THE HIDDEN DANCE OF COMPLEXITY

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https://www.flickr.com/photos/mixtapepl/7165728374/

AN INTRODUCTION TO

COMPLEXITY (THEORY)

ELEMENTS FROM

SAFETY SCIENCE

SYSTEMS THINKING

INFORMATION THEORY

CHAOS THEORY

WARNING: IT'S PRETTY COMPLICATED

COMPLEXITY IS ALL AROUND US

"Everywhere we look, we see complexity. In everything we do, we participate in complexity."

NEIL THEISE

https://pixabay.com/photos/trees-canopy-crown-shyness-forest-4450514/

https://pixabay.com/photos/birds-swarm-flock-of-birds-heaven-1714542/

https://w.wiki/CZ7i

https://www.vecteezy.com/photo/43993323-nuclear-plant-sunset-silhouette

https://pixabay.com/photos/city-sun-sky-mood-architecture-5092432/

https://pixabay.com/photos/people-crowd-street-crossing-japan-4259948/

CHARACTERISTICS OF A COMPLEX SYSTEM

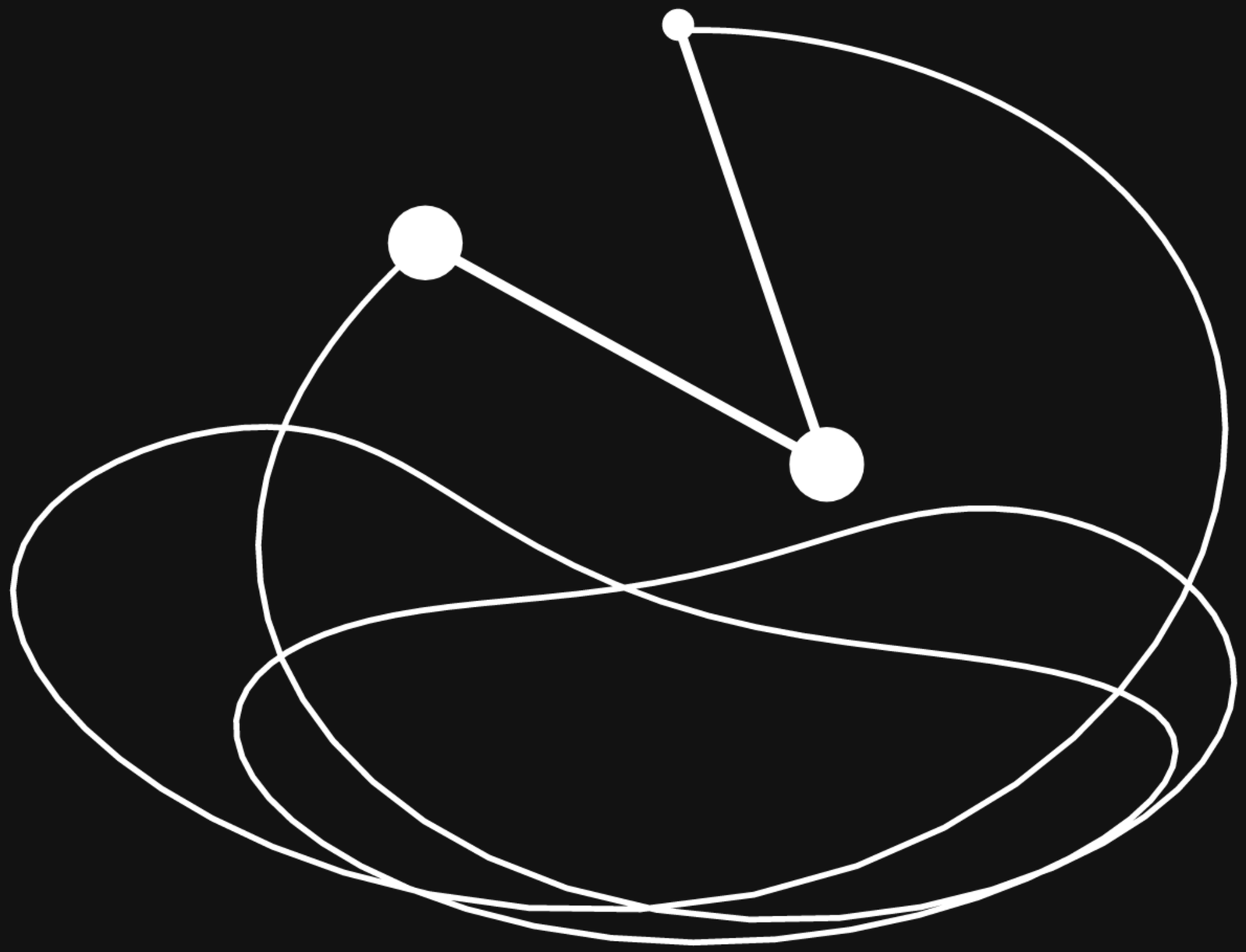
CHANGES NOT REVERSIBLE

EVENTS NOT REPLICABLE

NON-LINEARITY

THE WHOLE IS GREATER THAN THE SUM OF ITS PARTS

SENSITIVITY TO INITIAL CONDITIONS



https://github.com/theabbie/DoublePendulum

BUTTERFLY EFFECT

EMERGENCE

https://pixabay.com/photos/castle-storm-clouds-weather-rain-8033915/

(APPARENT) RANDOMNESS

POSITIVE FEEDBACK

NEGATIVE FEEDBACK

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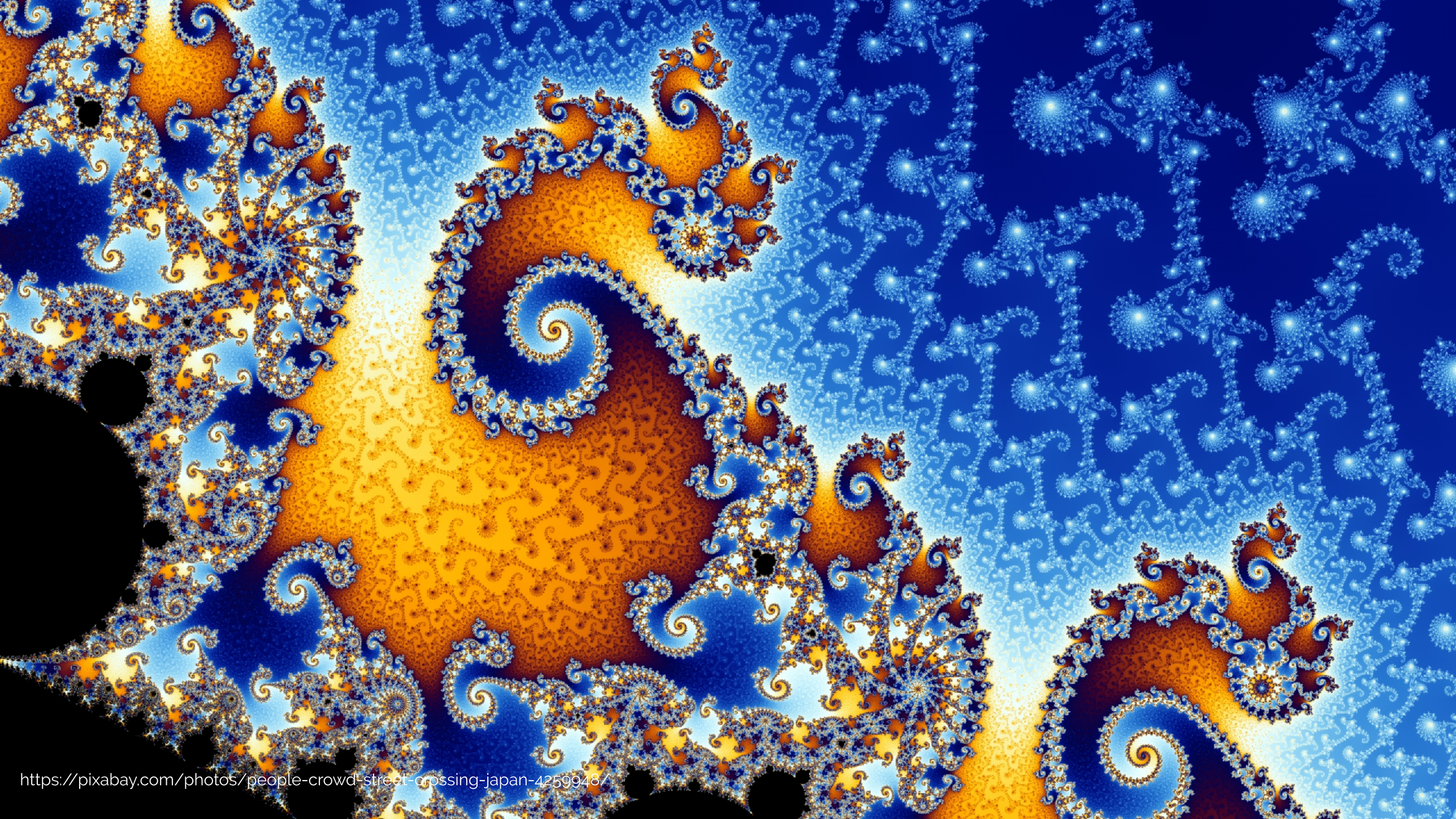
SELF-ORGANIZATION

"Components interacting in ways that cannot be predicted."

CHARLES PERROW



https://pixabay.com/photos/people-crowd-street-crossing-japan-4259948/

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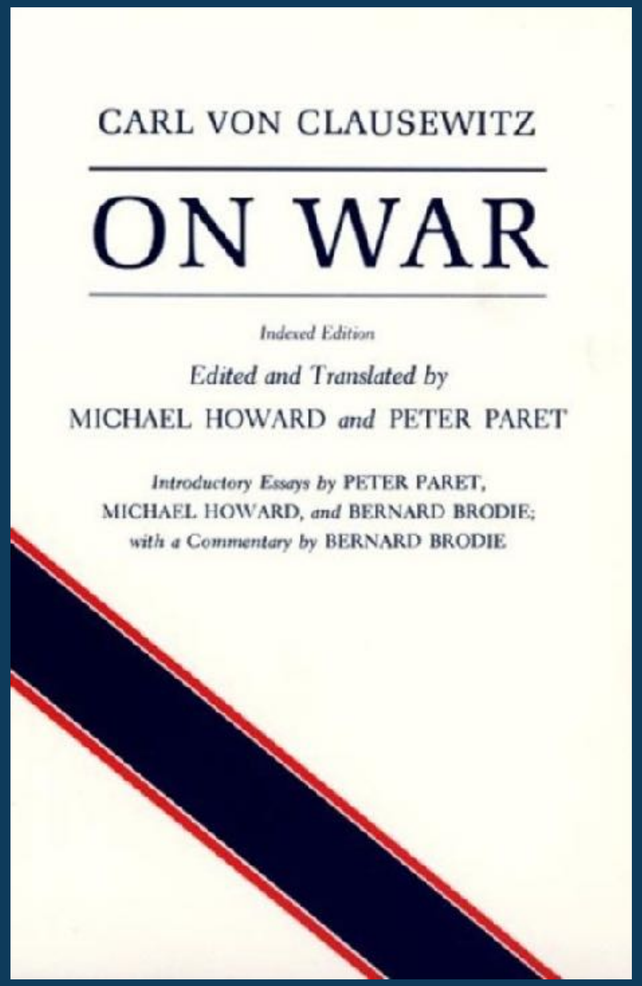
FRICTION



"Everything is very simple in war, but the simplest thing is difficult. These difficulties accumulate and produce a friction."

– CARL VON CLAUSEWITZ

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COUPLING

TIGHT COUPLING

TIGHT TOLERANCES

NO DELAYS OR SLACK

CENTRALIZED & RIGID

INTERDEPENDENCE

LOOSE COUPLING

DECENTRALIZED

BUFFERS

NO RIGID SEQUENCES

TIME TO CORRECT PROBLEMS

CANADA POST
POSTES CANADA
Iqaluit

29-073

Bonjour
Bonjour
Bonjour

CHAOTIC SYSTEMS?

"In a chaotic system, a computer model shows that the same starting conditions will always generate the same emergent properties. The whole is predictably greater than the sum of its parts."

SIDNEY DEKKER

HOW DO WE (HUMANS) PERCEIVE COMPLEX SYSTEMS?

WE DON'T (REALLY) UNDERSTAND

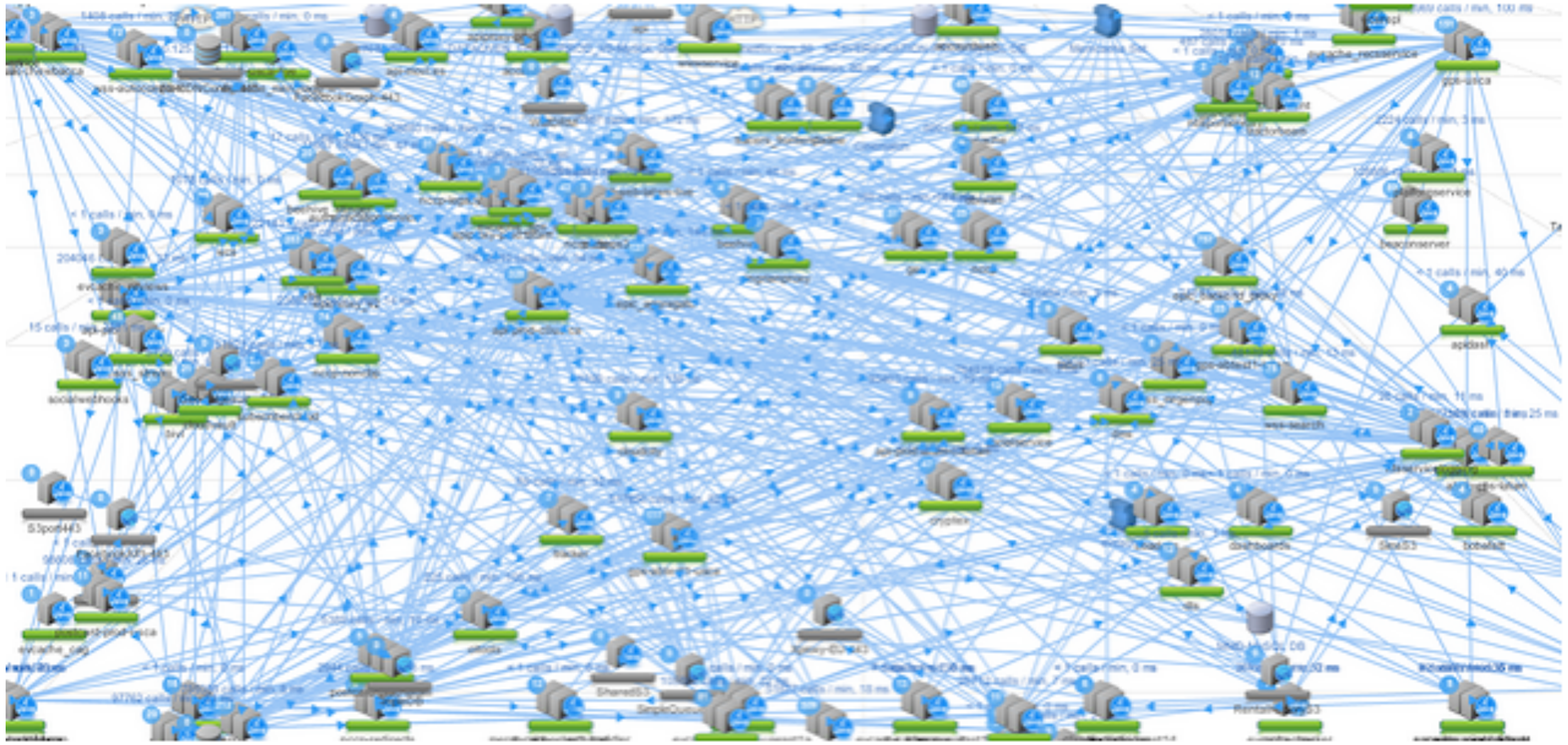
"Complex systems can never be wholly understood or exhaustively described. If they could, they would either not be complex, or the entity understanding them would have to be as complex as the whole system."

SIDNEY DEKKER

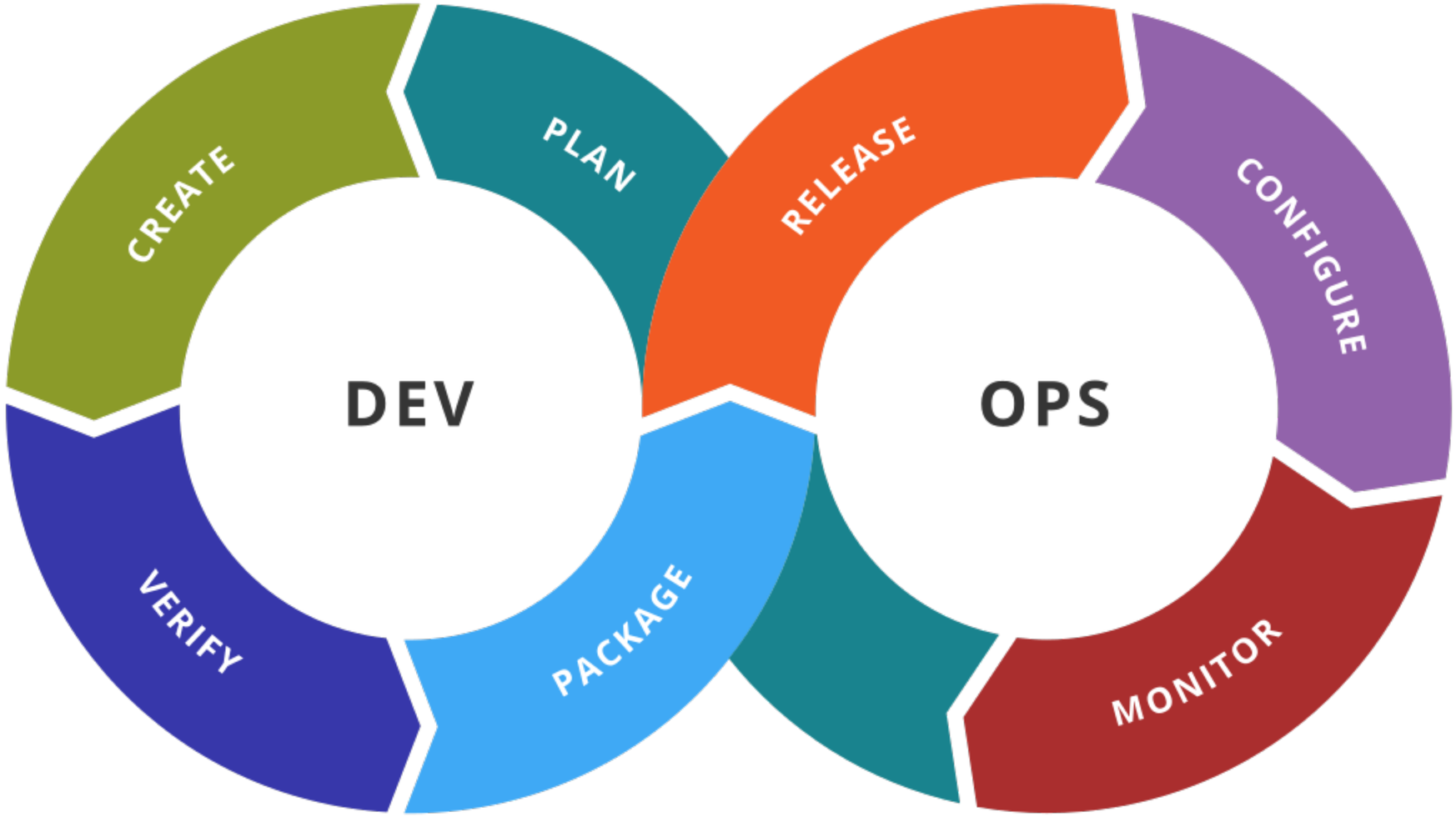
"As the complexity of a system increases, the accuracy of any single agent's own model of that system decreases rapidly."

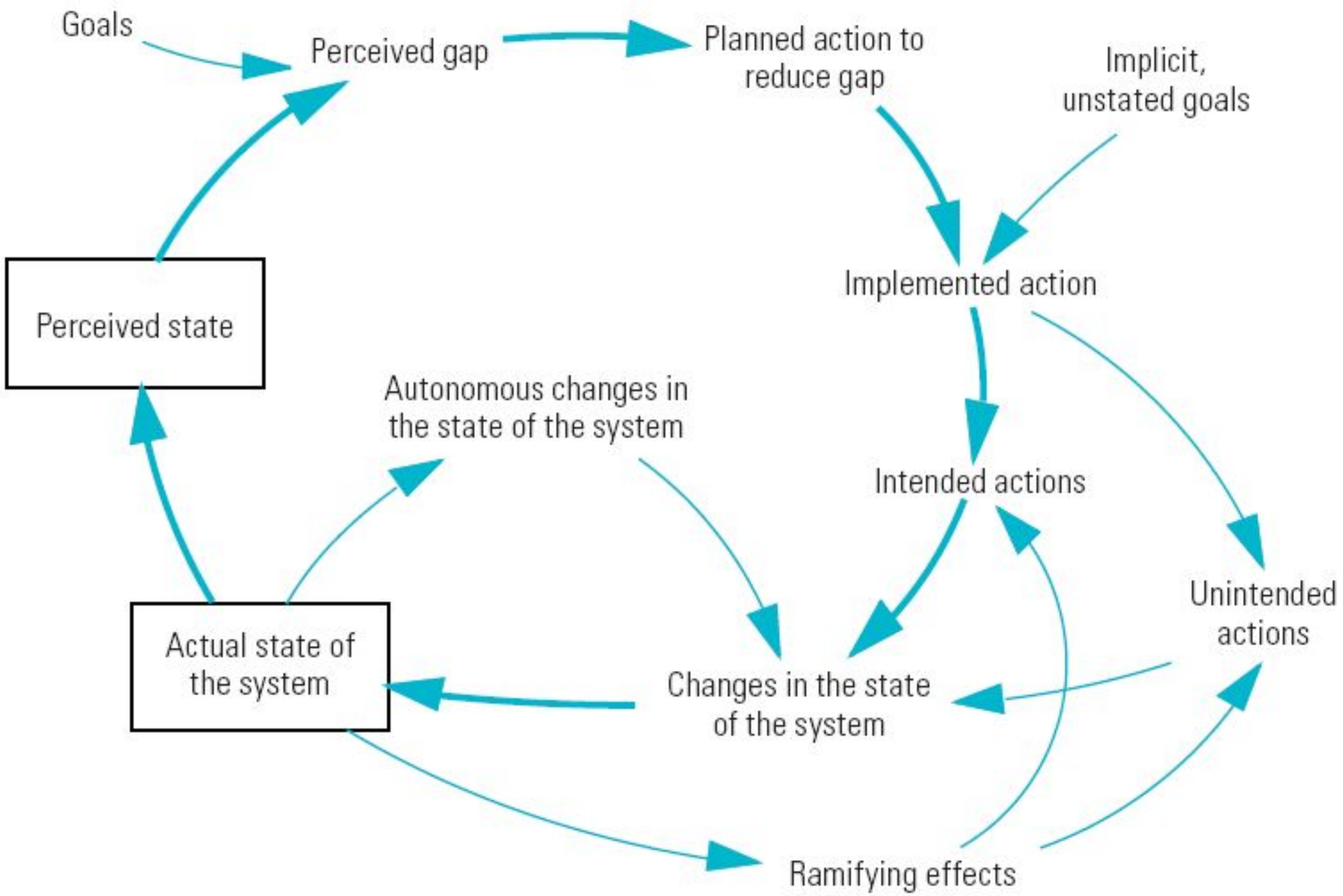
DAVID WOODS

OUR MODELS DO NOT MATCH REALITY



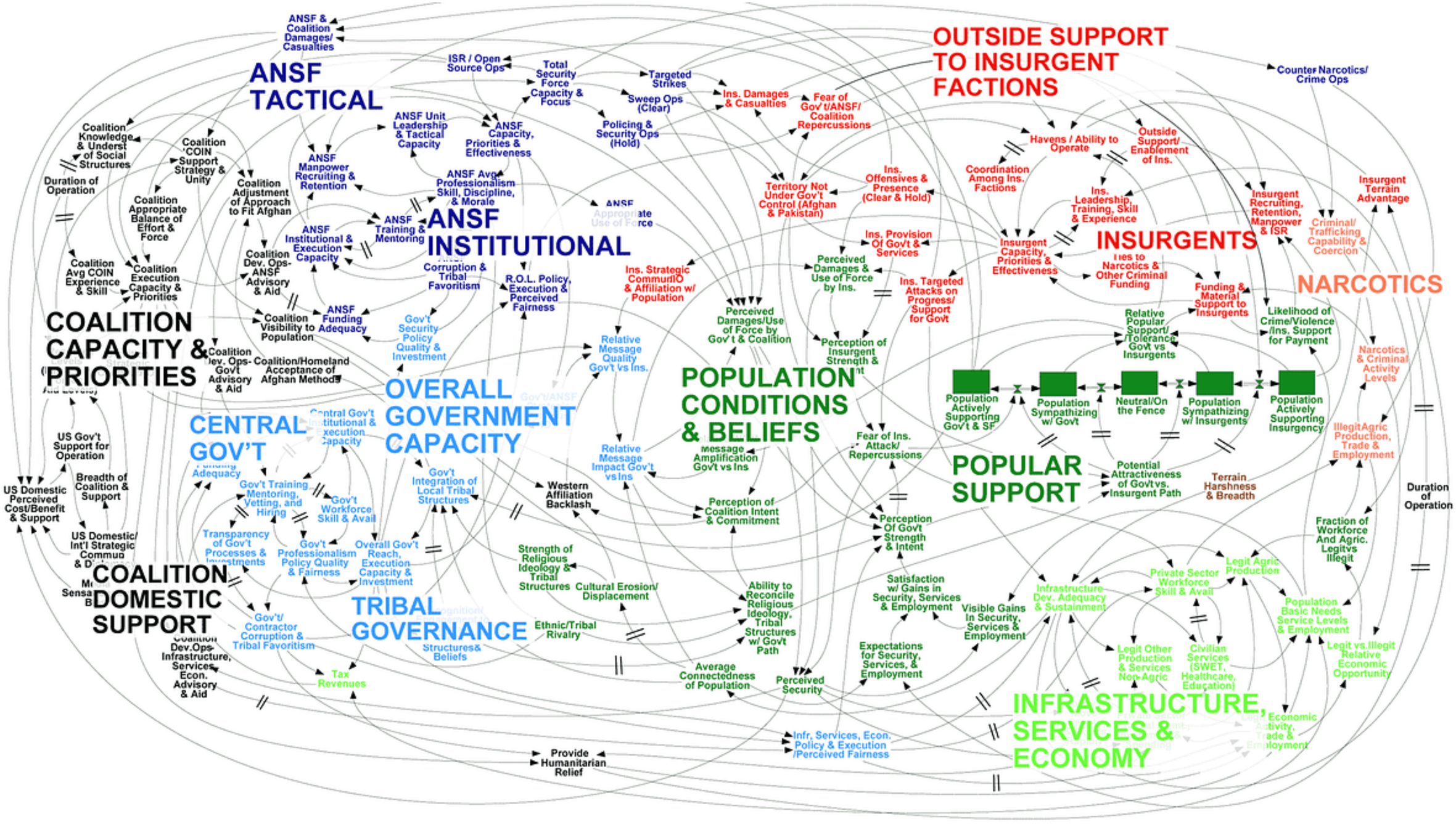
FEEDBACK LOOPS NOT (ALWAYS) UNIDIRECTIONAL!


CREATE
PLAN
RELEASE
CONFIGURE
DEV
OPS
VERIFY
PACKAGE
MONITOR



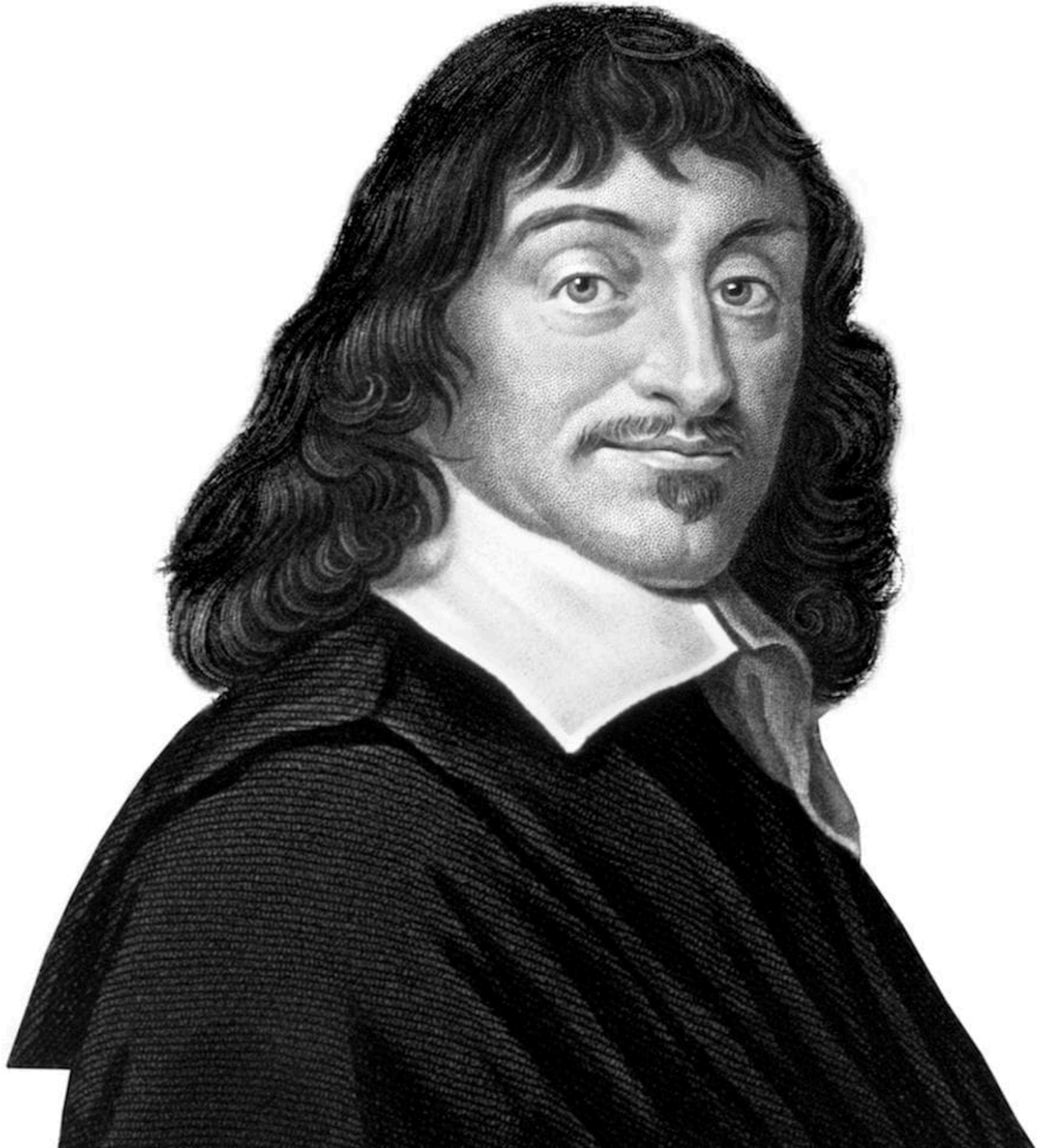
https://w.wiki/CyTs

THE SEARCH FOR (PERFECT) INFORMATION


ANSF TACTICAL
ANSF & Coalition Damages/ Casualties
ISR / Open Source Ops
Total Security Force Capacity & Focus
Targeted Strikes
Sweep Ops (Clear)
Policing & Security Ops (Hold)
ANSF Unit Leadership & Tactical Capacity
ANSF Capacity, Priorities & Effectiveness
ANSF Manpower Recruiting & Retention
ANSF Avg Professionalism Skill, Discipline, & Morale
ANSF Training & Mentoring
ANSF Institutional & Execution Capacity
ANSF INSTITUTIONAL
Coalition Knowledge & Underst of Social Structures
Coalition COIN Support Strategy & Unity
Duration of Operation
Coalition Appropriate Balance of Effort & Force
Coalition Adjustment of Approach to Fit Afghan
Coalition Avg COIN Experience & Skill
Coalition Execution Capacity & Priorities
Coalition Dev. Ops- ANSF Advisory & Aid
Coalition Visibility to Population
ANSF Funding Adequacy
COALITION CAPACITY & PRIORITIES
Coalition Dev. Ops- Gov't Advisory & Aid
Coalition/Homeland Acceptance of Afghan Method
Corruption & Tribal Favoritism
R.O.L. Policy, Execution & Perceived Fairness
Gov't Security Policy Quality & Investment
OVERALL GOVERNMENT CAPACITY
CENTRAL GOV'T
Central Gov't Institutional & Execution Capacity
Gov't Training Mentoring, Vetting, and Hiring
Gov't Workforce Skill & Avail
Gov't Integration of Local Tribal Structures
Transparency of Gov't Processes & Investments
Gov't Professionalism Policy Quality & Fairness
Overall Gov't Reach, Execution Capacity & Investment
Gov't/ Contractor Corruption & Tribal Favoritism
Tax Revenues
US Gov't Support for Operation
US Domestic Perceived Cost/Benefit & Support
Breadth of Coalition & Support
US Domestic/ Int'l Strategic Commun
COALITION DOMESTIC SUPPORT
Coalition Dev.Ops- Infrastructure, Services, Econ. Advisory & Aid
TRIBAL GOVERNANCE
Structures& Beliefs
Ethnic/Tribal Rivalry
Cultural Erosion/ Displacement
Strength of Religious Ideology & Tribal Structures
Ins. Strategic Commun/IO & Affiliation w/ Population
Relative Message Quality Gov't vs Ins.
Relative Message Impact Gov't vs Ins
Message Amplification Gov't vs Ins
Western Affiliation Backlash
Perception of Coalition Intent & Commitment
Ability to Reconcile Religious Ideology, Tribal Structures w/ Gov't Path
Average Connectedness of Population
Perceived Security
Provide Humanitarian Relief
Infr, Services, Econ. Policy & Execution /Perceived Fairness
OUTSIDE SUPPORT TO INSURGENT FACTIONS
Counter Narcotics/ Crime Ops
Ins. Damages & Casualties
Fear of Gov't/ANSF/ Coalition Repercussions
Havens / Ability to Operate
Outside Support/ Enablement of Ins.
Coordination Among Ins. Factions
Ins. Leadership, Training, Skill & Experience
Territory Not Under Gov't Control (Afghan & Pakistan)
Ins. Offensives & Presence (Clear & Hold)
Insurgent Recruiting, Retention, Manpower & ISR
Insurgent Terrain Advantage
Criminal/ Trafficking Capability & Coercion
INSURGENTS
Ins. Provision Of Gov't & Services
Insurgent Capacity, Priorities & Effectiveness
Ties to Narcotics & Other Criminal Funding
Funding & Material Support to Insurgents
NARCOTICS
Perceived Damages & Use of Force by Ins.
Ins. Targeted Attacks on Progress/ Support for Gov't
Perceived Damages/Use of Force by Gov't & Coalition
Perception of Insurgent Strength & Intent
Relative Popular Support/ /Tolerance Gov't vs Insurgents
Likelihood of Crime/Violence /Ins. Support for Payment
Narcotics & Criminal Activity Levels
POPULATION CONDITIONS & BELIEFS
Population Actively Supporting Gov't & SF
Population Sympathizing w/ Gov't
Neutral/On the Fence
Population Sympathizing w/ Insurgents
Population Actively Supporting Insurgency
Fear of Ins. Attack/ Repercussions
POPULAR SUPPORT
Potential Attractiveness of Gov't vs. Insurgent Path
Terrain Harshness & Breadth
Illegit Agric Production, Trade & Employment
Duration of Operation
Perception Of Gov't Strength & Intent
Fraction of Workforce And Agric. Legit vs Illegit
Satisfaction w/ Gains in Security, Services & Employment
Visible Gains In Security, Services & Employment
Infrastructure Dev. Adequacy & Sustainment
Private Sector Workforce Skill & Avail
Legit Agric Production
Population Basic Needs Service Levels & Employment
Expectations for Security, Services, & Employment
Legit Other Production & Services Non-Agric
Civilian Services (SWET, Healthcare, Education)
Legit vs.Illegit Relative Economic Opportunity
INFRASTRUCTURE, SERVICES & ECONOMY
Economic Activity, Trade & Employment

WE OVERSIMPLIFY

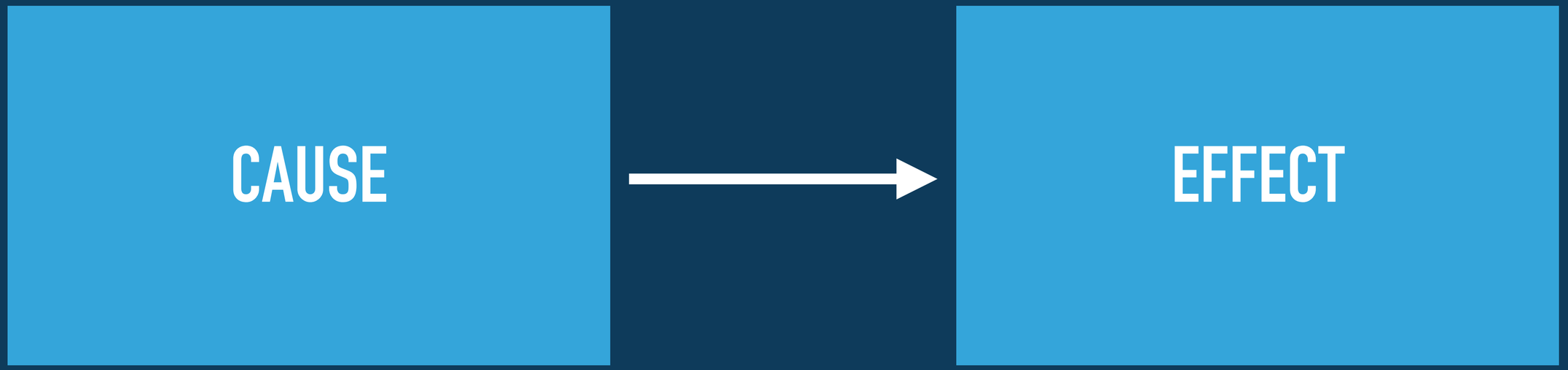
NEWTONIAN & CARTESIAN VIEWS



"Cartesians view the mind as being wholly separate from the corporeal body"

REDUCTIONISM

"To every action, there is always opposed an equal reaction"


CAUSE
EFFECT

CONSPIRACY THEORIES

"The more elaborate a conspiracy theory is, and the more people that would need to be involved to pull it off, the less likely it is true."

MICHAEL SHERMER

HOW DO ORGANIZATIONS DEAL WITH COMPLEX SYSTEMS?

"When the variety or complexity of the environment exceeds the capacity of a system (natural or artificial) the environment will dominate and ultimately destroy that system."

W. ROSS ASHBY

COMPLEX DOMAIN = COMPLEX ORGANIZATION

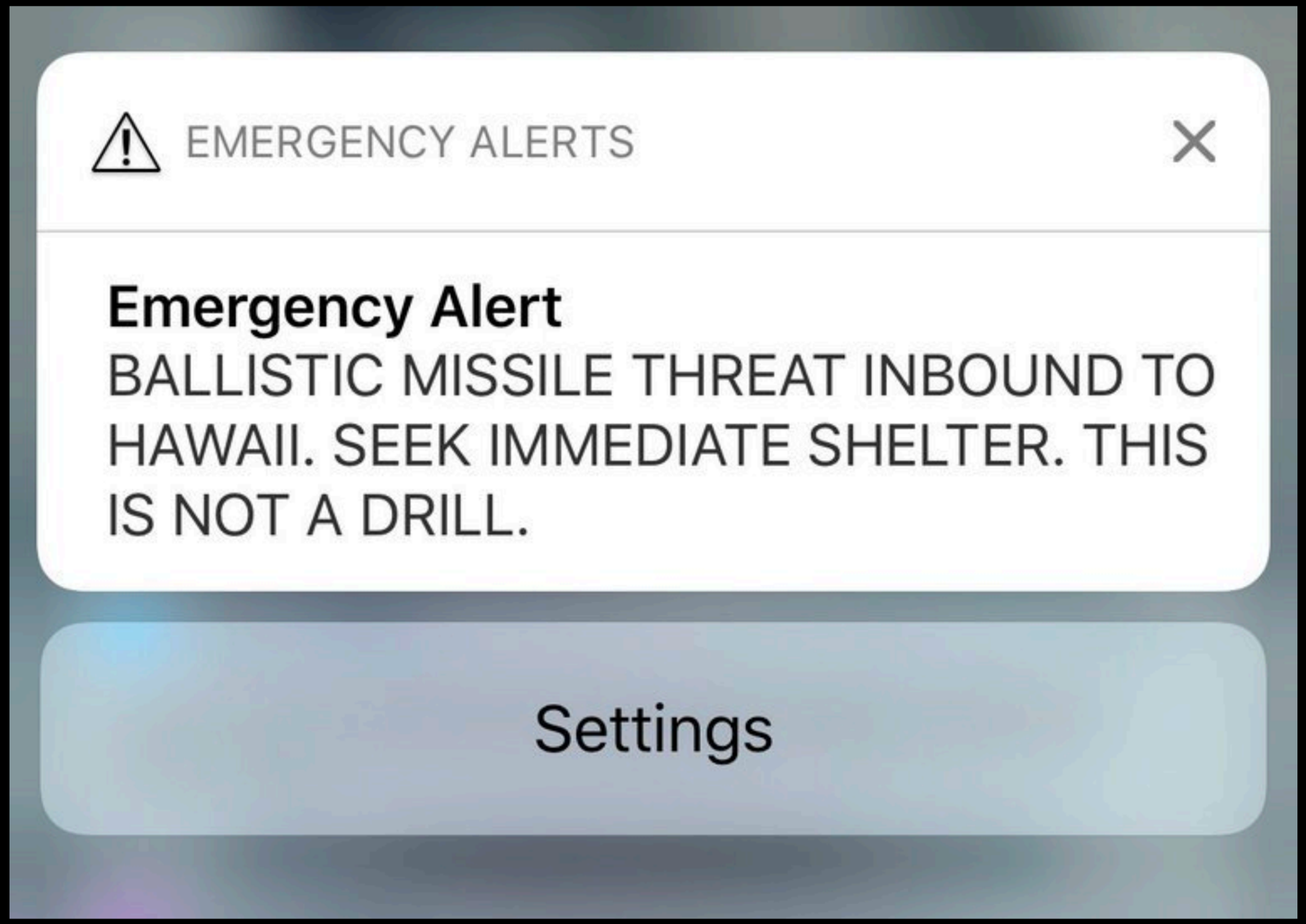
"No organization operates in a vacuum."

SIDNEY DEKKER

DIVERSITY

CONTRADICTING GOALS

LINEAR MEASURES TO NON-LINEAR EFFECTS


EMERGENCY ALERTS
Emergency Alert
BALLISTIC MISSILE THREAT INBOUND TO HAWAII. SEEK IMMEDIATE SHELTER. THIS IS NOT A DRILL.
Settings

SUBJECT: False ballistic missile alert incident investigation for January 13, 2018 – Findings and Recommendations

u. Conduct a command climate survey to all HI-EMA members to determine morale and communication within the division.

v. HI-EMA leadership should be properly trained to ensure employee performance meets or exceeds expected levels.

w. Based on my findings the Director of HI-EMA should take appropriate disciplinary action regarding involved employees.

Brigadier General [Ret] Bruce Oliveira
Investigating Officer

False Ballistic Missile Alert Investigation for January 13, 2018, Hawaii Department of Defense

CHANGE IN COMPLEX SYSTEMS

TO OBSERVE IS TO CHANGE

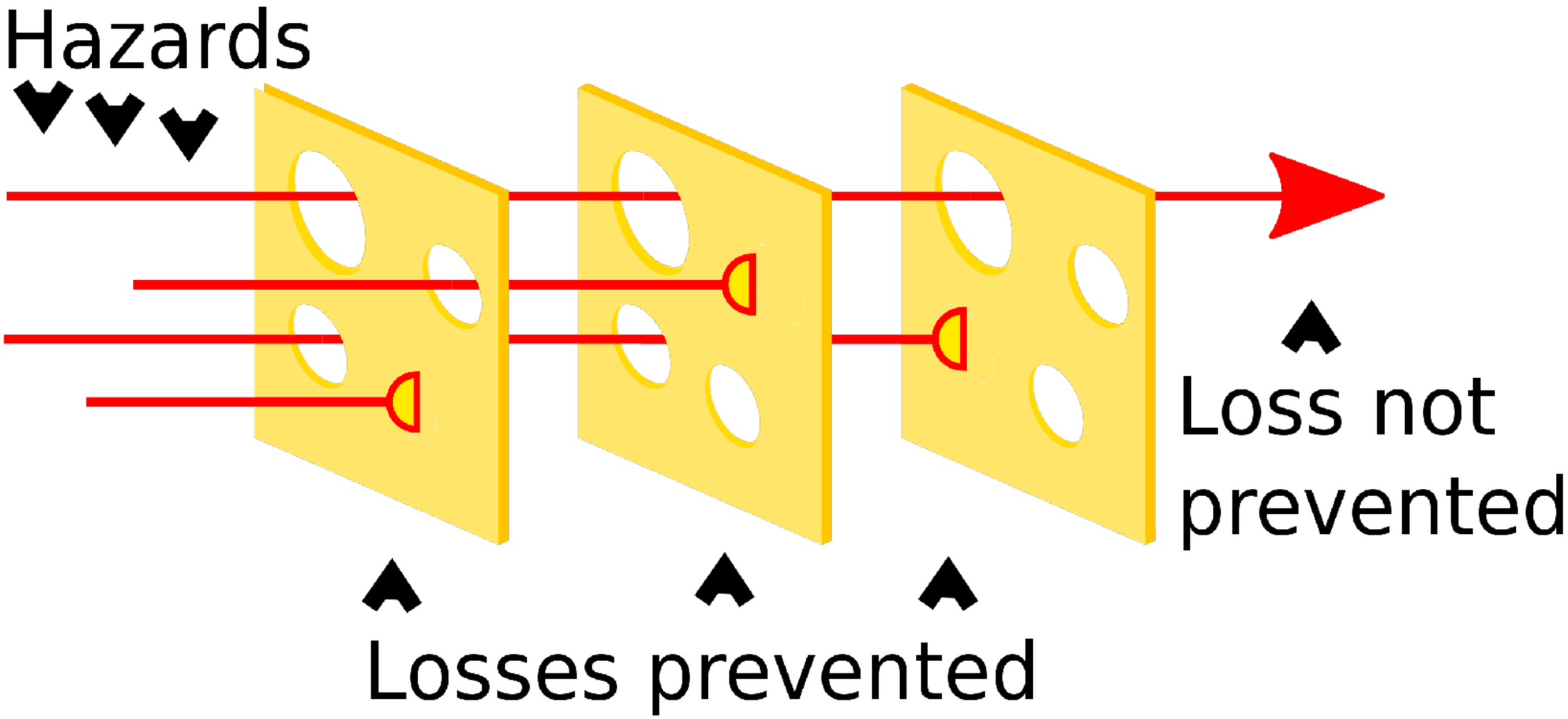
WE MAKE LIFE (MORE) DIFFICULT

OUTSOURCING?

DISTRIBUTED ARCHITECTURES

PLATFORMS

REDUNDANCY & AUTOMATION


Hazards
Loss not prevented
Losses prevented

LAW OF UNINTENDED CONSEQUENCES

“Everything is unprecedented until it happens for the first time.”

CHESLEY B. SULLENBERGER

INCIDENTS IN COMPLEX SYSTEMS

SURPRISING FAILURE MODES

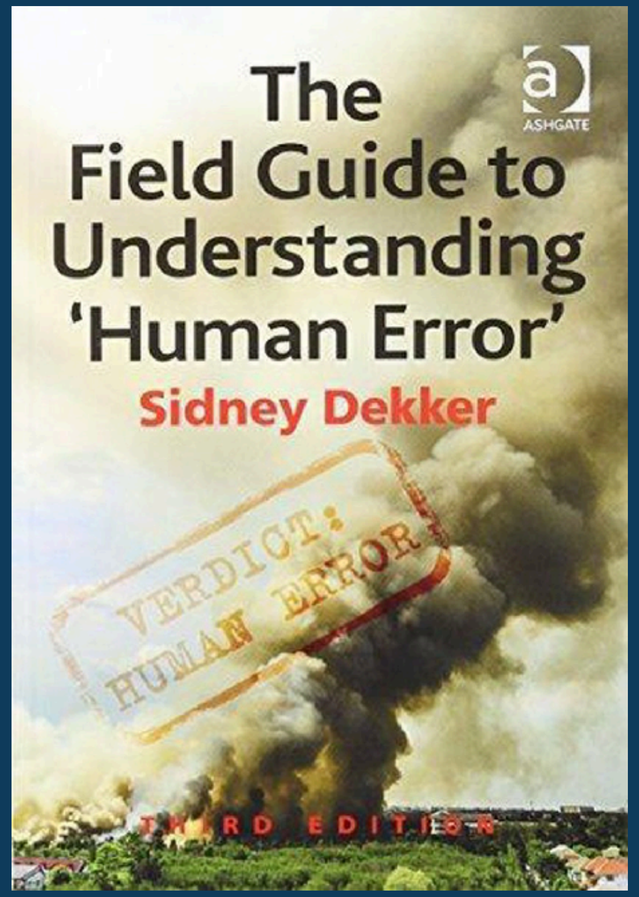
SYSTEM INCIDENTS

SYSTEMS THINKING

ROOT CAUSE ANALYSIS?

“Failures in complex systems require multiple contributing causes, each necessary **but only** jointly sufficient.”

RICHARD COOK



"What you call *'root cause'* is simply the place where you stop looking any further."

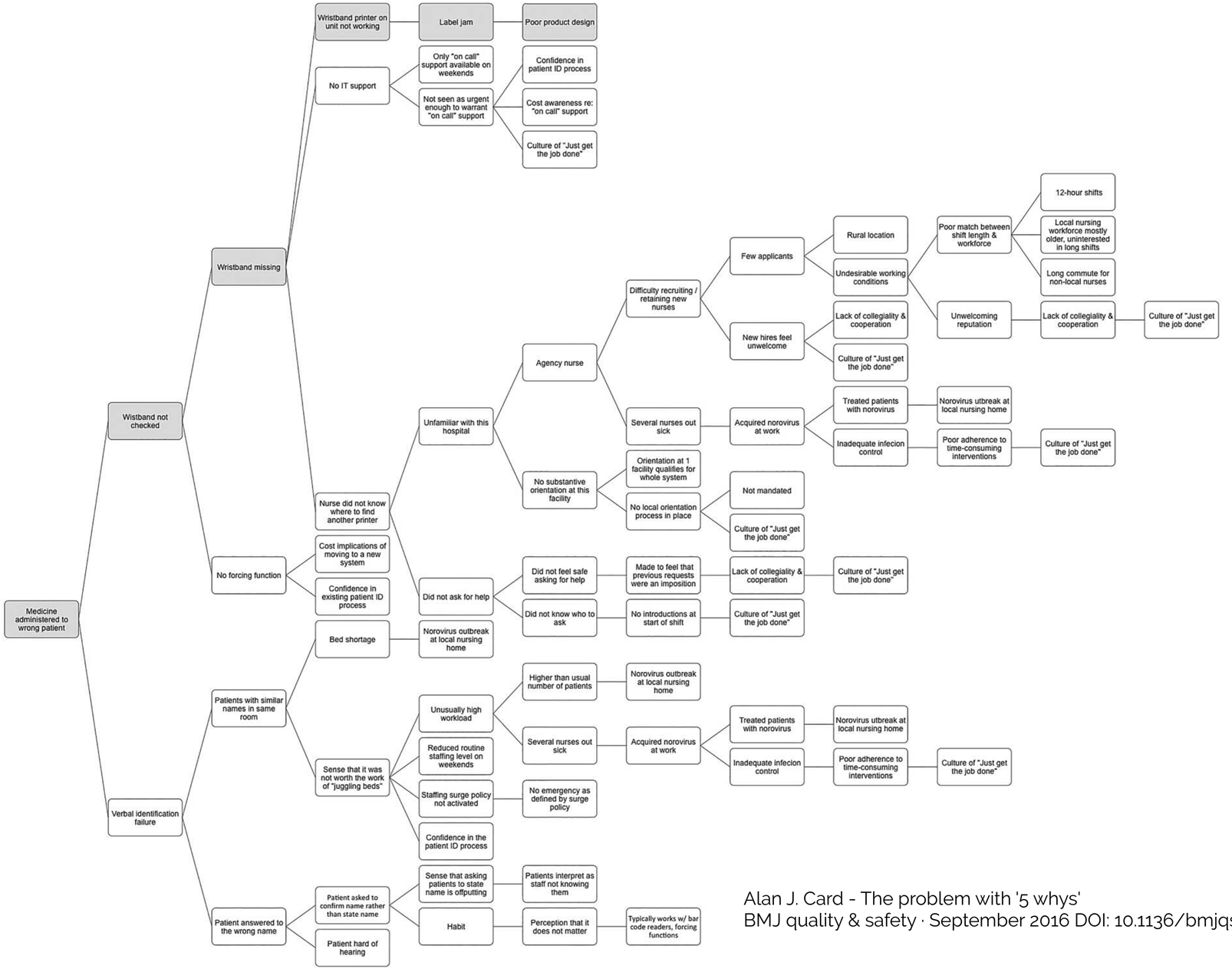
SIDNEY DEKKER

ROOT CAUSES?

“Finding the root cause of a failure is like finding the root cause of a success.”

JOHN ALLSPAW

5 WHYS



Alan J. Card - The problem with '5 whys'
BMJ quality & safety · September 2016 DOI: 10.1136/bmjqs-2016-005849

“For every complex problem, there is an answer that is clear, simple, and wrong.”

H. L. MENCKEN

SO WHAT?

THE WORLD IS VUCA

VOLATILE
UNCERTAIN
COMPLEX
AMBIGUOUS

COMPLEXITY = REALITY

REALITY = COMPLEXITY

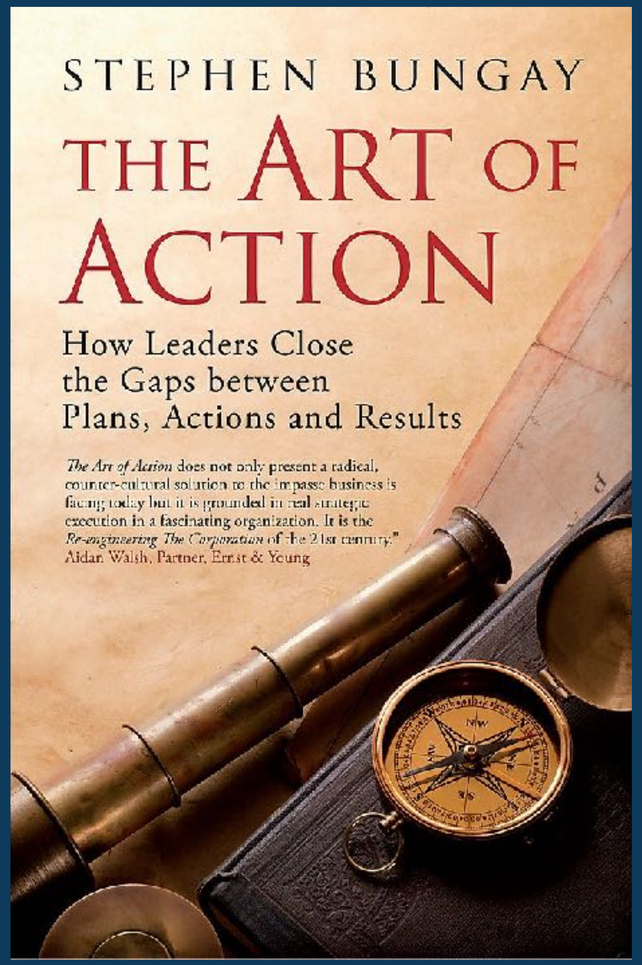
COMPLEXITY REQUIRES NUANCE

WE DO SEE PATTERNS

https://pixabay.com/photos/performance-music-musician-concert-3202707/

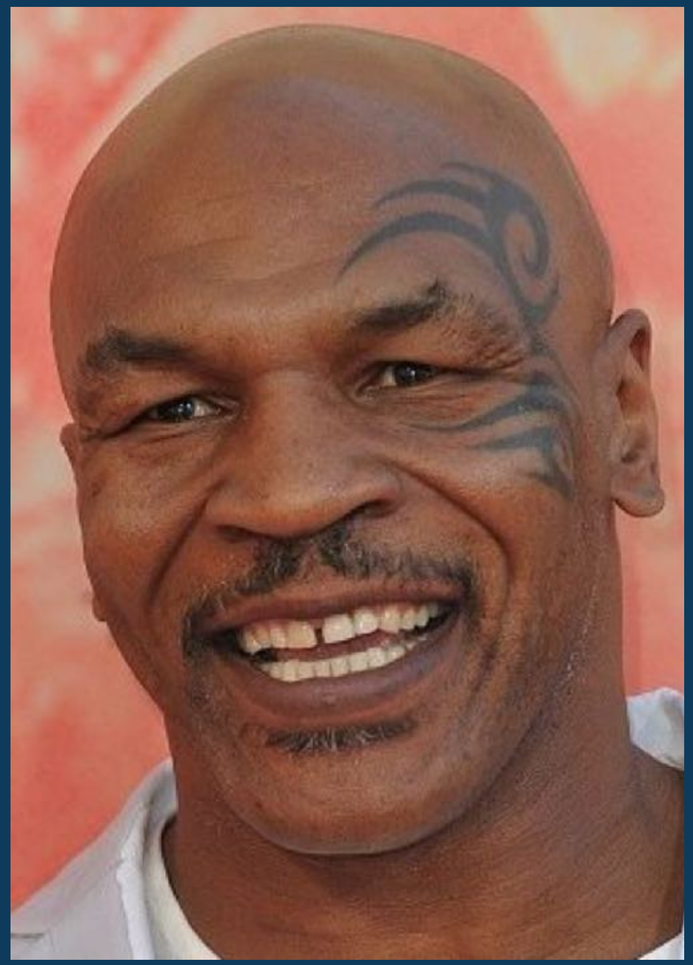
https://pixabay.com/photos/forest-trees-path-nature-autumn-8584311/

WE CAN ADAPT



"There is only one way the plan can go right, but any number of ways in which it can go wrong."

– STEPHEN BUNGAY



"Everyone has a plan 'till they get punched in the mouth."

– MIKE TYSON

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ORGANIZE FOR WHAT WE DON'T KNOW

	Knowns	Unknowns
Knowns	**Known Knowns** Things we are aware of and understand.	**Known Unknowns** Things we are aware of but don't understand.
Unknowns	**Unknown Knowns** Things we understand but are not aware of.	**Unknown Unknowns** Things we are neither aware of nor understand.

	Knowns	Unknowns
Knowns	**Known Knowns** Things we are aware of and understand.	**Known Unknowns** Things we are aware of but don't understand.
Unknowns	**Unknown Knowns** Things we understand but are not aware of.	**Unknown Unknowns** Things we are neither aware of nor understand

POKE THE SYSTEM TO LEARN THE SYSTEM

COPING WITH COMPLEXITY IS COPING WITH UNCERTAINTY

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RESILIENCE

"Requires expertise, experience, autonomy, imaginative adaptability, heuristics, and the ability to make, adjust and reject provisional conclusions as information changes."

THE JOLLY CONTRARIAN

HUMANS ARE ADAPTABLE ASSETS

THANK YOU FOR LISTENING!

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www.michielrook.nl

https://www.michielrook.nl/2024/08/literature-tips/