



SAS-085 C2 Agility Model Validation Using Case Studies

18th ICCRTS: C2 in Underdeveloped, Degraded and Denied Operational Environments

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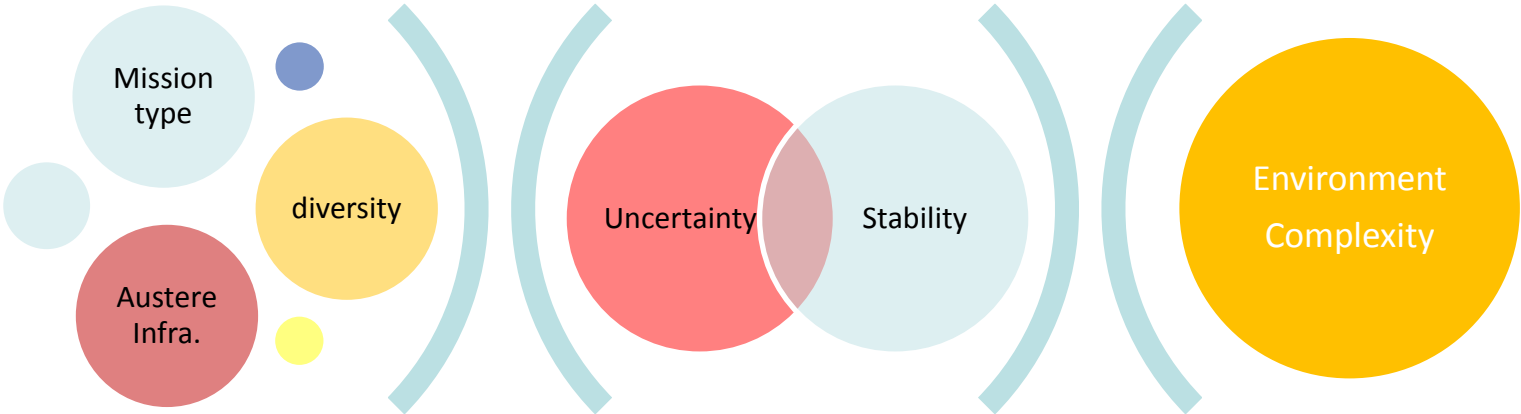
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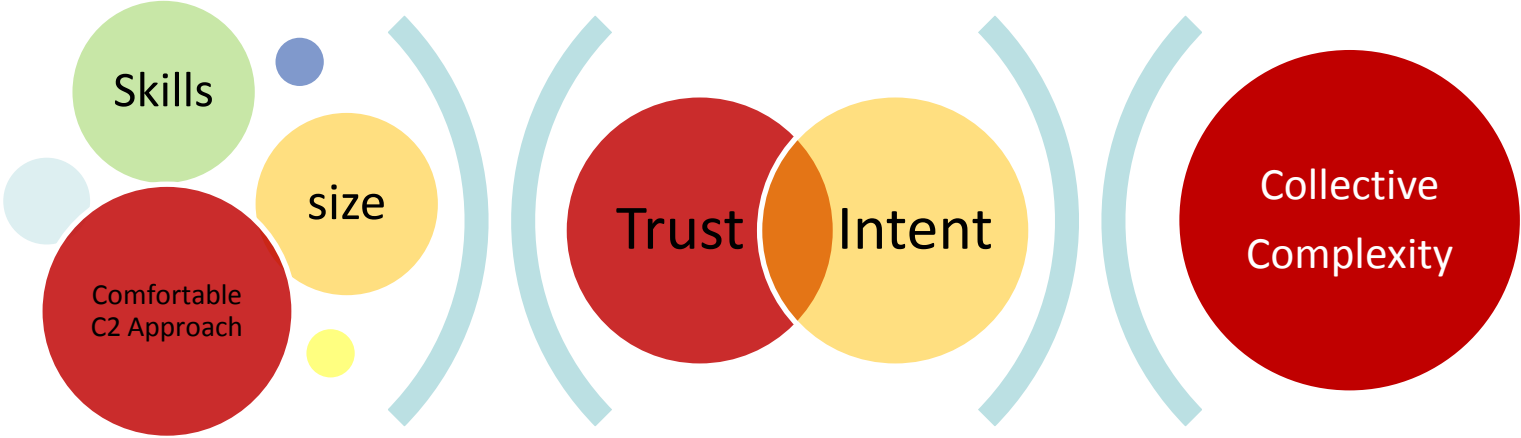
Case Studies

- C2 Agility in Brief
- Case Study Plan
- Case Study Evidence
- Hypotheses Findings
- Conclusions

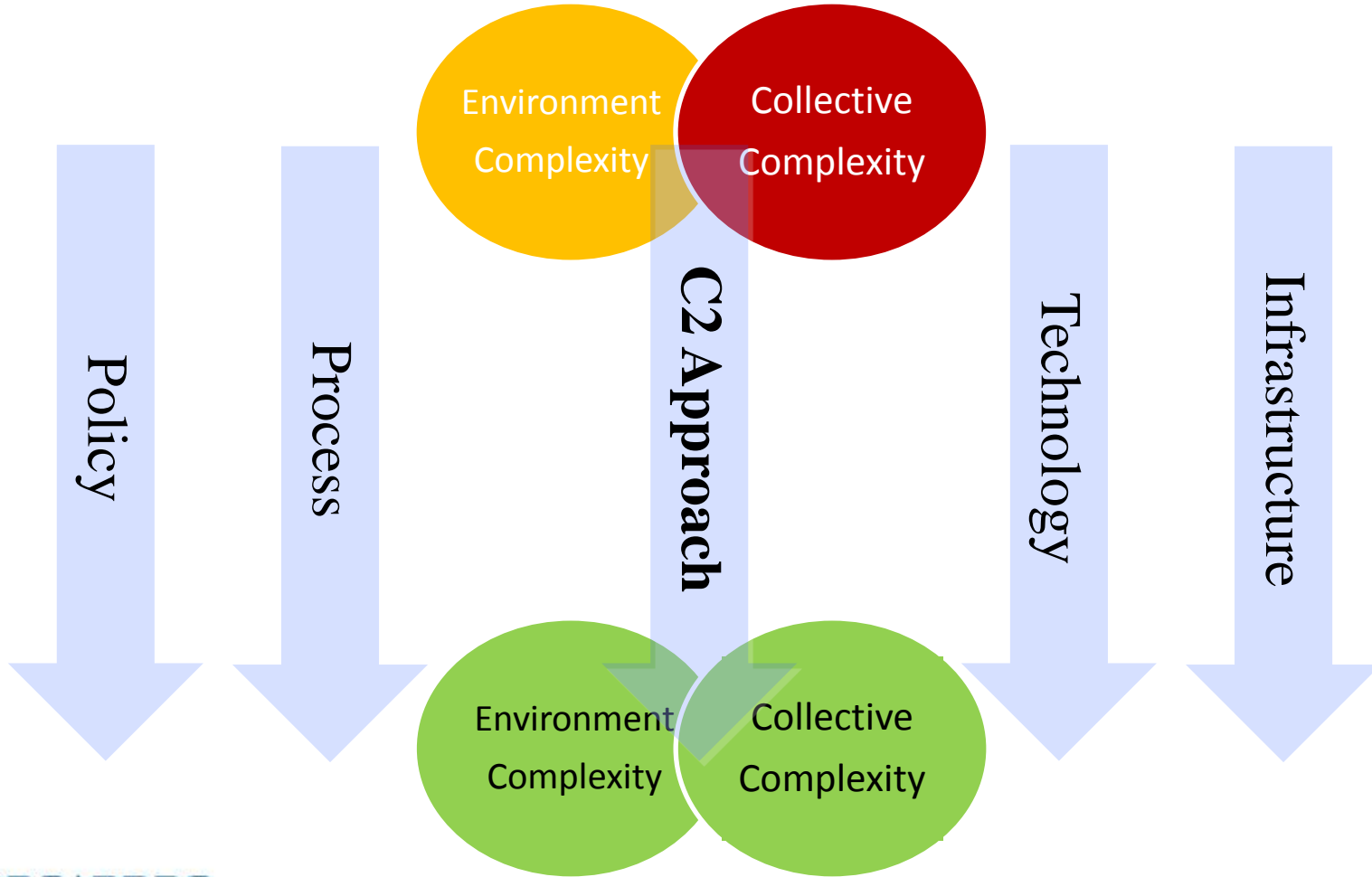
C2 Agility in Brief – Environment is complex!



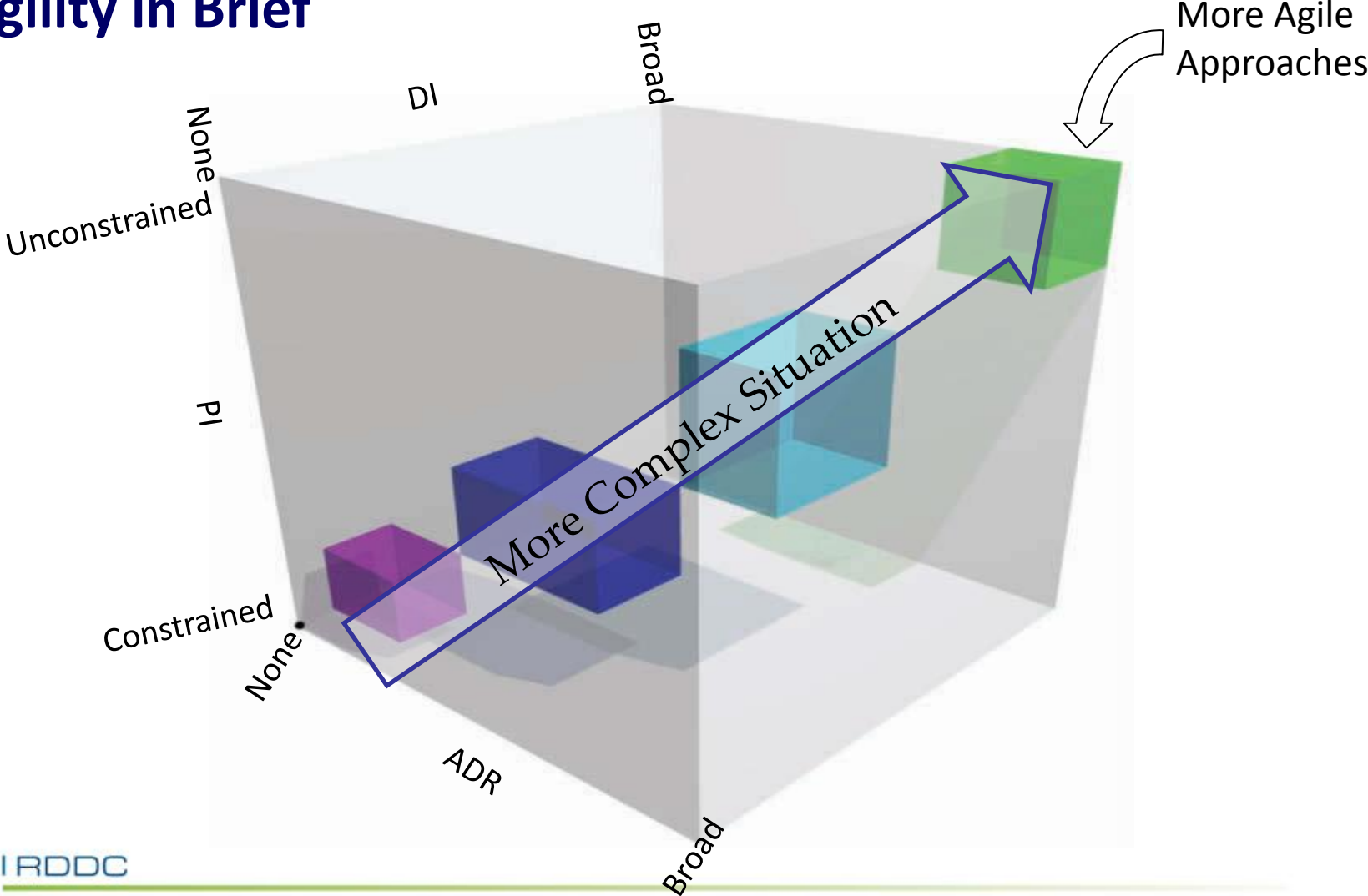
C2 Agility in Brief – Collective is complex!



C2 Agility in Brief



C2 Agility in Brief



C2 Agility in Brief

- C2 Manoeuvre Agility - transitioning from current to required approach to maximize effectiveness and efficiency
 - Situation complexity, Allocation of Decision Rights, Patterns of Interaction, Distribution of Information, self-monitoring.
- C2 Approach Agility - the agility of a C2 Approach
 - Flexibility, Responsiveness, Resilience, Versatility, Adaptiveness, Innovative.



Case Study Plan

- Detailed analyses of historical situations where evidence is sought that may confirm (or not) concepts, notions, or hypotheses
- Advantage: any conclusions drawn from the analysis pertain to real situations, thus providing “face” validity.
- Disadvantage: these conclusions pertain only to those situation(s) being analysed, and therefore it becomes difficult to generalise and extrapolate to other situations.

Case Study Plan

Objectives for conducting Case Study analyses are to:

1. Find evidence for key concepts, components, constraints, and behaviours related to C2 Approach Agility and C2 Manoeuvre Agility in the cases.
2. Help clarify the language of C2 Agility
3. Opportunity to demonstrate and verify that the model, in fact, occurs in the real world
4. Contribute to validation by testing C2 Agility-related hypotheses

Case Study Plan

- Develop a Template that reflects C2 Agility model
- Collect Evidence based on Template
- Conduct Meta-analysis looking for:
 - Evidence across multiple studies
 - Evidence of other notions for C2 Agility model

Case Study Plan

The first template was designed to capture relevant source data in one location.

I: Executive Summary
II: Identify the Focus of and the Boundaries for the Case Study
III. Describe the Challenge or Opportunity that gave rise to the need for C2 Approach and C2 Manoeuvre Agilities.
IV: What would have been the consequences of a failure to act in a way that demonstrates C2 Approach Agility and C2 Manoeuvre Agility?
V: Was C2 Approach Agility and C2 Manoeuvre Agility Manifested? If so, How?
VI: Which Enablers and Inhibitors of C2 Approach Agility were observable?
VII: What C2 Approaches were relevant (i.e., did different situation complexity levels require a corresponding different C2 Approach)? How can C2 Manoeuvre Agility be inferred from what was reported or observed?
VIII: What interesting and important vignettes are included or can be derived from the case study to help create illustrative stories?
IX: Case Study Assumptions and Limitations:
XI: Bibliography

Case Study Plan

The second template was designed to summarize evidence for each notion, sub-concept, and variable for each case study.

Concept/Component	
C2 Manoeuvre Agility	Transitioning from one approach to another
Endeavour Space Complexity	Endeavour Space Complexity values: low, medium, and high
Appropriate (Required) C2 Approach	Labels: De-conflicted, Coordinated, Collaborative, Edge
C2 Approach Space	ADR, DoI, and PoI
Allocation of Decision Rights	Allocation of Decision Rights varies from None to Broad.
Distribution of Information	Distribution of Information varies from None to Broad.
Patterns of Interaction	Patterns of Interaction varies from Constraint to Unconstraint.
Actual C2 Approach	Labels: De-conflicted, Coordinated, Collaborative, Edge
Self-Monitoring	Ability to know where entity is in the space and when to move
C2 Approach Agility	Enabler (or opposite) values: low, medium, and high.
(Lack of) Flexibility	Ability to exceed in multiple ways
(Lack of) Adaptiveness	Ability to change work processes
(Lack of) Responsiveness	Ability to react to changes in the environment
(Lack of) Versatility	Ability to maintain effectiveness across many conditions
(Lack of) Innovativeness	Ability to do new things or old things in new ways
(Lack of) Resilience	Ability to adjust and recover from “self”-damage

Case Study Plan (fictitious input)

Concept/Component	Phase 1	Phase 2	Phase 3
C2 Manoeuver Agility			
Endeavour Space Complexity	High	Medium	Low
Appropriate (Required) C2 Approach	Collaborative	Coordinated	De-conflicted
C2 Approach Space			
Allocation of Decision Rights	Somewhat broad	Narrow	Narrow
Distribution of Information	Broad	Broad	Not as Broad
Patterns of Interaction	Constrained	Constrained	Constrained
Actual C2 Approach	Between Collaborative and De-conflicted	Between Coordinated and De-conflicted	Closer to De-conflicted
Self-Monitoring	None	√	√
C2 Approach Agility			
Flexibility	√	?	?
Adaptiveness	√	√	?
(Lack of Responsiveness)		High	?
Versatility	√	√	?
(Lack of Innovativeness)	√	√	Low
Resilience	Medium	?	?

Case Study Plan

Complex Battlespace

A. *Helmand Province*, Dr. William Mitchell, Royal Danish Defence College, **Denmark**

B. *Comprehensive Approach in NATO Operations*, Cdr Marten MEIJER PhD, C2 CoE, **NLD**

Peace-keeping and Personal Agility

C. *Rwanda Genocide 1994*, Micheline Bélanger, Defence R&D Canada – Valcartier, **Canada**

Cyber Warfare

D. *Estonia Cyber Attack 2007*, Prof. Michael Henshaw, Loughborough University, **UK**

E. *Georgia*, Douglas J. Ball, M.D., UNC Chapel Hill Gillings School of Global Public Health, **USA**

Natural Disasters

F. *Garda Earthquake 2004*, Claudia Baisini, Swedish National Defence College, LTC Arne Norlander, **Sweden**

G. *Haiti Earthquake 2010*, Dr. Richard Hayes, Evidence Based Research, **USA**

Major Events

H. *Munich Olympics 1972*, Dr. Philip S. E. Farrell, Defence R&D Canada – Toronto, **Canada**

I. *Vancouver Olympics 2010*, Dr. Philip S. E. Farrell, Defence R&D Canada – Toronto, **Canada**

Case Study Evidence

- Phister, P. W. (2012). *Humans and Their Impact on Cyber Agility*. Paper presented at the 17th International Command and Control Research and Technology Symposium: Operationalizing C2 Agility. Washington D.C., USA. (former SAS-085 member)
- Henshaw, M., Tetlay, A., & Siemieniuch, C. (2013). *SAS-085 Case Study – Estonia: Estonia Cyber Attack in Spring 2007*. Engineering System of Systems Group, School of Electronic, Electrical and Systems Engineering Loughborough University (UK), Loughborough, UK.
- Meijer, M. (2012). *Consequences of the NATO Comprehensive Approach for Command and Control*. Paper presented at the 17th International Command and Control Research and Technology Symposium: Operationalizing C2 Agility. Washington D.C., USA.
- Mitchell, W. (draft). *Case Study Report Generated as an Official Danish Defence Contribution to NATO SAS-085*. Royal Danish Defence College.
- Basini, C. (draft). *Italian Civil Protection's Operation after the Garda Earthquake, Province of Brescia, 2004 : A Case Study for NATO SAS085 on C2 Agility and Requisite Maturity*. Swedish National Defence College.
- Banbury, S., Kelsey, S. R., & Kersten, C. (2011). *Evaluating C2 Approach Agility in Major Events: Final Report (CONTRACT #: W7714-083663/001/SV No. DRDC CR 2011-004)*. Scientific Authority Dr. Philip S. E. Farrell. Centre for Operational Research and Analysis (CORA), Ottawa, Ontario, Canada: Defence R&D Canada.
- Jobidon, M.-E., Fraser, B., Smith, D., & Farrell, P. S. E. (2011). *Analysis of GM approach agility during the Vancouver 2010 Olympic Games (Technical Memorandum)*. Toronto: DRDC Toronto TM 2011-124.
- Farrell, P. S. E., Jobidon, M.-E., & Banbury, S. (2012). *Organizational Agility Olympic Event Case Studies*. Paper presented at the 17th International Command and Control Research and Technology Symposium: Operationalizing C2 Agility. Washington D.C., USA.
- Bélanger, M. (in review). *The difficulty to document agility evidences from a C2 perspective*. Paper presented at the 18th International Command and Control Research and Technology Symposium: C2 in Underdeveloped, Degraded and Denied Operational Environments. Alexandria, VA., USA.
- Farrell, P. S. E., Baisini, C., Bélanger, M., Henshaw, M., William, M., Norlander, A. (in review). *SAS-085 C2 Agility Model Validation Using Case Studies*. Paper presented at the 18th International Command and Control Research and Technology Symposium: C2 in Underdeveloped, Degraded and Denied Operational Environments. Alexandria, VA., USA.

Case Study Evidence

Concept / Component	Evidence Found	I.D.	Case Study
C2 Maneuvre Agility	A, F		
Endeavour Space Complexity	A – I	A	Helmand Province
Appropriate (Required) C2 Approach	A, D, H, I	B	NATO Operations
<i>C2 Approach Space</i>		C ₁	Rwanda - DPKO
Allocation of Decision Rights	A – I	C ₂	Rwanda - media
Distribution of Information	A – I	D	Estonia
Patterns of Interaction	A – I	E	Georgia
Actual C2 Approach	A – I	F	Garda
Self-Monitoring	A, C ₁ , C ₂ , D, I	G	Haiti
C2 Approach Agility	A, C1, C2,	H	Munich
Flexibility	A, C ₁ , C ₂ , D, E, G, H	I	Vancouver
Adaptiveness	A, C ₁ , D, E, F, G		
Responsiveness	A, C ₁ , D, E, F, G, H, I		
Versatility	A, D, F, G, H, I		
Innovativeness	A, C ₂ , D, E, F, G		
Resilience	A, D, F, H		

Case Study Evidence

Other C2 Agility Model Concepts

Concept / Component	Evidence Found	I.D.	Case Study
Anticipation, Learning, Training, Exercises	F, I		
Role of Leadership	A, C, F, G, H, I	A	Helmand Province
Collective size changes over time	C, F, G, H	B	NATO Operations
Entities with different C2 approaches	C, D, G, I	C ₁	Rwanda - DPKO
'Comfortable' C2 Approach	G, I	C ₂	Rwanda - media
Risk Assessment	C	D	Estonia
Importance of Competency	D, E, F	E	Georgia
Requisite Variety in Skills and Resources	D, E, F	F	Garda
Trust and interpersonal relationships	C, F, H	G	Haiti
Role of Compromise	G	H	Munich
Understanding Conflicted C2	H	I	Vancouver
Politically Driven C2 Approach	I		
Off diagonal approaches	C, G, I		
Agility as an emergent phenomenon (not pre-designed)	A		

Hypotheses Findings

1. Each NATO NEC C2 Maturity Model Approach is located in a distinct region of the C2 Approach Space
 - By definition
2. No one approach is always the most appropriate
 - Evidence Found
3. More network-enabled approaches are more appropriate for Complex Endeavors; while less network-enabled approaches are more appropriate for less complex missions/circumstances
 - By definition
4. More network-enabled approaches are more agile (have greater C2 Approach Agility)
 - Unclear. However, Munich (conflicted or worse) does show lack of C2 Approach Agility
5. The dimensions of the C2 approach Space are positively correlated with agility
 - Unclear. This is likely related to the agility metric
6. More network-enabled approaches are better able to maintain their intended positions in the C2 Approach Space
 - Evidence found to support the notion of maintaining the appropriate approach whether they were more networked or not.

Hypotheses Findings

7. On-diagonal (balanced) approaches are more agile
 - No evidence
8. Increasing C2 Maneuver Agility increases agility
 - Unclear. should read the ability to transition from one approach to the appropriate approach increases the ability to successfully cope
9. More mature c2 capability is more agile than the C2 Approach Agility of the most network-enabled approach available
 - No evidence
10. Self monitoring is required for C2 Maneuver Agility
 - Evidence Found
11. : The six components (enablers) of agility are collectively exhaustive and thus all instances of observed agility can be traced to one or more of these components (enablers)
 - By definition. Evidence was found between C2 Approach Agility and enablers. However, other enablers were found (e.g., leadership, trust)
12. Each of these components (enablers) is positively correlated with agility
 - Evidence Found

Conclusions

- Evidence was found for the C2 Agility Conceptual Model, thus providing face validity for the model
- Other concepts and components were identified that may be under consideration for insertion into the C2 Agility Conceptual Model
- The Case Study results (face validity) will be compared to experimental results (empirical validity)

Questions?

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