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Variety Dynamics support for System Dynamics

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Undertaking systems projects for over 40 years…

Iconic retail residential~ $1 billion

Selected projects

Cockburn Quarter $1.1 billion

Indigenous night patrols
Federal Attorney Generals Office

Farmer support in India
Rainwater Harvesting

Multi-agency community development and crime prevention for public transport

What is Variety Dynamics?

- New theory foundation in systems theory, mathematics, ecology, crime prevention, ecology, warfare and security studies, quantum physics and other disciplines…

Variety Dynamics Origins

Developed in 1990s by Terence Love and Trudi Cooper to address some systems analysis limitations - ongoing

- Systems and sub-systems changing in boundaries, existence, purpose and ownership
- Incoherent boundaries
- 2 feedback loop limitation on mental prediction of outcomes
- Coercive systems
- Wicked (and super-wicked) problems
- Hyper-complex and chaotic systems
- Corrupt systems
- Control of complex systems by less powerful actors
- Implications for systems theory of robotisation, automation, AI and ML
- Managing incoherent actions – e.g. surprise attacks

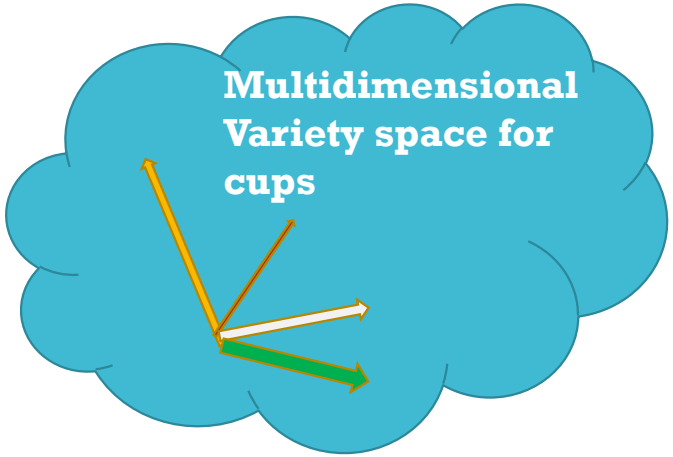
What is Variety?

Variety is the **number of possible states** of something

Variety = 5 of colour of the cakes - CARDINALITY

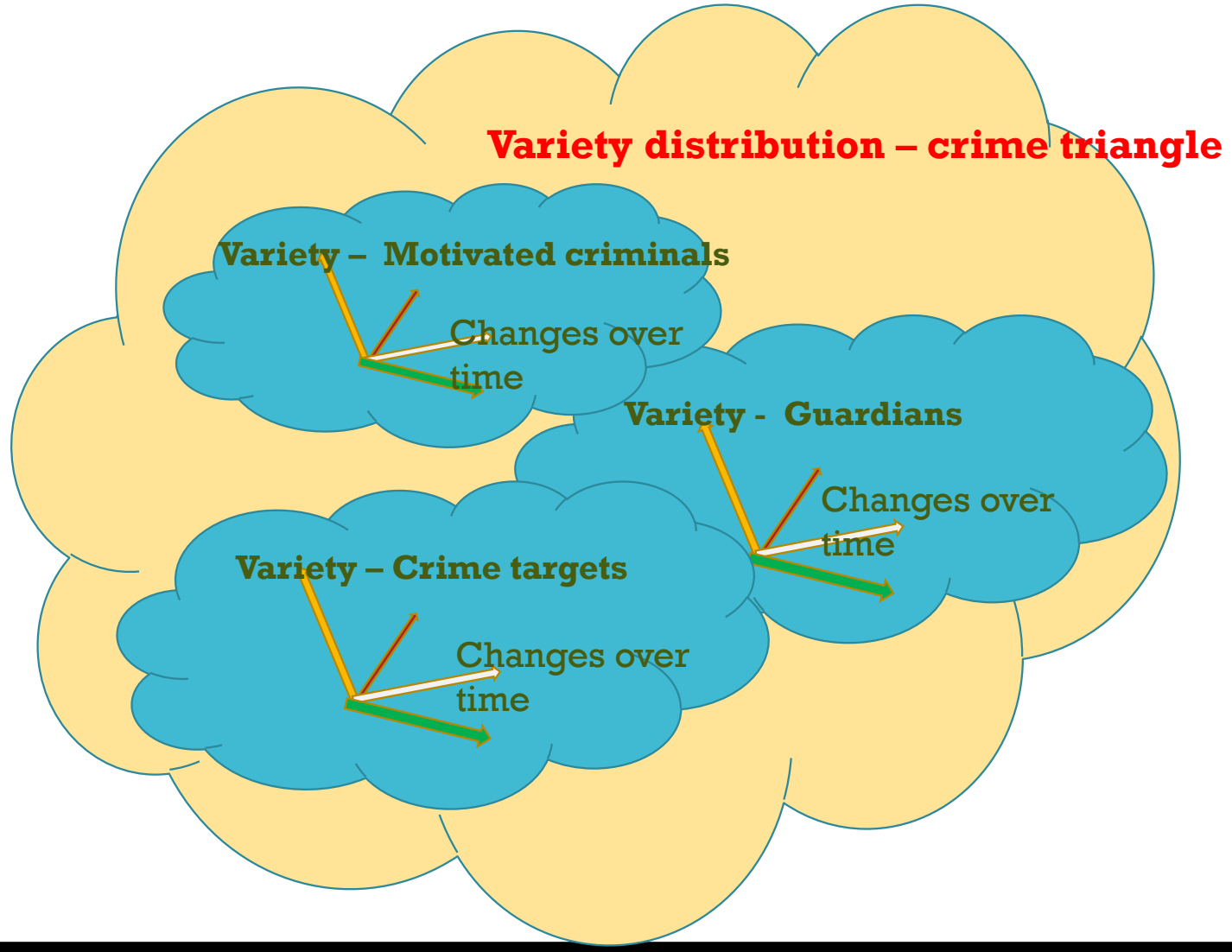
Variety space multidimensional

- The additional **variety** of handles, size, materials, style, coating etc can be represented in multiple dimensions in variety space



Variety Dynamics

Variety distributions can be ***dynamic*** – changing over time



System Dynamics

- Primary role of SD is to help managers of complex systems (2 or more feedback loops)
- Primary output of SD is the **prediction of** behaviours
- Uses causal relations between factors to create a time-stepped first order difference model
- Model predicts increases and decreases in specific variables given certain management decisions
- Managers can use the SD model predictions to help identify good decisions

Missing from SD is power dynamics and ability to guide managers in best choice of decisions (especially to manipulate flow of power)

Scope of Variety Dynamics

Managing behaviours, power relations and system structures in ***complex socio-technical and environmental systems***:

- Systems with changing porous system boundaries
- Multiple constituencies – changing over time
- Multiple overlapping dynamically changing sub-systems
- Multiple overlapping processes across subsystems
- Mixed and changing ownership of sub-systems
- Subsystem and system existence, roles, power, ownership and boundaries changing over time
- Varying purposes and roles of system and sub-systems changing over time
- Complex and dynamic distribution of formal and informal power and control

Law of Requisite Variety

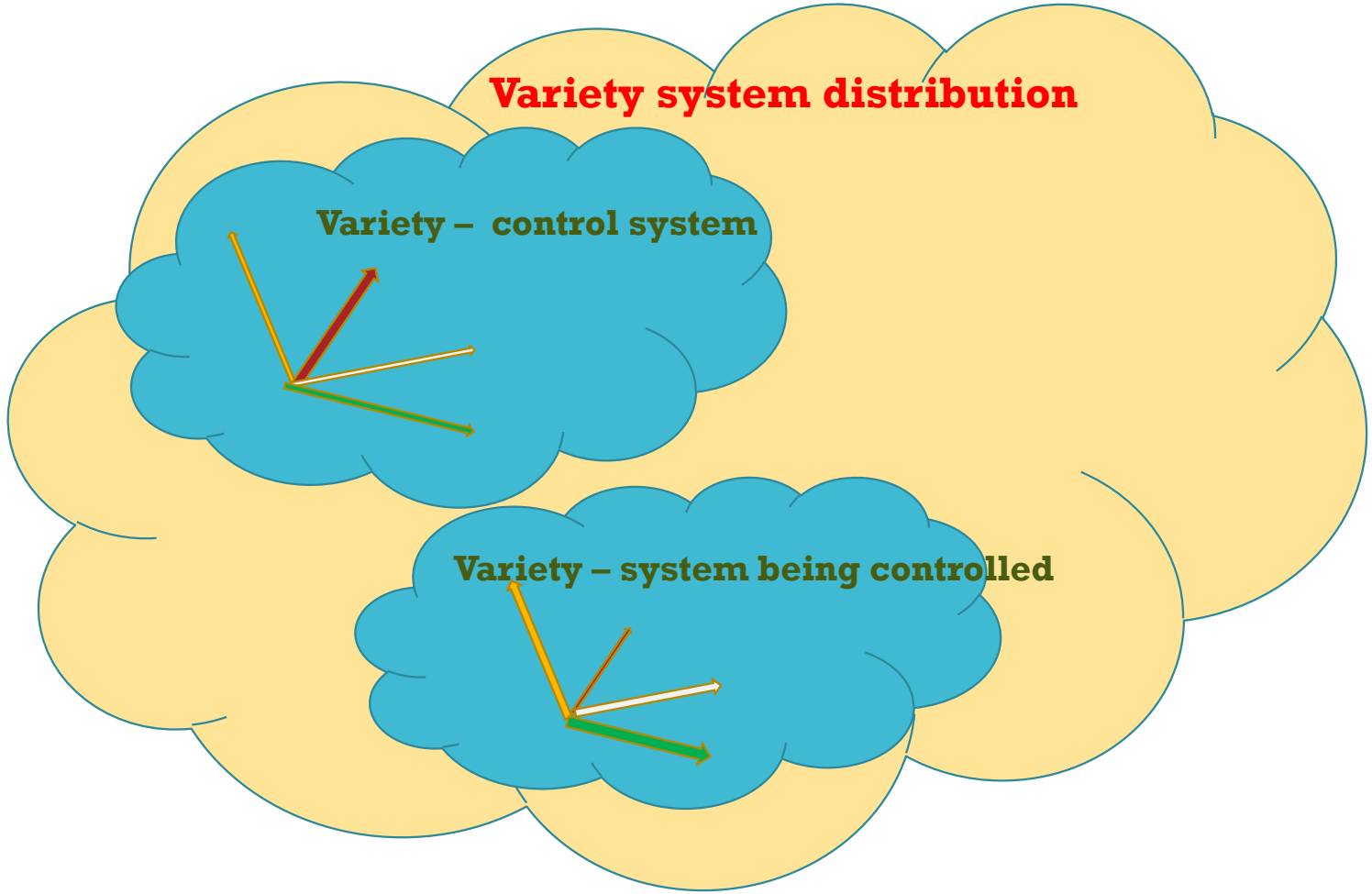
Law of Requisite Variety :

'For a system to be stable, the number of states that its control mechanism is capable of attaining (its variety) must be greater than or equal to the number of states (the variety) in the system being controlled.'

(W. Ross Ashby (1956): An Introduction to Cybernetics, Chapman & Hall, London.)

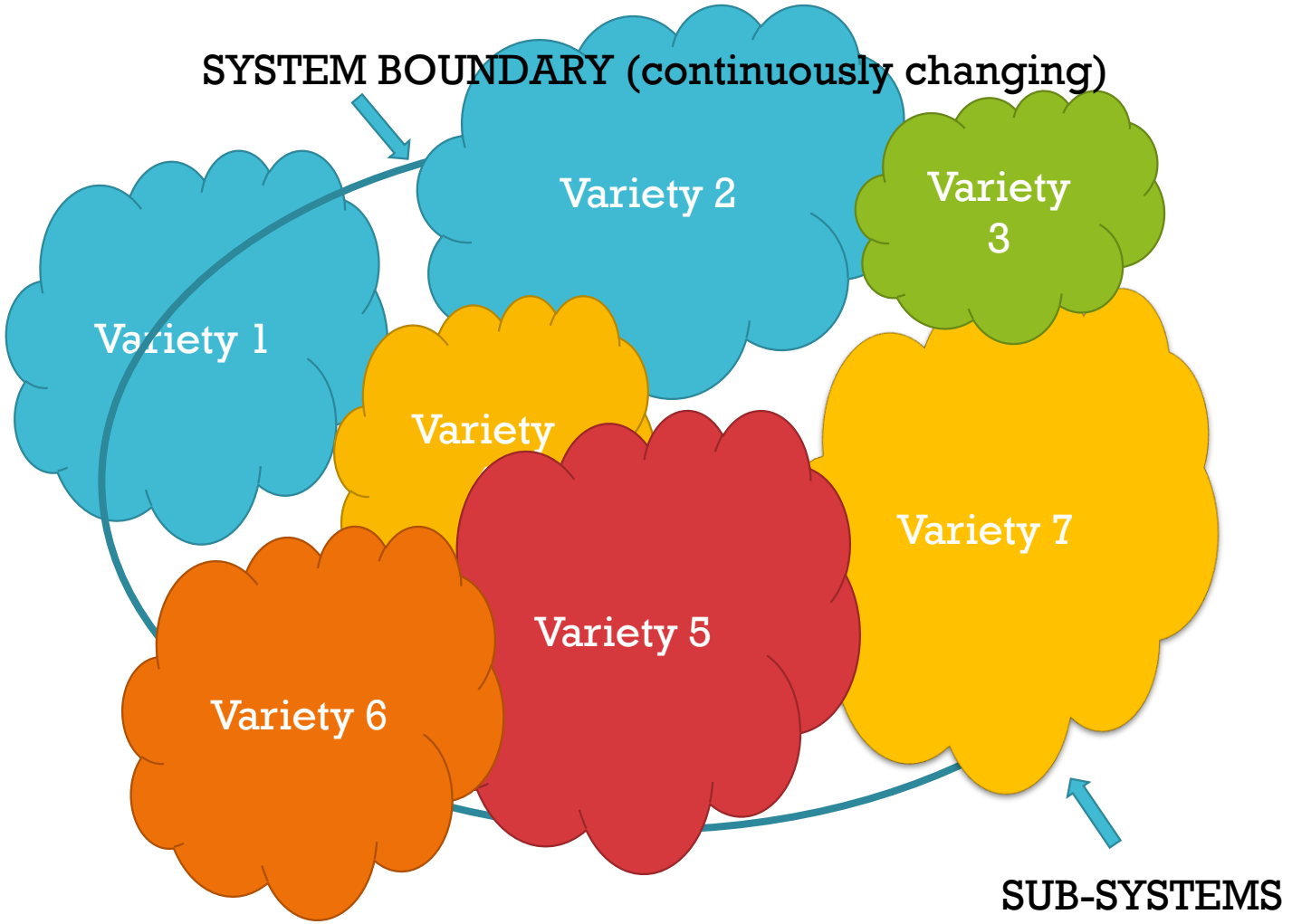
LoRV is one of the few laws that applies across most disciplines

Control variety and system variety (Ashby's Law)



Variety of control system must be greater than the system being controlled
(Ashby's Law of Requisite Variety)

Real situations with dynamic variety distributions



- Distributions of variety and control and ownership are changing continuously in highly irregular interrelated ways

Variety Dynamics Axiom example

So far have identified 29 Variety Dynamics axioms:

Axiom 1:

For complex, layered and hierarchical systems involving multiple constituencies in which the distribution of variety generation and control is uneven across the system

THEN

The differing distributions of generated and controlling variety result in a structural basis for differing amounts of power and hegemonic control over the structure, evolution and distribution of benefits and costs of the system by particular constituencies.

Practical example Axiom 1:

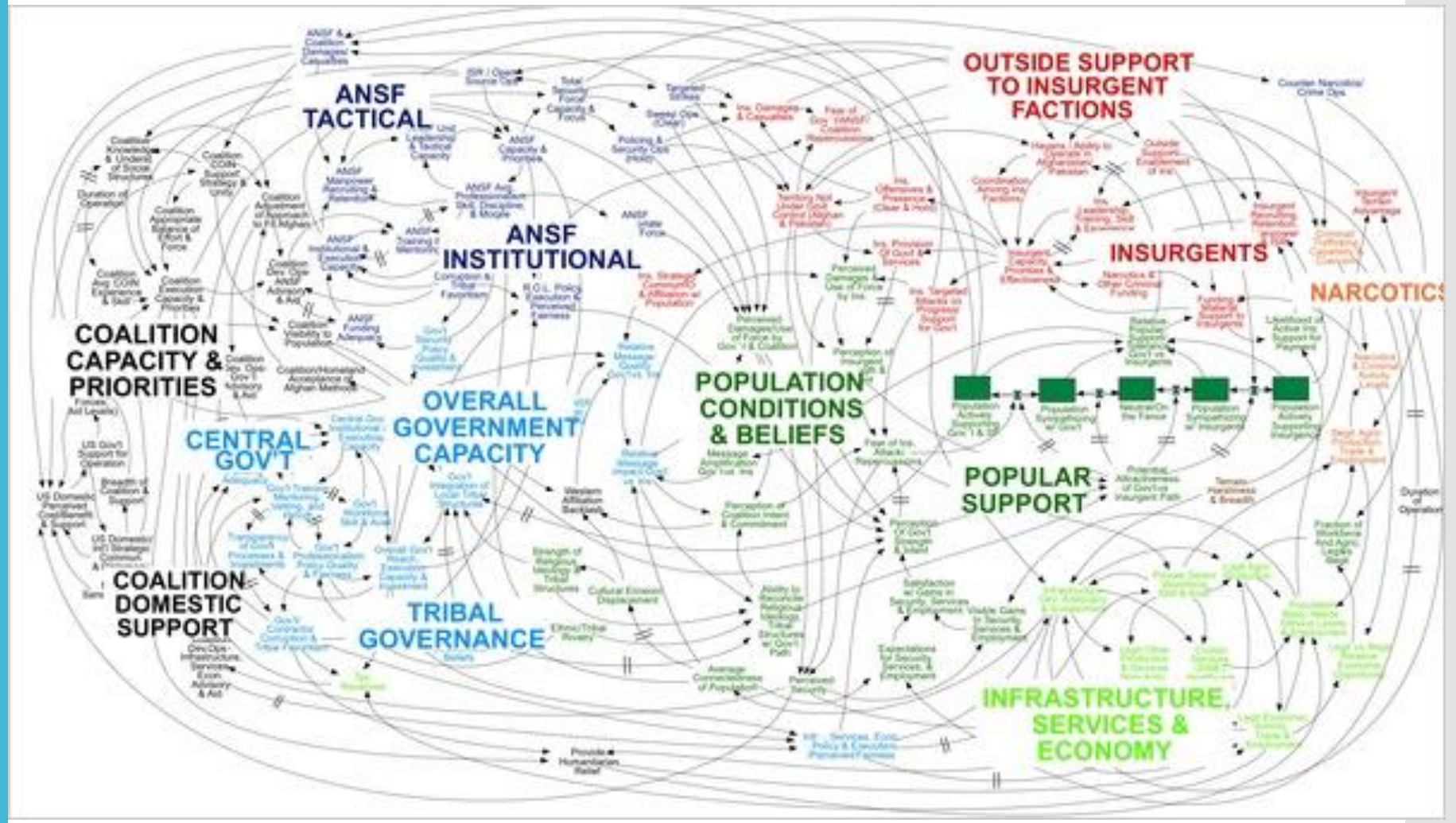
Activists vs motor industry

Environmental activists were able to overcome motor industry resistance to emissions control:

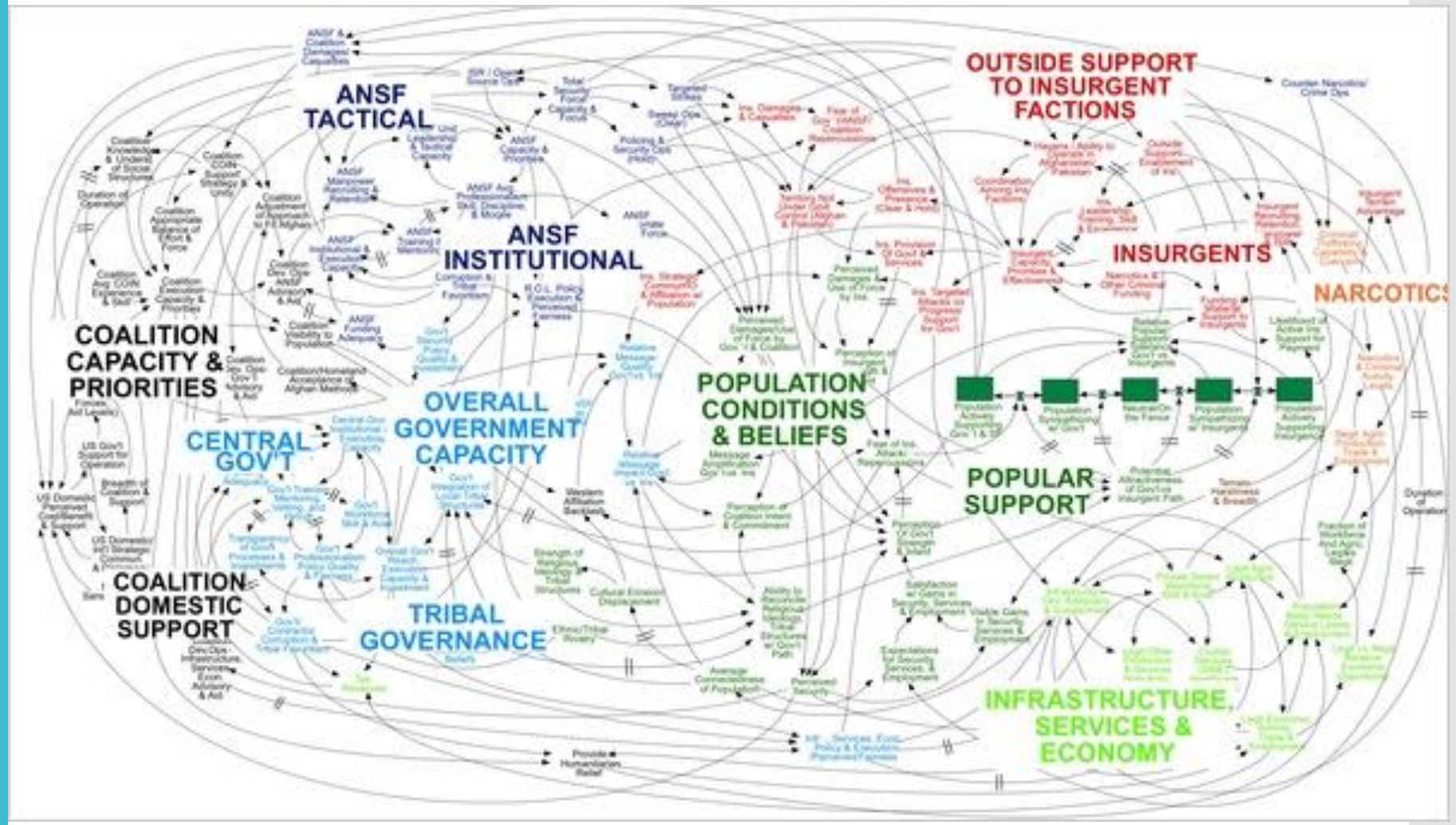
1. Activists asked motor industry to implement strict emission standard - motor industry refused
2. Activists persuade each state to create **different** emission standards (i.e. increased variety beyond motor industry's ability to control)
3. Motor industry agrees to single strict emission standard

Management of variety resulted in transfer of power to activists from motor industry.

Causal loop diagram as used by US Army COIN strategists in Afghanistan



Variety dynamics analysis for managing flow of power



Variety available to military **less than** variety available to insurgents, e.g. Pashtunwali

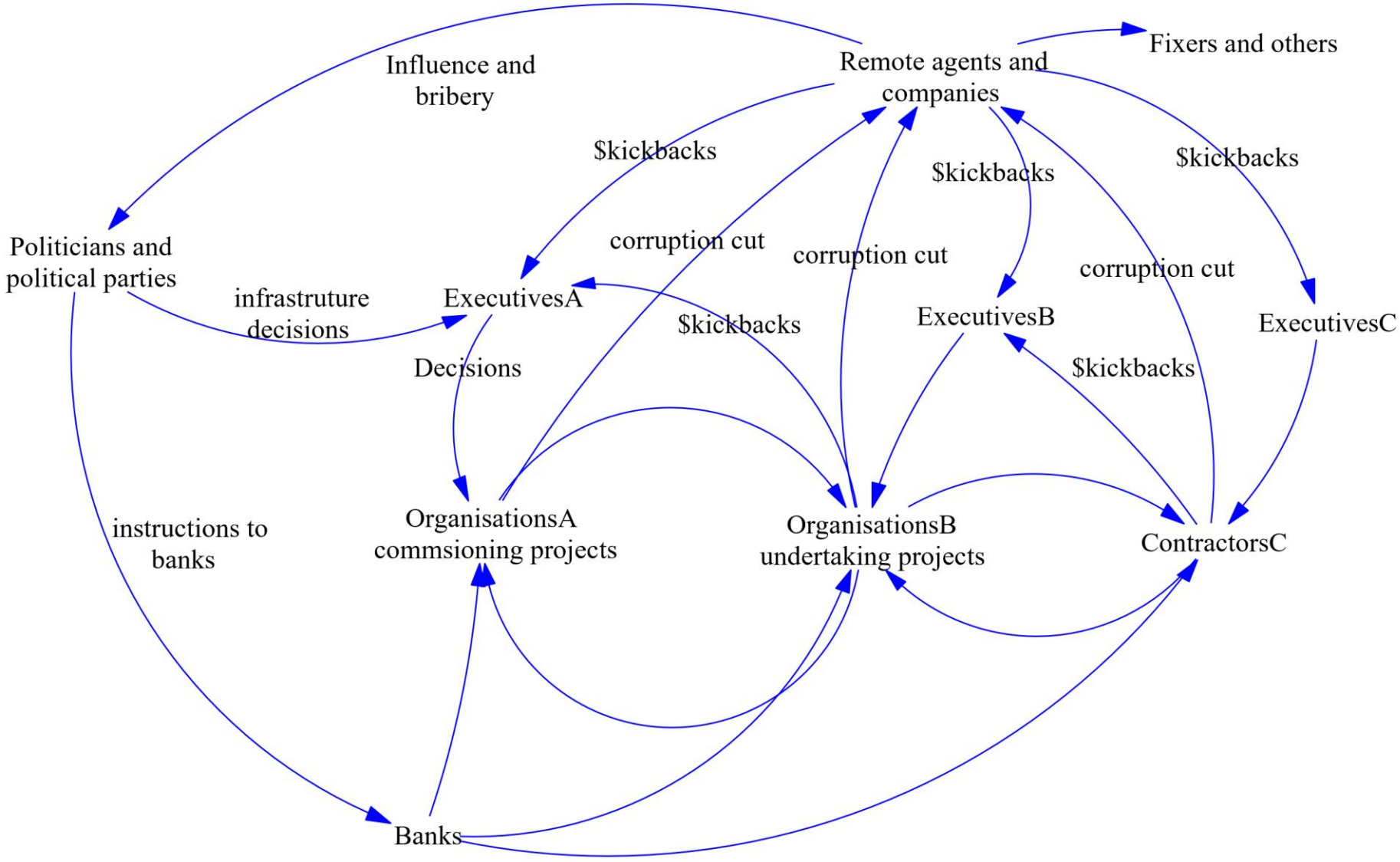
Variety Dynamics Axioms

- We have currently identified a further **29 Variety Dynamics axioms**
- Each of these Variety Dynamics axioms provides managers with guidance
- They indicate the best management decisions when using on an SD model or Causal Loop diagram
  - To achieve intended outcomes
  - To change the flow of power in preferred ways
- More importantly, they extend System Dynamics into the realm of **hyper-complex systems** that cannot be currently addressed by SD approaches

Connection between Variety Dynamics and System Dynamics

- The mechanism of System Dynamics modelling is as time stepped first order difference equations
- Any type of variety assessment (e.g. colours, fruit etc) depends on human-defined criteria
- Variety criteria in SD can be specified similarly.
- That enables SD software to also map variety across causal relations
- Similar for sub-system definition, ownership and dynamics

Corruption model for analysis using Variety Dynamics



For more information on Variety Dynamics

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