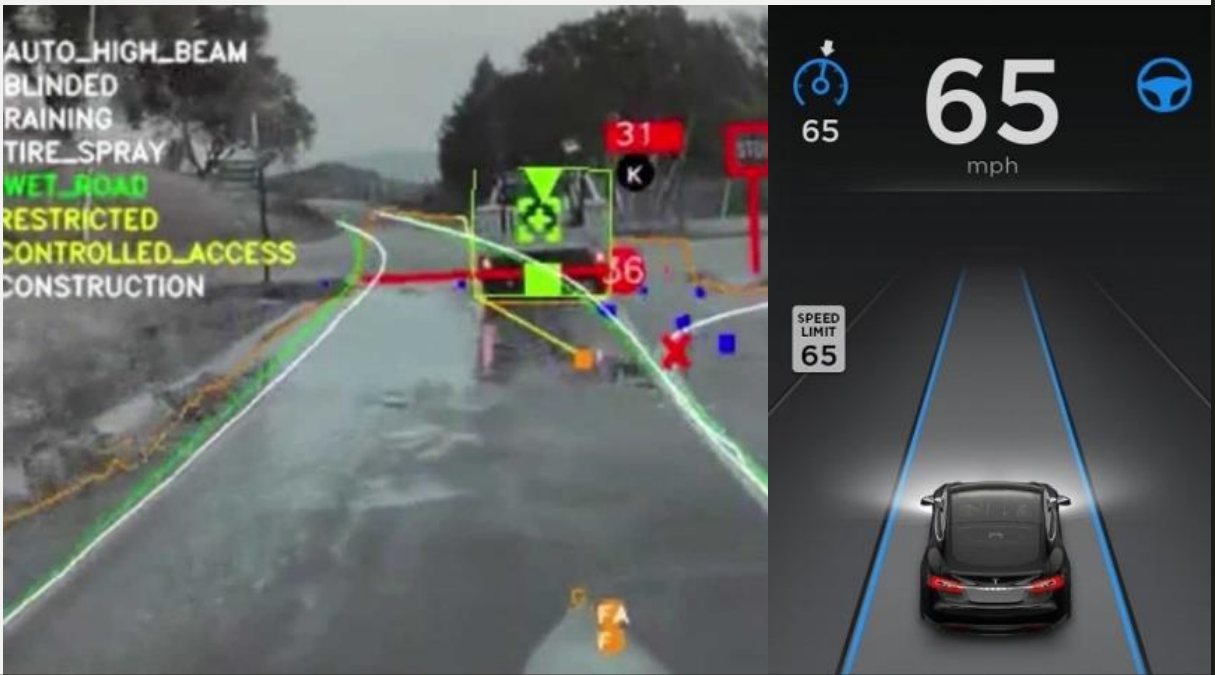
Risk Management Framework for Complex Systems



Right Tool for the Job

Precautionary, &
STPA

SMS



PPE



