



Operationalizing C2 Agility

Approaches to Measuring Agility in Command and Control Contexts

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- **Background**
- Perspectives on Agility
- Measurement
- Observations and a Request



- What is agility?
 - Response to the nature of the modern operational environment
 - Increasingly dynamic and complex
 - Inherent uncertainty
 - Comprised of:
 - Robustness
 - Resilience
 - Responsiveness
 - Flexibility
 - Innovation
 - Adaptation
- Goal of this endeavor
- Value of operationalization



- Operational definitions require describing how the defined properties will be assessed *
 - The object of the assessment
 - Environment under which assessment will occur
 - Metrics
 - Operations to be carried out during assessment
- Environmental considerations are particularly important for measuring agility
- Agility is manifested at the interface between the object of the assessment and the environment in which it operates

* Adapted from Ackoff, Russell L. and Maurice W. Sasieni. *Fundamentals of Operations Research*. New York, London, Sidney: John Wiley & Sons, Inc. 1968, p. 390-391.



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Perspectives on Agility: Agility in Selected CCRP Publications



- Defining the nature of the term
 - The capacity to react more effectively in a rapidly *changing operating environment*. (Understanding Information Age Warfare 2001, p197)
 - Adjusting to *changes in the operational situation* in a timely manner. (Understanding Information Age Warfare, 2001, p217)
 - An ability of the forces *to adapt, to learn and to change* to meet the threats that they face. (The Agile Organization, 2005, p164)
- Other key observations
 - *Presumes effective actions* and implies a degree of self-synchronization. (Understanding Command and Control, 2006, p201)
 - A key characteristic of an Information Age organization; a characteristic to be sought *even at the sacrifice of seeking to perfect capabilities associated with specific missions or tasks*. (Information Age Transformation, 2002, p82)



International Recognition of the Agility Concept for Defense



- These ideas have been adopted by others
 - NATO C2 Conceptual Reference Model (SAS-050)
 - SAS-065 and other NATO working groups (involving Australia, Belgium, Canada, Denmark, France, Germany, Italy, The Netherlands, Norway, Portugal, Slovakia, Sweden, Switzerland, the United Kingdom, and the United States)
- Agility is making its way into the doctrine and planning of other defense organizations as well
 - US: Joint Staff, Services, OSD
 - International partners: e.g., MOD (UK), DSTO (AS)
- Emphasis and terminology vary, but common recognition of the importance of the concept



- CCRP publications
- US conceptual documents from Joint and Service perspectives
- Published doctrine from selected international partners
- NATO Working Group products
- Non-defense communities
 - Engineering, evolutionary biology, complexity sciences
 - Commercial sector
 - Common-language use of terms

24 References Sampling a Variety of Perspectives were Reviewed



For incorporation

- Organizational agility
- Command agility
 - Differentiation between possessing means to change and having ways and willingness to effect change
 - Separation of concepts of organizational (endeavor) change and process change
- Self-reflection
 - Ability to self-reflect on aims, methods, command style
 - Importance of sensemaking and decision making capabilities

Already reflected or out of scope

- Scalability
 - A particular type of robustness
- Diverse, distributed, survivable
 - Potential enablers of or ways to achieve aspects of agility
- Mobility
 - Refers to size of options space available to one player vs. another
 - Relative flexibility
- Evolvability
 - Refers to ability of random changes to produce improvement

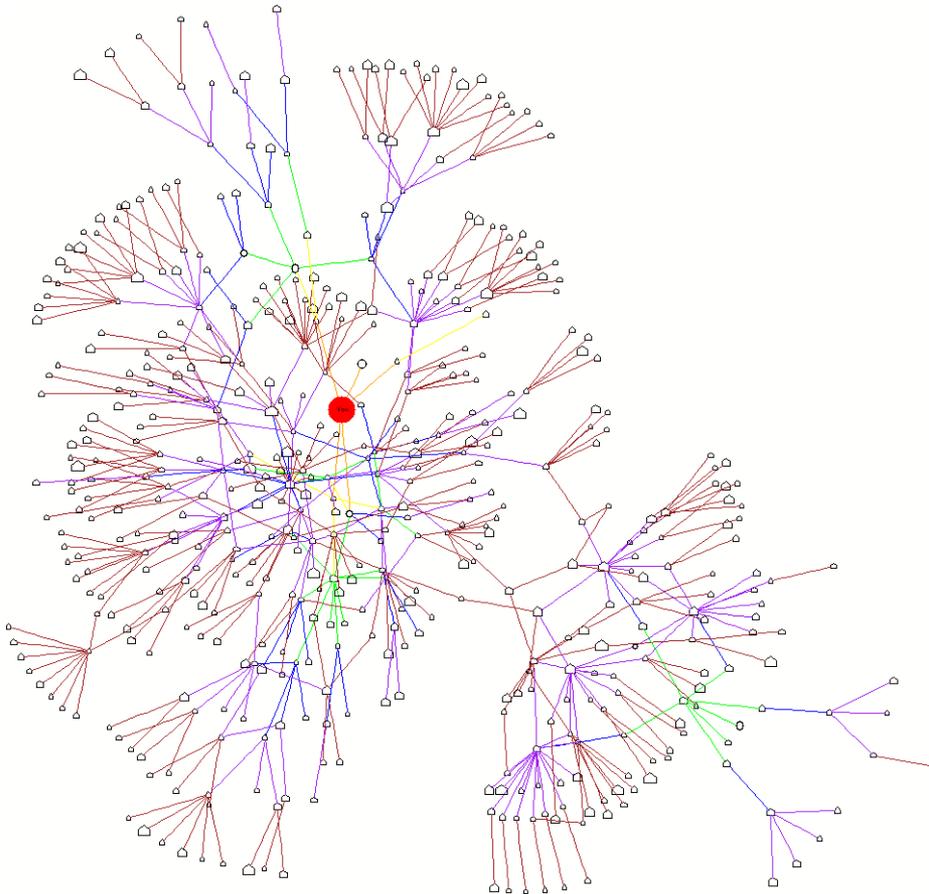


Agility

- Possessing the potential for robustness, resilience, responsiveness, flexibility, innovation and adaptation and a capability to synergistically exploit these components to achieve and maintain effectiveness in a dynamic, uncertain and risky environment
 - Not just the potential to succeed in the face of change or uncertainty
 - Also need the sensemaking capability to recognize the need for change and the nature of the response required to achieve or maintain effectiveness



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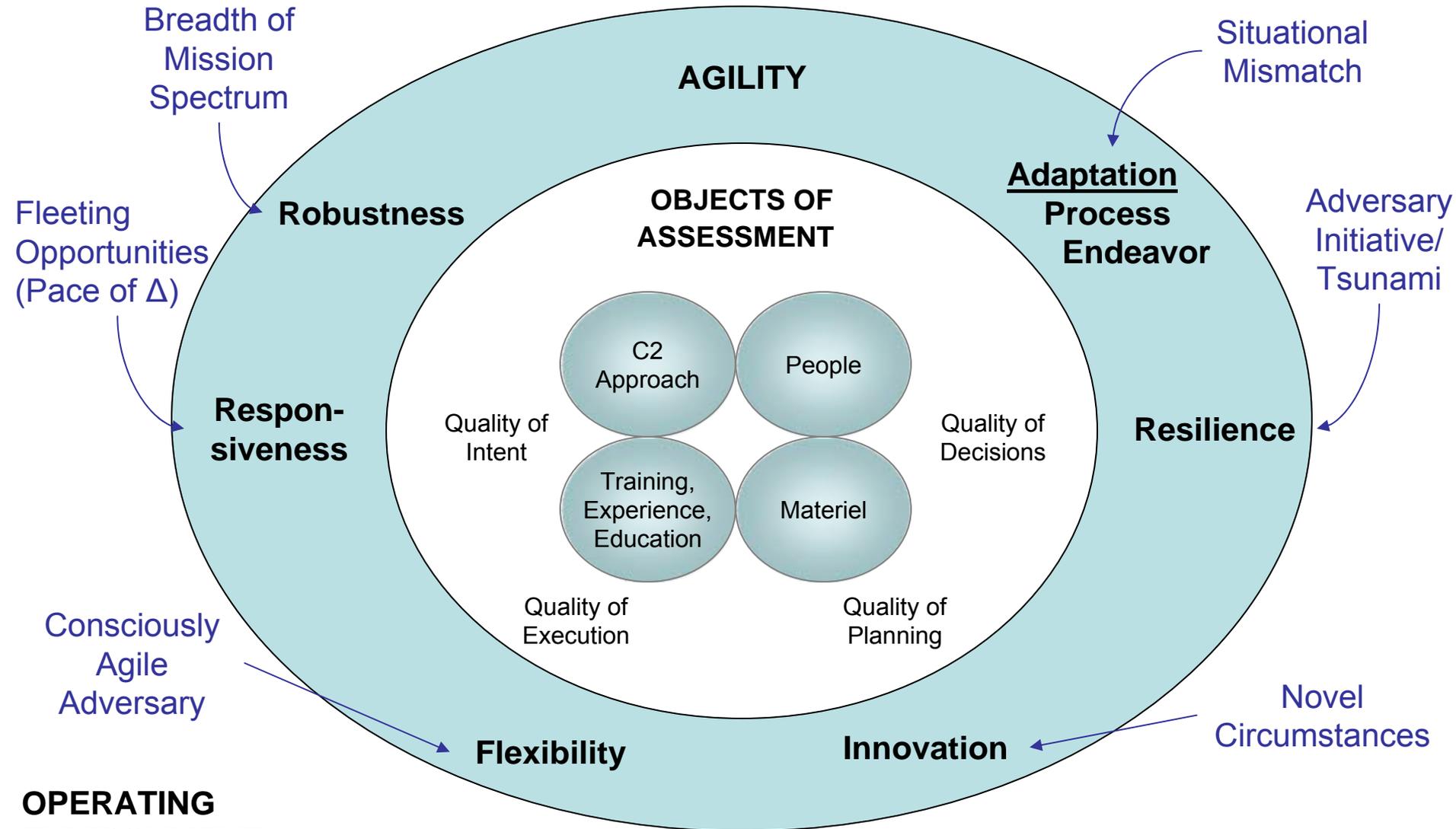
- Complex endeavors* are of particular interest for agility measurement
 - Has a purpose or set of related purposes
 - Large number of disparate entities whose activities are related to a broad range of effects
 - No single “leader” or commander
 - Individual participants may be working toward different purposes
 - No subset of participants is capable of achieving its relevant goals absent contributions of others
 - Participants may have a variety of relationships with one another
- Object boundaries may vary depending on units of interest

Image source: Dodge, Martin, “An Atlas of Cyberspace,” <http://www.cybergeography.org/>, accessed June 14, 2007.

*Complex endeavors are introduced in Hayes and Alberts, *Planning: Complex Endeavors*, CCRP Publication Series, 2007.



Operating Environment, Agility, and the C2 Object of Assessment





- **C2 Robustness:** The ability to maintain effective C2 across a range of tasks, situations, and conditions
- Measurement approach: Identify a set of use cases that sample the problem space (set of environments) and assess C2 effectiveness in each; e.g.:
 - Endeavor: Missions or mission conditions that may be faced by the endeavor
 - Element: Above, plus range of endeavors in which the element may participate
- Metric:
 - Estimated proportion of the problem space within which effective and appropriate C2 capability can be achieved
 - Weighted by criticality or importance of region of the problem space



- **C2 Resilience:** The ability to recover from or adjust to loss of C2 capability due to misfortune, damage, or a destabilizing perturbation in the environment
- Measurement approach: Identify a set of use cases that sample the problem space of how degradation may occur, and assess residual effectiveness and assess
 - Fractional effectiveness of remaining C2 capability
 - Rate of C2 effectiveness restoration
- Metric:
 - Estimated proportion of problem space in which adequate C2 capability remains after degradation and in which timely and relevant restoration is possible



- **C2 Responsiveness:** The ability to react to a change in the environment in a timely manner
 - Involves monitoring, decision-making, and synchronization aspects of C2 capability
 - Emerging threats or fleeting opportunities
- **Measurement approach:** Define a set of use cases sampling the space of emerging threats or opportunities and assess
 - Timeliness of responses (assumes appropriateness)
 - Effectiveness retained after change as a function of time
- **Metric:**
 - Estimated proportion of change space to which timely response can be provided



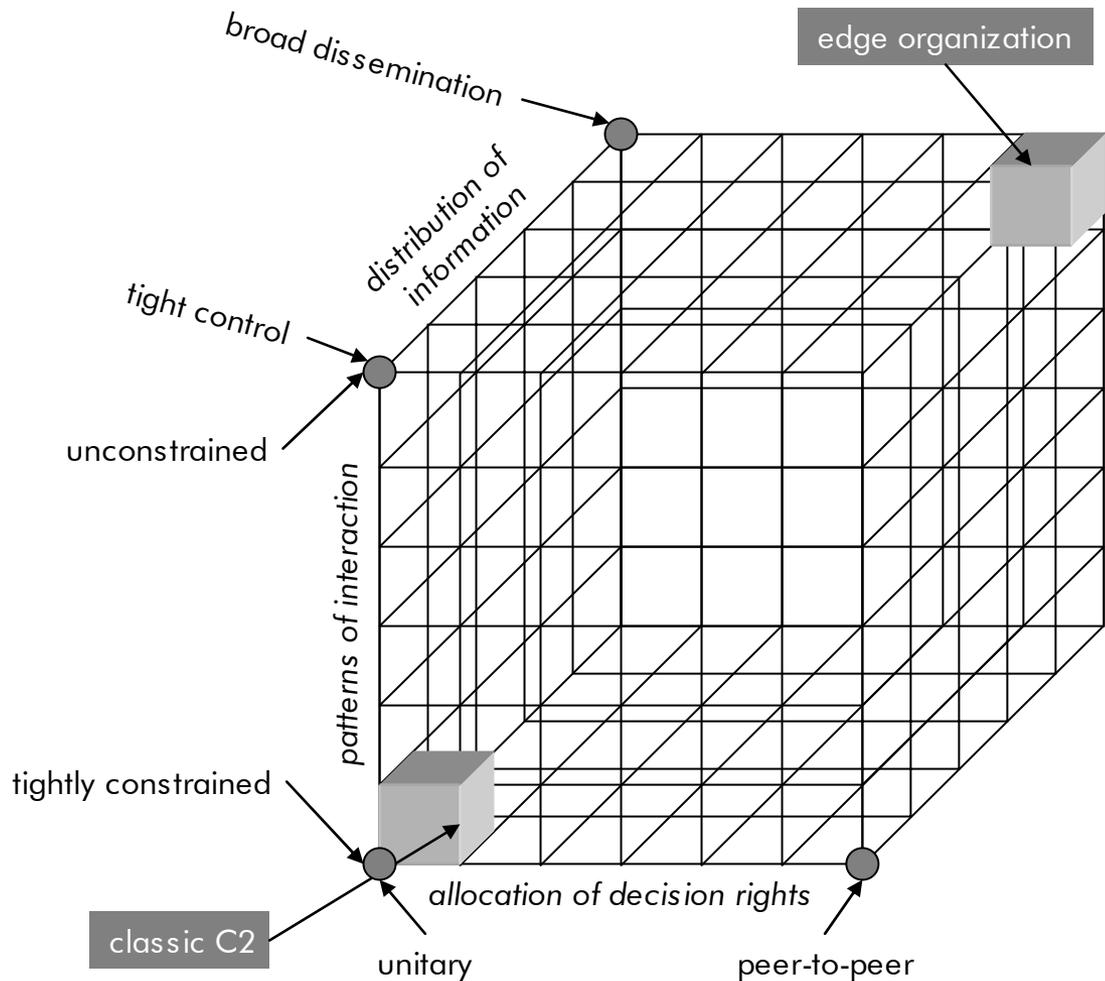
- **C2 Flexibility:** The ability to employ multiple ways to succeed and the capacity to move seamlessly between them
 - An aspect of the decision making element of the C2 capability
- **Measurement approach:**
 - Assess the degree to which C2 processes and organizations explored alternative ways and means of achieving success
 - Examine how well the organization performed as changes were made in planned operations
- **Metrics:**
 - Number of relevant courses of action considered
 - Degrees of freedom maintained over time
 - Number of contingencies put into place
 - Effectiveness retained during and after transition



- **C2 Innovation:** The ability to do new things and the ability to do old things in new ways
 - An aspect of the decision making element of the C2 capability
 - One of the most difficult attributes to objectively assess
- **Measurement approach:**
 - Direct observation: During operations, examine the development and implementation of approaches outside established TTPs and near the boundaries of established doctrine
 - Indicants: Measure likely precursors of innovation (e.g., broad collaboration, diversity)
- **Metrics:**
 - Measure: Number of new options generated during operations
 - Indicant: Variety of perspectives represented in C2 collaboration processes

• C2 Adaptation:

- C2 Process Adaptation:
The ability to change work processes
- C2 Structure Adaptation:
The ability to change the composition of and/or relationships between and among constituent entities
- Greater adaptation enables access to more regions of the *C2 approach space*



C2 Approach Space



Measuring C2 Adaptation: Direct Observation and Indicators



Direct Observation

- Measurement Approach:
 - Specify a set of C2 approaches sampling the approach space
 - Assess ability to transition to and execute each approach
- Metrics:
 - Estimated proportion of C2 approach space to which the object of assessment has timely access

Assessment must account for potential for object of assessment to change over time

Indicant

- Measurement Approach
 - Assess the presence and effectiveness of adaptation mechanisms within the assessment target
 - Ability to monitor the environment and recognize the need for change
 - Ability to identify implications of recognized change for C2
 - Ability to generate options and select appropriate changes to process or structure
 - Ability to synchronize changes across constituent elements
- Metrics:
 - Best judgment of adaptation capability



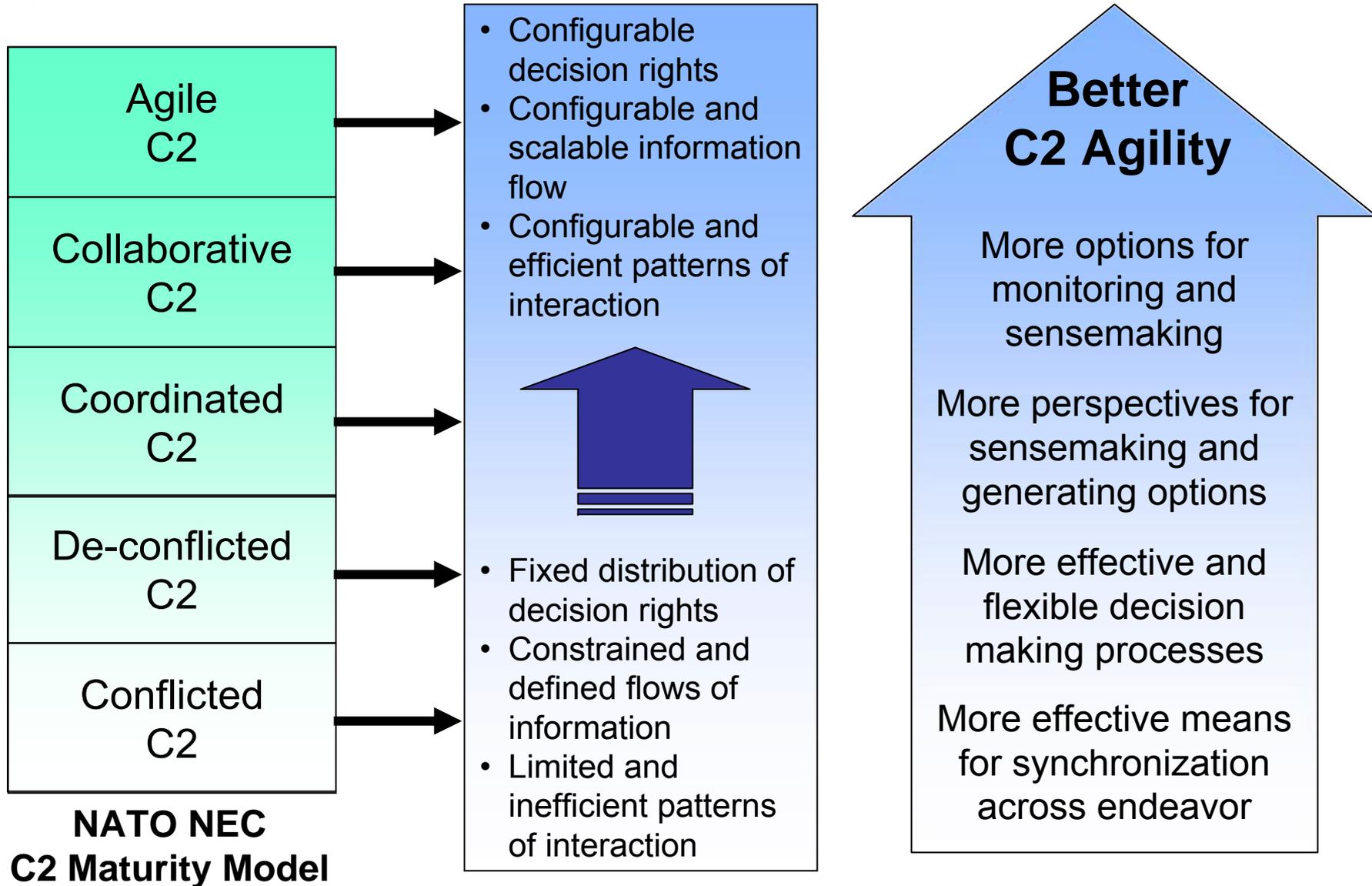
- **C2 Agility:** Possessing the potential for robustness, resilience, responsiveness, flexibility, innovation and adaptation and a capability to synergistically exploit these components to achieve and maintain effectiveness in a dynamic, uncertain and risky environment
- Measurement approach: Composite measure comprised of all the components of agility
- Metrics:
 - A synthesis of the components of agility
 - Resistance to degradation in effectiveness over range of conditions
- Can also assess “requisite agility” by comparing agility to that called for in a particular situation



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Relationship to NNEC C2 Maturity Model





Implementing Operationalized C2 Agility – and a Request



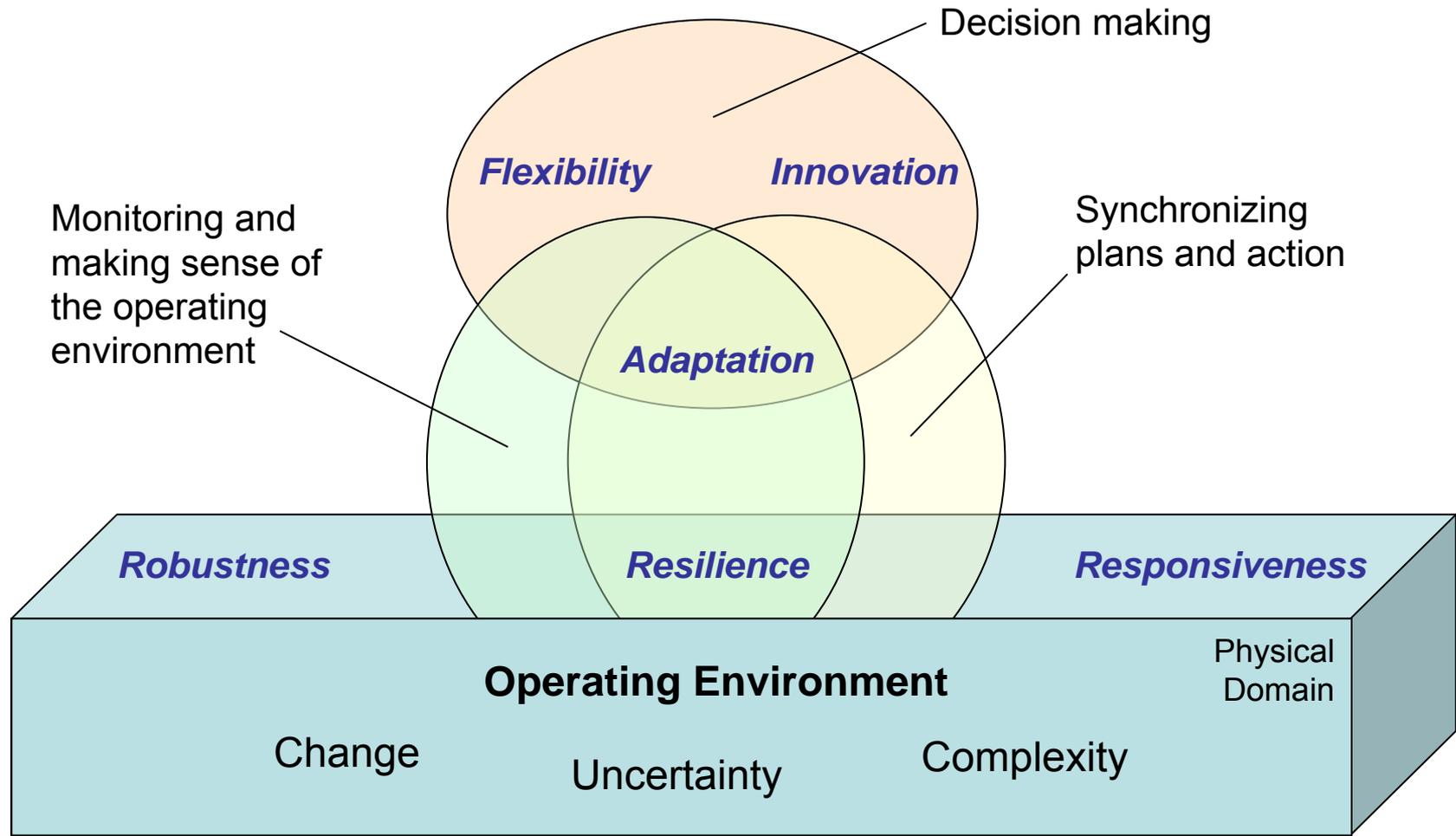
- Metrics and assessment activities will need to be tailored for systems of interest
 - Approaches here and those under development intended to serve as illustrative guides for more specific implementation
- Users should be aware of, and make explicit where possible, risks of measuring agility in particular ways
 - Possible bias due to uneven definition of environment or construct of indicants
 - Keys are appropriate scoping and characterization of use cases
- Bottom line is that including assessments of agility in research and experimentation is critical to appropriately capture essence and complexity of 21st century operations

Request: Your help in refining and applying these ideas



Questions/Comments?

Please forward comments, suggestions,
and ideas to mcever@ebrinc.com





Two Example Endeavors to Illustrate Notional Assessment



- Disaster response
 - Endeavor assembled to respond to a large-scale natural disaster
 - Elements initially assembled from DoD, FEMA, National Guard, Local responders, Red Cross, Local medical entities, other volunteers
 - Looting
 - Disease outbreak (CDC)
 - Mass resettlement effort
 - Cleanup and reconstruction
 - Situation dynamic, but no intelligent adversary
- Illustrative application:
 - Measure agility of endeavor responding to disaster
- Counterinsurgency
 - Similar to current operations in Iraq and Afghanistan
 - Endeavor focused on democratization and reconstruction finds itself target of isolated harassment activities
 - Grows into large-scale insurgency movement
 - Requires full-spectrum effects-based approach
 - Insurgency very adaptive
 - Intelligent adversaries
- Illustrative application:
 - Measure agility of counterinsurgency endeavor



Assessing C2 Agility in a Disaster Response Endeavor



Attribute	Assessment Approach Comments	Notional Assessment Comments	Score
C2 Robustness	Use cases defined by ways in which the disaster may play out, range of conditions that may be encountered	Prepared for adverse weather conditions Prepared for law enforcement challenges Not prepared for cholera outbreak, etc.	0.6
C2 Resilience	Use cases defined by potential failure, degradation, or loss of endeavor elements	Redundant, interoperable C2 capabilities; only a few key groups with extensive experience, but they are unlikely to be lost or disconnected	0.8
C2 Responsiveness	Use cases describe changes in the environment (levy breaking, disease outbreak, etc.) – measure time and quality of response	Trust established among anticipated participants, but culture, doctrine, and security challenges make it difficult to bring in new elements – results in low scores in some cases	0.6
C2 Flexibility	Assessment made of the number of different responses considered, ease with which endeavor changed tacks	Only a single COA considered, with some contingencies	0.2
C2 Innovation	Number of different types of organizations part of endeavor C2 processes, variety of experience of key personnel	Representation from extremely wide cross-section of response communities, but public health organizations not present at first	0.6
C2 Adaptation	Rate ability of endeavor to recognize need for change, ID implications for C2, generate and select appropriate options, and synchronize change across the endeavor elements	Extensive lessons learned capability that is bought into by all participants Legal and resource challenges make it difficult to act on recognized need for change	0.4



Assessing C2 Agility of a Counterinsurgency Endeavor



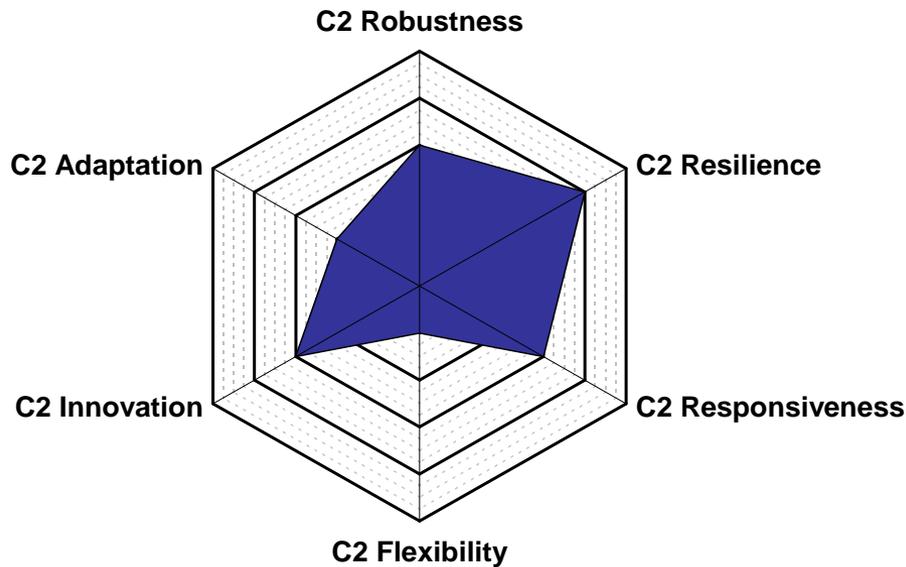
Attribute	Assessment Approach Comments	Notional Assessment Comments	Score
C2 Robustness	Use cases describe a (hopefully) representative set of possible futures regarding how insurgency may evolve	High reliance on armored vehicles leads to greater levels of risk in dismounted ops	0.4
C2 Resilience	Use cases defined by potential failure, degradation, or loss of endeavor elements	Comms networks and C2 capabilities are highly redundant and self-healing; critical assets well-protected; but “first mile” fragile	0.8
C2 Responsiveness	Uses cases describe changes in the environment (e.g., new type of tactic employed by insurgents) – measure time and quality of response	Information security protocols hinder information flow to the edge, but informal blogs have emerged to facilitate sharing of information and collaborative adaptation	0.8
C2 Flexibility	Assessment made of the number of different responses considered, and ease with which endeavor changed tacks	Many COAs considered strategically and operationally; several considered tactically	0.8
C2 Innovation	Assessed by number of different types of organizations part of endeavor C2 processes, variety of experience of key personnel	Broad diversity of mission partners involved in endeavor, but “group think” and cultural issues limit collaboration	0.4
C2 Adaptation	Rate ability of endeavor to recognize need for change, ID implications for C2, generate and select appropriate options, and synchronize change across the endeavor elements	Extensive lessons learned capability that is bought into by all participants (long term) Near-term security concerns and resource challenges make it difficult to act on recognized need for change quickly	0.4



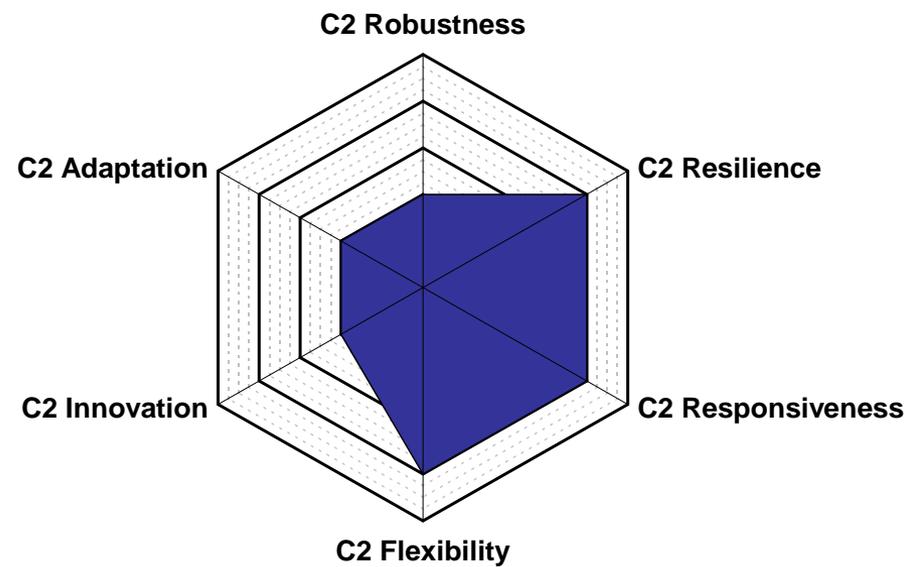
C2 Agility Notional Results



Disaster Response Endeavor



Counterinsurgency Endeavor



- The C2 agility of the target can be characterized as the area of the shape traced by the attribute results
- It may be more useful to show attribute results separately
 - Different contexts may emphasize different aspects of agility
 - Requisite agility may vary by dimension, context