Exploiting Complexity

The abaci Partnership

A Complexity Science-based Approach to Conflict Analysis and Influence

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Contents

Aim:
To engage analysts and mathematicians in
the critique and strengthening of a 'soft' approach

01 Utility of Academic Complexity in Practice?

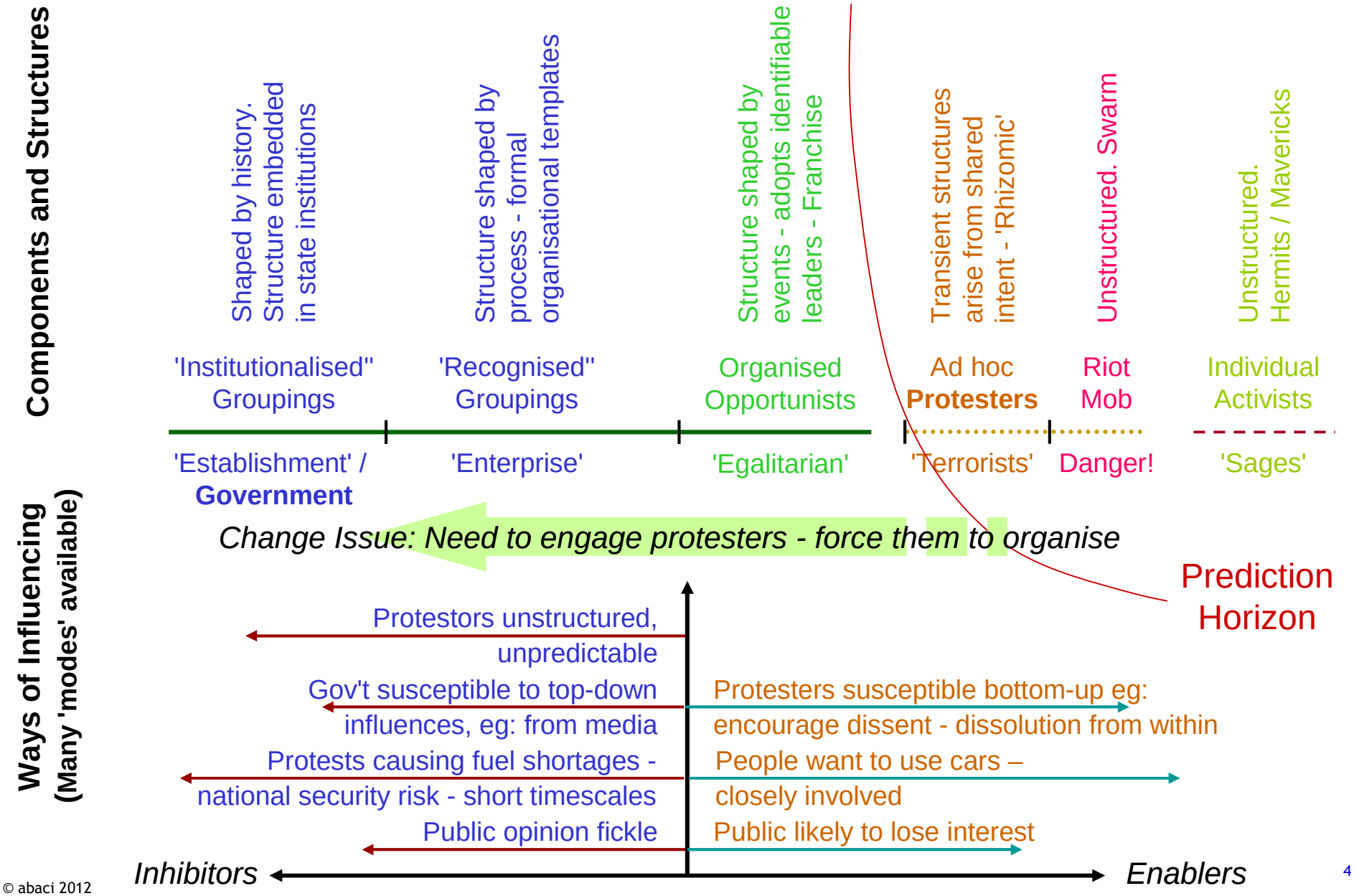
- Principles of academic complexity include:
  - self-organisation
  - emergence
  - connectivity
  - interdependence
  - feedback
  - far from equilibri
  - space of pos
  - co-ev
  - l me
  - pendence

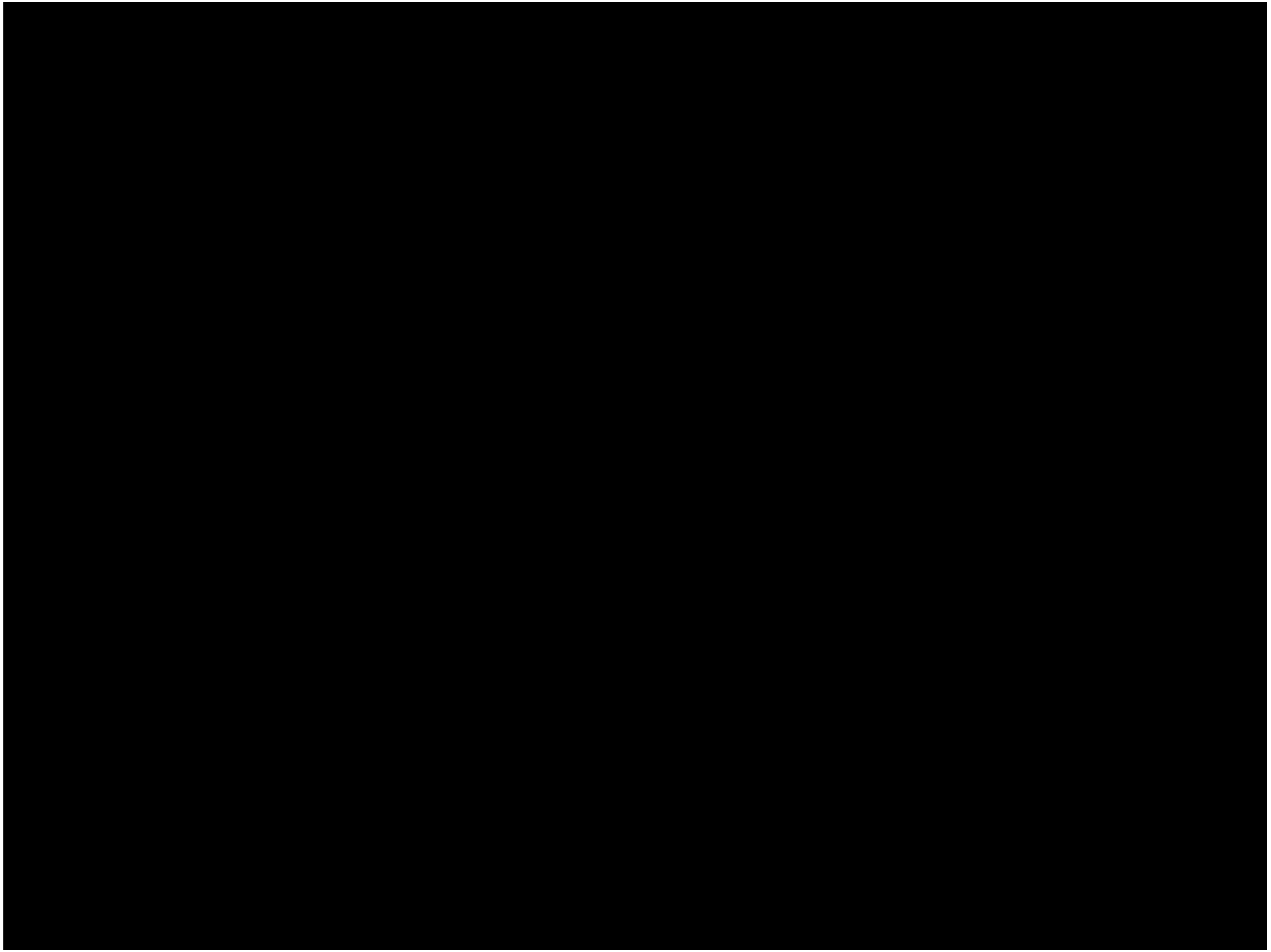
Do not provide practitioners with real-world discriminators, but ***do provide insights*** on how everyday phenomena 'work'

Mittleton-Kelly (2004)

01 Fuel Crisis, UK 2000 - 'Structures' and Tensions

(Case Study p181)





01 Another Approach – Why?

Andrew Mackay and Steve Tatham say in their book "Behavioural Conflict" (2011):

> "If we seek to influence behaviour in order to determine more appropriate choices then we will have to *radically change both our approach and our methodologies*".

- NB: Other commanders have been asking for change, eg, Sir Sherard Cowper Coles in 2011 on ways-of-working:

> "Everyone fell into the same trap: of substituting acquaintance for knowledge, activity for understanding, reporting for analysis, quantity of work for quality".

- Key questions for the analysis community include:
  - what is the nature of the radical changes that need to be made – where are the mismatches and why? and
  - which changes to approaches and methodologies are appropriate under which circumstances and what has/not worked and why? …

01 USA JFCOM Comments on EBO

- Effects-based Operations tried (by exhaustive analysis in advance) to predict the future effects of interventions.
- Comd JFCOM in 2008 rejected EBO / ONA (operational network analysis) approaches because they:
  - assume a level of predictability which is unachievable
  - cannot correctly anticipate reactions of 'complex systems' (e.g. leadership, societies, political systems, etc)
  - call for an unattainable level of knowledge of opponents
  - are too prescriptive, focussed on 'facts' and over engineered
  - discount the social and human dimensions of conflict (eg: passion, imagination, loyalty, willpower, variability, culture and power)
  - promote centralisation and lead to micro-management from HQs
  - are staff-led [ie, controlled by process-followers], not Command led [ie, hypothesis-led by active problem-solvers]
- And what of other models that are being used? …

01 Prof Michael Batty on Models - ECCS'09

"We do not have any idea how the people in our models will adapt to change and this is not new. The very fact [that] a generation ago we thought [that] we could treat cities [as if they are] in equilibrium is testament to the limits of our knowledge.

But I believe that what this is showing is that we need new forms of intelligence system to deal with the future where we will have many different models running in parallel, mediated by a context that seeks to 'inform' rather than 'predict'. The quest is to find the appropriate milieu in which to act this way."

Enough already!

We all know that all models are wrong yet that some are useful, and that …

Gödel's 'Incompleteness Theorem' sets the milieu in which models should be used …

So what's the issue now?
*There's a **perceived mismatch** between operators' imperatives and analysts' models and products …*
So, what is needed to overcome this?

Contents

Thesis - Approaches are Needed:

- which acknowledge the givens and realities revealed by complexity science eg: that underlying complexity generates features experienced as 'simplicities'.

- which are appropriate to conflict in dynamic situations and

- which work with ***the possibilities and opportunities of real-world change as experienced by operational practitioners …***

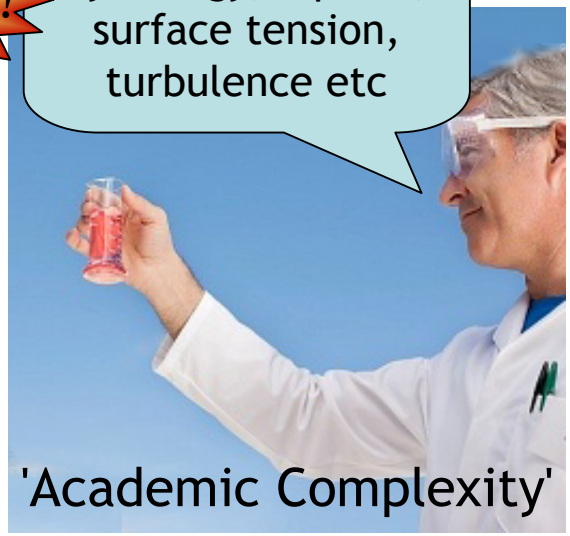
02 Differences between Experienced, Academic and Underlying Natural Complexity

(p108) Practitioners' types of 'Experienced Complexity'

Phenomena

Mismatch!

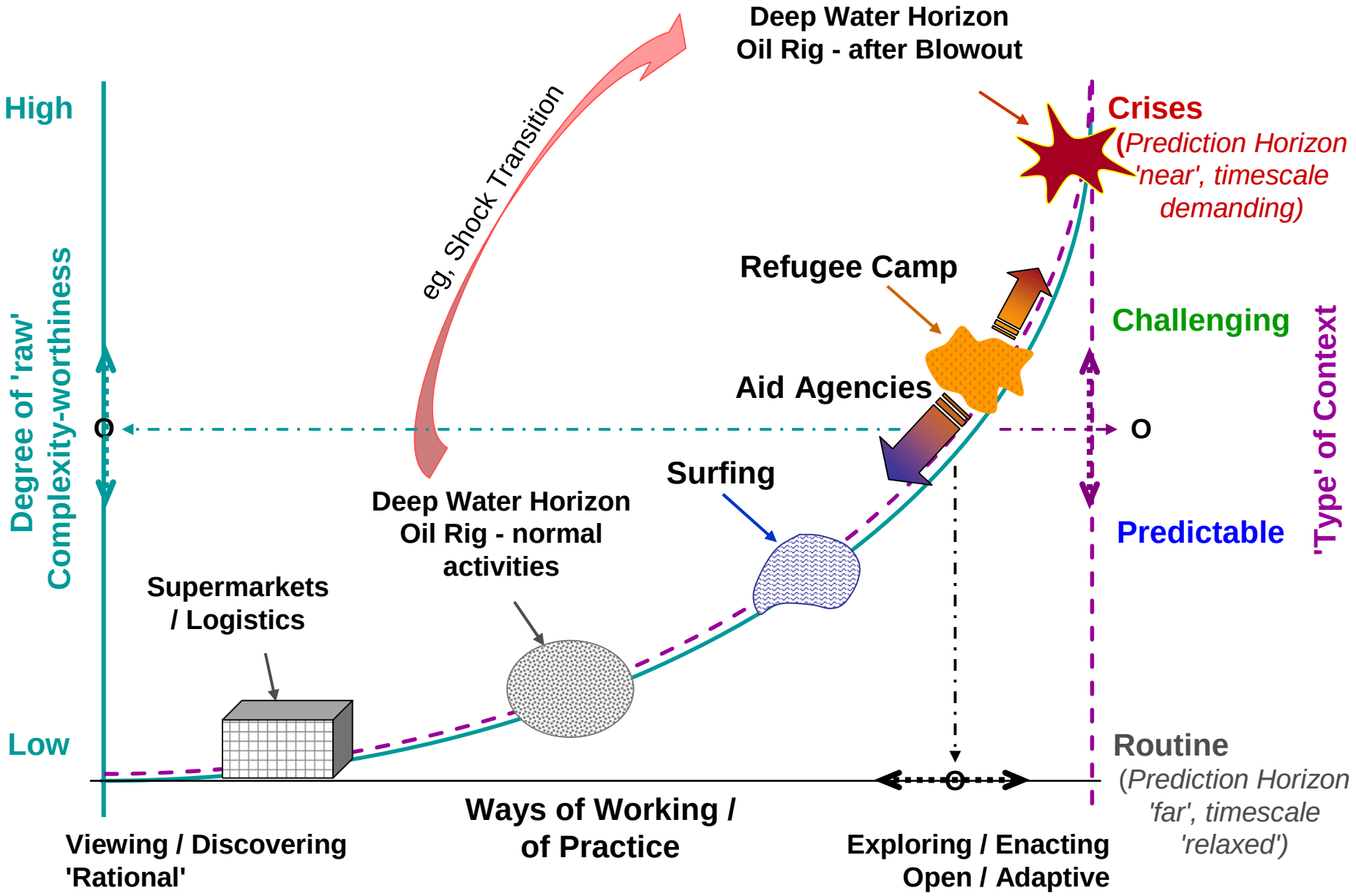
Wave propagation, hydrology, dipoles, surface tension, turbulence etc



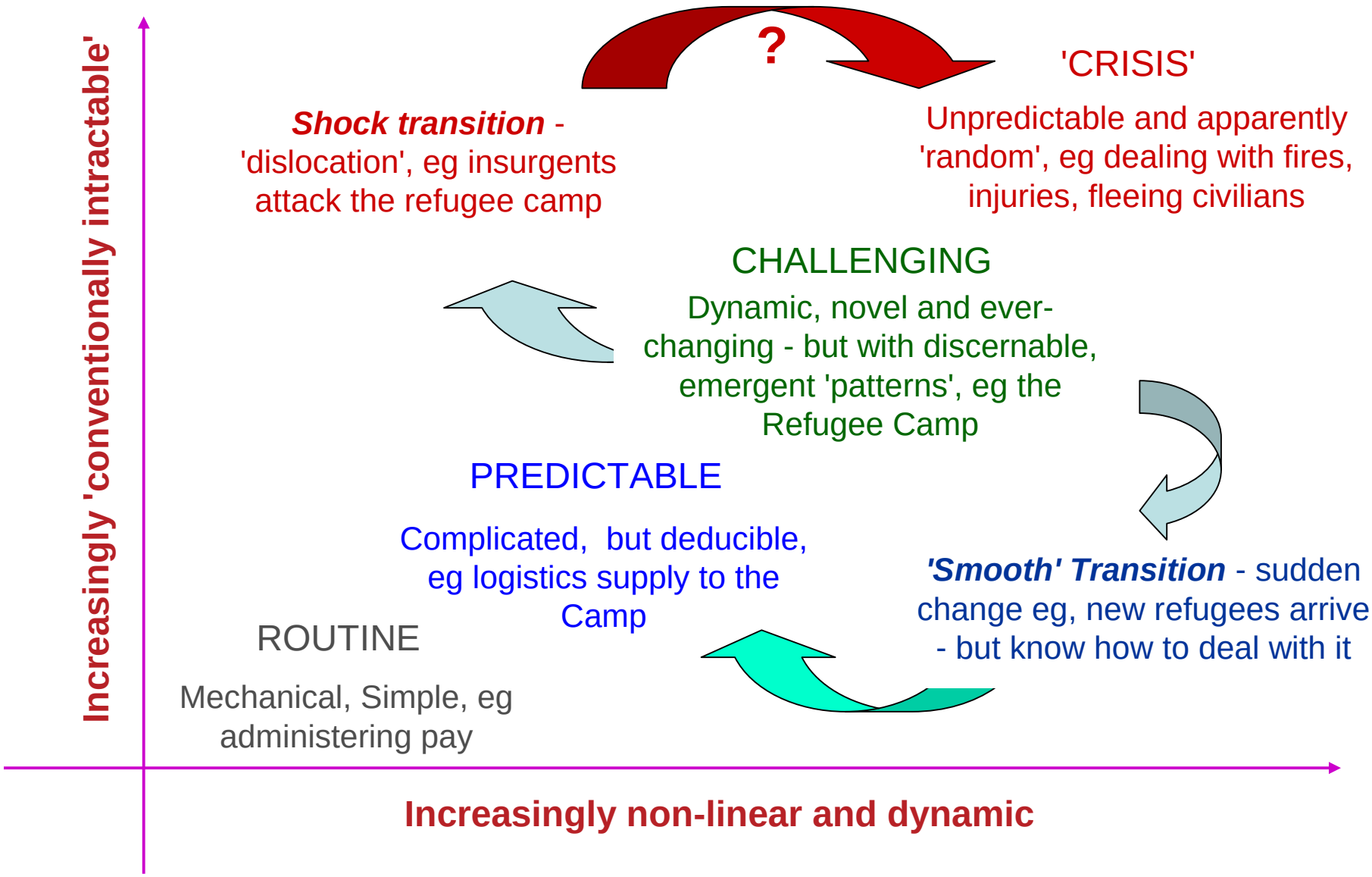
Dynamic interactions in underlying 'Natural Complexity'

(eg: sea-bed shape, solar radiation, water density, salinity, temperature, organic chemicals, wing-form-profiles, human physique, thrill-seeking drives, sex-appeal)

02 Experienced Complexity in Practice

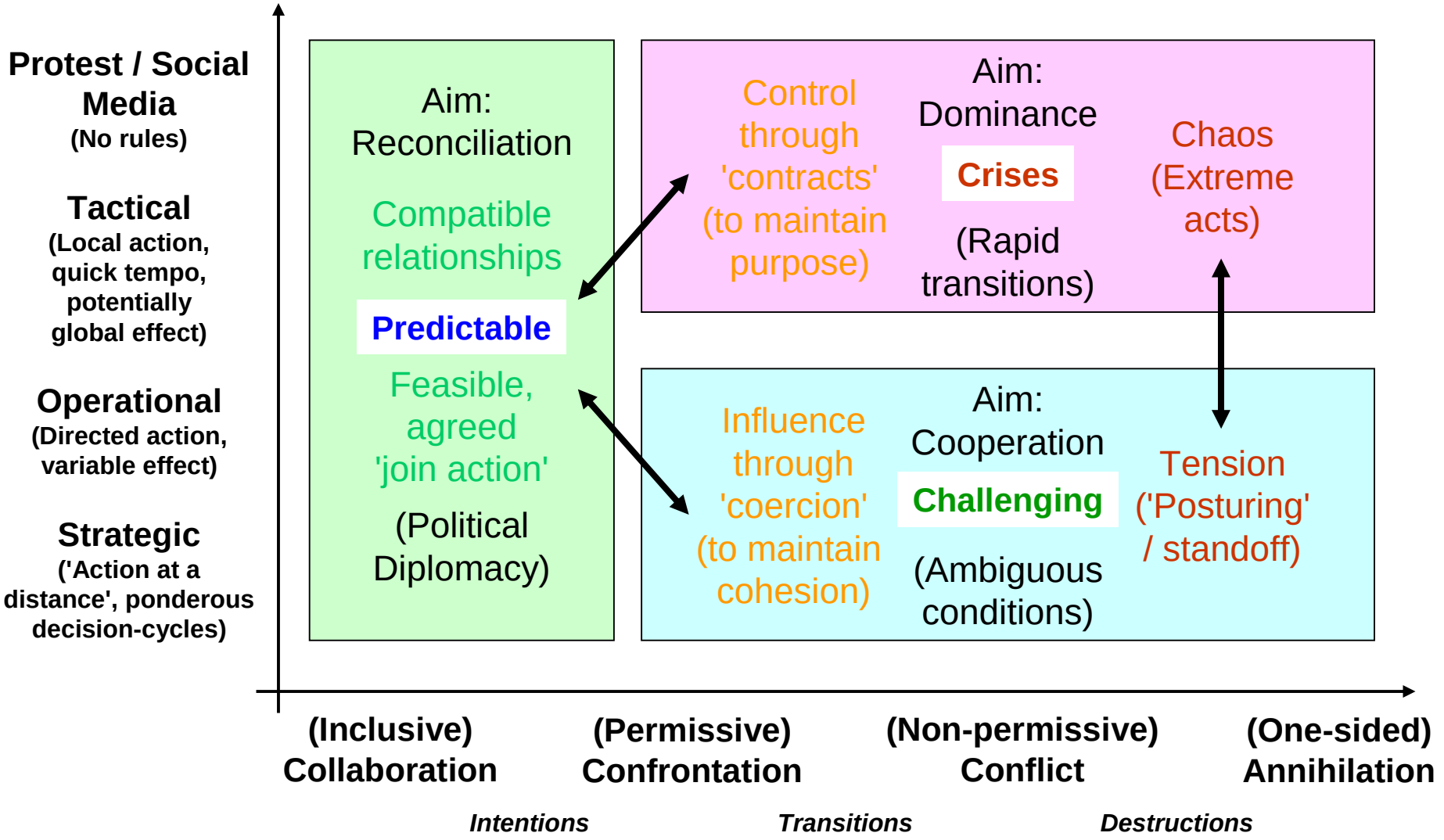


02 Types of Dynamic Transitions



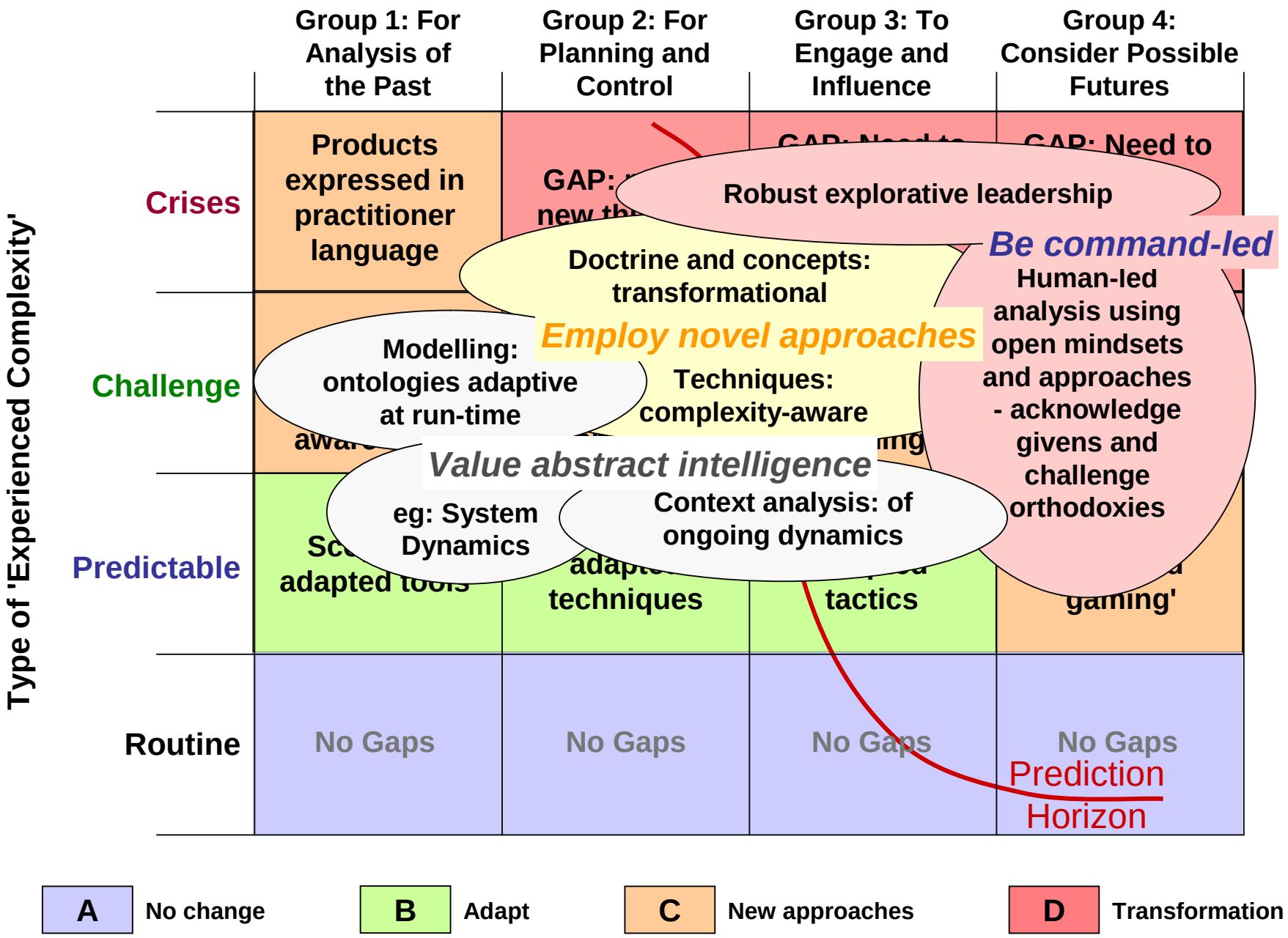
 For a fuller list, see p124 of Complexity Demystified

02 Stage on Which Conflict is Played Out

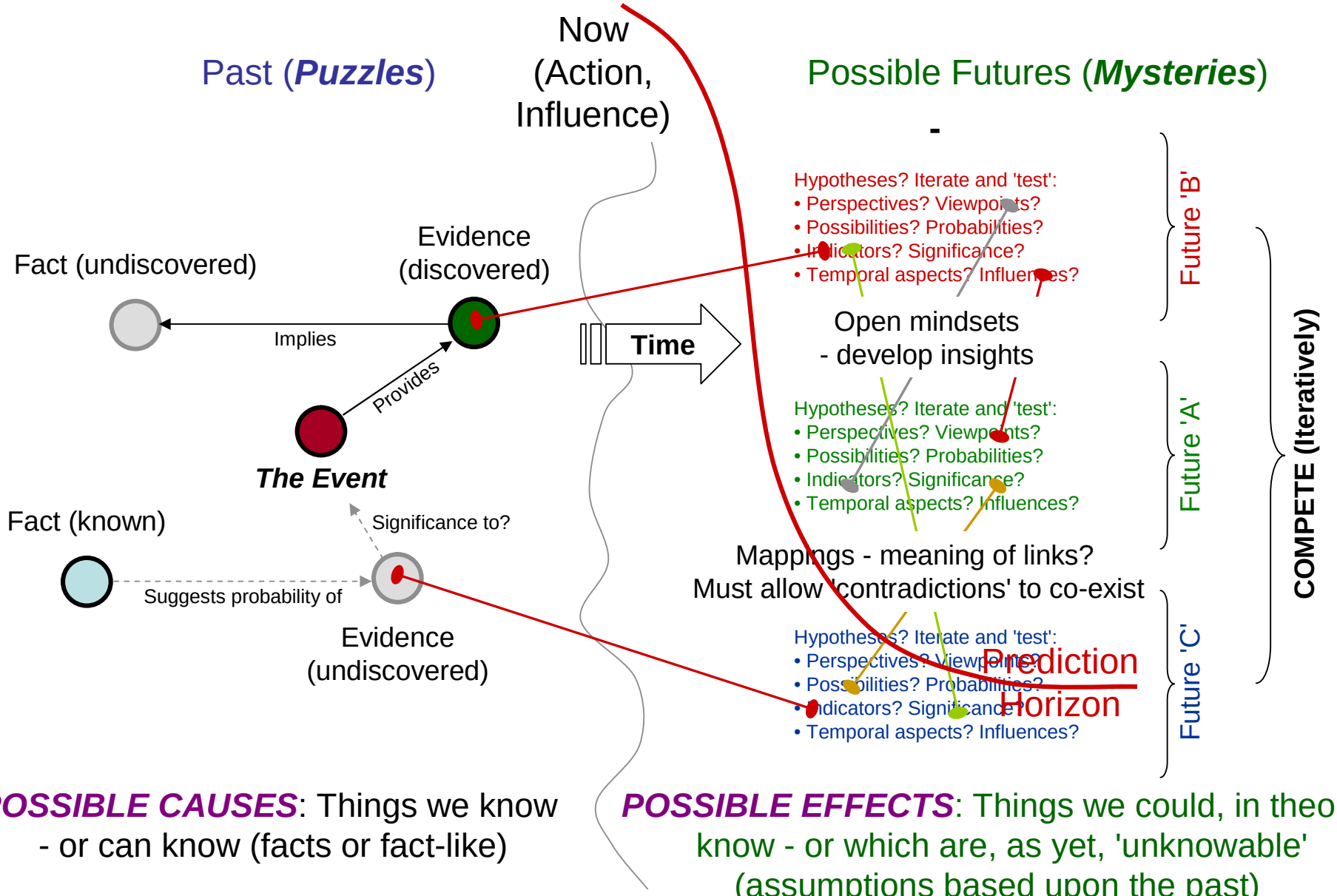


Adapted from: Gen Sir Rupert Smith

02 Practitioners' Contexts vs 'Analysis' Capabilities



02 Past Analysis to Future Prediction



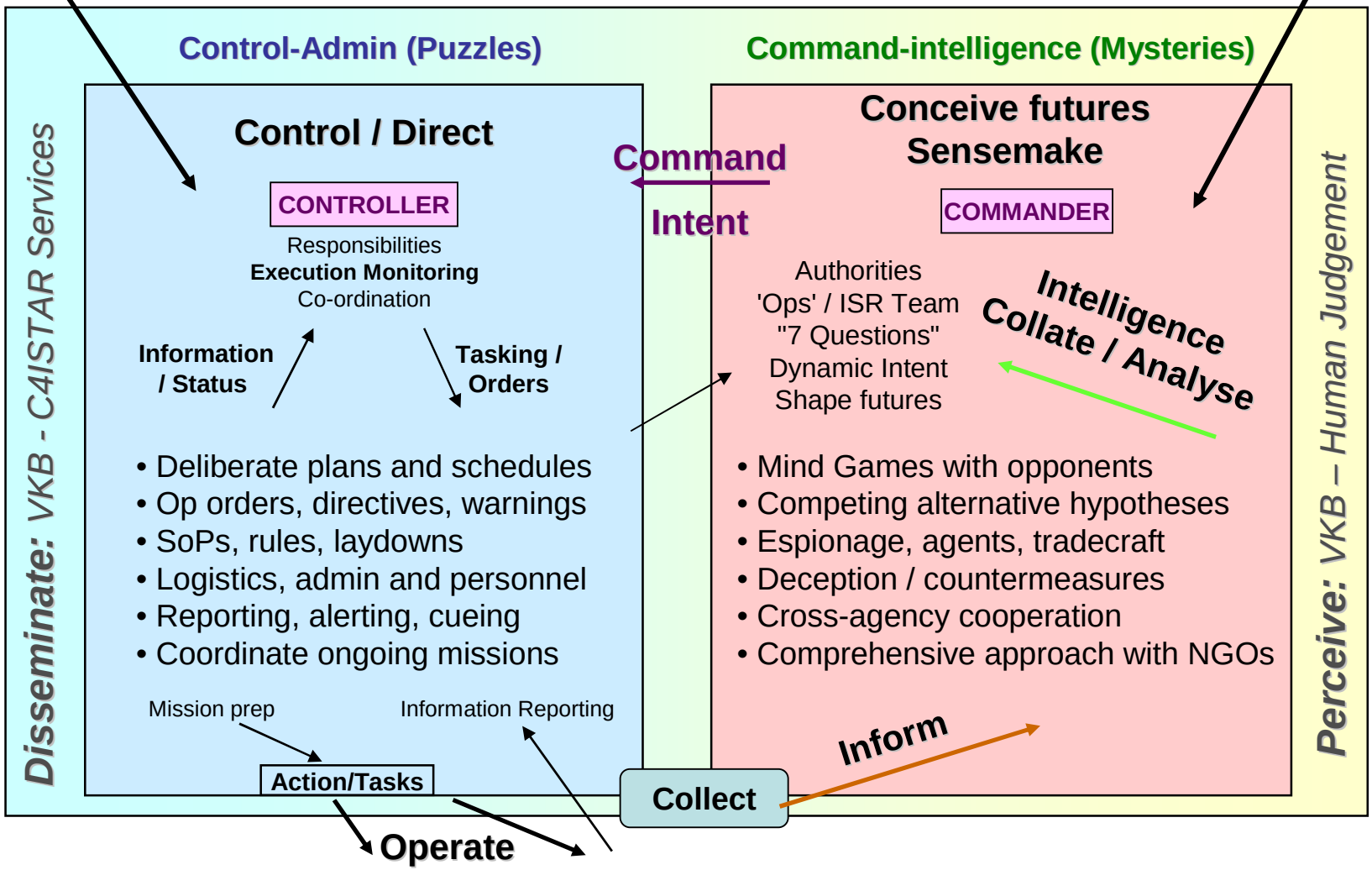
POSSIBLE CAUSES: Things we know - or can know (facts or fact-like)

POSSIBLE EFFECTS: Things we could, in theory, know - or which are, as yet, 'unknowable' (assumptions based upon the past)

02 The Deployed Defence Enterprise

"The Nervous System"
(Process-driven)

"The Brain"
(Context-driven)



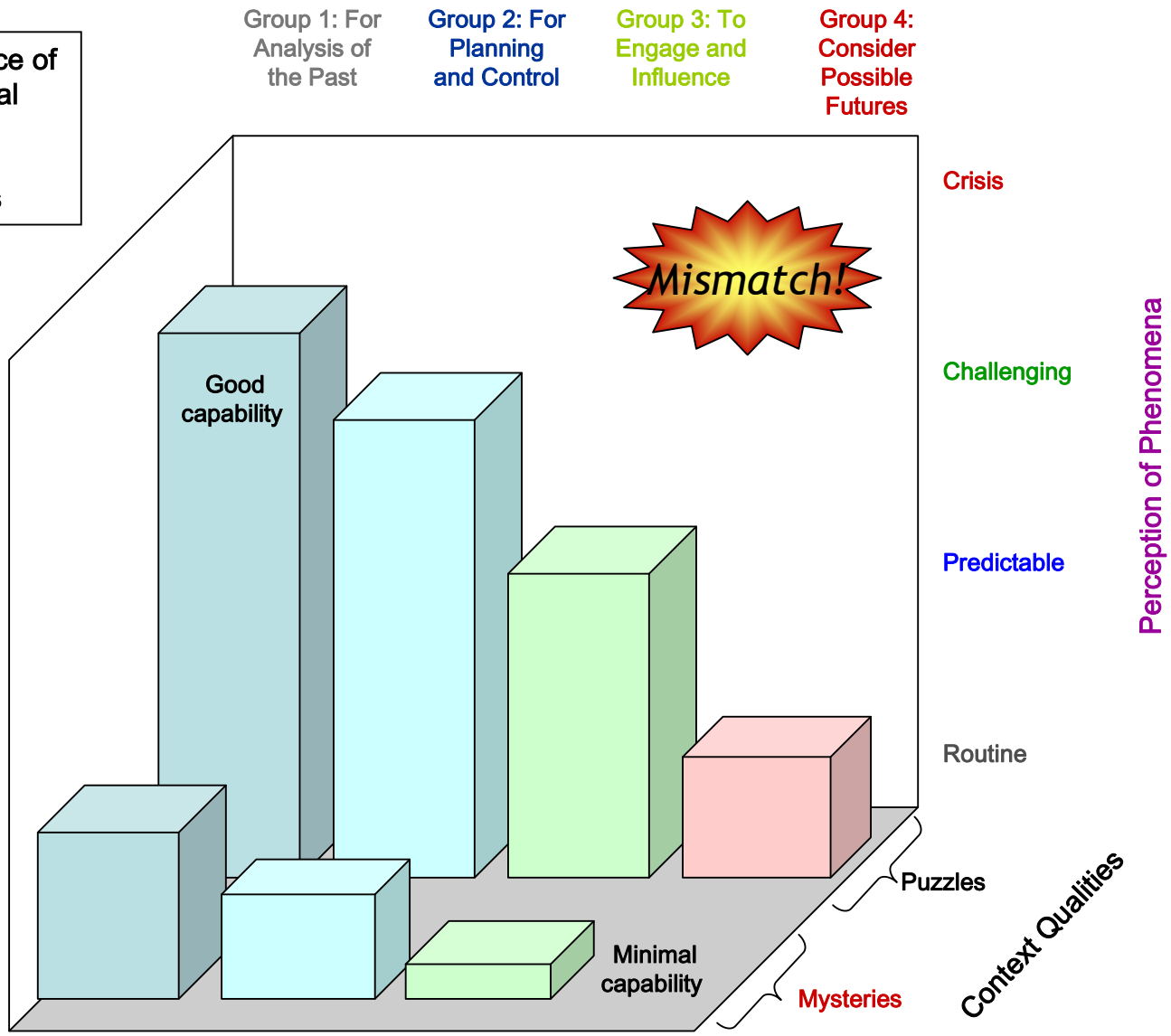
Events / Effects in The World

After M. Chin / J. Clothier DSTO 1998

02 Analysis in Complex Operational Realities – Mismatch Assessment Cube

Volume of Cube = Space of Complex Operational Realities that Practitioners must be able to address

Height of Bar = Conflict analysis techniques' Degree of Real-world Readiness



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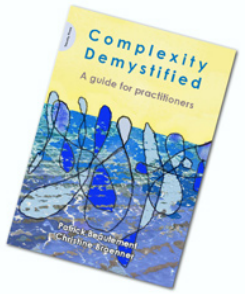
Integrative …

Engage and influence phenomena and drivers directly - 'Landscape of Change'

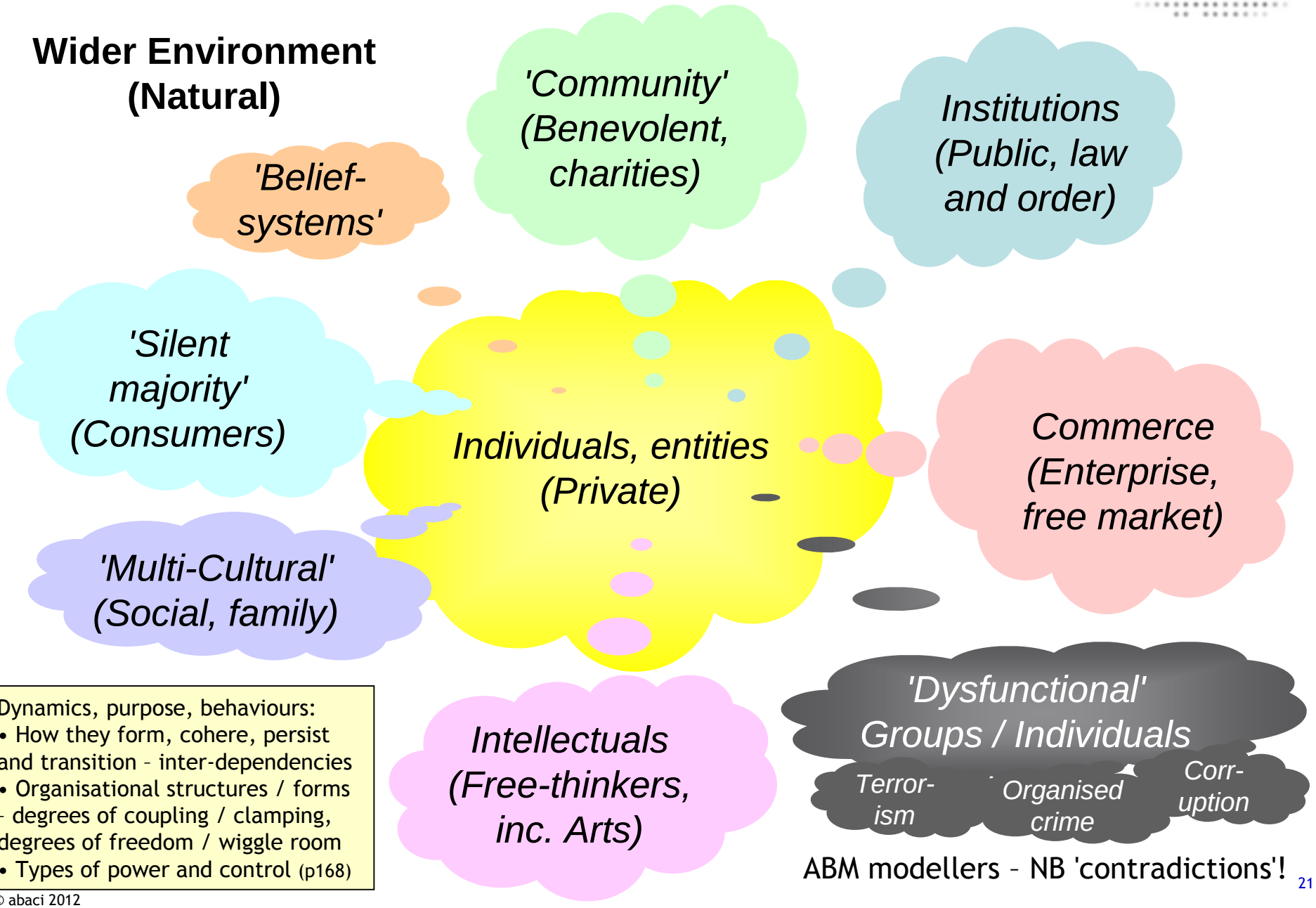


"Complexity Demystified – A Guide for Practitioners"

03 What is Needed in Practice?

- An Approach which:
  - ***accepts the givens and realities*** and complexity science insights and
  - is ***open to the possibilities*** and opportunities of change and
  - focuses on ***engaging directly with real-world phenomena*** and
  - influences contexts, and their underlying drivers and dynamic transitions, purposefully and effectively as appropriate
- An Approach that mitigates the ops / analyst mismatch - where:
  - Engaging and influencing = Shaping Context – Landscape of Change (p134)
  - Reflecting on Real-world Practice = Factoring in modifiers and tensions - 'Trade-off space' (p145)
  - Reflecting on, appreciating and questioning the Experienced Realities = Enacting and exploring - 'Symptom Sorting' (p158)
  - Employing appropriate Capabilities: 'Complexity-worthiness' (p99)
- **An Approach that has *the necessary requisite variety* and which fully acknowledges the richness of real-world contexts …**

03 Contexts - Communities of Practice



Dynamics, purpose, behaviours:
- How they form, cohere, persist and transition – inter-dependencies
- Organisational structures / forms – degrees of coupling / clamping, degrees of freedom / wiggle room
- Types of power and control (p168)

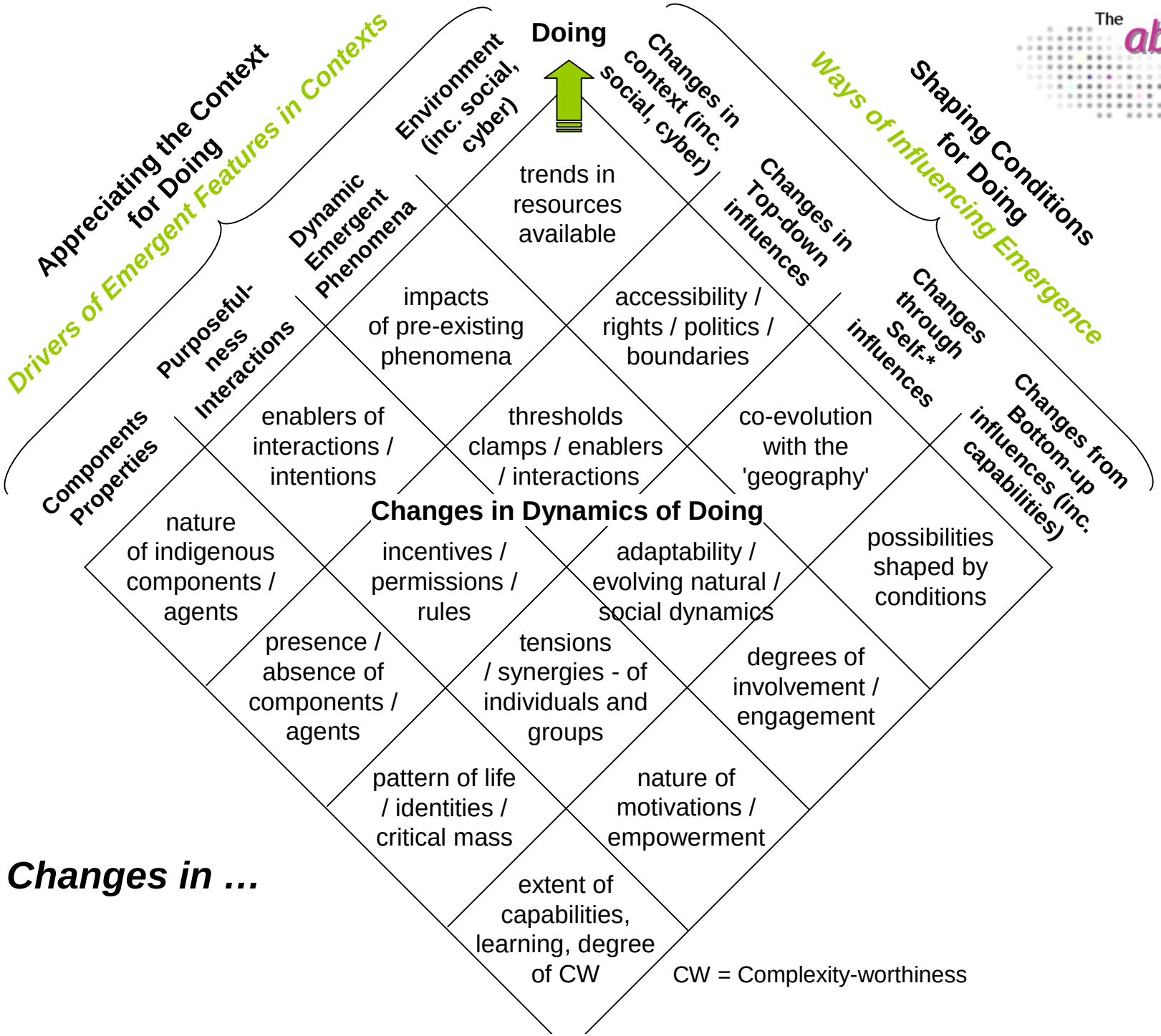
ABM modellers – NB 'contradictions'!

03 Principles - Axioms of Complexity: appreciating the Drivers of Change

- 'Complexity' arises because, in **some environment**, there are **components** that **interact** at levels of time and scale resulting in the **dynamic phenomena** that practitioners experience - enablers:
  - *a suitable environment is one in which the phenomena can arise and be sustained* - in the surfing example, the sea, the beach and surroundings
  - *the 'components' or entities have suitable attributes and properties that enable them to interact with each other in novel ways* - in the example: objects in the sea, the water itself, the surfers and their equipment
  - *the interactions of the 'components' in the environment have 'purpose'* - such as the contact between the surfer and the surfboard, the board with the sea and the surfers desire to compete, and
  - *that the dynamic (emergent) patterns generated from the interactions are persistent enough to be detectable as features* - ie, phenomena appearing at different times, at different scales and in different modes (sound, light, force, signals). In the surfing example, these features include: waves, eddies and whirlpools, speech, human courage and so on.

03 Principles - Ways of Influencing: Shaping the Conditions for Change

- Four main ways:
  - *changing the environment*: eg, 'seeding', so preferred phenomena are more likely to come about – in the surfing example changing the shape of the sea bed or providing facilities for surfers
  - *changing the nature of top-down influences*: eg, via orders, policy directives, direct interventions, incentives, rules and permissions – in the example, imposing environmental or health and safety rules
  - *changes in / manipulation of self-organisation / self-regulation* (self-*) 'mechanisms': eg, through peer-to-peer social drivers - such as ethos, behavioural norms and the evolution of surfer group popularity;
  - *changes in the nature of bottom-up influences*: e.g., via 'the people' who can think / act locally but cause effects with potentially broad impact. Note that certain phenomena are enablers for change at 'higher' levels and so have a bottom-up influence e.g., waves enable surfing which enables people to have fun – ie, 'cascades' of emergence
- Plus at least two others (p67):
  - *influencing cyberspace*: because of the role it plays in shaping human behaviour – in the example, using social networking
  - *'doing nothing', active disengagement*: or just 'letting things follow their course'. Given that 'timeliness' is a key factor in perceptions someone who apparently 'does nothing, may in fact be playing a game with timescales over years or decades (as Machiavelli did in his political scheming).


Appreciating the Context for Doing
Drivers of Emergent Features in Contexts
Doing
Environment (inc. social, cyber)
Changes in context (inc. social, cyber)
Ways of Influencing Emergence
Shaping Conditions for Doing
Dynamic Emergent Phenomena
Changes in Top-down influences
Changes through Self-* influences
Changes from Bottom-up influences (inc. capabilities)
Purposeful-ness Interactions
Components Properties
trends in resources available
impacts of pre-existing phenomena
accessibility / rights / politics / boundaries
enablers of interactions / intentions
thresholds clamps / enablers / interactions
co-evolution with the 'geography'
Changes in Dynamics of Doing
nature of indigenous components / agents
incentives / permissions / rules
adaptability / evolving natural / social dynamics
possibilities shaped by conditions
presence / absence of components / agents
tensions / synergies - of individuals and groups
degrees of involvement / engagement
pattern of life / identities / critical mass
nature of motivations / empowerment
extent of capabilities, learning, degree of CW
Changes in …
CW = Complexity-worthiness

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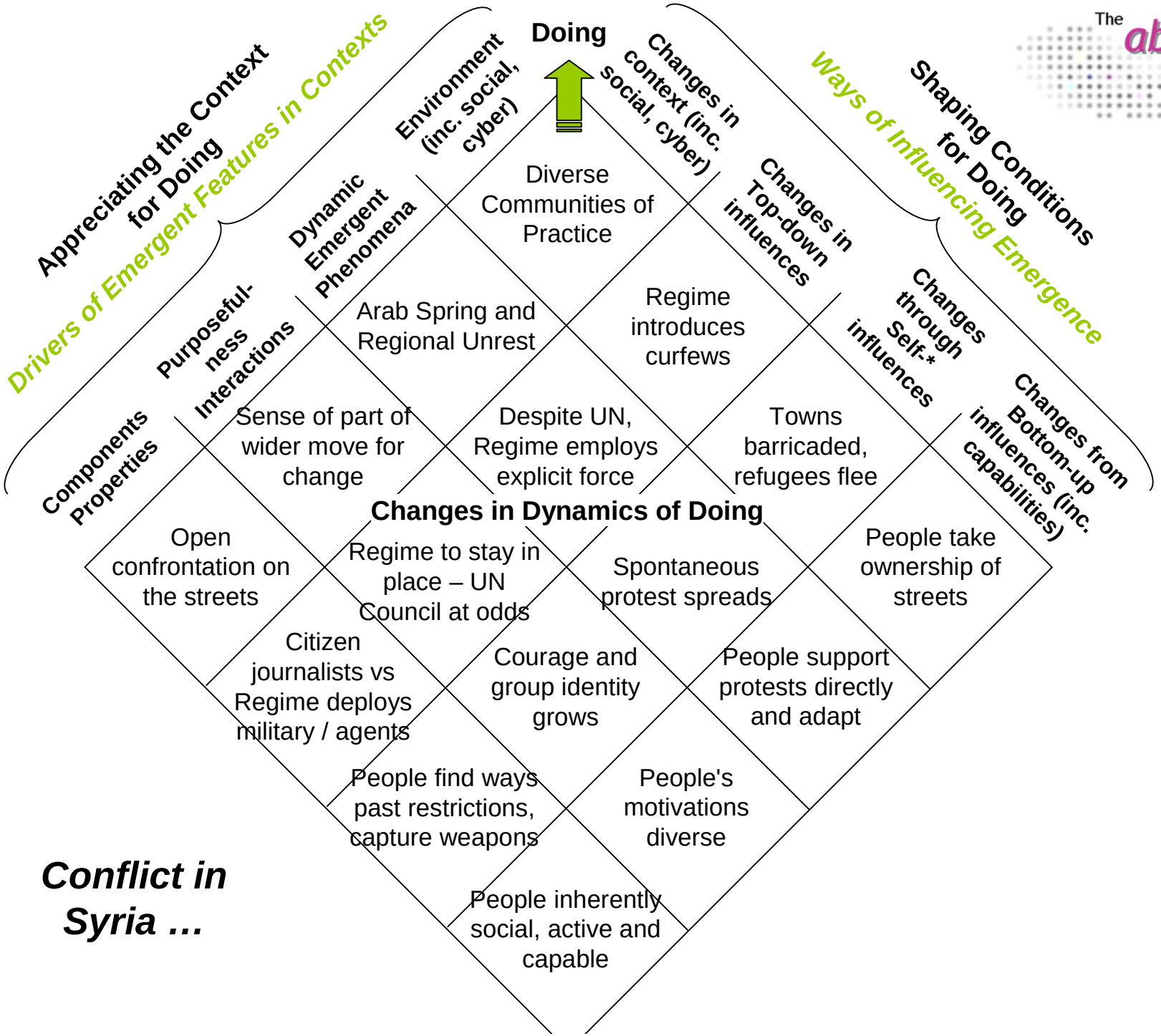
04 Conflict Example – Syria Analysis - Context

- Fundamental givens and realities:
  - Geographical position in the Middle East. Arab Spring
- Overlaps – Zero-sum conflict:
  - For the streets, for hearts and minds, for international support
- Blockers / paralysers / underminers / vulnerabilities:
  - Mutual 'intransigence' / determination
  - 'Insurgents', many ex-Syrian army, have copied C2 style - weakness
- Contradictions, disjoints – asymmetric opportunities:
  - Differences in kinetic power, agility and types of influence
- Enablers, gate keepers (intermediaries), energisers:
  - Roles of UN, Russia, China and Iran part of the wider environment
- Unknowns, unknowables, hypotheticals, intangibles:
  - The 'solution'? Hidden agendas of others. Will. Extent of resilience



Conflict in Syria …

04 Modifiers of Degrees of Freedom (DoF)

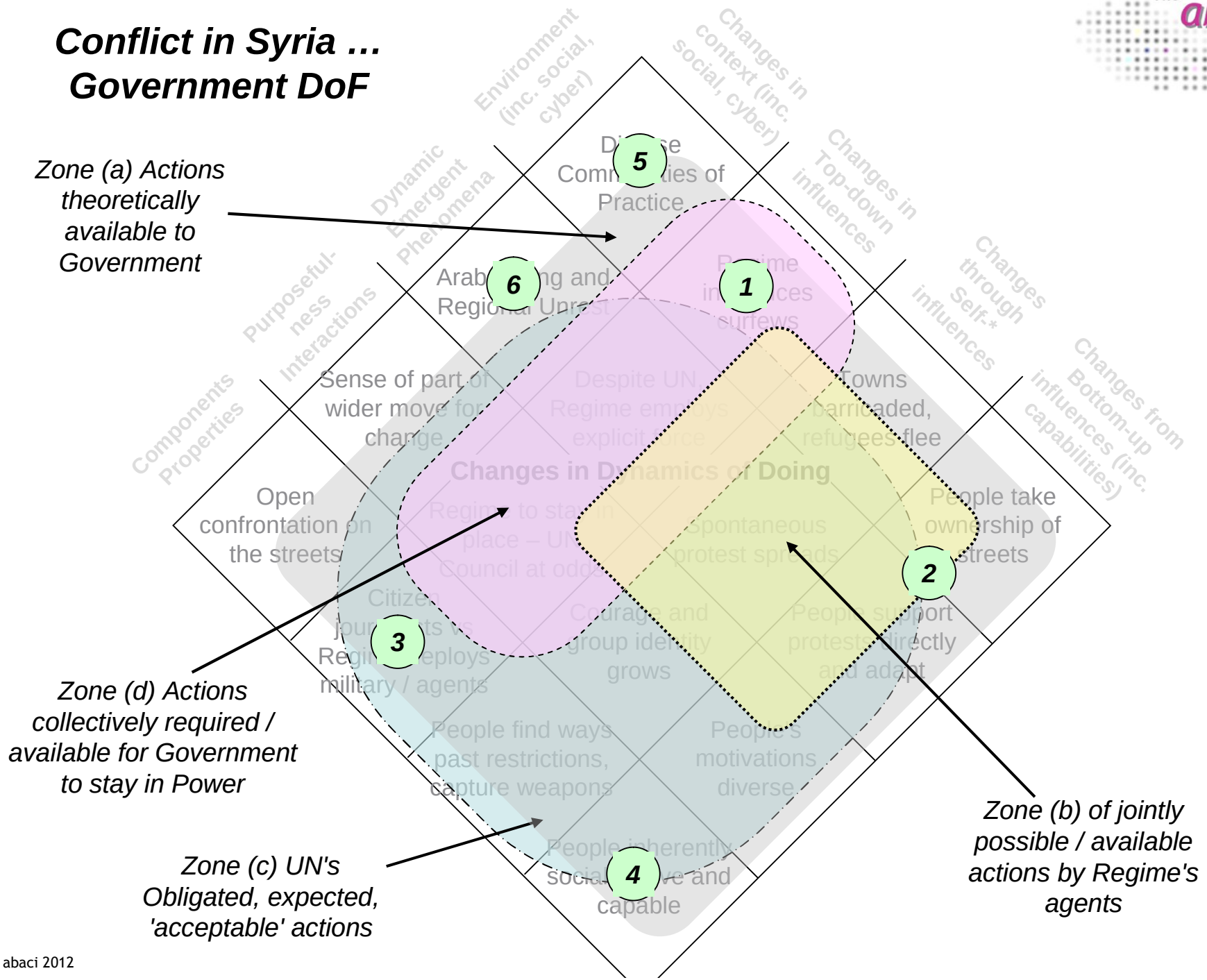
'Contractual' Modifiers: Largely top-down

- Possible actions (everything you can think of)
- Potential actions (ones that are theoretically do-able by actors)
- Performable actions (ones you know how to do - expert power)
- Permitted actions (within policy restraints - reward and punishment power)
- Available actions (what's feasible, inc with other actors on-hand or on-call)
- Achievable actions (eg, within time constraints)
- Obligated actions (eg, rituals, rules – imposed by those with positional power)
- Required actions (eg, demanded by circumstance, the context)
- Value-driven actions (from ethos, beliefs etc)
- Cultural and social norms (expected / acceptable behaviour)
- Peer-pressure influenced actions (eg, fashions, desire to identify with groups)
- Leadership (referent power: courage / risk / attitude to breaking constraints)

Social / Cultural Modifiers: Largely self-*

p137. Also see list in Paul Feltovich's "We regulate to Coordinate" (IHMC)

Conflict in Syria … Government DoF



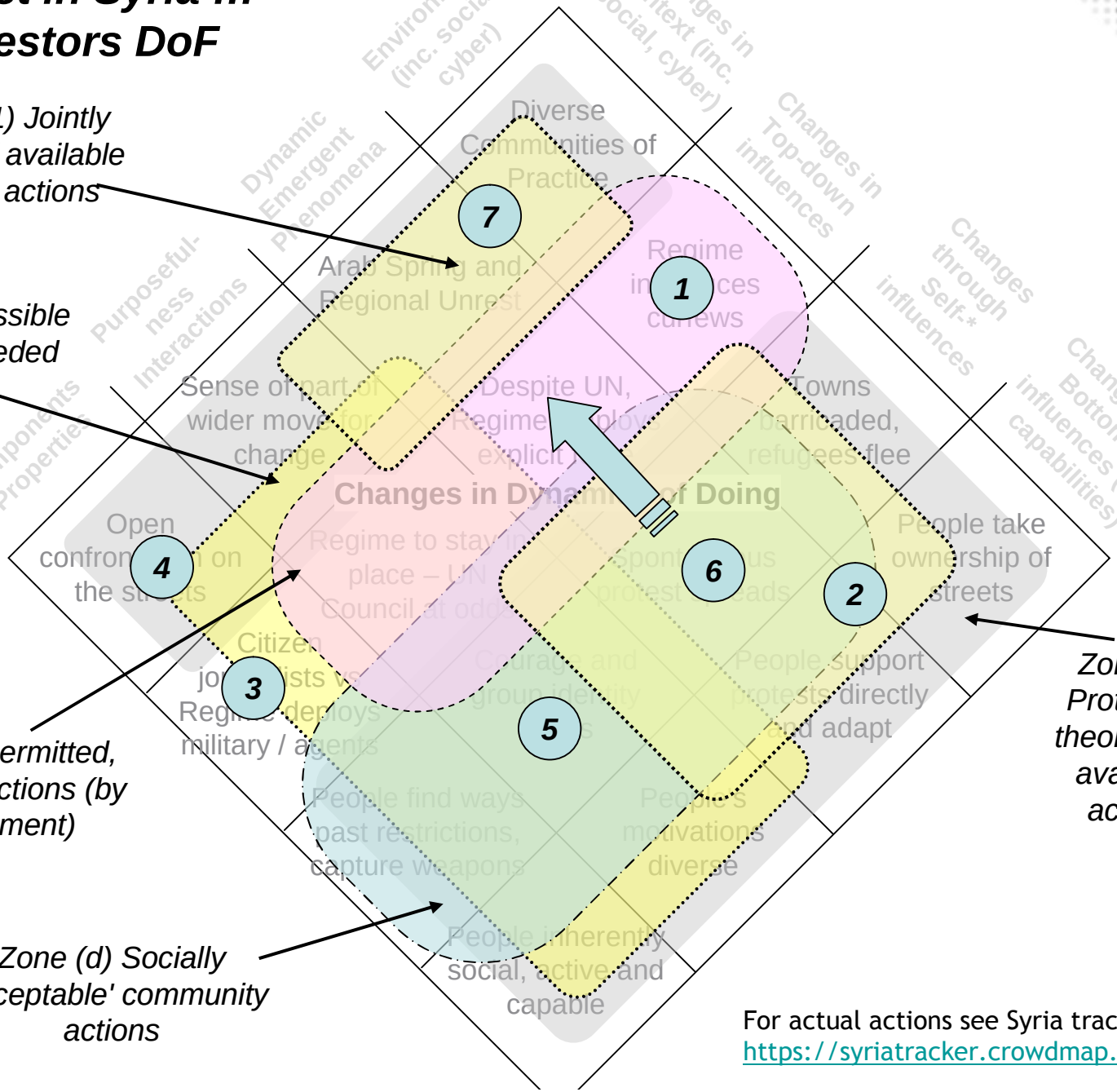
Zone (a) Actions theoretically available to Government

Zone (d) Actions collectively required / available for Government to stay in Power

Zone (c) UN's Obligated, expected, 'acceptable' actions

Zone (b) of jointly possible / available actions by Regime's agents

Conflict in Syria … Protestors DoF



Zone (b1) Jointly possible / available needed actions

Zone (b2) Individually possible / available needed actions

Zone (c) Permitted, obligated actions (by Government)

Zone (d) Socially 'acceptable' community actions

Zone (a) Protestors theoretically available actions

For actual actions see Syria tracker crowdmap at: https://syriatracker.crowdmap.com/

04 Conflict Example – Syria Analysis - Regime

- Influence challenges and opportunities - Regime:
  - *changing the environment*: by destroying districts, blockading roads, restricting resources (fuel, water etc)
  - *changing the nature of top-down influences* (a strength): via orders to the army and police, policy directives (changing the rules), direct political interventions
  - *changing peer-to-peer social drivers*: through the Alawi tribe and Assad family; via protecting favoured businesses and through 'patronage' – limited outside these zones
  - *changing the nature of bottom-up influences*: through intimidation, informers and disinformation
  - *influencing cyberspace*: monitoring and restricting Internet access and mobile phone usage – bypassed by satellite dishes (Lebanon)
  - *'doing nothing', active disengagement*: 'ignoring' agreements with the UN and blaming 'foreign forces'.

04 Conflict Example – Syria Analysis – The People

- Influence challenges and opportunities - protestors:
  - *changing the environment*: taking to the streets in 'swarms', painting wall slogans – a weak area (supported by provisioning from outside Syria)
  - *changing the nature of top-down influences*: via proxy through international pressure (though within own communities cultural / religious structures important)
  - *changes peer-to-peer social drivers*: group, family, religious and ethnic 'norms' and influences a powerful vehicle for cohesion and coherence of collective action. Encourage defections from army.
  - *changes in the nature of bottom-up influences*: support to radical action comes from the will and determination of highly motivated individuals
  - *influencing cyberspace*: use of social networking, citizen journalists and externally provided technical resources
  - *'doing nothing', active disengagement*: not an option – a vulnerability, it's all or nothing.

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05 Summary – So What?

- Such an Approach is appropriate for complex operations because it uses structured discourse to reflect on the realities and conditions for practice and to work with change, such as:
  - What is the nature of the current situation? What has caused the phenomena perceived to come about? What can be understood about this situation, how it 'works' the viewpoints, motivations, influences of others (go to Symptom Sorting).
  - What is motivating 'us' to intervene in this complex situation, what is the problem / opportunity 'we' perceive? Why did 'we' feel it was a problem - what discomforted 'us' enough to trigger 'our' involvement? What are the implicit intentions? We are intervening in order to do what? (go to Strategies and Possibilities).
  - Who is challenging the assumptions? What is the nature of the change 'we' are trying to bring about? What are the tensions and modifiers (go to Trade-off Space).
  - What / who could be engaged with to shape and influence the phenomena, to change the underlying drivers? Given what is / could be known, would the proposed interventions make sense - how would 'we' know if they did? (Go to Landscape of Change).

05 Summary – So What?

- The 'so what' for analysts is that:
  - this kind of approach and types of techniques could usefully extend your portfolio into 'difficult' areas
  - the approach exploits insights from complexity science which provides underpinning robustness to analysis
  - the techniques are complementary to those currently in use
- The 'so what' for operators / OGDs / NGOs is that these techniques:
  - use the everyday, operational, terminology of experienced complexity not the prescriptions of academic complexity
  - make the most of expert judgement and experience
  - are straightforward and 'light' in the need for data collection
  - have already proven to be effective in real-world situations
- But: ***to what degree can / should 'rigour' be added …***

05 Some References

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Questions?

Aim:
To engage analysts and mathematicians in
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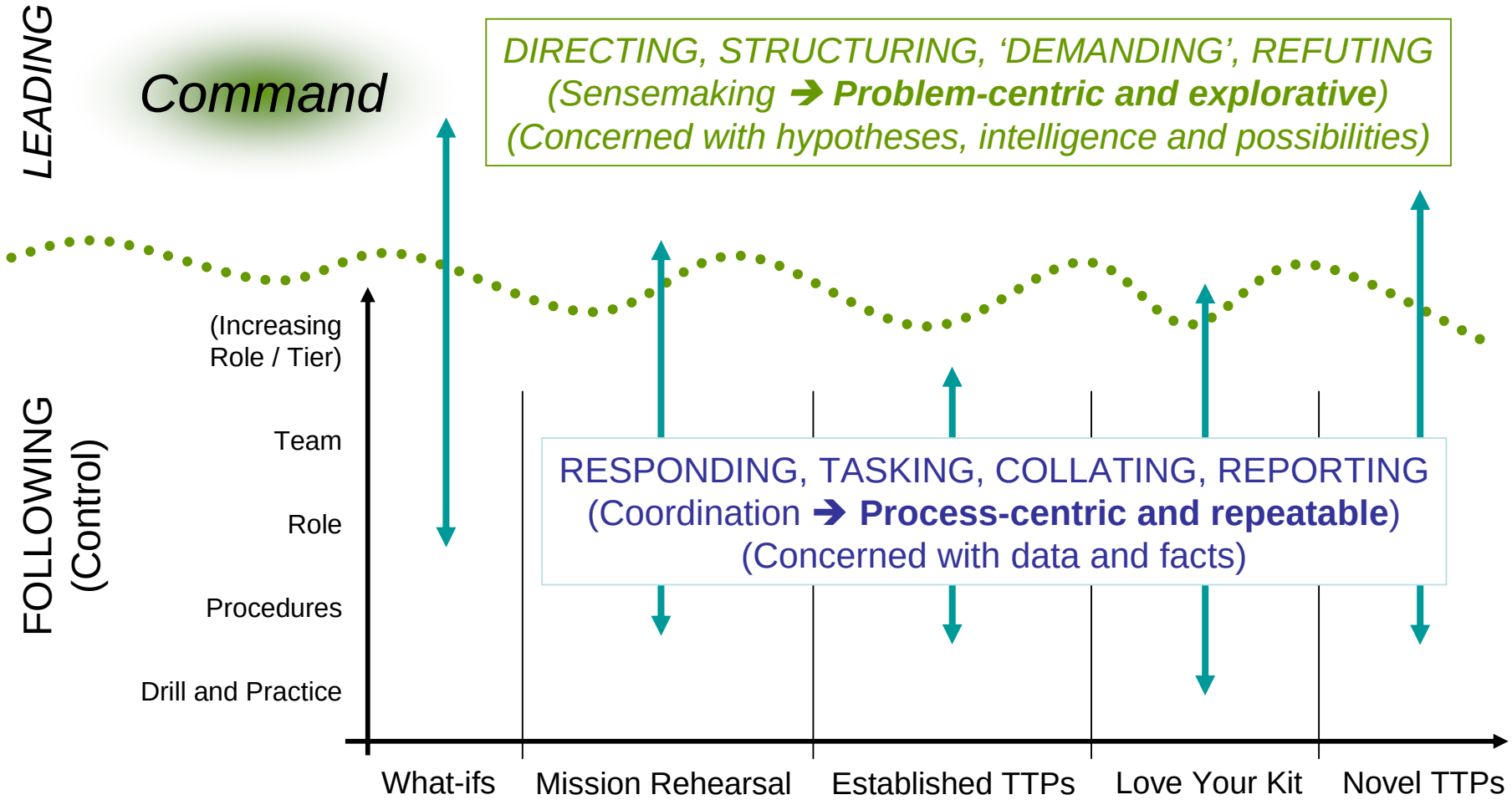
09 The Command Dimension

- Command and control are, wrongly, treated as equivalent



Aspects of Real-world Complexity-worthiness

The abaci Partnership

Example Caricatures	Open to change - appreciates what to sense	Can reason about change - has will to act appropriately	Can engage, influence and learn by doing	Ability to PCtW
A1: Effective practice	Yes	Yes	Yes	Well-placed
A2: Inhibited practice	Yes	Yes, but not how	No, so ineffective	Aware, well meaning, but inhibited
BI / 2: Directed practice	Yes, but forced to	No, 'empty-headed'	Yes, possibly inappropriate	Outside Intent provided. 'Dysfunctional'
Watcher / 'lurker'	Yes, 'voyeur'	No	No	Aware, not interested in opportunity
C1: Ill-informed volunteer	No, so 'blind'	Yes, based on own doing	Yes, but ill-informed	Could do it, can't detect what or when
'Arm-chair' volunteer	No	Yes, hypothetically	No	Has visions, dreams about change
Interfering volunteer	No	No	Yes, impulsively	'Loose-cannon' capability - miss-aligned
C2: Entrenched institution	No	No, in 'world of their own'	No	Detached, indifferent

Consequences in Real-World Terms

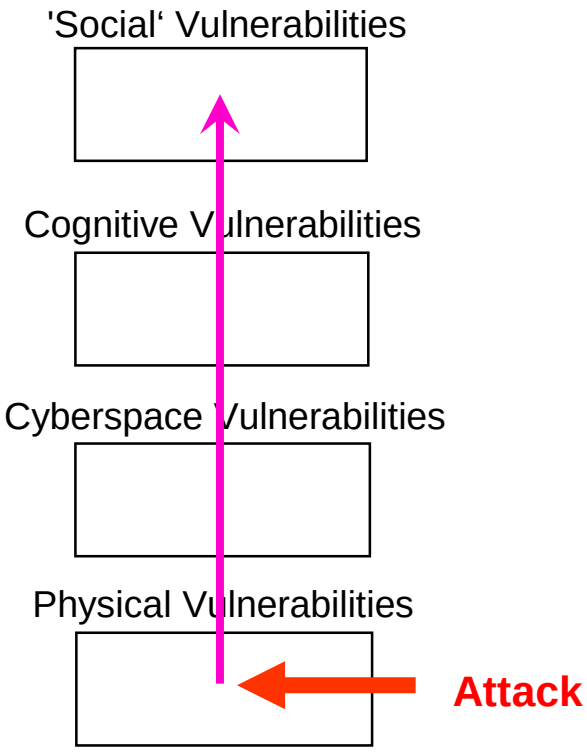
NB: Assume the natural complexity is a similar for all cases

Increasingly Hyper-dimensional Stressing Ambiguous

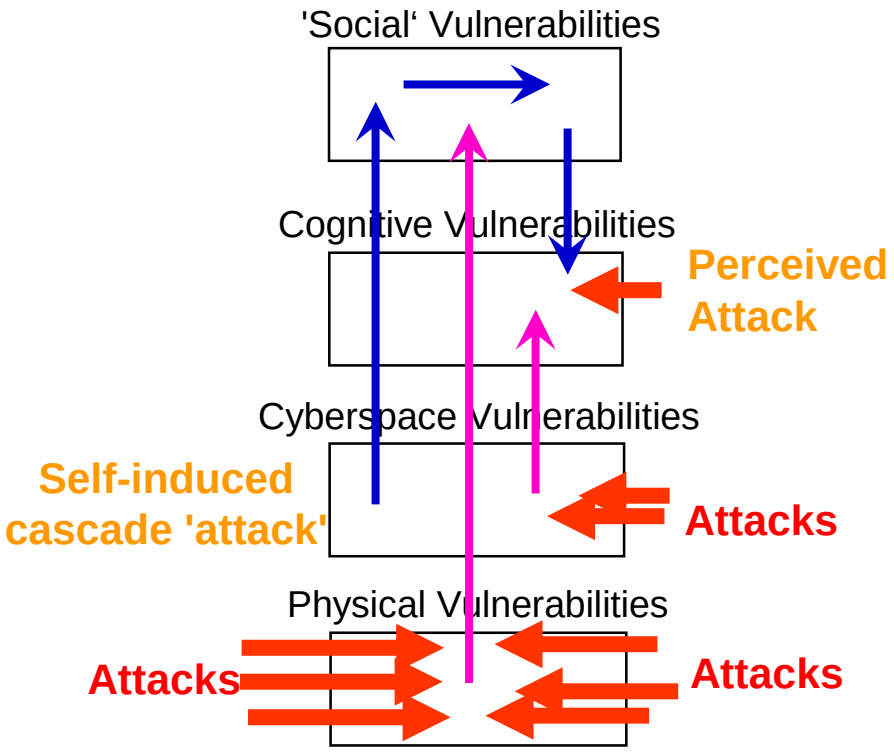
Nature of Context (Symptoms)			Appropriate Iterative Ways-of-working		
Example 'Type'	**Phenomena**	**Structures**	**Strategies**	**Information**	**Influence**
Crisis	Unordered, apparently random, no recognisable relationships	Fleeting transient opportunistic ('rhizomic' / swarms)	ENACTING Imagine-Probe-Compete Hypotheses-Seed	Possible futures / potentially significant indicators - hypothesise	Susceptible to bottom-up influences - usually indirect
Challeng-ing	Ever-changing novel emergent patterns - only coherent in retrospect	Shaped on-the-fly by events. Identifiable leaders (franchise)	EXPLORING Engage-Perceive-Adapt-Learn Influence	Equivocal indicators with many potential meanings - judgement	All ways of influencing are potentially relevant
'Predict-able'	Complicated but deducible varying in time, space and mode	Shaped by process and formal organisational 'templates'	DISCOVERING Sense-Analyse-Plan-Respond	Probabilistic factors induct / hedge / deduct procedurally - gap filling	Susceptible to top-down influences - via processes, templates and assumptions
'Routine'	Simple, familiar phenomena, perceivable, repeatable and self-evident	Determined by history and imposed / embedded institutions / instructions	'VIEWING' Sense-Recognise-Act / React (repeating the known)	Data are observable facts - categorise knowns	Change the rules / constraints / structures and procedures

'Stable' Understandable Tractable

02 Contexts - Influence / Attack Levels



Single Cascade attack



Co-ordinated Cascade Attack

(With self-induced cascade)

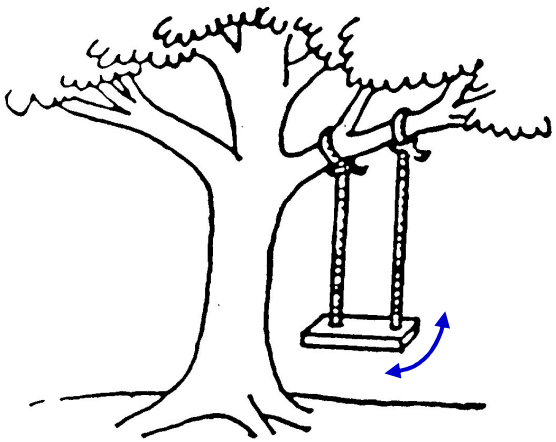
03 Contexts – Reality of Cross-scale Interactions

- Human-machine 'symbiosis' (extend into cyberspace)
- Human society, structures and machines
- Socially intelligent beings who conceive futures
- Tribal, co-operative creatures
- Stereo-vision air-breathing creatures
- Fast 'pack' land animals
- Purposeful creatures
- 'Sensible', free-moving creatures
- Self-*, cell-based forms
- 'Stable' biological environment
- 'Stable' geo-chemical environment
- Large-scale to sub-nano-scale structures and forces

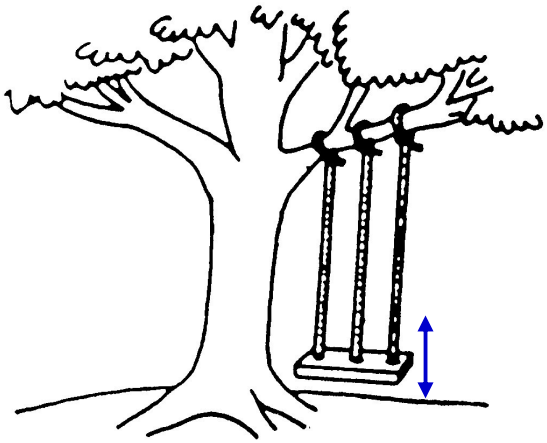
All are, potentially, significant actors in Real-world Complex Realities

Some Command words to consider …

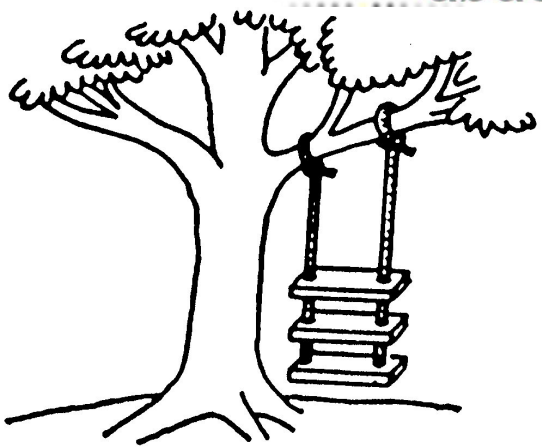
- Abduction, Analyse, Assumptions
- Act, Agility, Adaptation, Authority, Authorisation, Appropriate
- Available, Achievable, Accessible
- Attractor, Chaotic
- Blockers, Boundaries, Constraints
- Categorise, Classify
- Coherence, Cohesion, Coupling, Competing, Collaborating, Conflicting
- Dialectic, Deducible, deduction
- Discovery, Engage, Enacting, Enablers
- Emergence, Equivocality, Evidence
- Facts
- Federation, Flocking, Franchise
- Flexibility, Fleeting
- Form, Formal, Function
- Hypotheses, Hedge, History
- Innovative
- Independent, Interdependant
- Induction, Indicator, Identifiable
- Influence
- Imprecise, Improbable, Impossible, Indifferent, Inexplicable
- Irrelevant, Inaccurate, Inconsistent, Incorrect, Indirect
- Leadership, Judgement
- Modifiers, Novelties
- Openness, Organisation, Obligation
- Patterns, Phenomena
- Processes, Procedures
- Plan, Practice, Purpose, Power
- Potential, Perceive, Probe
- Random, Repeatable, Realisable, Range
- Reflection, Responsibility
- Responsiveness, Robustness, Resilience
- Rhizomic
- Rules, Schema
- Service, System (of systems)
- Respond, Shape, Sense
- Significance, Strange, Surprise
- Structure, Swarming
- Susceptibility
- Templates, Trade-offs
- Transience, Tensions
- Unanticipated, Unbelievable, Uncertain, Unexpected, Unlikely, Unknown, Unfamiliar, Unknowable, Unpredictable, Unrecognisable
- Unordered
- Vague, Virtual, Variation



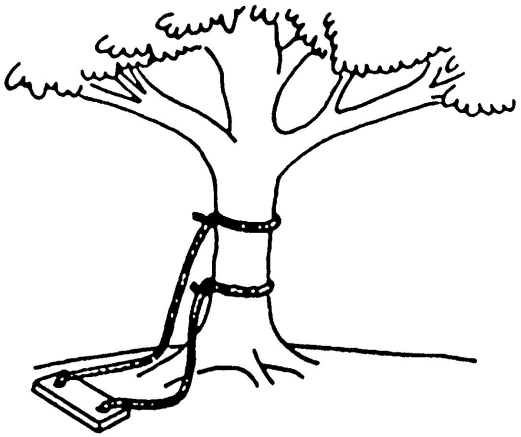
The Real World to be modelled



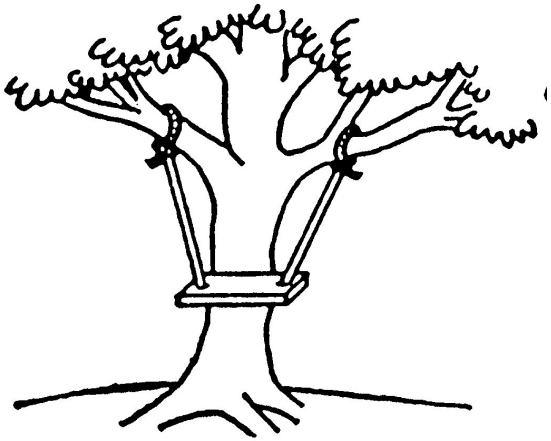
How the data captured it



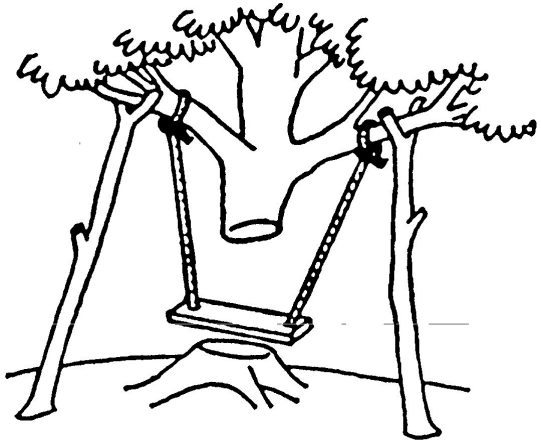
What the first 3 runs produced



Project manager's corrections



What the funding approved



Analysis outputs that the military got