

# Paper 107: Implementing Edge Organizations: Exploiting Complexity

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the Command and Control Research Programme.

**QinetiQ**

# Agenda

- Aims and Approach.
- The Taxonomy
- The “Concept” – Form and Function
- Way Ahead

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# Aim

- Define the command and control arrangements pertinent to Edge Organisations

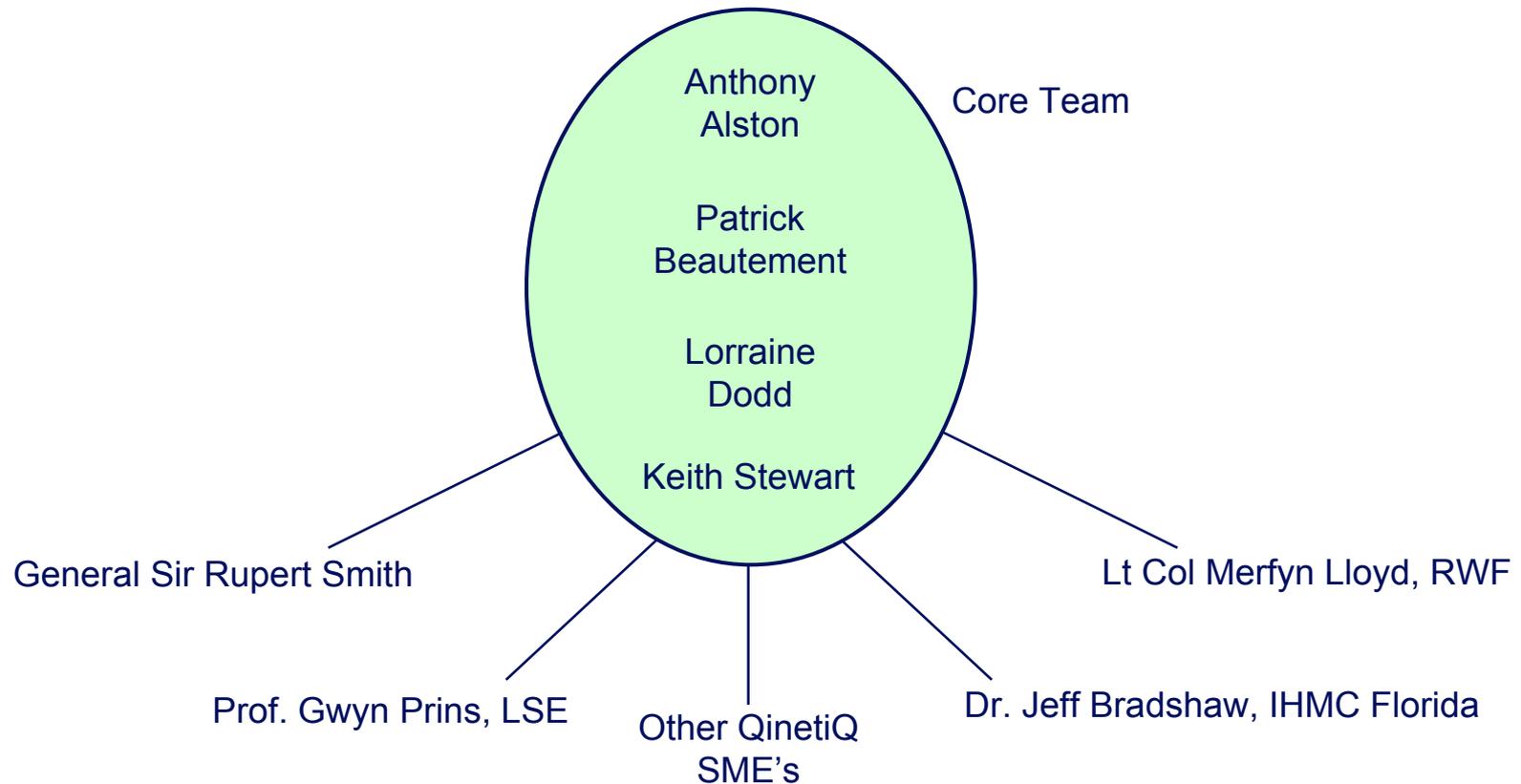
by

- Identifying the constraints and necessary critical aspects of the C2 arrangements.

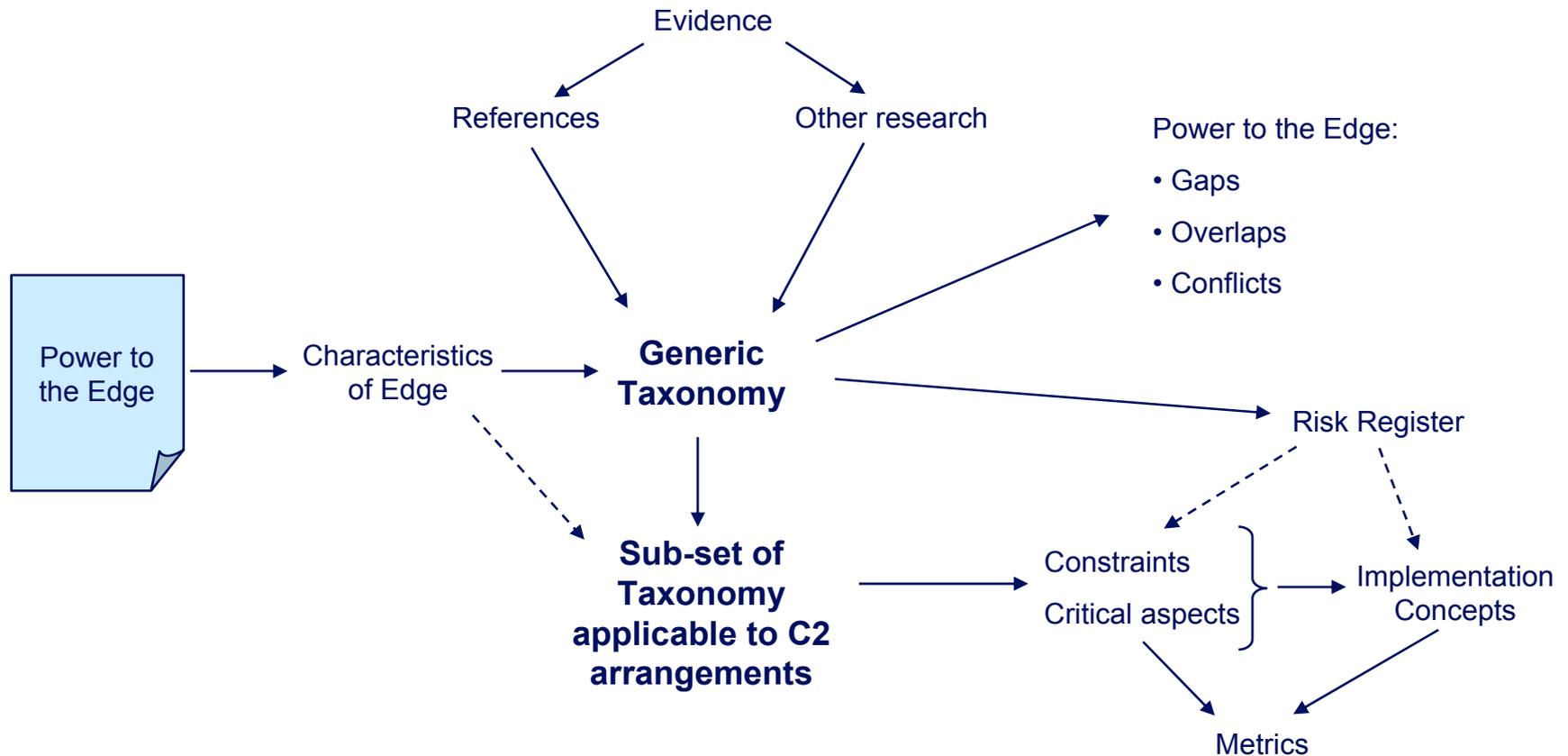
# Approach

- How command and control is performed can only be determined through an understanding of how the organisation behaves within the environment.
- Hence:
  - Describe the environment and its components that the edge organisation will operate within and how the edge organisation will interact with them.
  - Describe the internal structures, the command and control arrangements and behaviours of edge organisations required to achieve its stated interactions with the environment.

# The Team



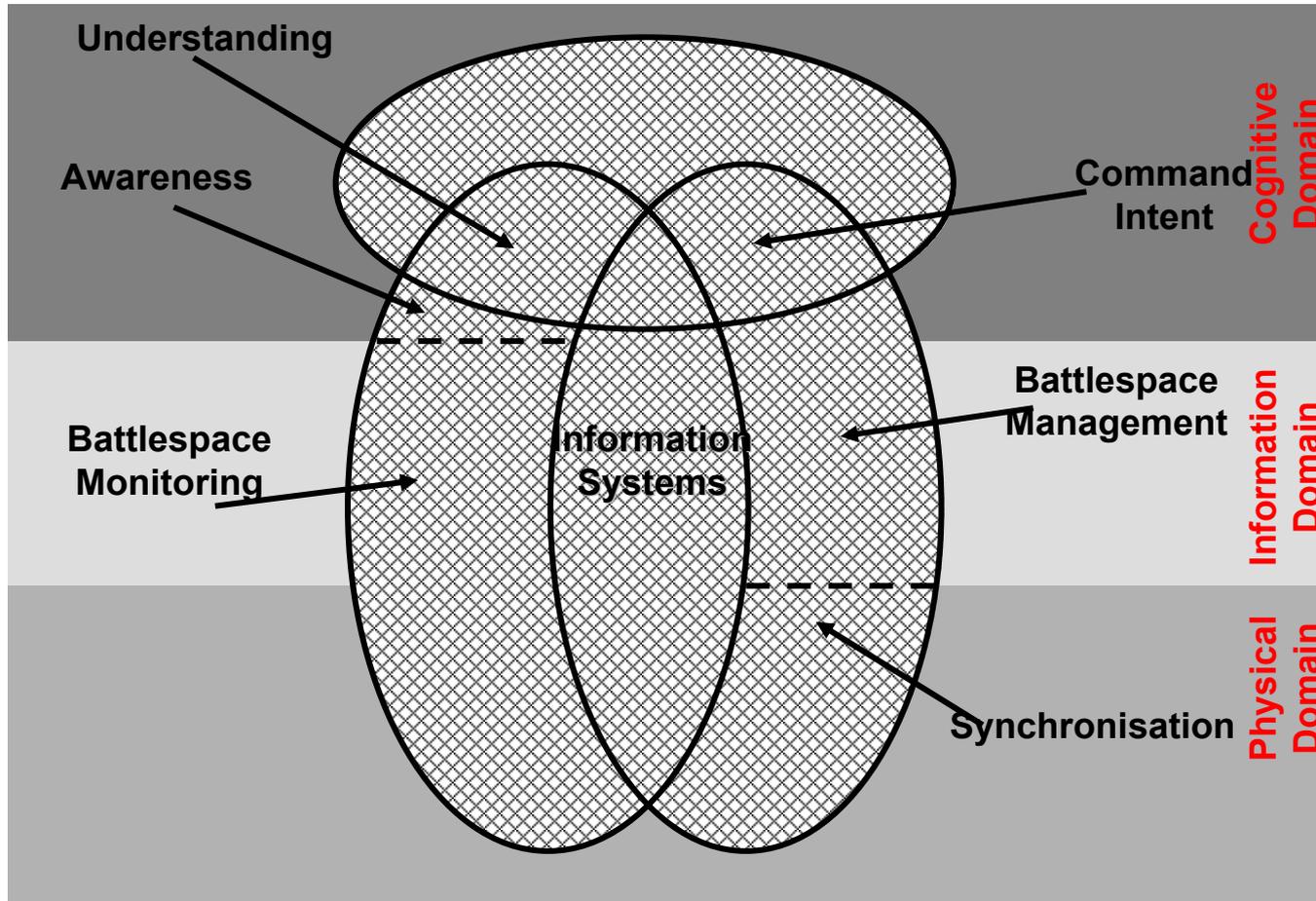
# Approach – The Edge Knowledge-base



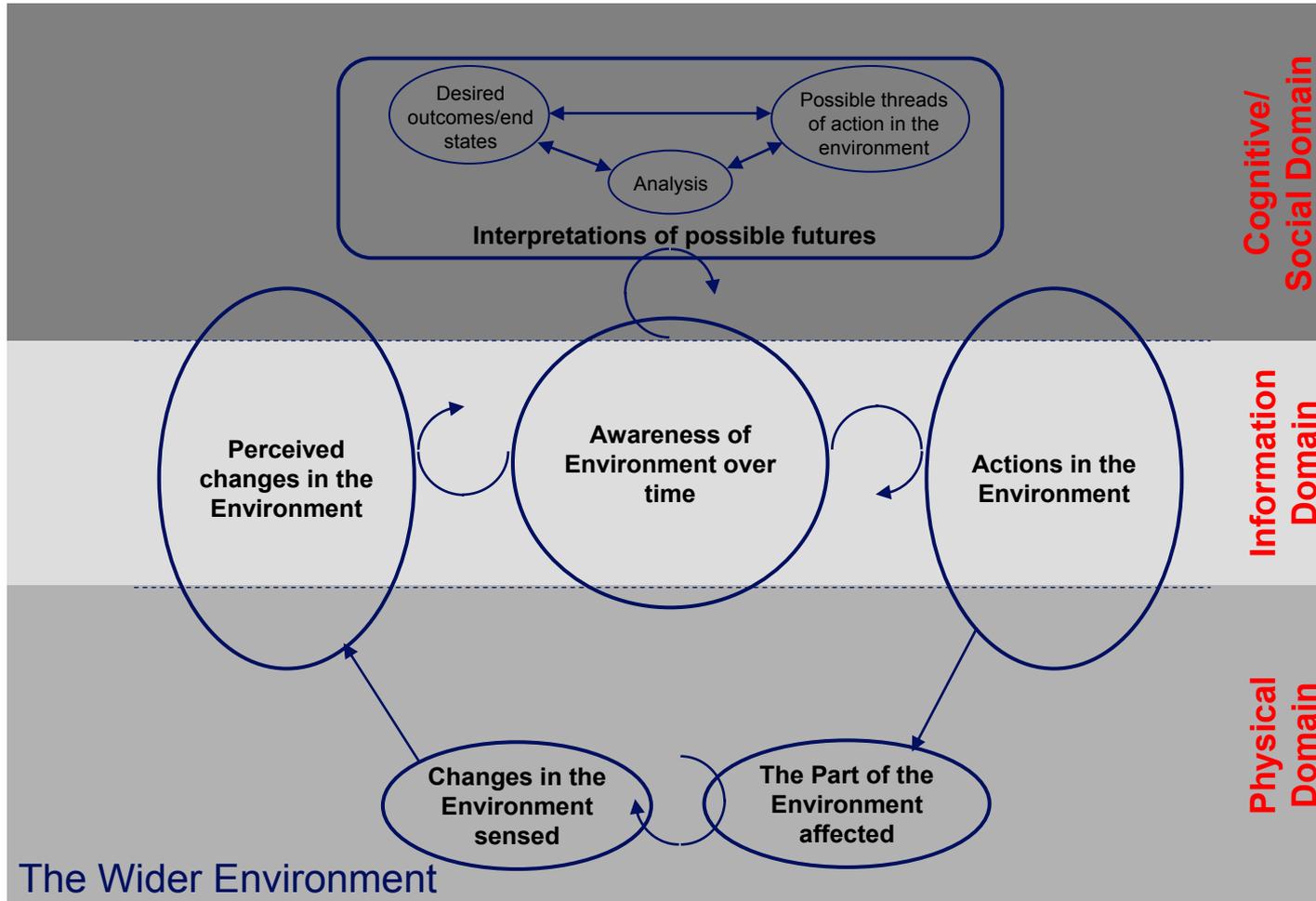
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- **The Taxonomy**
- The “Concept” – Form and Function
- Way Ahead

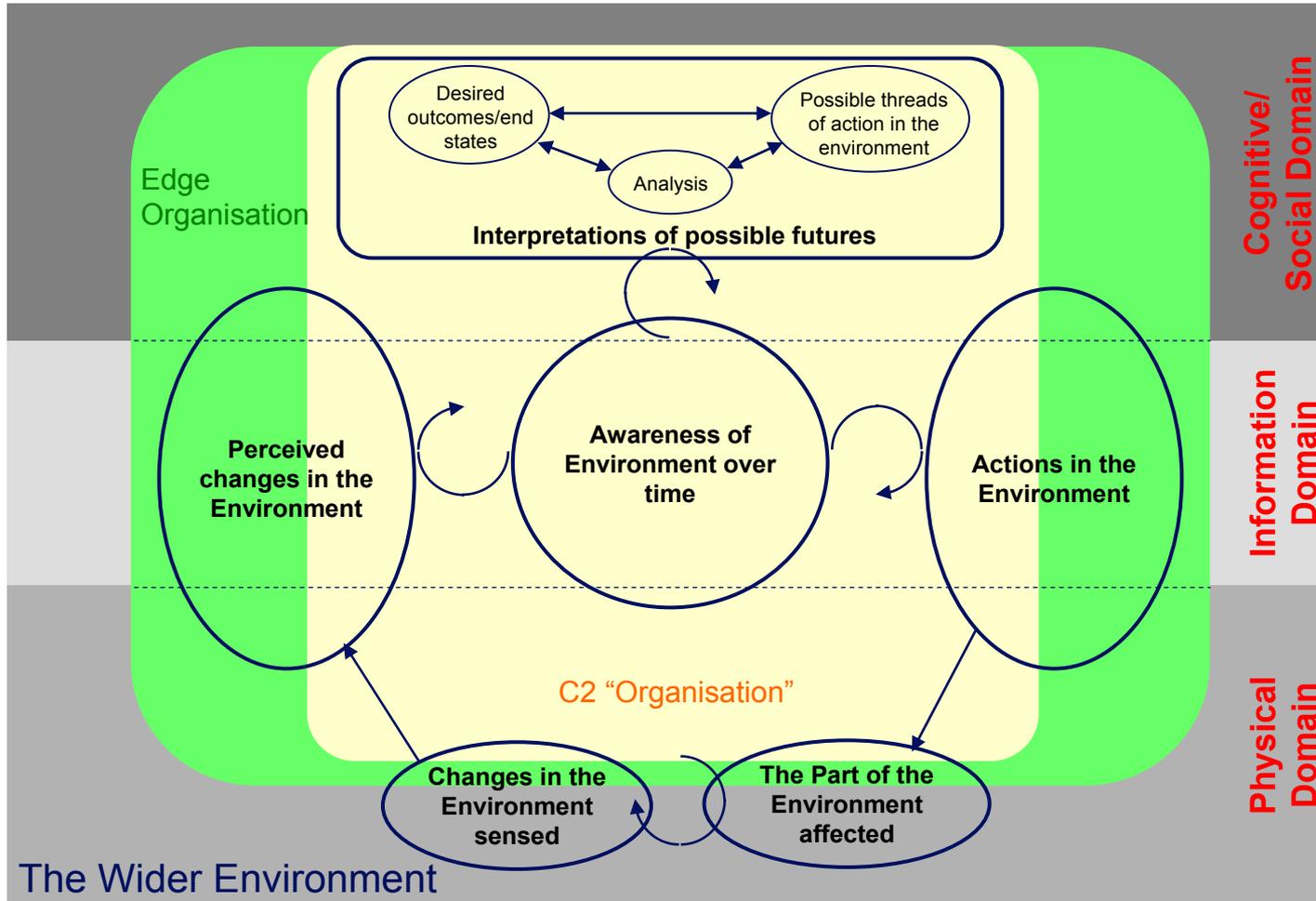
# Future C4ISR



# Edge Organisation Framework



# Edge Organisation Framework



# Enumerated Taxonomy

## 1. Perceived changes in the environment

- 1.1. "Spectral" Coverage
  - 1.1.1. Coverage Management
  - 1.1.2. Characteristics of the "spectrum"
  - 1.1.3. Sampling rate
- 1.2. Direct sensing
- 1.3. Indirect sensing

## 2. Awareness of environment over time

- 2.1. Self-awareness (us, super-us and sub-us)
  - 2.1.1. Value system
  - 2.1.2. Personality
  - 2.1.3. Capability
- 2.2. Awareness of others (them, super-them, sub-them)
  - 2.2.1. Value system
  - 2.2.2. Personality
  - 2.2.3. Capability
- 2.3. Awareness of relationships (us-us, us-them, them-them)
  - 2.3.1. Social constructs
  - 2.3.2. Conversations
  - 2.3.3. Characteristics
- 2.4. Understanding the environment
  - 2.4.1. Past
  - 2.4.2. Current
  - 2.4.3. Change sensing
  - 2.4.4. Sharing mechanisms
- 2.5. Learning
- 2.6. Stored information
  - 2.6.1. Sharing mechanisms
- 2.7. Stored knowledge
  - 2.7.1. Sharing mechanisms

## 3. Interpretations of possible futures

- 3.1. Desired Outcomes/end states
  - 3.1.1. Way of command
    - 3.1.1.1. Problem formulation
    - 3.1.1.2. Problem solving
    - 3.1.1.3. leadership
  - 3.1.2. Intent
    - 3.1.2.1. Sharing mechanisms
    - 3.1.2.2. Desired states
    - 3.1.2.3. Goals
- 3.2. Analysis
  - 3.2.1. Way of command
    - 3.2.1.1. Problem formulation
    - 3.2.1.2. Problem solving
    - 3.2.1.3. leadership
  - 3.2.2. Monitoring actual against expected
  - 3.2.3. Decision-making
  - 3.2.4. Tasking
- 3.3. Possible threads of action to possible futures
  - 3.3.1. Way of command
    - 3.3.1.1. Problem formulation
    - 3.3.1.2. Problem solving
    - 3.3.1.3. leadership
  - 3.3.2. Potential courses of action
    - 3.3.2.1. Tasks
    - 3.3.2.2. Sequencing
    - 3.3.2.3. De-confliction
    - 3.3.2.4. Prioritisation
    - 3.3.2.5. Tempo/rhythm

## 4. Actions in the environment

- 4.1. Execution
  - 4.1.1. Effects
  - 4.1.2. Side (Secondary) effects
  - 4.1.3. Contention mechanisms
  - 4.1.4. Team building
  - 4.1.5. Tasks
  - 4.1.6. Sub-tasks
  - 4.1.7. Co-ordination
  - 4.1.8. Synchronisation

## 4.2. Team

- 4.2.1. Value system
  - 4.2.2. Membership
  - 4.2.3. Cohesion
  - 4.2.4. Leadership
  - 4.2.5. "Personality"
  - 4.2.6. Tasking
  - 4.2.7. Capability/skills
- ## 4.3. Way of command
- 4.3.1. Problem formulation
  - 4.3.2. Problem solving
  - 4.3.3. leadership
- ## 4.4. Means
- 4.4.1. Characteristics
  - 4.4.2. Infrastructure
  - 4.4.3. Assets
  - 4.4.4. Interactions

## 5. The environment

- 5.1. Phenomena
  - 5.1.1. Weather
  - 5.1.2. Natural events (e.g. earthquakes)
- 5.2. Artefacts
  - 5.2.1. Natural
  - 5.2.2. Man-made
- 5.3. Actors
  - 5.3.1. General public
  - 5.3.2. Adversary
  - 5.3.3. Others
  - 5.3.4. Own organisation
    - 5.3.4.1. Components
    - 5.3.4.2. Structure
    - 5.3.4.3. Characteristics
    - 5.3.4.4. Relationships
    - 5.3.4.5. Acquisition
    - 5.3.4.6. Training
- 5.4. Topology
  - 5.4.1. Physical
  - 5.4.2. Battlespace

## 6. Changes in the environment

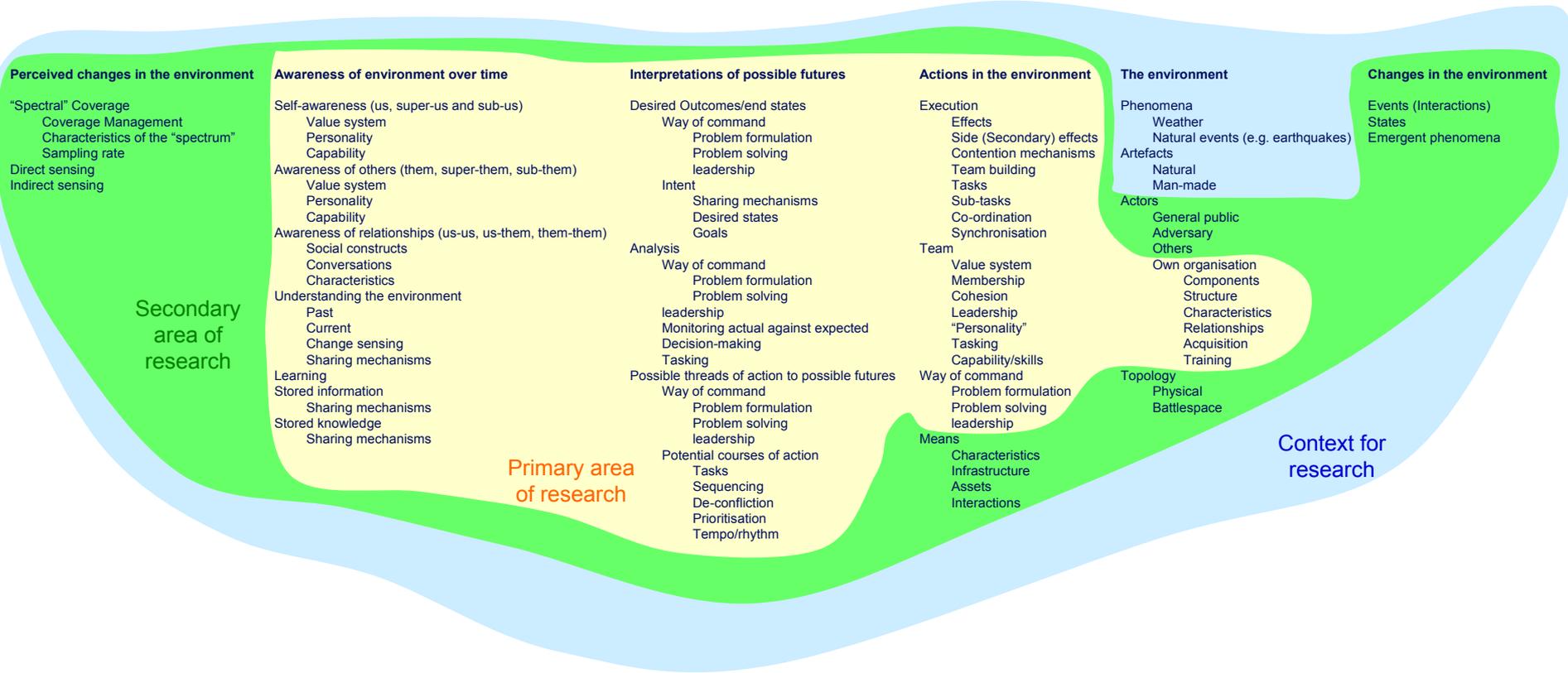
- 6.1. Events (Interactions)
- 6.2. States
- 6.3. Emergent phenomena

# Taxonomy

Perceived changes in the environment	Awareness of environment over time	Interpretations of possible futures	Actions in the environment	The environment	Changes in the environment
<ul style="list-style-type: none"> <li>"Spectral" Coverage</li> <li>Coverage Management</li> <li>Characteristics of the "spectrum"</li> <li>Sampling rate</li> </ul> Direct sensing Indirect sensing	Self-awareness (us, super-us and sub-us) <ul style="list-style-type: none"> <li>Value system</li> <li>Personality</li> <li>Capability</li> </ul> Awareness of others (them, super-them, sub-them) <ul style="list-style-type: none"> <li>Value system</li> <li>Personality</li> <li>Capability</li> </ul> Awareness of relationships (us-us, us-them, them-them) <ul style="list-style-type: none"> <li>Social constructs</li> <li>Conversations</li> <li>Characteristics</li> </ul> Understanding the environment <ul style="list-style-type: none"> <li>Past</li> <li>Current</li> <li>Change sensing</li> <li>Sharing mechanisms</li> </ul> Learning <ul style="list-style-type: none"> <li>Stored information</li> <li>Sharing mechanisms</li> </ul> Stored knowledge <ul style="list-style-type: none"> <li>Sharing mechanisms</li> </ul>	Desired Outcomes/end states <ul style="list-style-type: none"> <li>Way of command</li> <li>Problem formulation</li> <li>Problem solving</li> <li>leadership</li> </ul> Intent <ul style="list-style-type: none"> <li>Sharing mechanisms</li> <li>Desired states</li> <li>Goals</li> </ul> Analysis <ul style="list-style-type: none"> <li>Way of command</li> <li>Problem formulation</li> <li>Problem solving</li> <li>leadership</li> <li>Monitoring actual against expected</li> <li>Decision-making</li> <li>Tasking</li> </ul> Possible threads of action to possible futures <ul style="list-style-type: none"> <li>Way of command</li> <li>Problem formulation</li> <li>Problem solving</li> <li>leadership</li> </ul> Potential courses of action <ul style="list-style-type: none"> <li>Tasks</li> <li>Sequencing</li> <li>De-confliction</li> <li>Prioritisation</li> <li>Tempo/rhythm</li> </ul>	Execution <ul style="list-style-type: none"> <li>Effects</li> <li>Side (Secondary) effects</li> <li>Contention mechanisms</li> <li>Team building</li> <li>Tasks</li> <li>Sub-tasks</li> <li>Co-ordination</li> <li>Synchronisation</li> </ul> Team <ul style="list-style-type: none"> <li>Value system</li> <li>Membership</li> <li>Cohesion</li> <li>Leadership</li> <li>"Personality"</li> <li>Tasking</li> <li>Capability/skills</li> </ul> Way of command <ul style="list-style-type: none"> <li>Problem formulation</li> <li>Problem solving</li> <li>leadership</li> </ul> Means <ul style="list-style-type: none"> <li>Characteristics</li> <li>Infrastructure</li> <li>Assets</li> <li>Interactions</li> </ul>	Phenomena <ul style="list-style-type: none"> <li>Weather</li> <li>Natural events (e.g. earthquakes)</li> </ul> Artefacts <ul style="list-style-type: none"> <li>Natural</li> <li>Man-made</li> </ul> Actors <ul style="list-style-type: none"> <li>General public</li> <li>Adversary</li> <li>Others</li> <li>Own organisation</li> <li>Components</li> <li>Structure</li> <li>Characteristics</li> <li>Relationships</li> <li>Acquisition</li> <li>Training</li> </ul> Topology <ul style="list-style-type: none"> <li>Physical</li> <li>Battlespace</li> </ul>	Events (Interactions) States Emergent phenomena

NB: Interactions between elements of the taxonomy meaning not shown on this taxonomy (part of the concepts)

# Taxonomy



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# Form and Function

- Form:
  - Being able to put in place, at design-time, the conditions which would enable appropriate organisations to be assembled at run-time
  - Has run-time sensing and assessment capability
  - Is able to respond appropriately (Balance of risk and reward)
  - Definition of edge is context dependant (as is self and non-self)
  - More resources expended at the edge
  - Leadership is at the edge

# Form and Function

- Form:
  - Embodies a notion of command function that provides the directing mind
  - Concept of ownership is different – cooperative interdependence (is intolerant of monopolies), universal concepts of trust
  - Composed of heterogeneous, distributed, mobile (organisationally agile), interacting “Operating-Units”
  - Structures arise from the pattern of dynamic interactions over time (relationships and interdependencies etc)

# Form and Function

- Function:
  - The edge organisation has purpose, senses itself and the environment, and is tolerant of uncertainty by exploiting complexity
  - Shapes itself better to fit the environment
  - Shapes the environment (and hence other actors) through effects stimulated by the “Operating Units”

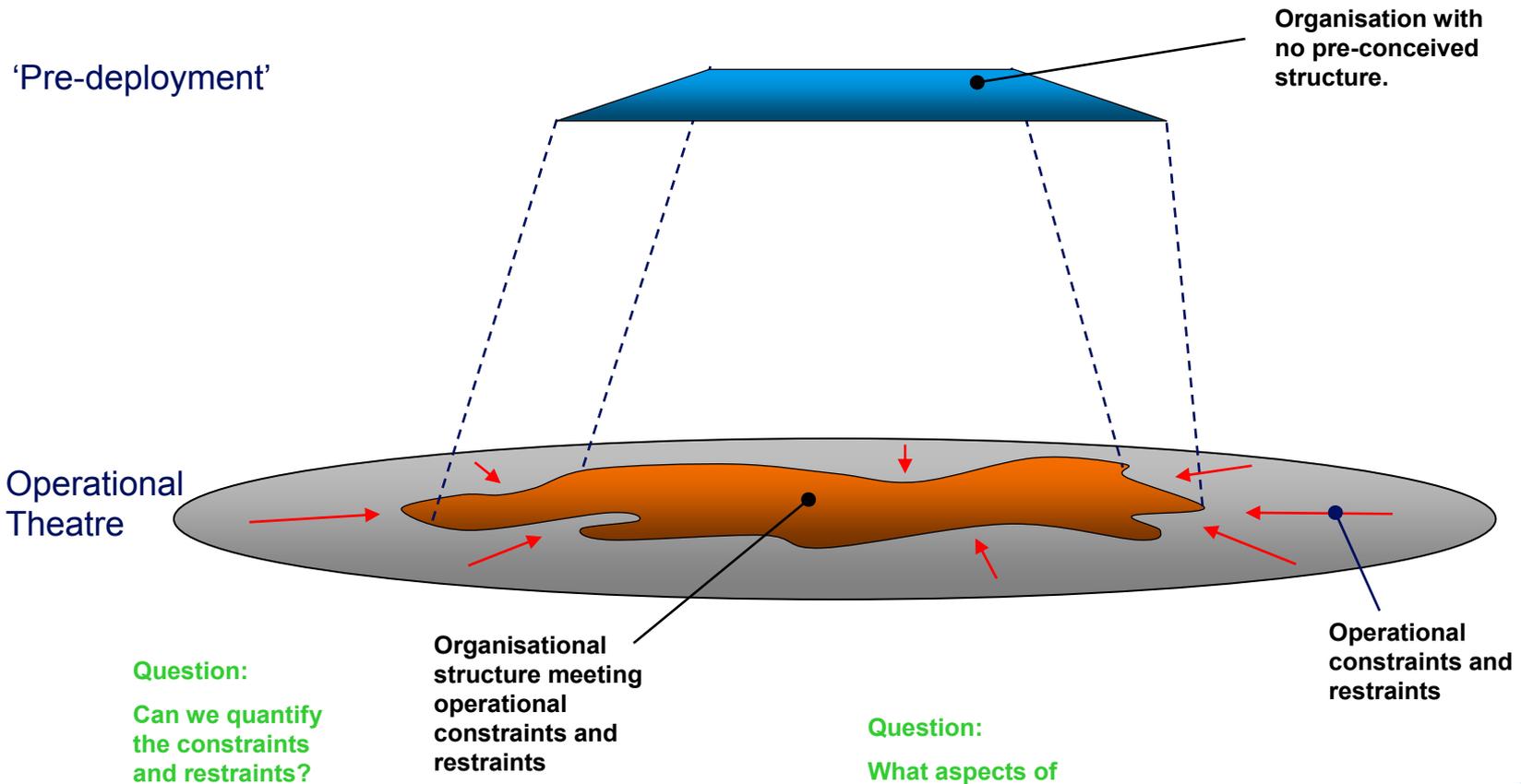
# Edge Concepts

- Run-time and acquisition time
  - This paper
- 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. Beaument
- Capability architectures
  - Paper 232, Track 12 M. Lloyd

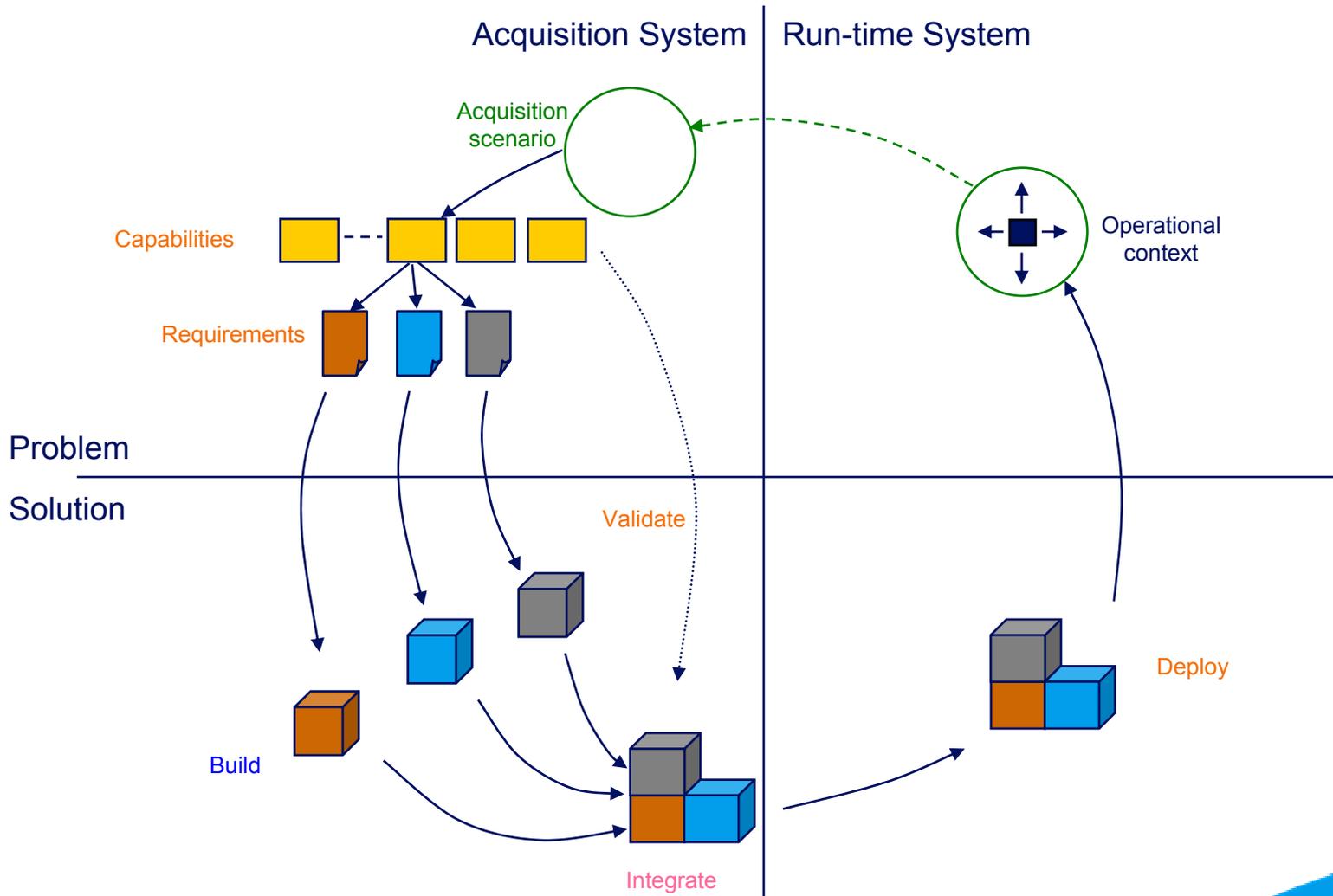
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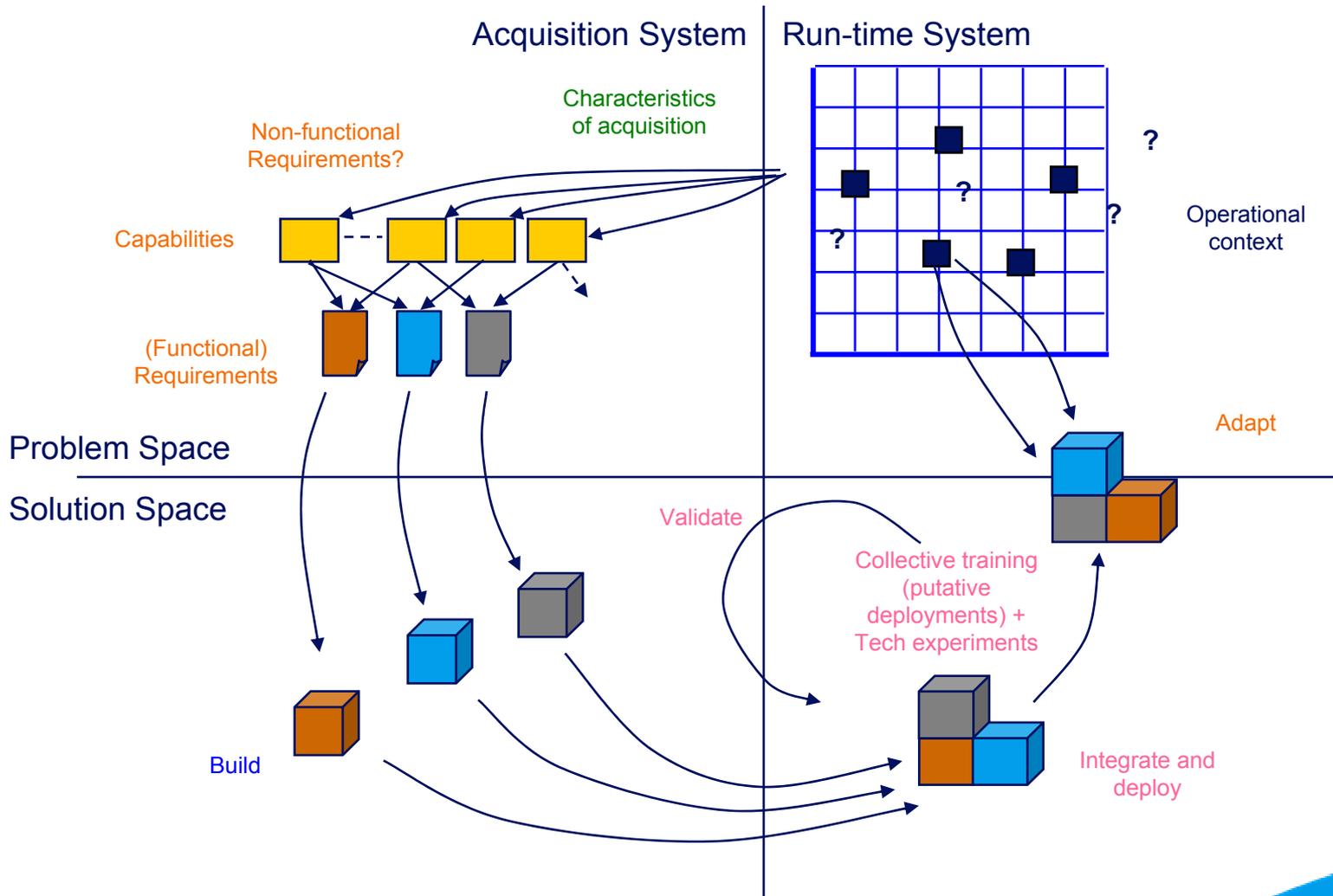
# Constraints and Restraints on Structure



# How it used to be



# Responding to the Challenge space



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# Way Ahead

- Increase our understanding of Edge Organisations.
  - Collate and assimilate June Workshop.
  - Build up the Form and Function Edge Concept – through understanding the detailed concepts.
- Begin to consider the employment of Edge Organisations.
  - Complete the Risk Register.
  - Write the Edge CONOPS.

# Questions?

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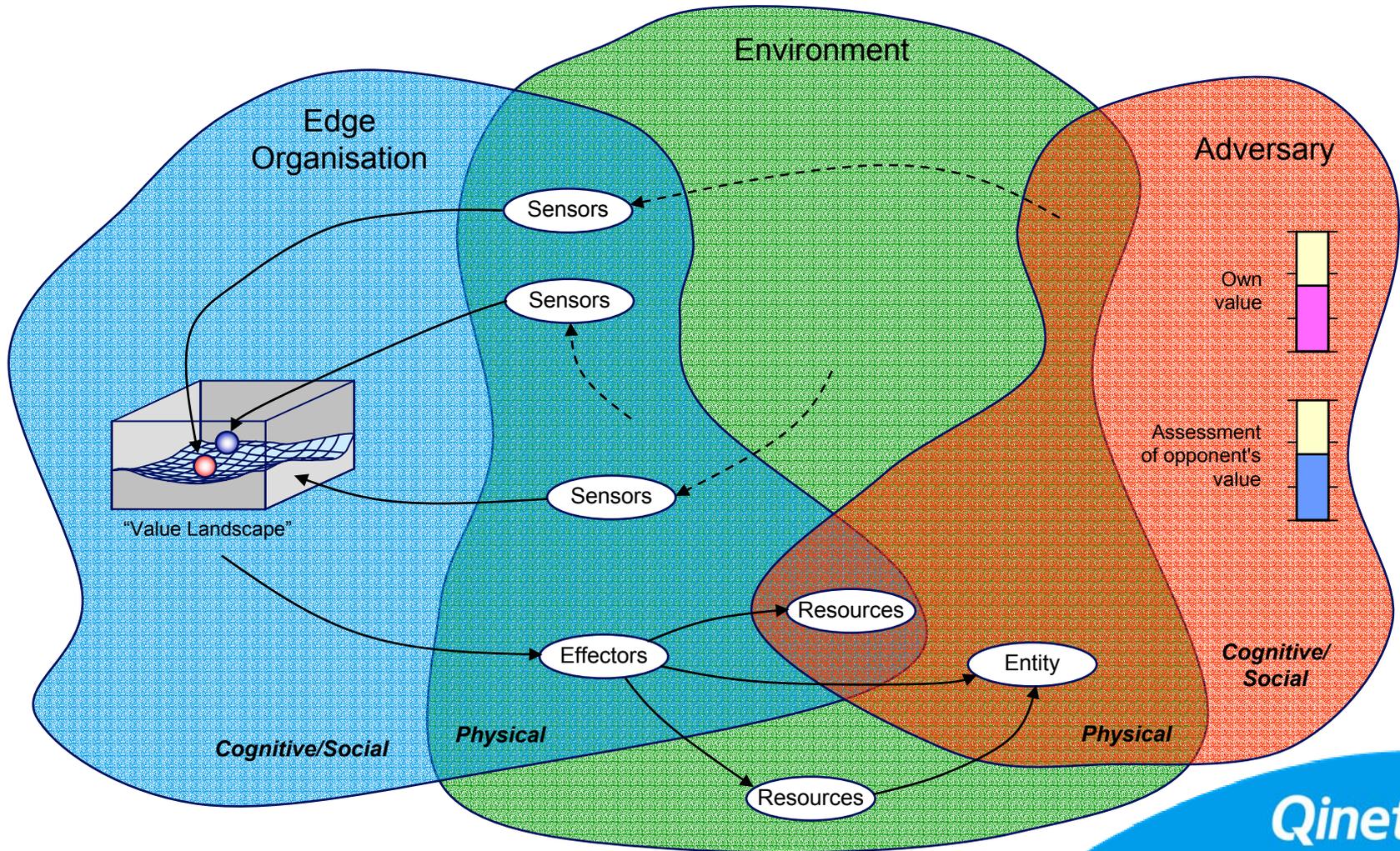
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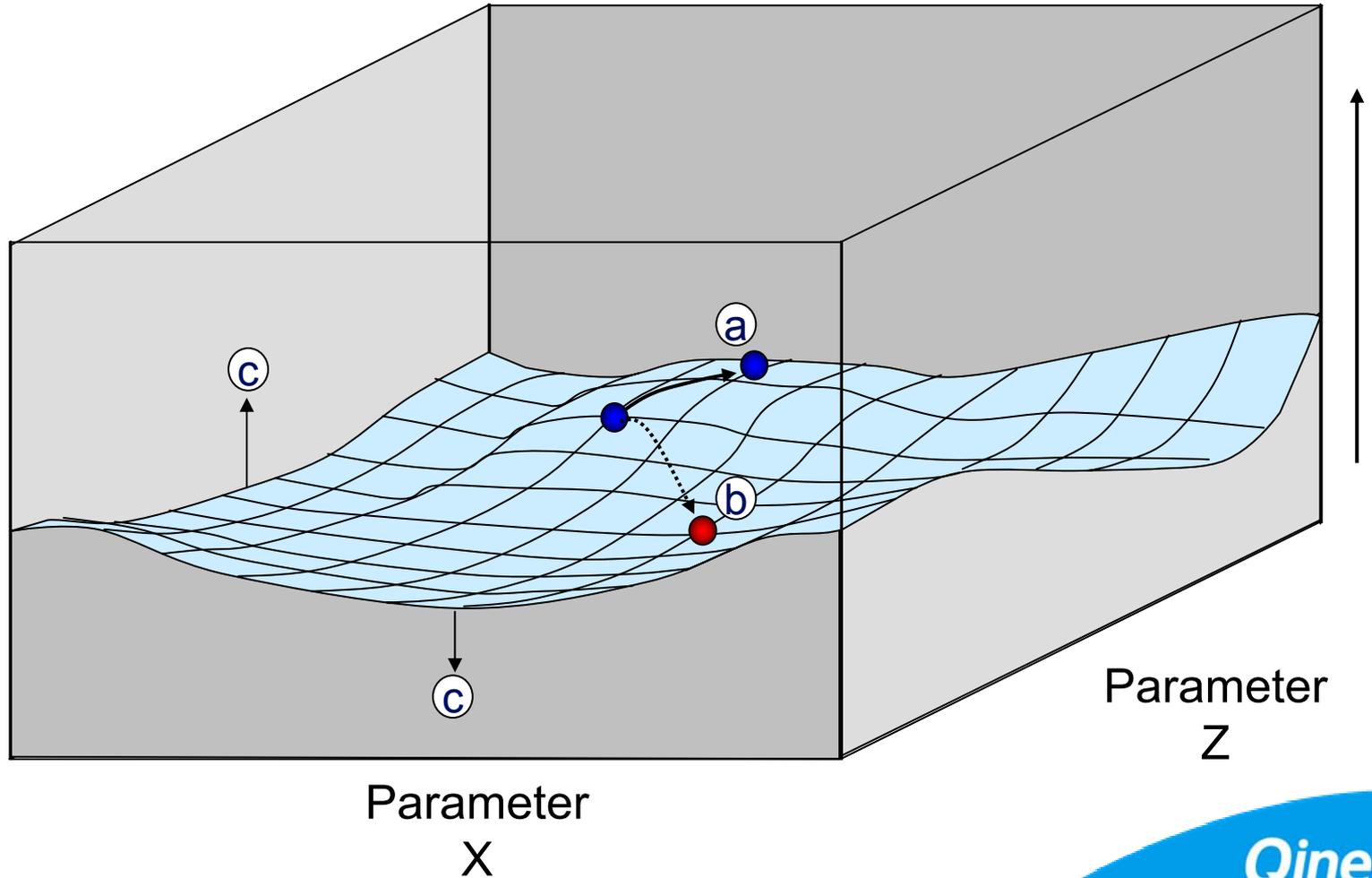
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The QinetiQ logo is located in the bottom right corner of the slide. It consists of the word "QinetiQ" in a white, sans-serif font, set against a blue curved background that resembles a stylized wave or a partial circle.

# The Value Cycle



# Value Landscape



# “Levers and Gauges Diagram”

