

# Use of complexity-related ideas in understanding military operations and military capability

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# Motivation

- Does networking imply an increase in complexity?
  - How should we cope with (or seek to manage) complexity?
  - What is the impact of uncertainty on complexity?

What do we mean  
by *networking*?

What do we mean  
by *complexity*?

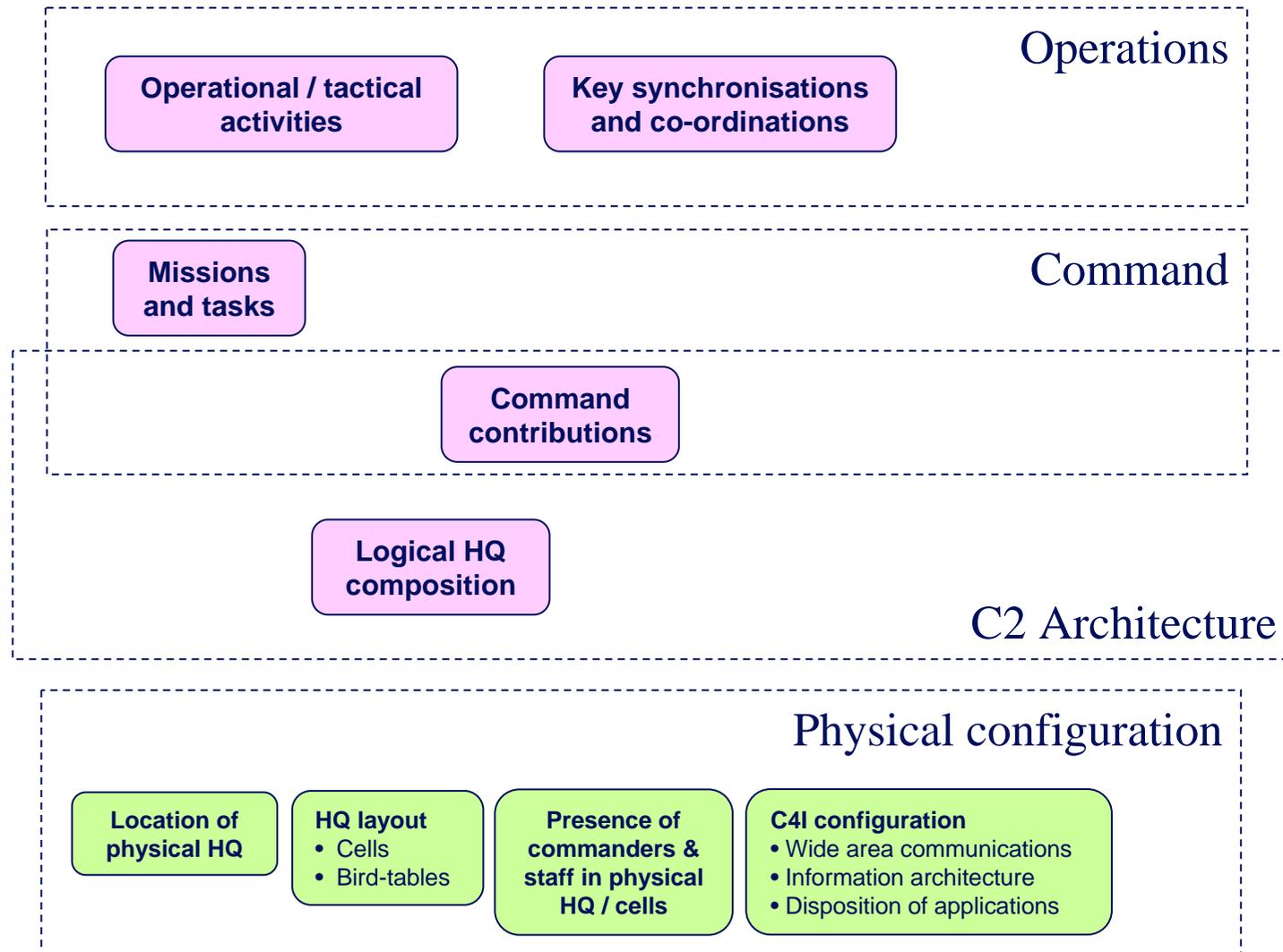
# Pertinence

- Networking and NCW/NEC
- Nature of future operations
- The Comprehensive Approach

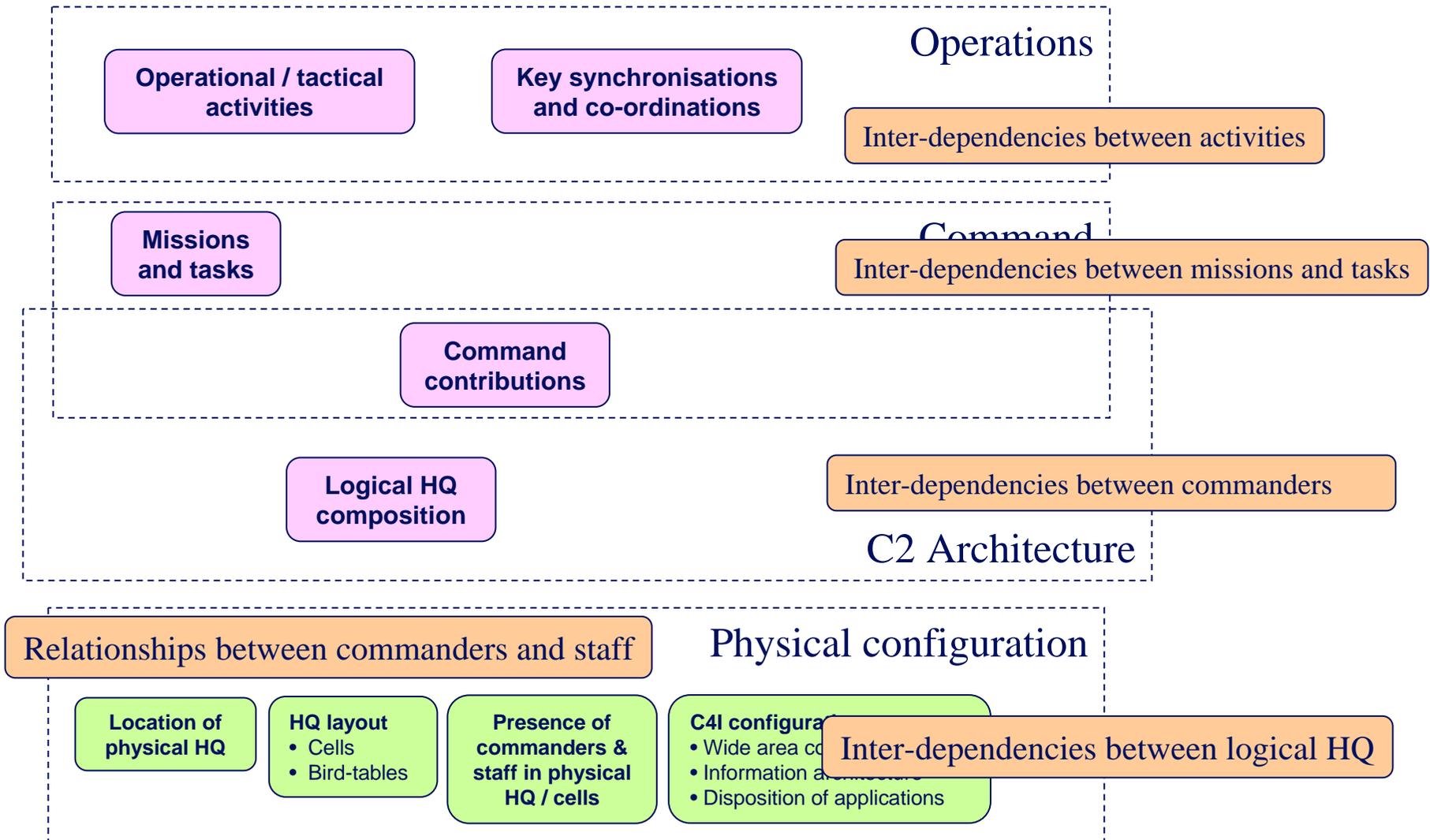
# Purpose of this work

- The aim has been to build a simple model of the military business to which complexity considerations can be applied
- Can now address the practical aspects of organising command (and control) because we are able to draw formal connections between the nature of interactions and structural forms
- The model provides a way to understand how inherent complexity drives the structural requirements for C2, including:
  - delegation of authority
  - information sharing
  - depth and fidelity of supervision and monitoring

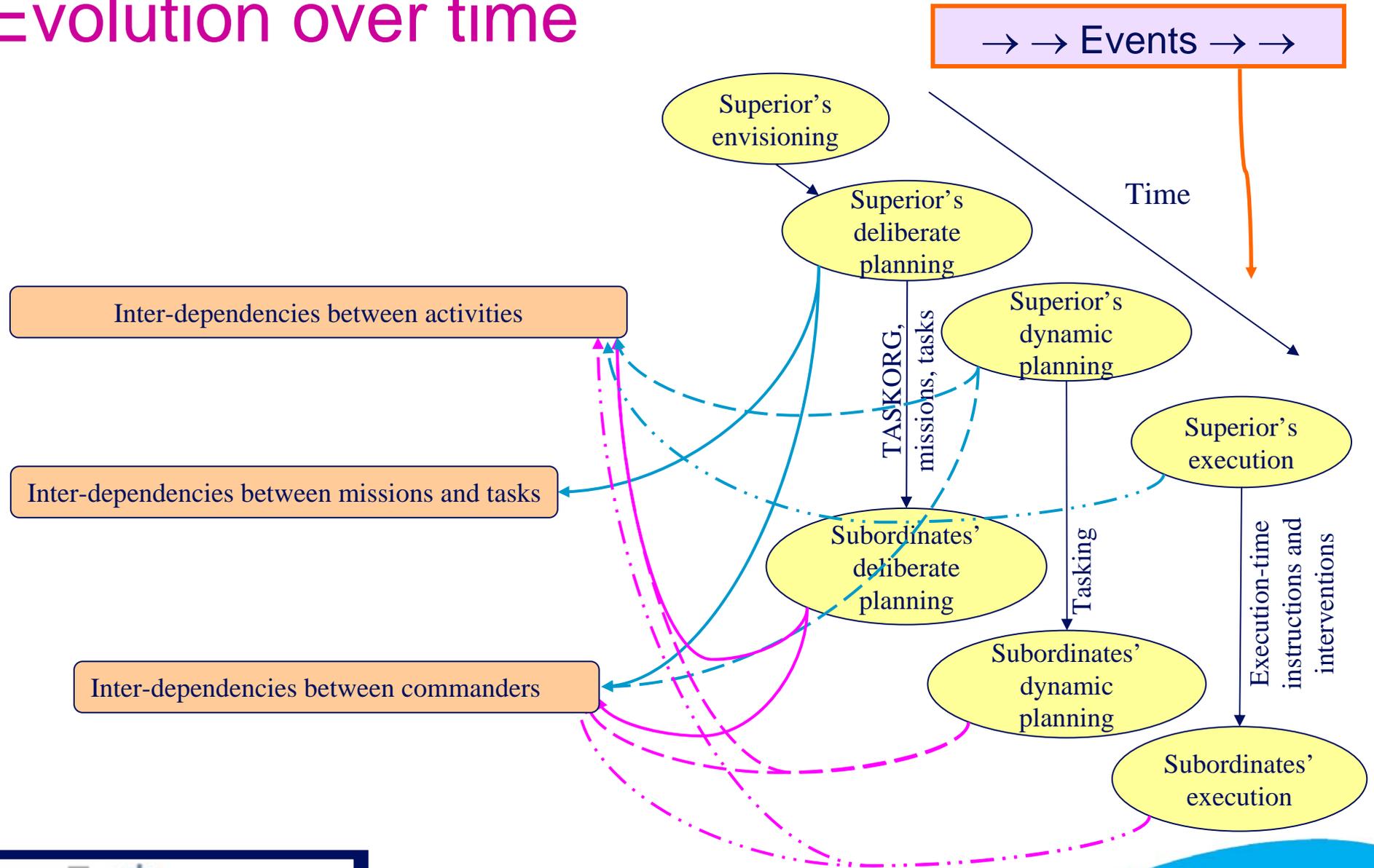
# Relating structural characteristics of command and organization back to the envisioned operation



# Structural aspects with 'complexity' considerations



# Evolution over time



# Understanding these relationships over time?

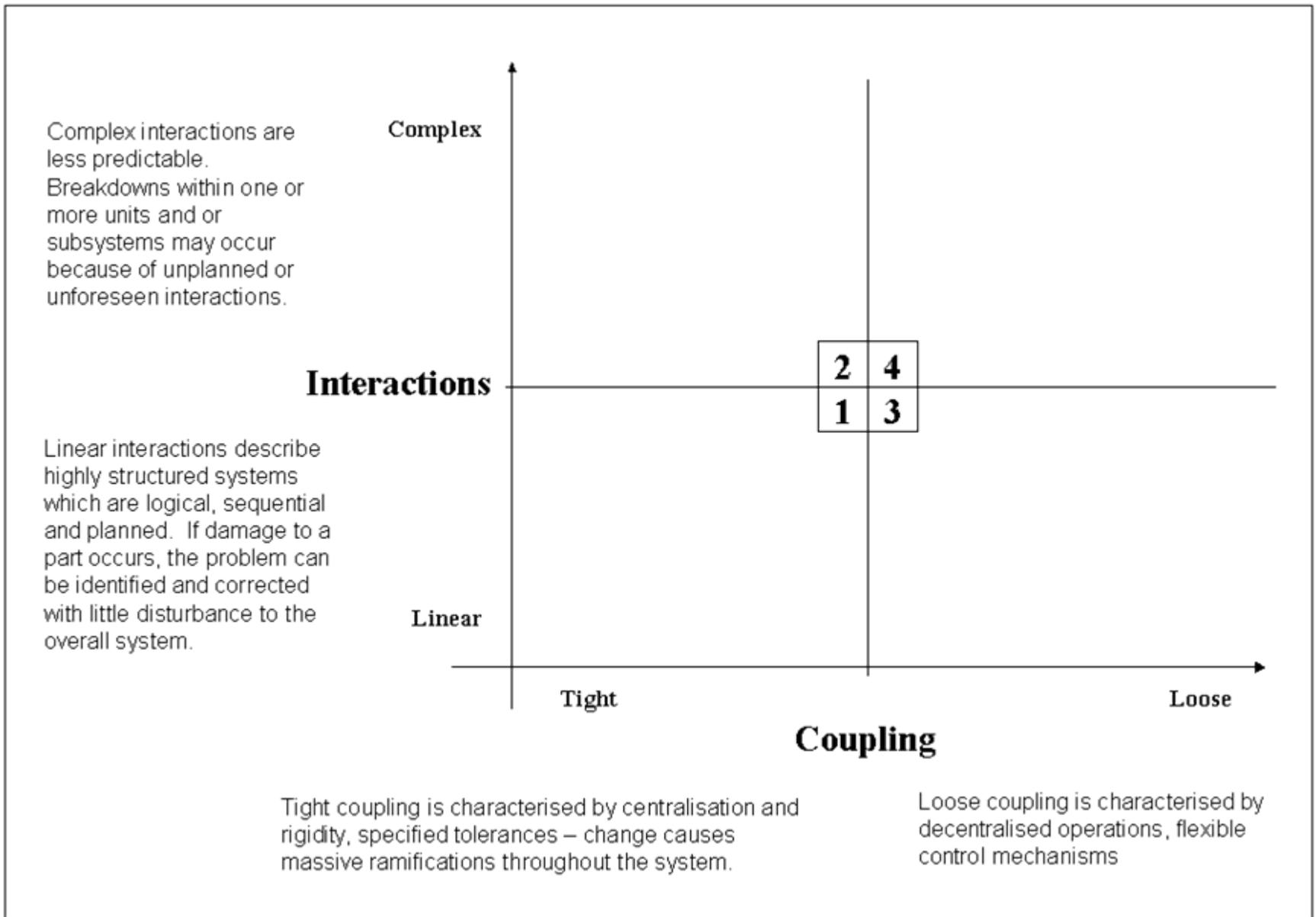
- Do we have a model which helps us understand how these relationships evolve over time?
- Charles Perrow\*\* looked at the behaviour of organizations and derived a simple two-dimensional model
- This is a model about organizational dynamics – we have to do some work to see how it applies to military operations

\*\* Charles Perrow, 'Normal Accidents', Basic Books, Inc., New York, 1984

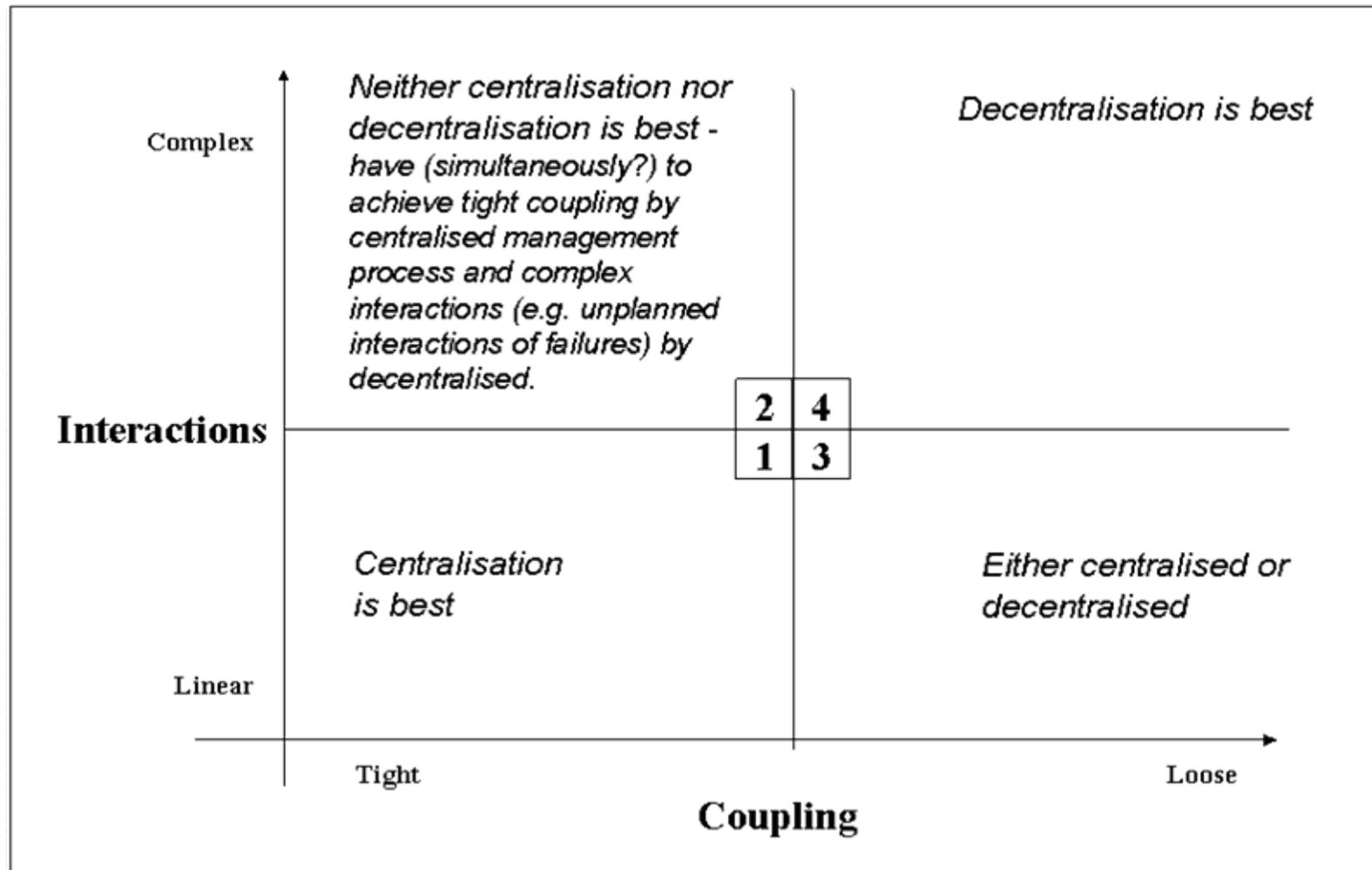
# Perrow's axes – coupling and interactions

- The main influence of the **interactions** axis is in one's ability to project forward in time; in particular, complexity takes the form of unintended and unanticipated consequences due to interactions that are difficult to 'linearise-out' because of their inter-dependencies.
- The **coupling axis** relates to “the amount of slack, buffer or give between two items”. The “coupling axis” relates to system criticality due to constraining factors; it is about tolerances, buffering and tightness.

# Perrow's quadrants



# Preferred management styles

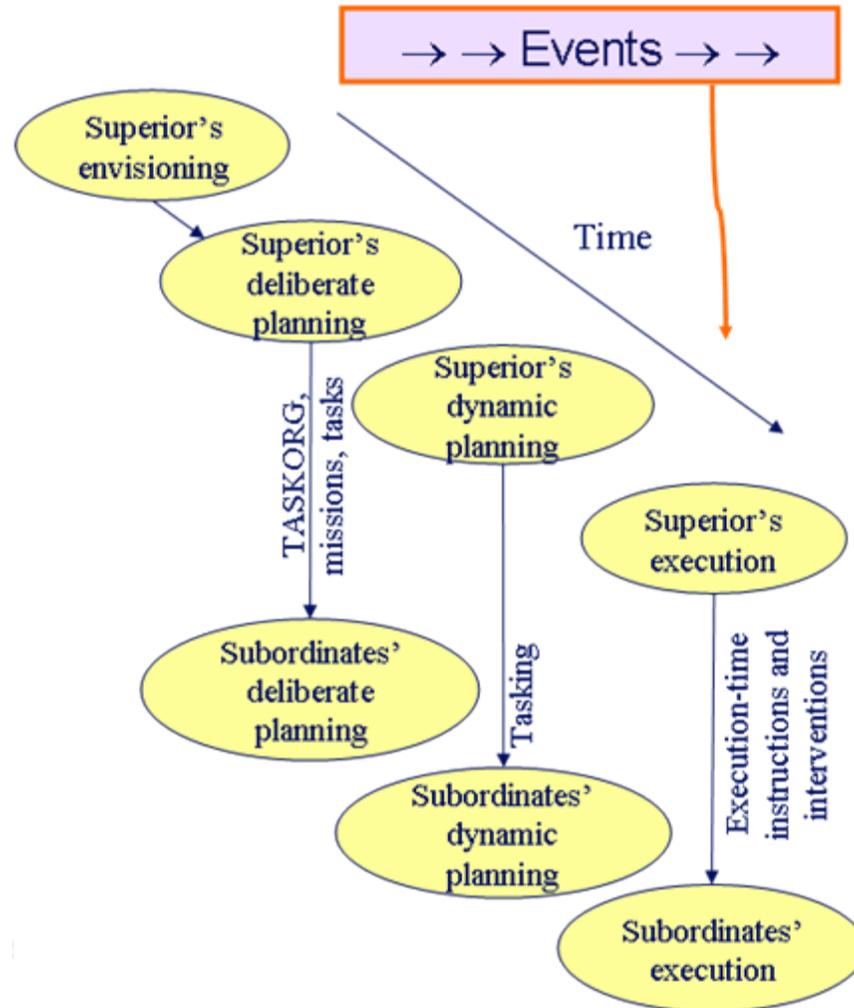


# Build time / run-time interpretation of Perrow

- **Couplings** refer to the pathways or potential connectivity created at 'build time':
  - the composition of the organization, and in particular its management structures
- **Interactions** refer to the 'run-time' excitation or stimulation of these potential linkages that create the active linkages -
  - 'run time' refers to the events that occur through the interaction of the organization and the environment, that is, actions performed by the organization and environmental stimuli.

# Build time / run-time interpretation of Perrow

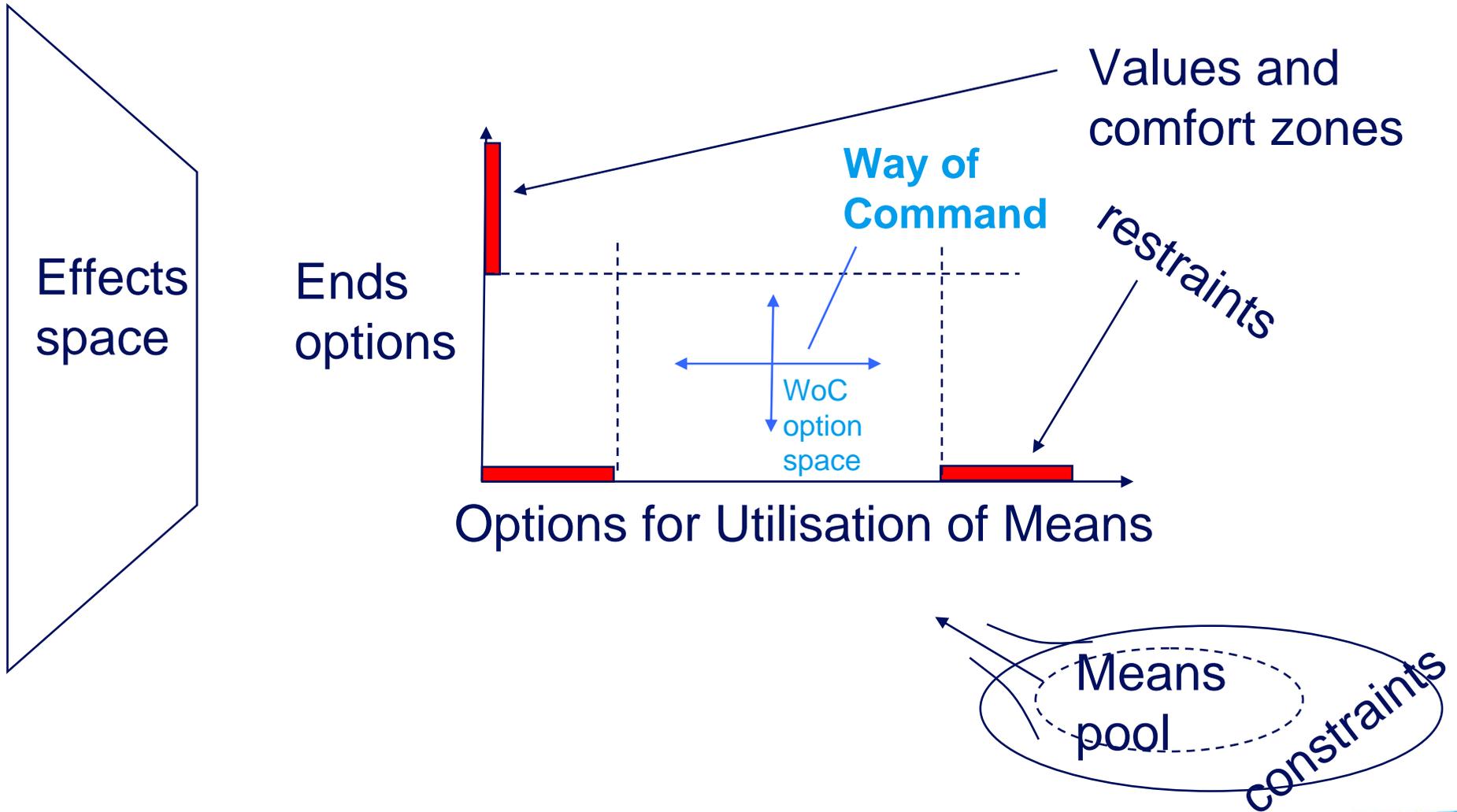
- **Couplings:**  
the pathways or potential connectivity created at 'build time.
- **Interactions:**  
the 'run-time' excitation or stimulation of these potential linkages that create the active linkages.



# Military organization and command

- This is a translation from Perrow's world of organizational dynamics
- In our model, the commander uses the characteristics of Perrow's quadrants to set the characteristics he requires of his command structure and C2 organization.
- This is about setting 'Ways' in response to 'Ends' and 'Means'
  - Viewing the military organization as pursuing defined 'Ends' in an environment which generates 'numerous and unpredictable' stimuli
  - Not (at this stage) modelling military conflict

# Ends, Ways and Means



# Resource sharing and coupling



Options for Utilisation of Means



*is a characteristic or measure of*



The effect of scarcity is to tighten coupling, through inter-dependencies on assets / resources



*is one factor influencing*

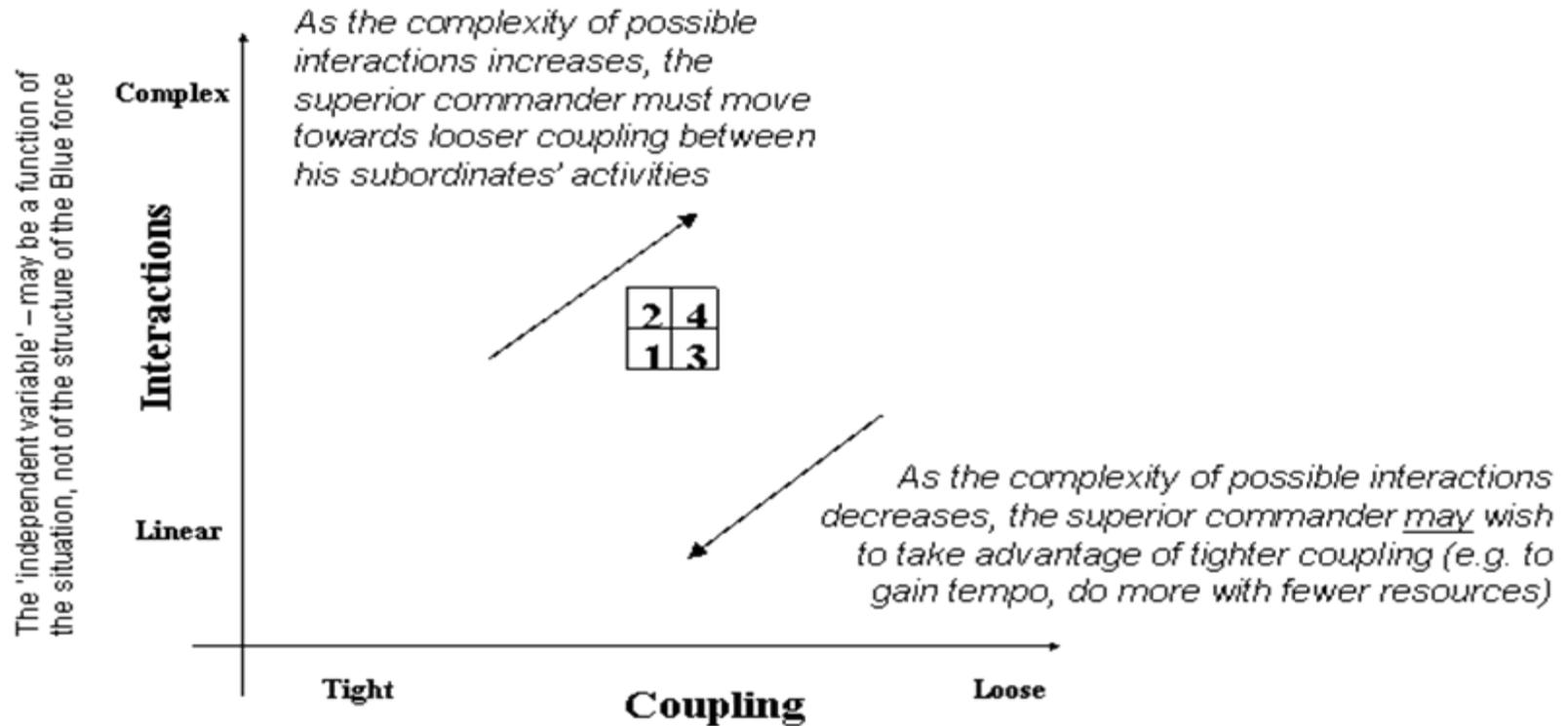


See the paper for a catalogue of possible mechanisms for increasing coupling

# Commander's considerations

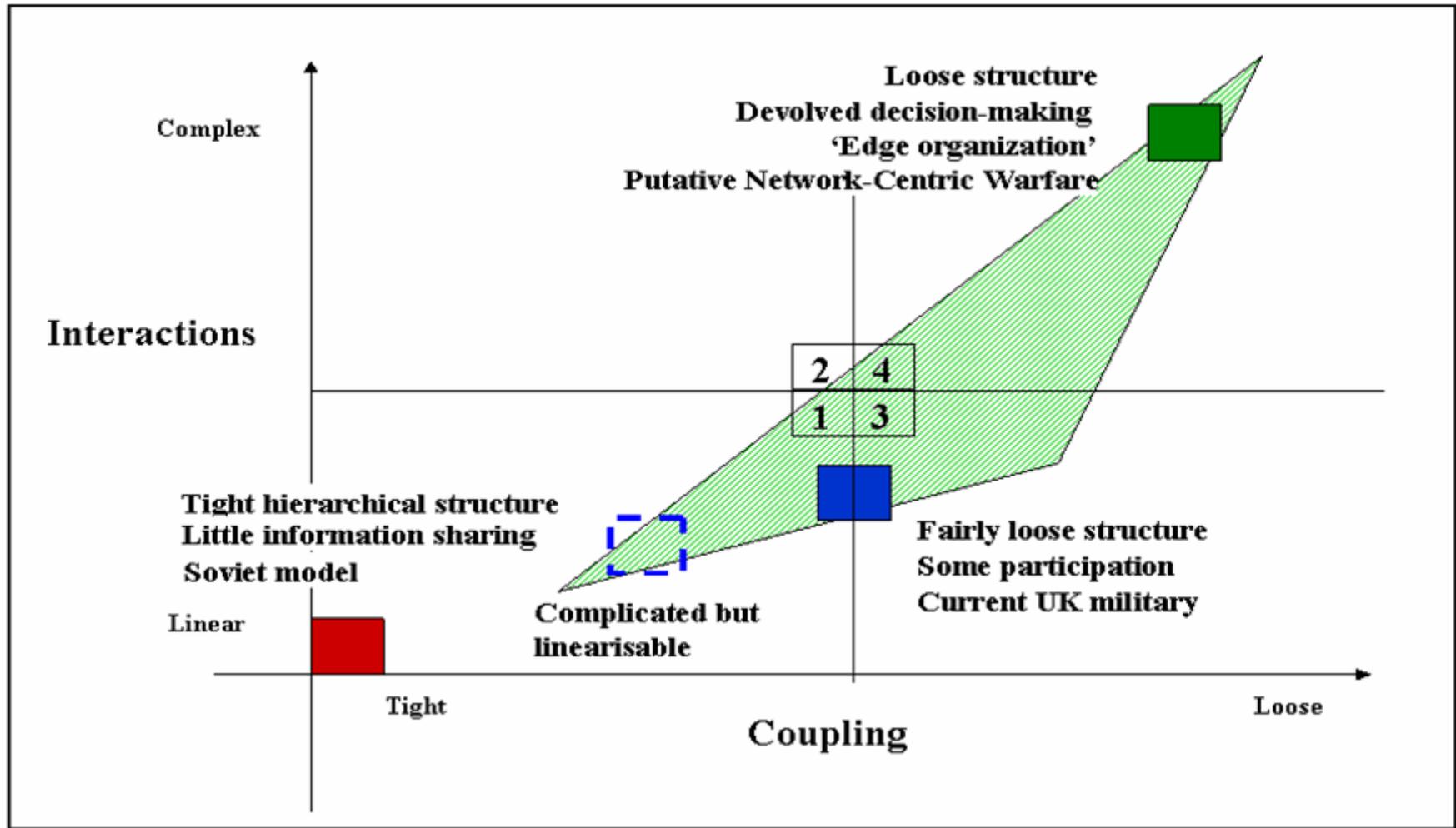
- Fixing the level of coupling (and avoiding Quadrant 2)
  - if the complexity of interactions is viewed as an independent variable (i.e. inherent in the situation), the commander of a force should be moving the style of working within his organization (or at least specific parts of it) in response
  - however, drivers such as the need for accuracy and resource limitations call for tight coupling and hence inhibit working in Quadrant 4
  - there are some inherently-linear operations, e.g Air Manoeuvre
- But concerned with the fitness of the organization to survive and react to events, rather than simply tuned to deliver pre-defined effects
- In the face of rising complexity and loss of predictability, complicated and co-ordinated activity must not be attempted.
  - traditional hierarchical (linear centralised) structure must be abandoned and a more distributed model of command decision-making adopted, with greater responsiveness to the environment

# Commander's response to rising interaction complexity

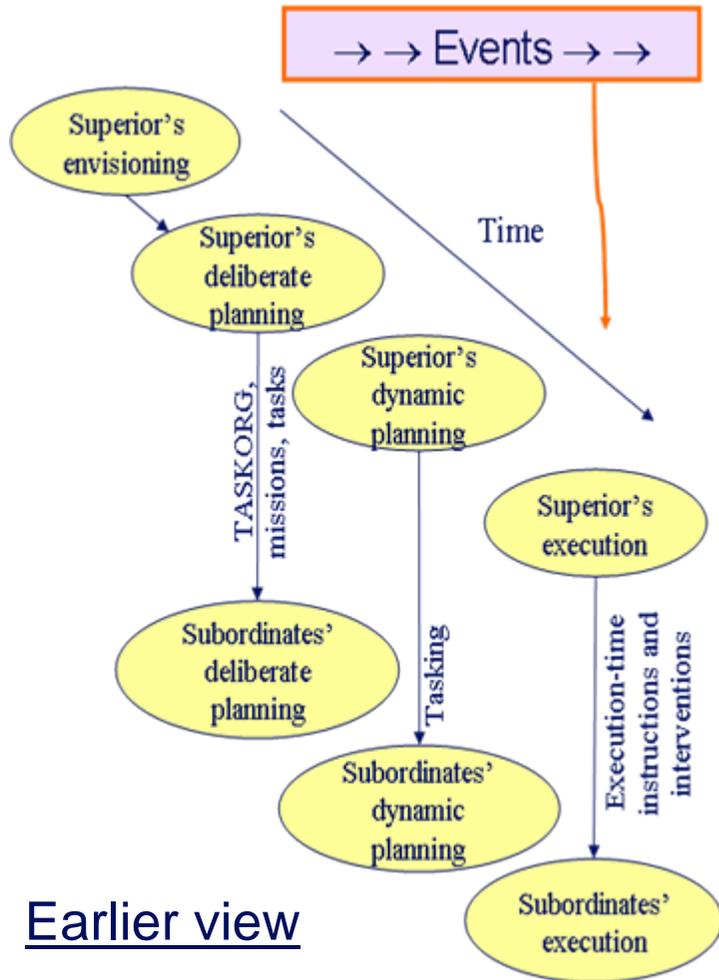


The "controllable variable" – set by command management. The commander cannot linearise a situation, but he has some control over the coupling (within some externally-imposed constraints)

# Different styles of command

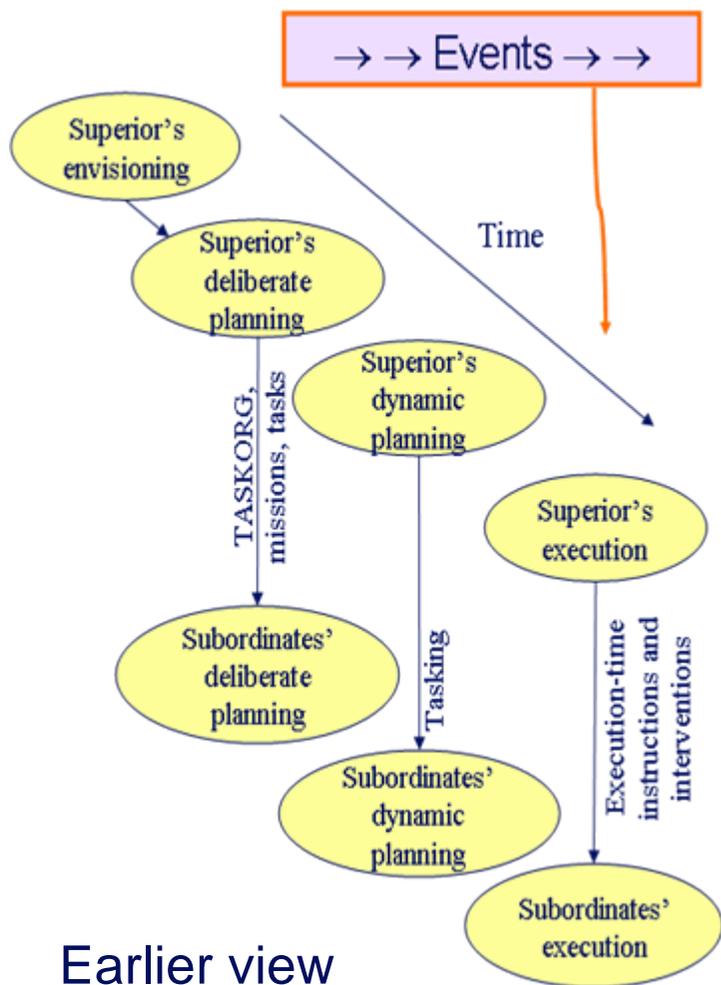


# Decisions at multiple levels of command

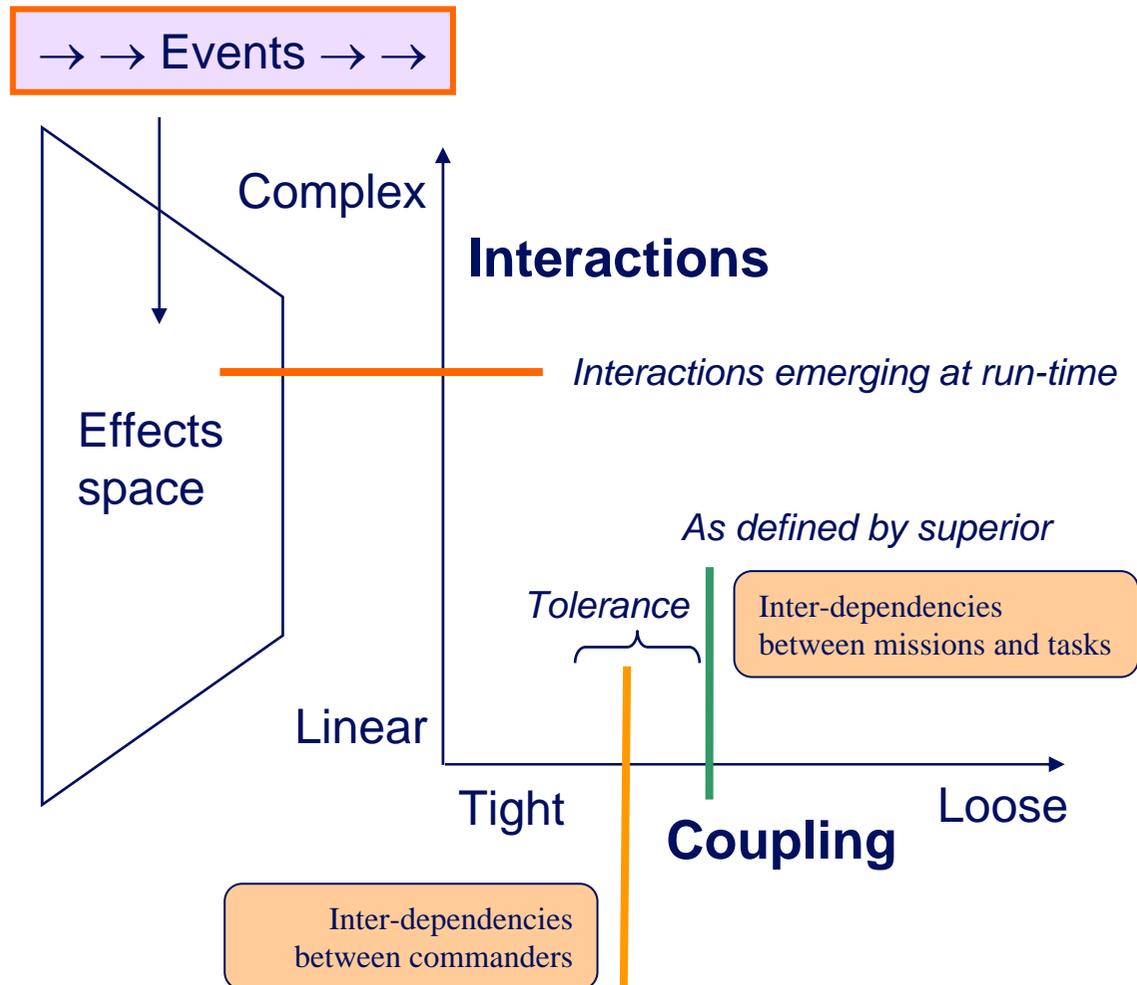


Earlier view

# Decisions at multiple levels of command



Earlier view



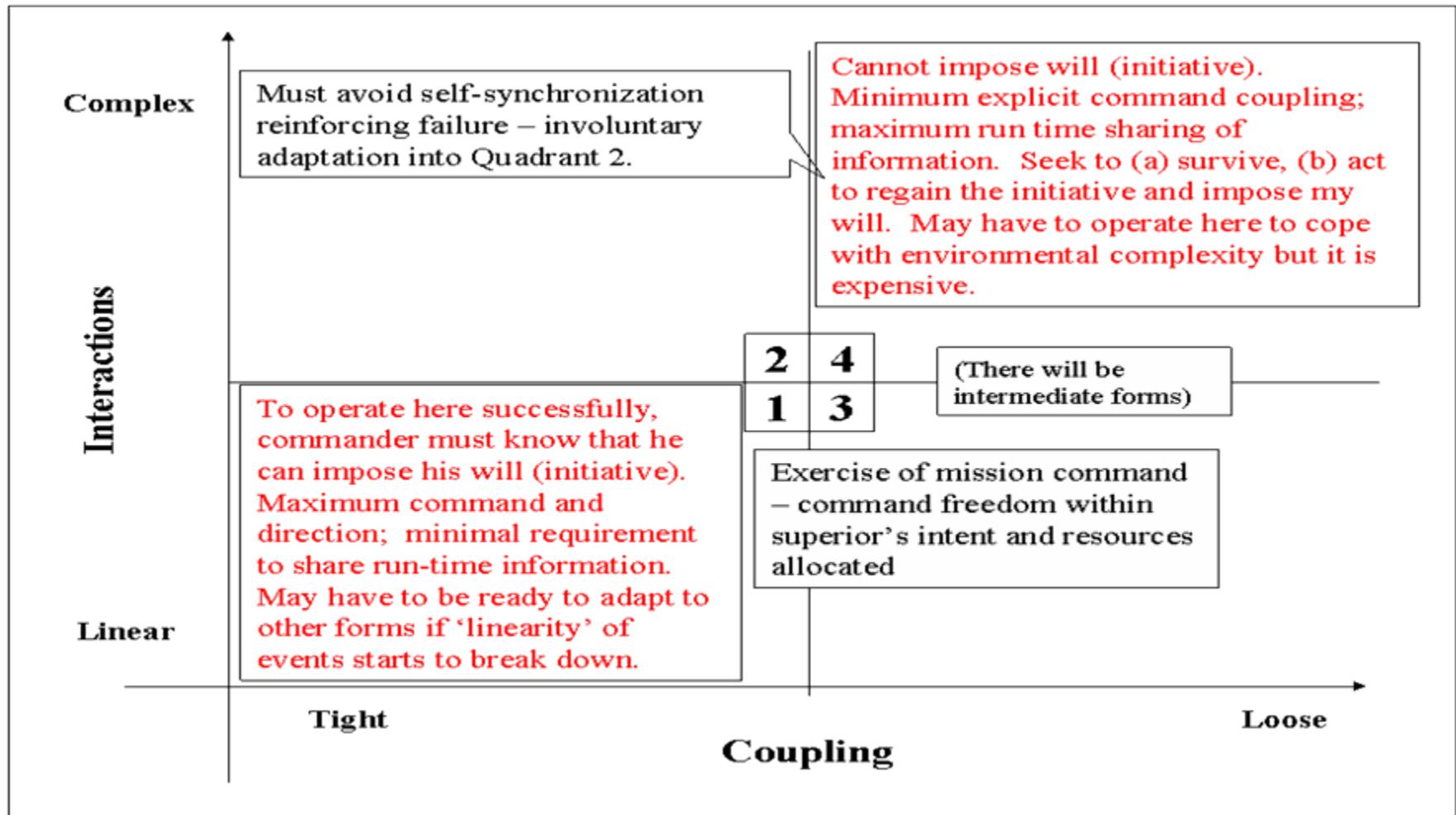
New view

*As implemented by subordinates*

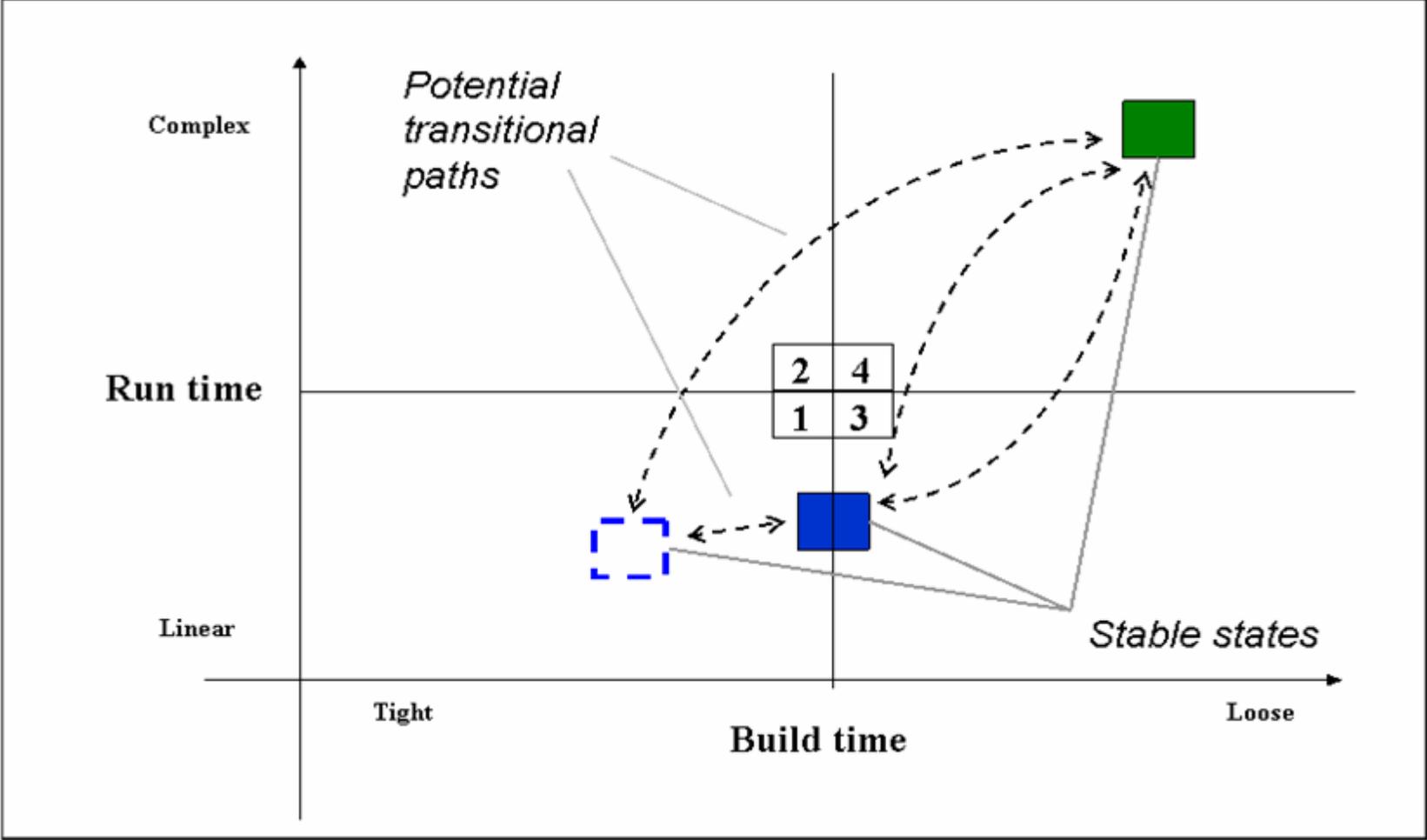
# Military conflict

- Environmental stimuli will not be arising randomly but will, in some measure, be at the direction of an enemy
- The enemy's exploitation of our systemic weaknesses is usually the result of his conscious appreciation of our vulnerabilities
- Likewise, his capacities for observation, cognition and intervention are not infinite, and may have their own fallibilities which we can exploit
- Characteristics of conflict may evolve over time:
  - E.g. an attack on a conventional enemy's command and control cohesion may decouple the enemy's component organizations and encourage them to pursue local initiatives
  - The commander's ability to impose his will may be constrained at particular times

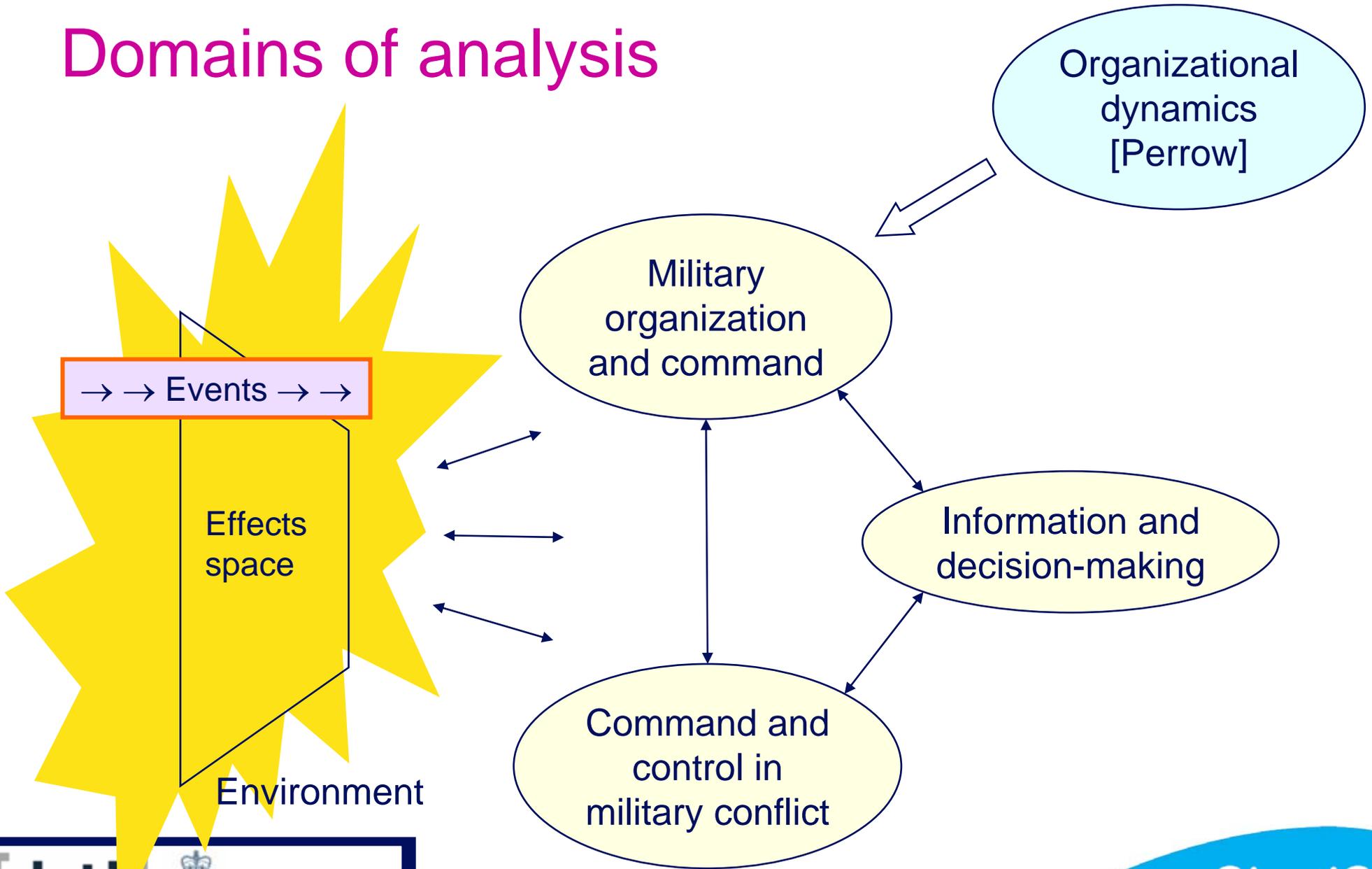
# The commander's ability to impose his will



# Command agility and structural agility



# Domains of analysis

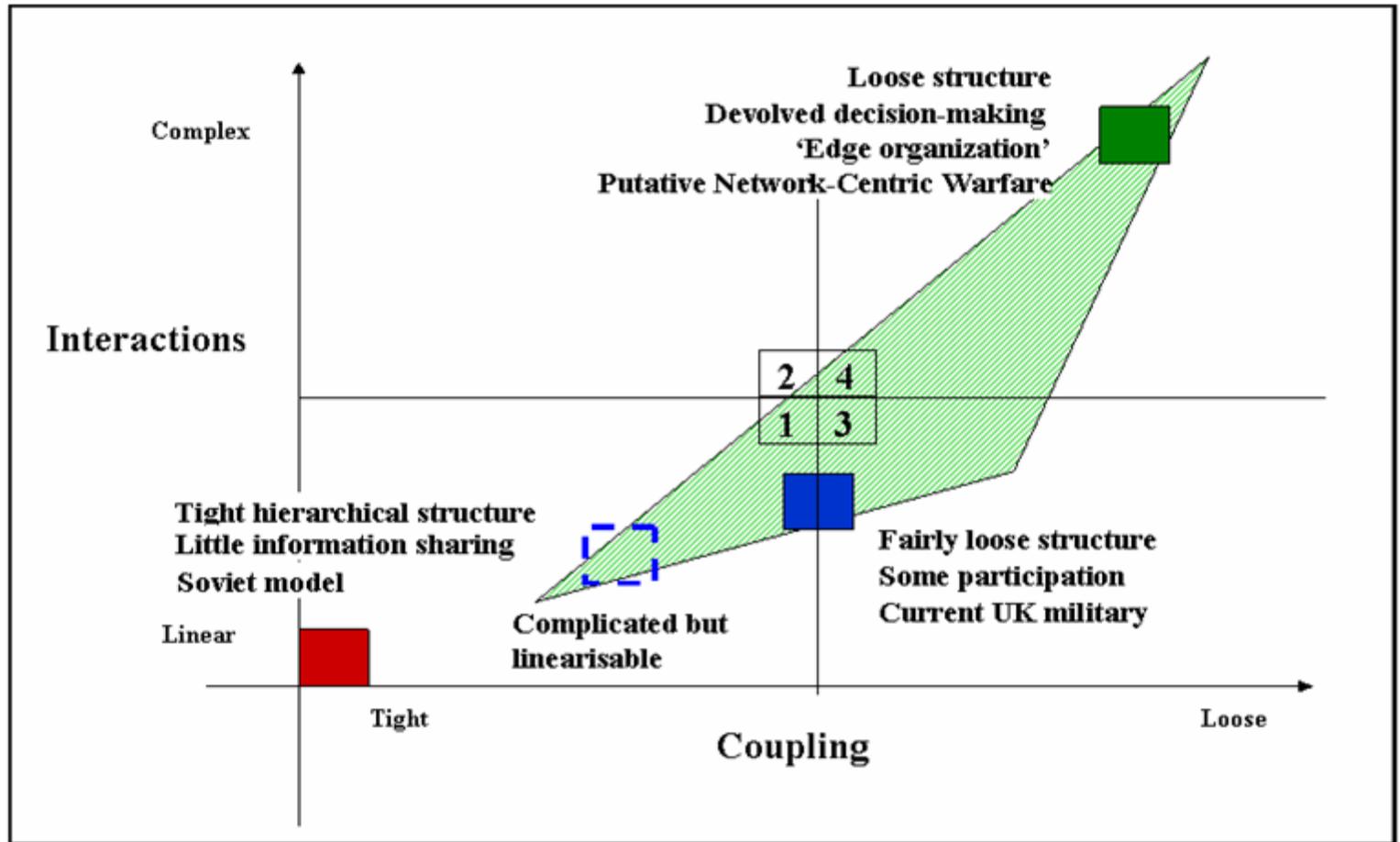


# Networking and complexity

- Networking is concerned with:
  - the configuration of the organization at ‘build-time’ in terms of:
    - delegation of authority & responsibility
    - distribution of information-sharing and decision-making
    - depth and fidelity of supervision and monitoring
  - *Coupling* is a measure of the pathways or potential connectivity in the organization ‘as built’
  - the exercise of the organization at ‘run-time’ through the interaction of the organization and the environment, that is, actions performed by the organization and environmental stimuli
    - *Complexity* is a measure of the ‘run-time’ excitation or stimulation of these pathways that create the active linkages

# Networking, complexity and Perrow's quadrants

*Driven at least in part by the environment*



*May be facilitated by networking*

# Questions



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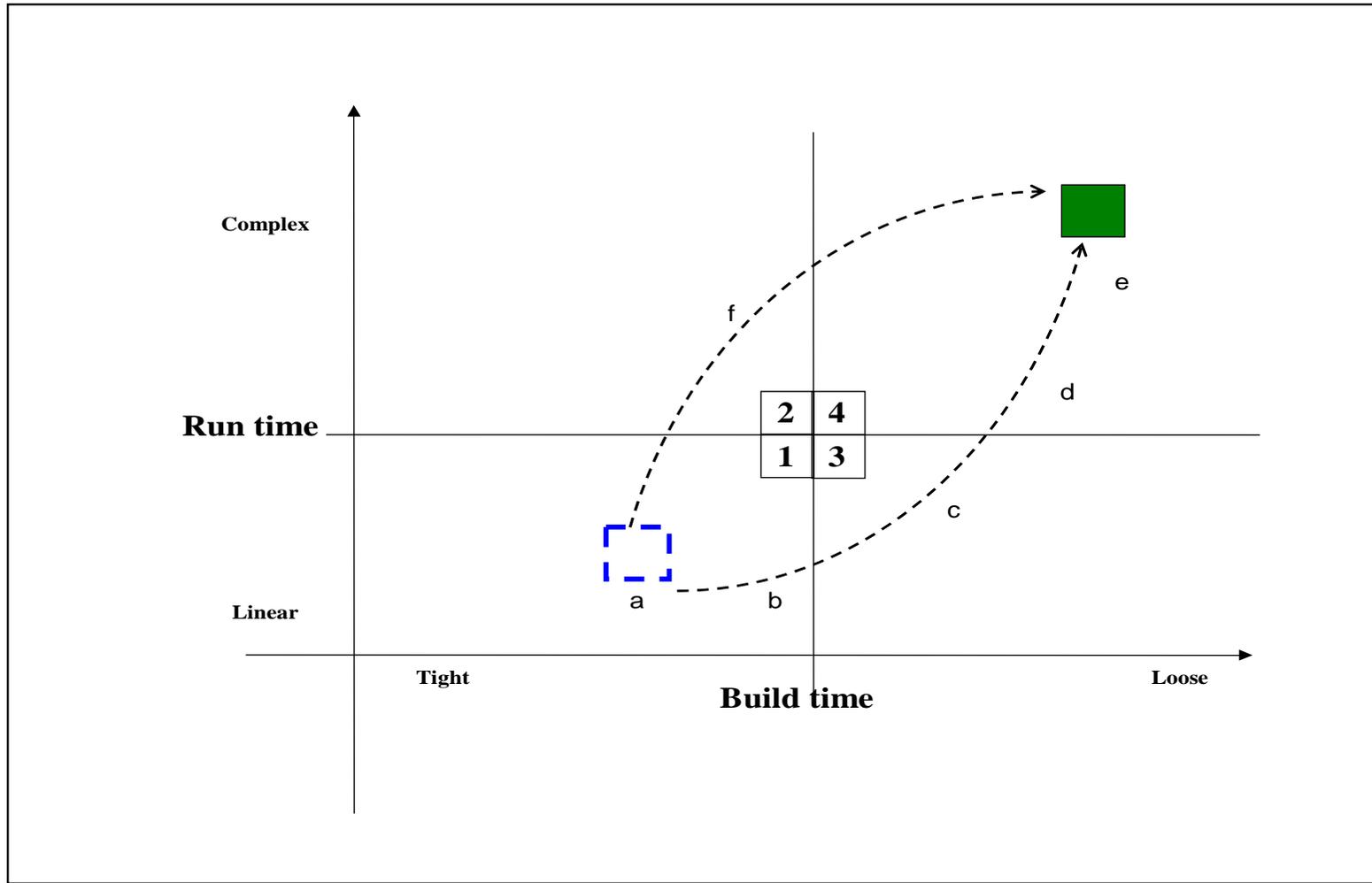
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# Alternative paths



# Energy consumption rates for the quadrants on the two pathways

