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2008 13th ICCRTS

International Command and Control Research and Technology Symposium

C2 for Complex Endeavors

June 17-19, 2008
The Meydenbauer Center
Bellevue, WA

The Command and Control Research Program
www.dodccrp.org

CCRP

Complex Endeavors

- Various shades of "Blue"
  - A large number of disparate entities who are pursuing related, but not identical goals
  - The absence of a single leader or "commander"
  - Inherent dependencies and interdependencies – none of the entities can or believes it can or should accomplish its goals independently
  - A variety of different relationships between the entities
- Multi-dimensional Effects Space

Complex Endeavors Panel

- David S. Alberts (USA)
- Anthony Alston (UK)
- Lorraine Dodd (UK)
- Reiner Huber (GER)
- James Moffat (UK)
- Mink Spaans (NL)

Complex Endeavors Panel

Paradoxes in Complex Endeavors

Lorraine Dodd (UK)
Anthony Alston (UK)

Paradoxes for Command and Control in Complex Endeavours

Anthony Alston, Lorraine Dodd,
Geoff Markham, Patrick Turner, Mark Round
Command & Intelligence Systems, Malvern, UK
13th ICCRTS, Seattle

18th June 2008

Paradoxes and complexity

What is a paradox?

Websters' definitions:

- a tenet contrary to received opinion;
- a statement seemingly contradictory or opposed to common sense and yet could perhaps be true.

Paradox of planning for complex endeavours

- Alberts and Hayes' reflections on the character of complex endeavours, and complexity, led them to a key paradox*:

*"The circumstances in which planning may benefit the most from collaboration are precisely the circumstances in which **it** is most challenging."*

- Need to re-think the 'cognitive domain' and the repertoire of decision-making approaches which might be employed in order to make the most of complexity
  - both environmental complexity and social complexity.

*D Alberts and R Hayes, Planning for Complex Endeavors, CCRP 2007, (p.114)

Paradox of planning for complex endeavours

- Collaborators within any virtual organization face difficulties in making sense of this ‘complex theatre’ and making competent decisions about mutually coherent actions. A complex theatre is subject to two types of complexity:
  - Environmental complexity, due to the unbounded nature of effects through **interactions** within the ‘theatre of inter-relationships’ (the complex of actors) and the ‘physical and kinetic’ theatre of operations;
  - Social complexity, in respect of **relationships,** due to people's involvement in the virtual organization, of diverse participants with multiplicity of institutional backgrounds and a vast range of roles and responsibilities.
- Social diversity across a complex of actors is essential for making sense of a complex of problems.

Paradoxes of rationality…..

….. leading to dilemmas

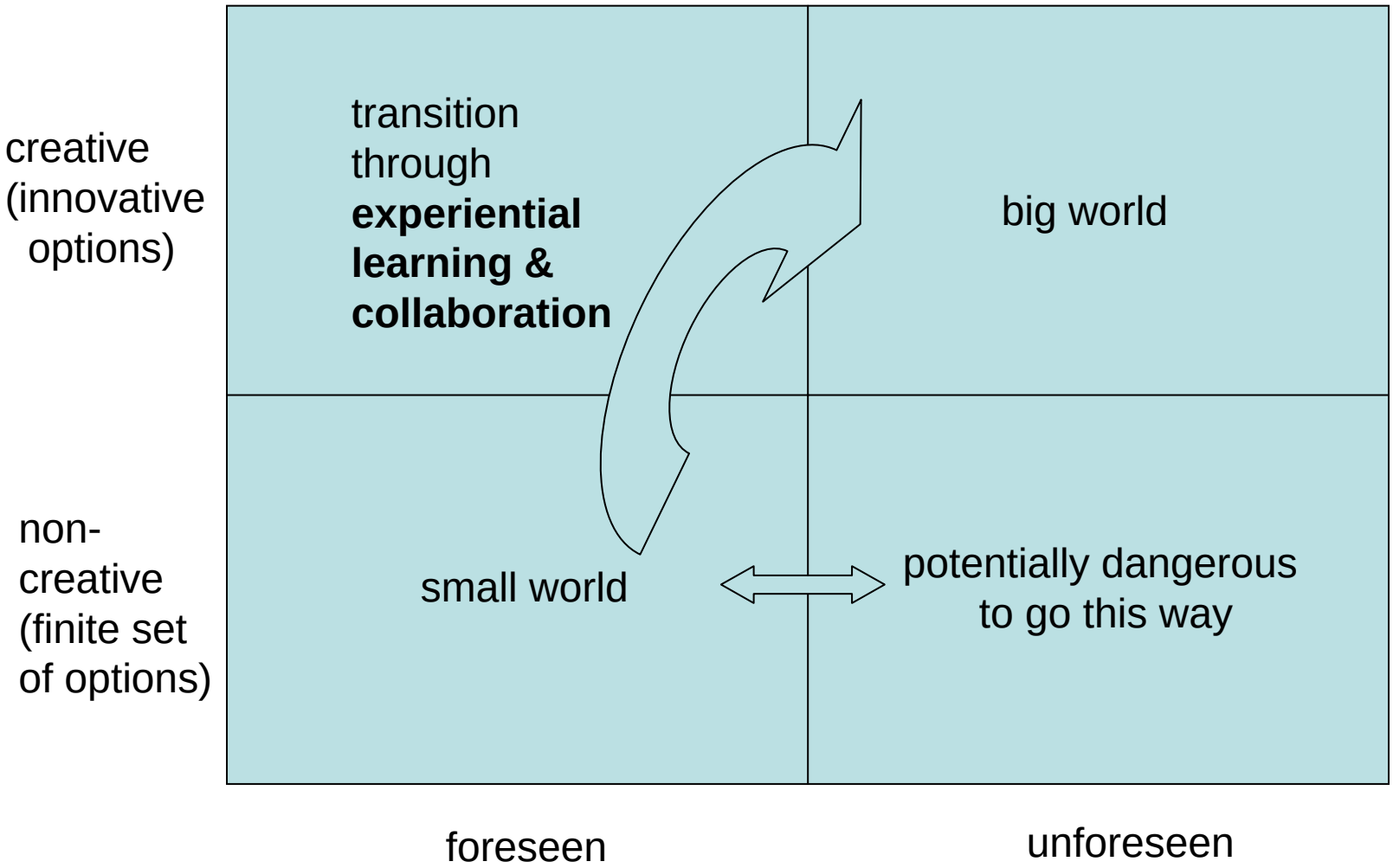
Paradox for analysis of complex endeavours

- Nigel Howard presents us with a paradoxical problem for analytical modelling.
  - If we accept that real-life ‘players’ actually see themselves dealing with a rather small and simple set of options, then models large enough to be realistic can be constructed for analysis. However, this is only because small, selected areas of ‘the game’ are being examined.
- To examine the whole of a ‘realistic game’ is still usually impractical
  - It is not just a simple case of scaling-up the analytical models;
  - We need to address differing viewpoints and multiple perspectives.

Nigel Howard, *Paradoxes of Rationality: Theory of Metagames and political behaviour*, MIT Press, Peace Research Studies, 1971

- 'Free will' Paradox:
  - We feel no misgivings about person A supposing himself able to predict B's choice; so why then should we find it so paradoxical, counter-intuitive and difficult to imagine person A believing that whatever B chooses will be what A has predicted?
  - The idea of a person A being able to predict a free choice made by person B is inherently counter-intuitive but, without such prediction, most of social life would be impossible. Thus it is perfectly possible, indeed very common, for B's choice to be predictable (or at least foreseen) by person A.

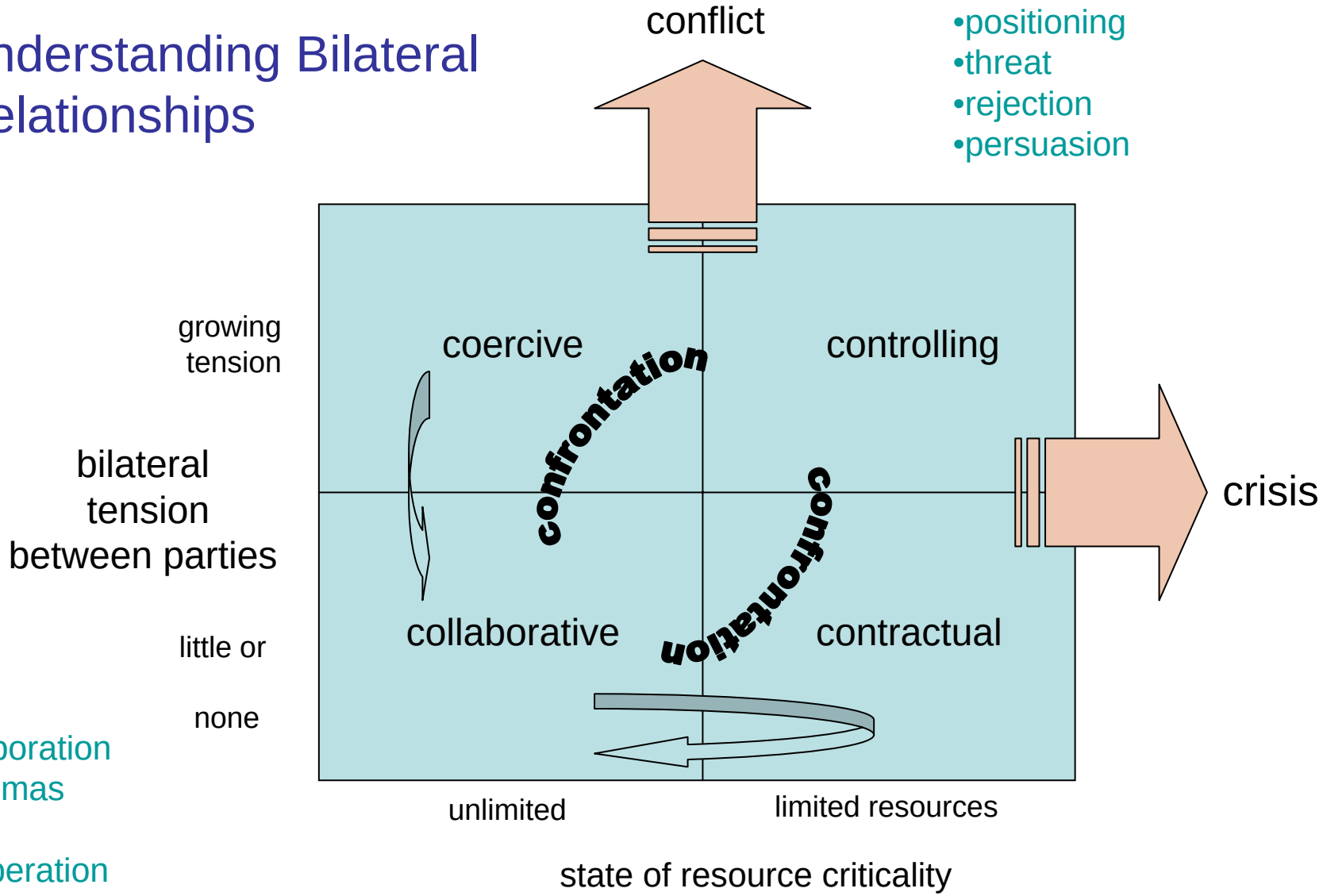
Journeying between small and big worlds*



*adapted from work by Nigel Howard, Andrew Tait and Rupert Smith

Understanding Bilateral Relationships

confrontation dilemmas
- positioning
- threat
- rejection
- persuasion



collaboration dilemmas
- trust
- cooperation

Need for new planning, sense-making and decision-making strategies for complex endeavours?

- Two key tenets:
  - Look for paradoxes – and then, rather than ‘trading them out’ or dissolving them, use them as a clear indication of the need to re-formulate and open-up the problem - to see and use the dialectics.
  - Look for metaphors, which are a valuable way of seeing complex systems differently, enable us to provide insights about ‘wholes’ without partitioning.
- New views on sense-making and decision-making as applied to building collaborations and building capabilities to make full benefit of:
  - complex of actors;
  - complex of problems.

Questions

Complex Endeavors Panel

C2 Maturity Levels and Hypotheses

David Alberts (US)

C2 Maturity Levels for NATO Network Enabled Capability (NNEC)

- NATO Research Group (SAS-065) chartered to:
  - Develop and validate a C2 Maturity Model for NNEC
  - Build on and extend the NATO C2 Conceptual Reference Model
- Belgium, Canada, Germany, Italy, Netherlands, Norway, Portugal, Slovakia, Sweden, Switzerland, UK, and the US as well as Allied Command Transformation and the Center for Excellence in C2
- Cooperation with NATO Human Factors Modeling (HFM) Working Group 156 is also enriching the CRM
- Case Studies undertaken to validate the C2 Maturity Model
  - British Natural Disaster Responses
  - Hurricane Katrina,
  - Tsunami Relief
  - Elbe River Flood
  - Pakistan Earthquake Relief
  - Kosovo
  - Bosnia, and
  - US forces (Stryker Brigades and Airborne Division) in exercises and Iraq

Variables Defining C2 Maturity Levels

Agile C2	Emergent Self-Synchronization Plus Adaptations	Unlimited Sharing as Required	Entities Contribute Resources to the Endeavor
Collaborative C2	Collaborative Process and Shared Plan	Significant Broad Sharing	Contributing Resources Required in Shared Plan
Coordinated C2	Coordination Process and Linked Plans	Limited Focused Sharing	Contribute Assets to Coordinated Actions
Deconflicted C2	Establish Constraints	Very Limited Sharply Focused Sharing	Sharing Environmental Resources
Conflicted C2	None	No Sharing of Information	None
	Collective C2 Process	**Required Information Sharing Behaviors**	**Required Resource Sharing**

C2 Maturity Levels: Expected Patterns of Interaction

Agile C2	Endeavor Objective(s) and Tasks	Complete	Tailored and Dynamic
Collaborative C2	Mixture, Largely Task and Some Home Entities	Rich	Continuous or Nearly Continuous
Coordinated C2	Mixture, Largely Home and Some Task Entities	Limited	Periodic
Deconflicted C2	Home Entity Organizations	Minimal	Episodic
Conflicted C2	Home Entity Organizations	None	None
	Cluster Attractor	**Degree of Inter-Cluster Connectivity**	**Frequency/ Continuity**

C2 Maturity Levels: Measures of Mission Effectiveness (MOE)

Agile C2	Tailored and Dynamic Synergies	Highly Efficient	Proactive and Agile across a Broad Range of Conditions
Collaborative C2	Substantial Synergies across Collaborative Areas/Functions	Substantial Efficiencies across Collaborative Areas/Functions	Substantial, Timely and Continuous
Coordinated C2	Limited Synergies Due to Coordination	Limited Efficiencies Due to Coordination	Limited to Coordinated Functions/Actions; Slow; Reactive
Deconflicted C2	Avoids Costs of Negative Cross-Impacts	Sub-Optimized Performance	Limited Agility; Vulnerable at Seams; Rigid from Specialization
Conflicted C2	Negative Cross-Impacts	Inefficiency Wasted Resources	Fragile and Vulnerable at the Seams
	Relative Effectiveness	**Efficiency, Given Effectiveness**	**Agility**

Complex Endeavors Panel

C2 for Complex Endeavors

Reiner Huber (GE)
Jim Moffat (UK)
Mink Spaans (NL)

C2 Maturity for Complex Endeavors

Conclusions from Case Studies Comparison

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13 ICCRTS Plenary Panel
Empirical Analysis of Complex Endeavors
Seattle, June 18, 2008

NNEC Maturity Levels

Operational Maturity

(NC3A NNEC Feasibility Study)

- Transformed Operations
- Integrated Operations
- Coordinated Operations
- De-conflicted Operations
- Stand Alone Operations

C2 Maturity

(SAS-065 NNEC C2 MM)

- Agile C2
- Collaborative C2
- Coordinated C2
- De-conflicted C2
- Conflicted C2

Distinguishing Characteristics of NATO NEC C2 Maturity Levels

C2 Maturity Level	Distinguishing Characteristics
Agile C2	Identification of additional C2 approach options Identification and implementation of appropriate approach given the situation
Collaborative C2	Shared intent Ability to configure/reconfigure roles Rich sharing of non-organic resources Some pooling of organic resources
Coordinated C2	Mutual support for individual intent Links among plans to enhance effects Initial pooling of non-organic resources
De-conflicted C2	Avoidance of adverse cross-impacts.
Conflicted C2	Only C2 of individual elements present

C2 Implications of NNEC C2 Maturity Levels

C2 Maturity Level	C2 Implications
Agile C2	Required for situations with high dynamics, uncertainty, complexity High degree of self-synchronization Widespread information sharing Rich continuous interactions
Collaborative C2	Sharing of resources, interdependence More information sharing/interactions Planning in parallel Effectiveness >> sum of parts
Coordinated C2	Actions may reinforce other actions Planning time may increase Effectiveness > sum of parts
De-conflicted C2	Willingness to accept constraints Limited information interactions Effectiveness approaches sum of parts
Conflicted C2	No collective C2 No avoidance of negative cross-impacts Effectiveness < sum of parts

Case Studies Comparison

Disaster Relief and Recovery Operations

- Elbe Flood 2002 in Saxony
- Tsunami 2004 in the Indian Ocean (Aceh)

The Elbe Flood Disaster (2002)

- August 2002
- Among the worst natural disasters in Germany
- 80,000 people evacuated
- 6.2 bn € material damage
- Response: 10 national GOs and NGOs comprising some 80,000 individuals

The Indian Ocean Tsunami (2006)

- 26 December 2004
- Deadliest natural disaster in modern history
- Over 227,000 killed
- 1.7 million people in 14 countries displaced
- 13.5bn US$ in international aid.
- Response: over 1,000 national and international organizations

Case Material Summary

- Management approach to disaster relief operations implied coordinated C2 in both cases

- Management performance was rated as
  - satisfactory in case of the Elbe Flood
  - inefficient and wasteful in case of the Tsunami

- Recommendations for improvement
  - Elbe Flood: some organizational adjustments to improve coordination capabilities and responsiveness
  - Tsunami: Fundamental reorientation of international humanitarian community

Conclusions: Requisite Maturity

Considering the scenarios underlying both case studies it may be concluded

• that at a given level of C2 maturity performance depends essentially on scenario characteristics and, by implication,

• that for a given set of scenario characteristics there should be a level of C2 maturity that is necessary and sufficient for efficient performance: **requisite maturity**

Scenario Characteristics

1) Nature of operations (mixed, peacekeeping, combat, stability, counter-terrorism, humanitarian assistance / disaster relief etc)
2) Number, nature, and diversity of different friendly / neutral / adversarial actors including the relationships between them
3) Role of military
4) Stability / predictability of the environment
5) Transparency
6) Familiarity
7) Infrastructure (available, austere etc)
8) Clarity, unity of intent (purpose) and strategy
9) Nature of the effects space (one <-> multidimensional)
10) Duration of operation.

Planning Scenario Characteristics

- Type (scale, nature and duration)
- Complexity (low, medium, high)
- Dynamics (low, medium, high).

Case Study Scenario Characteristics

C = Complexity
D = Dynamics

Elbe Flood (C, D) = (low, medium)

Tsunami-relief phases: (C, D) = (high, high)

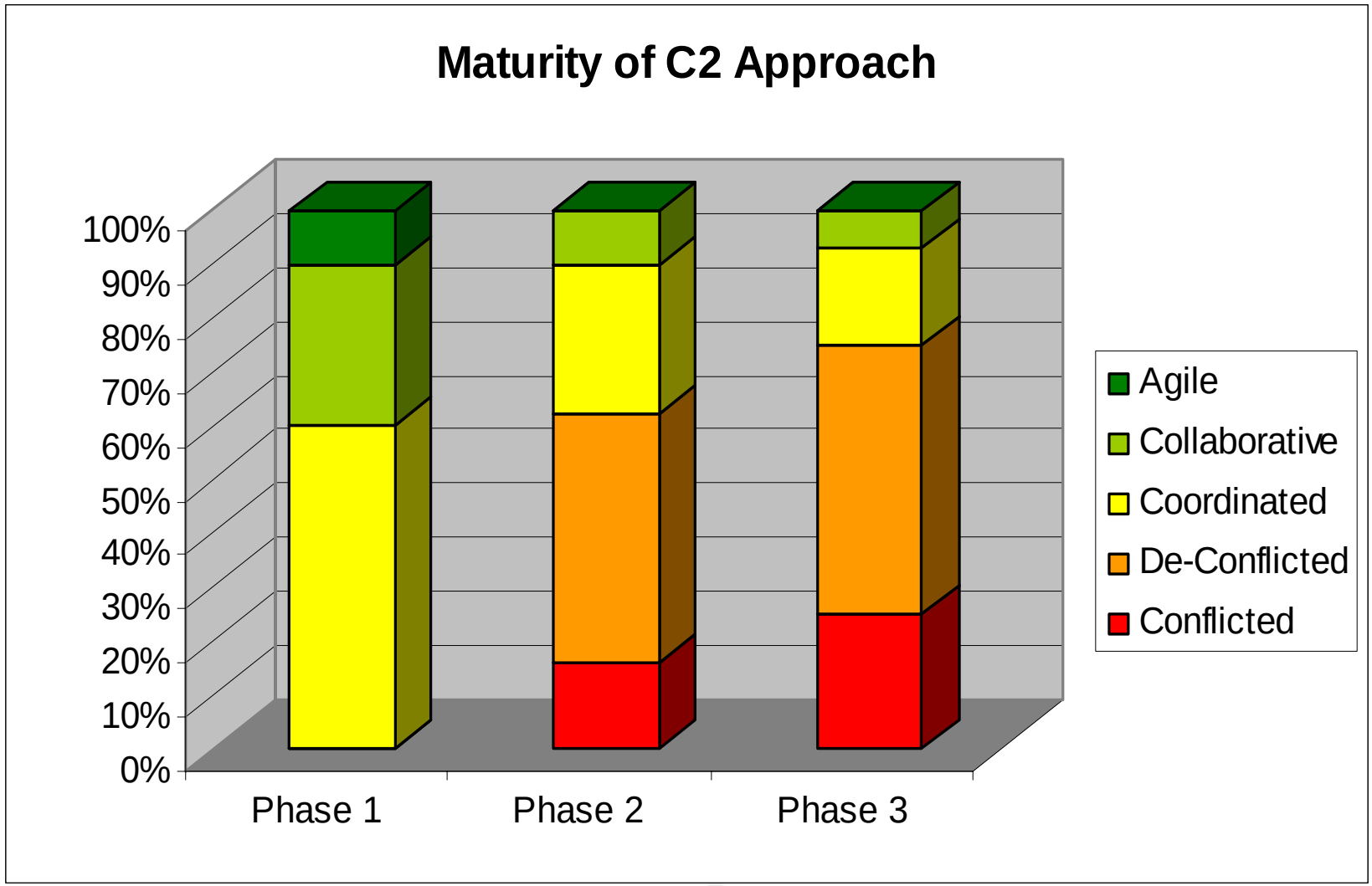
Tsunami-recovery/reconstruction: (C, D) = (high, medium)

C2 Maturity Requirements given Complexity and Dynamics of Senario

Hypotheses derived from case study comparisons

- Coordinated C2 is sufficient for (low, medium) scenarios
- Collaborative C2 is required, and Agile C2 desired, for (high, high) scenarios
- Collaborative C2 is sufficient for (high, medium) scenarios;

Quantitative Overall Assessment Aceh
Maturity of C2 Approach



Conclusions and Recommendations

Conclusions:

•There is no single (collective) C2 approach for managing the response to large scale rapid-onset disasters.

• participating organizations must be willing and capable of coordinating roles and actions among themselves.

Recommendations:

• Regional and local authorities improve preparedness and response capabilities (including requisite C2 approaches).

• International aid organizations fill capability gaps as they appear.

ISAF - Afghanistan

Scenario Evolution and Requisite C2 Maturity

C = Complexity
D = Dynamics

Year	Scenario (*C*,*D*)	Requisite C2 Approach
2003	(medium, low)	De-conflicted
2008	(high, medium)	Collaborative
2008 ++	(high, high)	Collaborative - Agile