Functional Impacts of NCO on Future C2

Perrow's Quadrants: coupling, interaction and projection

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Edge Concepts

- Run-time and acquisition time
  - Paper 107, Track 12 A. Alston

- Command Leadership and command styles
  - Paper 298, Track 9 K. Stewart

- **Organising for response to external stimuli**
  - **Paper 188, Track 12 L. Dodd**

- Influencing and exploiting the properties of complex adaptive systems
  - Paper 115, Track 12 P. Beautement

- Capability architectures
  - Paper 232, Track 12 M. Lloyd

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What we are trying to understand

- Nature of the challenge space
  - unpredictability
  - need for precision and accuracy

- How do structures and infrastructures then need to be configured (and re-configured) so that they are as fit as can be given the nature of the challenge space

- Use of Perrow's work to explore complexity and coupling

Changes in environment

- Our concern is military structures for deployment and employment of force in response to:
    - On-going actions by an opposing force
    - Events that cause damage
    - Anticipation of undesirable situations
    - Need to improve power position (to increase options-space)

- The structures must balance ENDS, MEANS and WAYS so that the WAY that the structures adapt allows the force to achieve the ENDS within the MEANS.

HOWEVER....
The structural design principles for EOs should address
the degrees of freedom of WAYS and MEANS given that
the purpose of the EO is to be able to effect change in any way
to its advantage in the context of any of the above four changes
in the environment.

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Disturbance and system damage

- The degree and nature of disturbance is directly related to what we define as "the system"

- In Perrow's framework, it is the character of the system – its intrinsic organisation- that CAUSES damage; although the stimulus mostly originates from outside the system.

- What are the critical aspects of the system that if disturbed would constitute system damage?

- What are the restraining and constraining features of the system that would affect recovery responses?

Then we can define (in terms of "system impact") what is meant by
- An event
- An incident
- An accident

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Perrow's quadrants

Complex

Complex interactions are less predictable. Breakdowns within one or more units and or subsystems may occur because of unplanned or unforeseen interactions and "knock-on" effects.

Interactions

2	4
1	3

Linear interactions describe highly structured systems which are logical, sequential bounded and planned. If damage to a part occurs, the problem can be identified, contained and corrected with little disturbance to the overall system.

Linear

Tight

Coupling

Loose

Tight coupling is characterised by centralisation and rigidity, tightly-specified tolerances – any change causes ramifications throughout the system.

Loose coupling is characterised by decentralised operations, flexible control mechanisms

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Interactions and coupling

- The main influence of the "interactions axis" is in one's ability to project forward in time; in particular, unintended and unanticipated consequences due to interactions that are difficult to "linearize-out" because of inter-dependencies. "Visibility" of interactions (sensors at key points) may help to limit undesirable system behaviours.

- The "coupling axis" relates to system criticality due to constraining factors. It involves application of the critical aspects to assess (i.e. is this OK or not?) feedback from the system as it goes about its purposeful function. It is about tolerances, buffering and tightness.

- The system/sub-system boundaries should be set to try to limit expected damage with respect to the range of purposes and the repertoire of controlled responses for recovery from failure.

Note though that more boundaries means more interfaces to manage

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Four types of interactivity

- **<u>Independent</u>**: Separate and discrete activities – i.e. concurrent activities without direct interdependencies (but usually both acting towards the greater good)

- **<u>Co-ordinated</u>**: Serial interdependency linked through shared artefacts or through a common metric space.

- **<u>Coherent</u>**: Acting coherently, in concert with mutual orientation in the same part of the environment and sharing the same feedback.

- **<u>Unitary</u>**: Behaving as if they were a single entity for some period of time (reduced degrees of individual freedom are traded off against being able to wield greater collective potential).
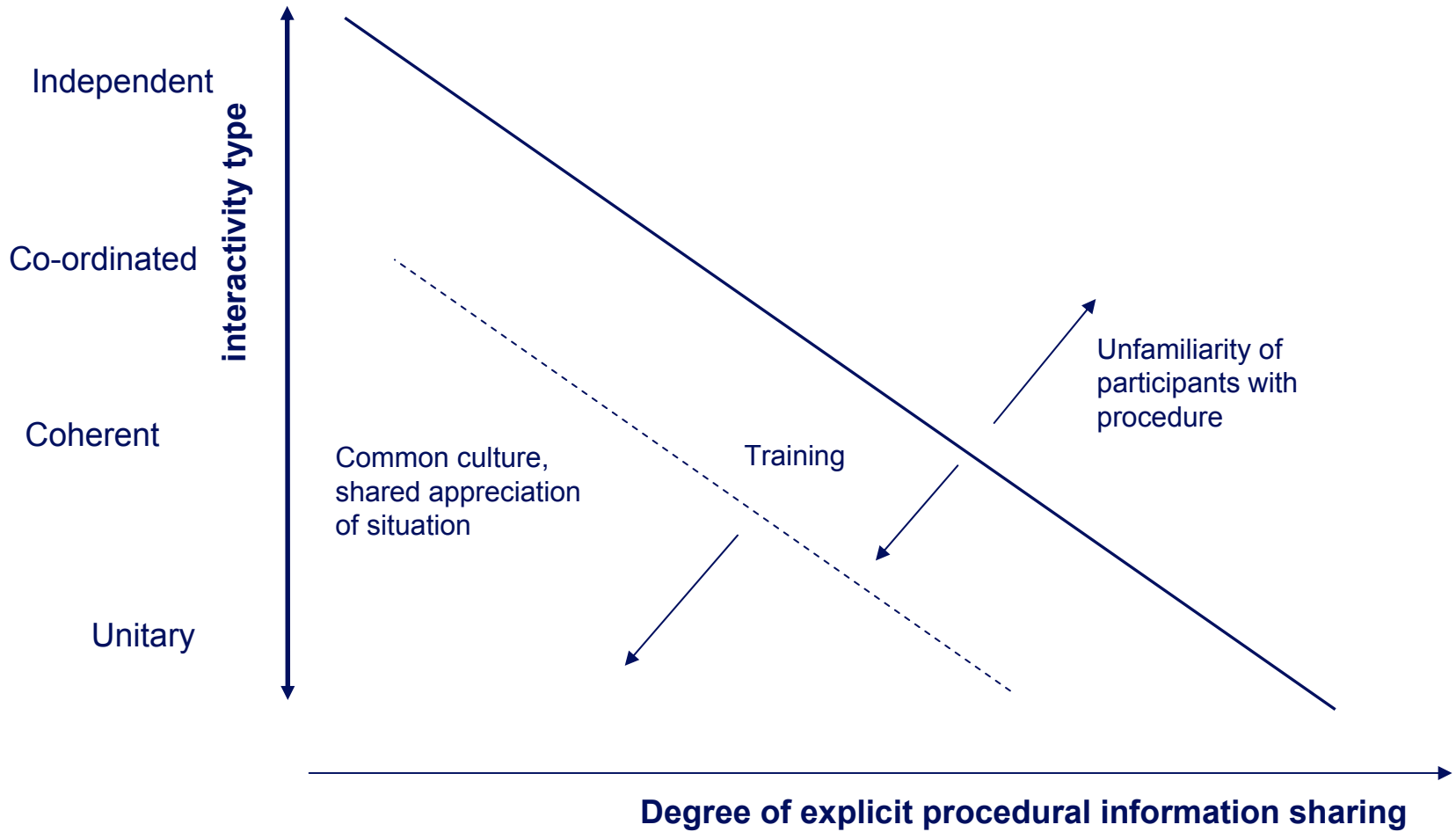
Types of feed-back & feed-forward

- Internal feed-back (proprioception and operative monitoring)

- Internal feed-forward (adjustment to internal WAYS, ENDS and MEANS – and structures to reduce discomfort)

- External feed-back (intents from external commands, ROEs, SOPs, Intel)

- External feed-forward (requests for resources, extra support, changes to decision authorities and planning process, directives to sub-ordinates)
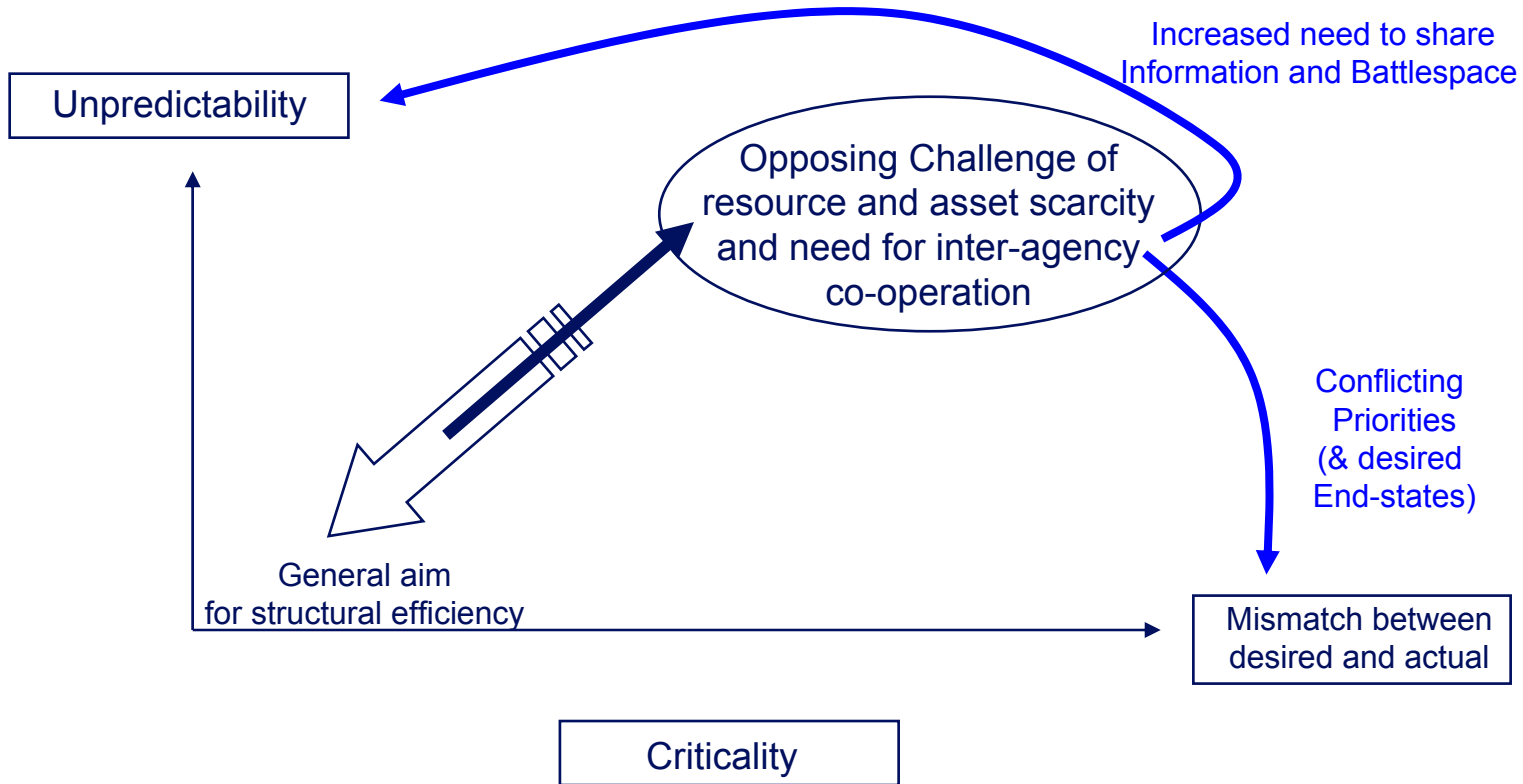
Note that feed-back generally is trying to reduce confusion & uncertainty to allow anticipation. Feed-forward is making adjustments to reduce discomfort and keep options-space as open as possible.

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What determines connection strength?

- The main driver is the degree of interdependency (need and willingness to inter-depend).

- The main "transaction-cost cutter" is the infrastructure which includes the degree of out-sourcing (see paper)

- The nature of the operational activities (the roles and the relationships of the operating units) in conjunction with the interdependencies and the infrastructures then determines the nature of the interactions.

- The strengths of the connections is then a changing function of the relative dynamics of the activities (in terms of their feed-back and feed-forward).
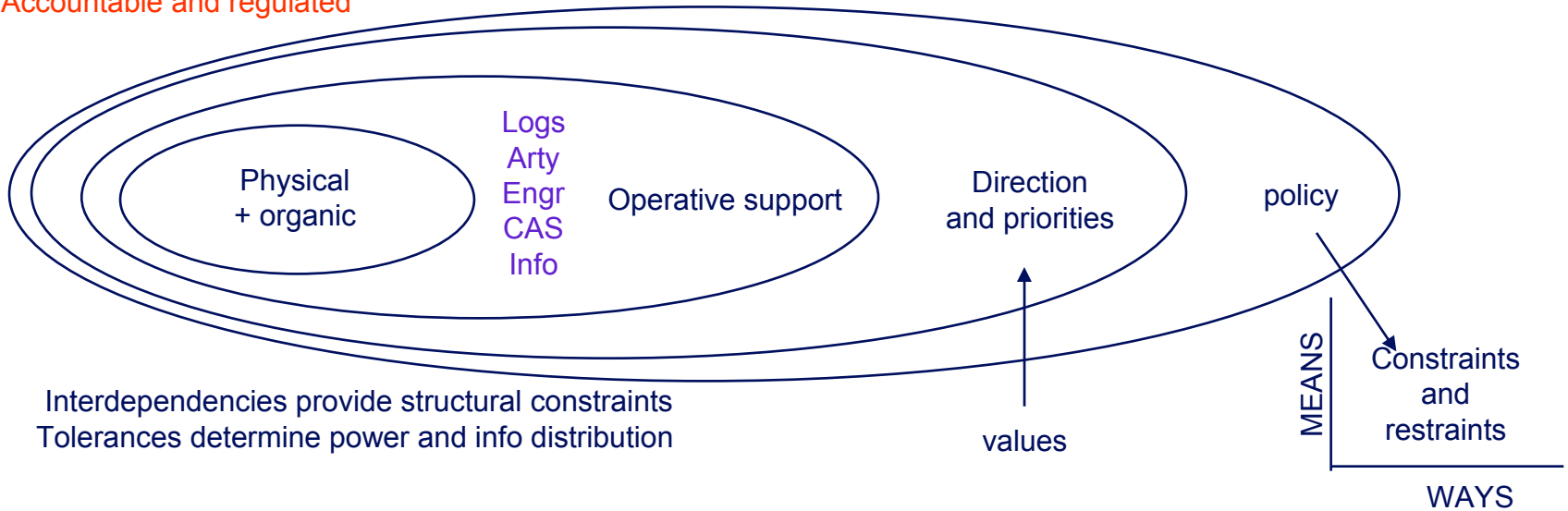
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Two structural drivers

C2 decisions essentially have two major driving components: consequences and their likelihood
C2 structures should adapt to allow C2 decision-making to balance these two components
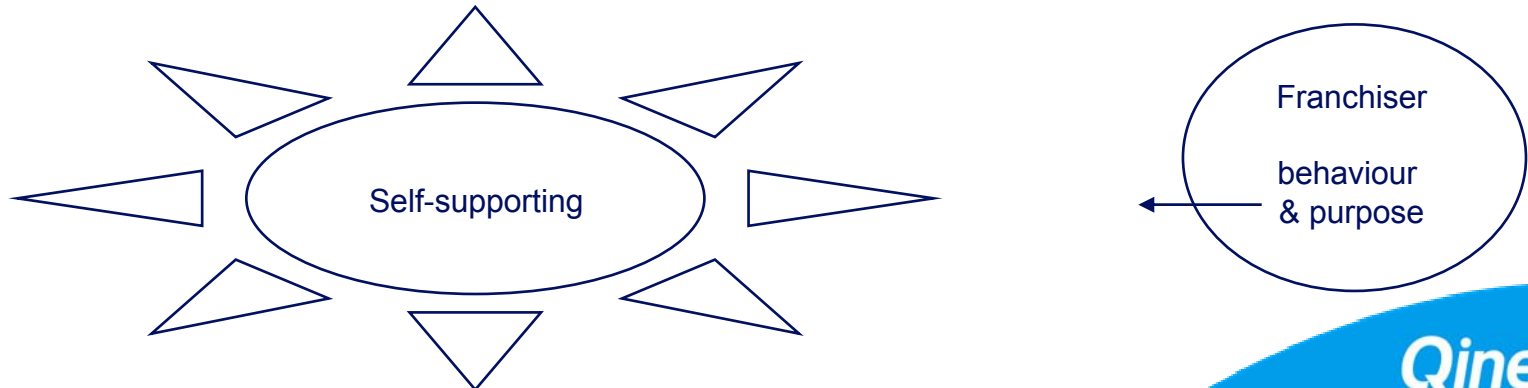Scarcity increases need for interdependence and number of interactions

Increased need to share
Information and Battlespace

Unpredictability

Opposing Challenge of
resource and asset scarcity
and need for inter-agency
co-operation

Conflicting
Priorities
(& desired
End-states)

General aim
for structural efficiency

Mismatch between
desired and actual

Criticality

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Two structural extremes

Accountable and regulated

Logs
Arty
Engr
CAS
Info

Physical
+ organic

Operative support

Direction
and priorities

policy

Interdependencies provide structural constraints
Tolerances determine power and info distribution

values

MEANS

Constraints
and
restraints

WAYS

Purposeful and self-regulated

Self-supporting

Franchiser

behaviour
& purpose

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Summary

The nature of the point at which the stimulus is sensed (i.e. the level of the operating unit and its connectivity - hence propagation of the stimulus) begins to define the structural requirements for the responsive action.

The response will be naturally constrained by MEANS available and WAYS will be restrained by policy (RoE's) but the organisation should maintain adequate degrees of freedom to place responsibility for action with those who have authority over the MEANS and Intelligence.

However, the need for accountability and levels of competence, experience and trust will play a major part in the allocation of decision responsibility and in setting the depth of supervision.

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Questions?

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