

Introduction to ELICIT

Experimental Laboratory for the Investigation of Collaboration, Information-sharing, and Trust

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ELICIT

Experimental Laboratory

for the Investigation of **C**ollaboration, **I**nformation-sharing, and **T**rust

- ELICIT was developed by the DoD CCRP to facilitate C2-related experimentation and analysis
- ELICIT was designed to facilitate assessments of the appropriateness of various C2 Approaches for a variety of missions, circumstances, conditions, and stresses including those associated with a contested cyber environment

ELICIT

Experimental Laboratory

for the Investigation of **C**ollaboration, **I**nformation-sharing, and **T**rust

ELICIT Ecosystem includes:

- An instrumented environment that logs every event

- Supports both person-in-the-loop and software agents

- Flexibly configurable

- Context and success criteria provided by instructions/scenarios

- Log Analyzer Tools

- Configuration Files for selected factoid sets, organizational designs, ELICIT agents representing humans and non-human intelligent collaborators (NIC)

- Mission model spreadsheets

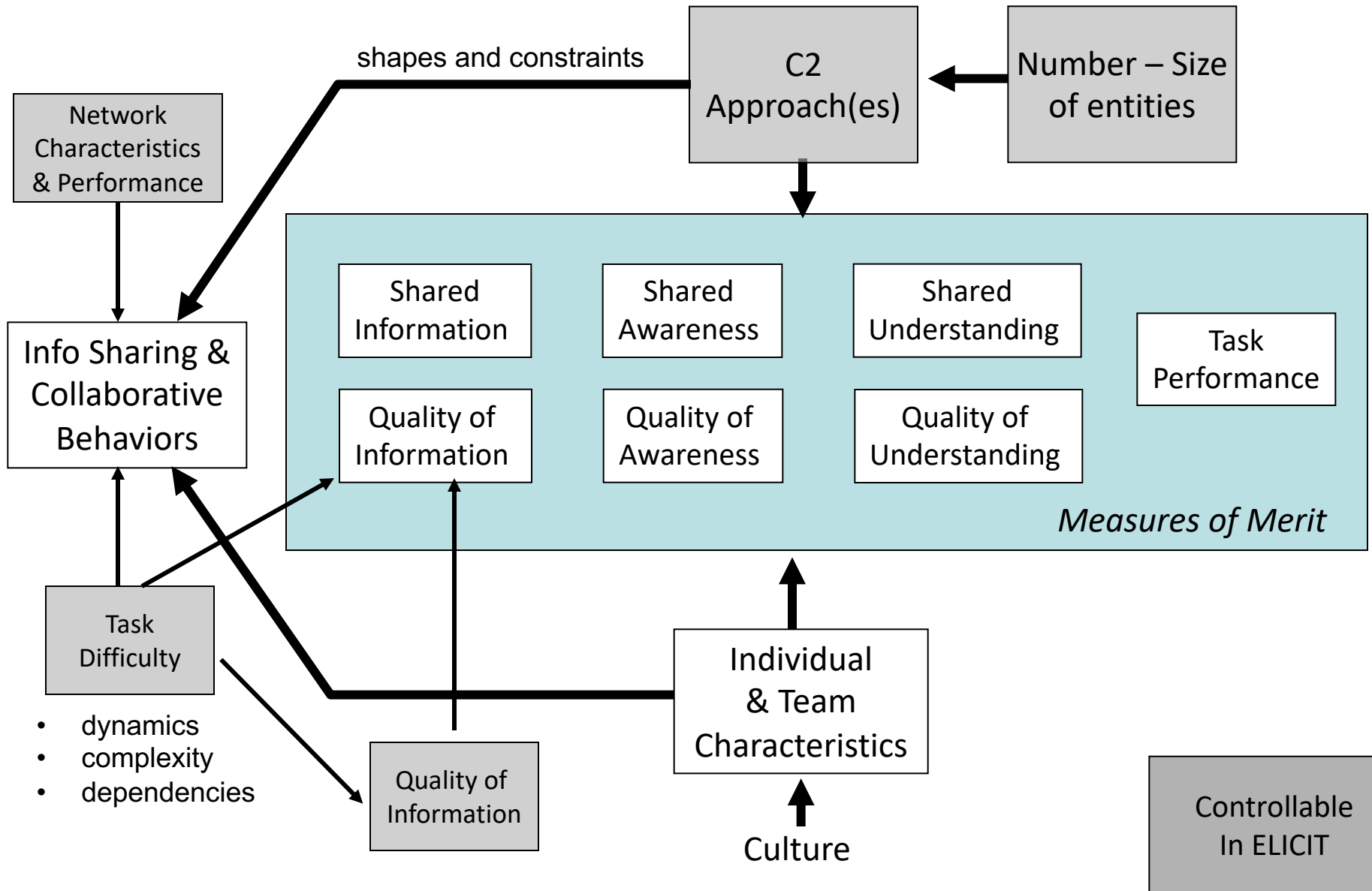
Researchers can also take advantage of the large body of previous results

ELICIT Challenge

- Participants (humans and/or ELICIT agents) are placed into an organization with a defined approach to command and control that constraints with whom they can directly interact and their accesses to websites
- ELICIT is 'shipped' with a pre-configured* mission challenge that is to correctly identify the who, what, where, and when of a terrorist attack in a timely manner
- Participants are assigned one or more tasks; which problem(s) they are to tackle
- The degree of difficulty of these tasks can be varied
- Many conditions including damage to networks and trust can be represented and manipulated

*Researchers can develop and instantiate their own 'problems'

Controllable in ELICIT with Human Participants



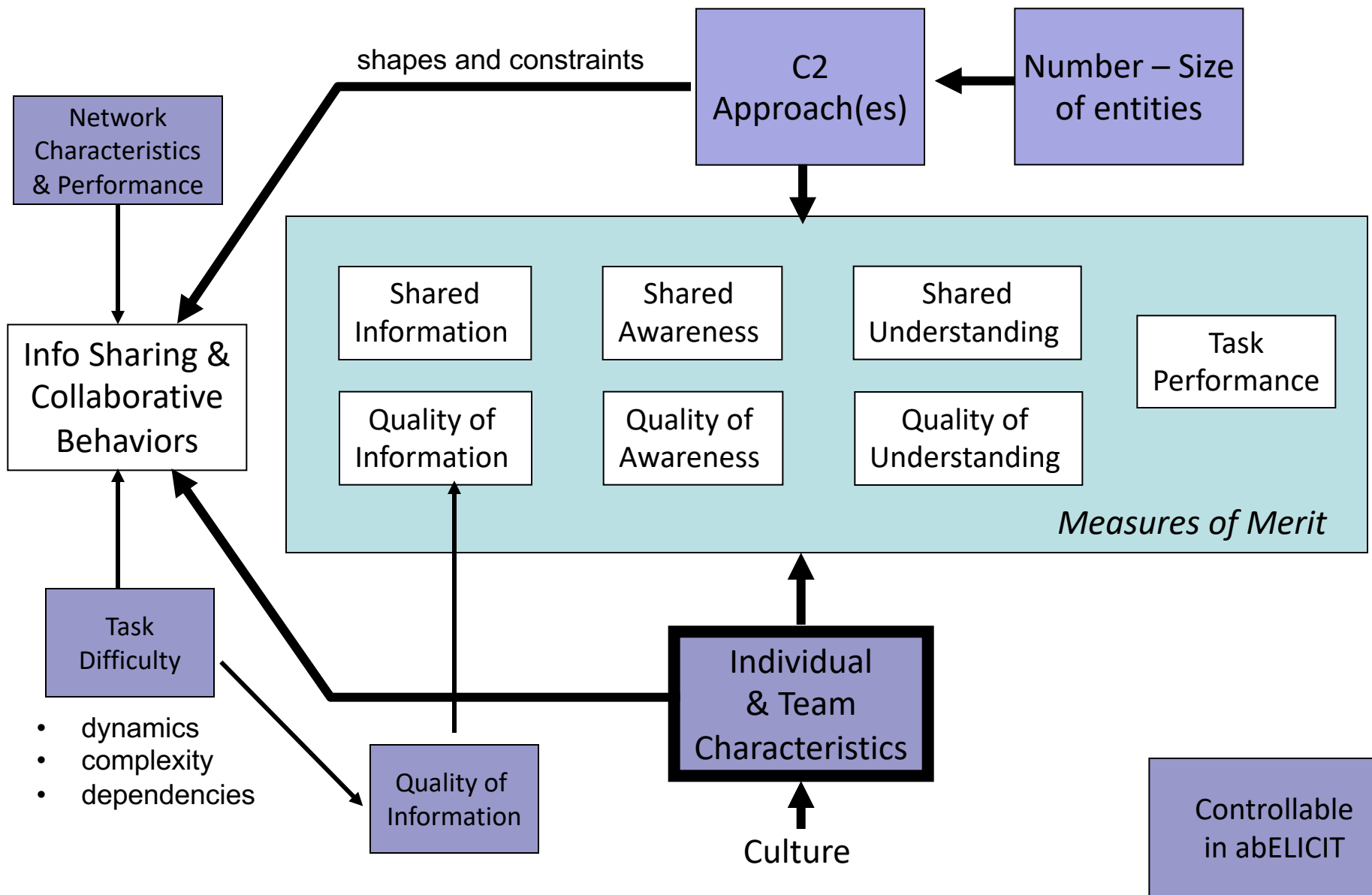
Agent-based ELICIT

- Experimentation with live groups of individuals is time consuming and expensive
- This limits the number of runs that can be made. This, in turn, limits the systematic exploration of treatments and effects
- Therefore, the DoD CCRP developed software agents that could be used in the place of people, and in all-agent trials
- abELICIT 'human' agents were designed and calibrated with data from many human participant runs
- The ability to mix agents and people has been used to permit experimentation with fewer humans
- SAS-143 is experimenting with agents designed to represent non-human intelligent collaborators (NIC) so it can explore mixed teams of humans and NICs with specific capabilities

Verification and Validation of abELICIT Agents

- ELICIT produces a transaction log that notes every agent's actions and reports upon every change in agent awareness and decision-making
- Verification that abELICIT agents perform and behave consistently and as designed required hundreds of trial runs conducted over several months
- Verification that abELICIT trials could be run deterministically and the development of standard testing when new code was introduced required dozens of runs over a period of one month
- Validation that abELICIT agents can mimic particular types of human behaviors required analysis of the behavior of several hundred humans and matching agent parameters to the human patterns. This process continues

Controllable in abELICIT



Designing an Experiment

- Instructions to Participants, Orientation, and Incentives (Human only)
- Run Configurations
 - Organization Files – specifies entity C2 Approach for a single entity or for multiple entities Entity C2-Harmonization Approach
 - Factoidsets – list of factoids and to whom and when they are distributed (a different subset of factoids is needed to solve each of four problems)
 - Agent Parameter Files – set parameters values for each agent that shapes and constrain their behaviors
 - Run Files – specifics run duration, organizational file, factoidset, and specifies assignments of agents to player positions
- Analysis
 - Scenario – provides shared knowledge requirements for key scenario milestones, time available to solve problems and complete tasks, dependencies between and among tasks
 - Mission Model – provides link between simulation run outputs and determination of mission success based upon scenario

Agent Parameters (1)

- Message Selection
 - LIFO or FIFO, Size of Inbox, Memory, Speed
- Message Screening
 - Is this a duplicate factoid?
 - What is the task focus area(s)?
- Process Information
 - High value information?
 - Update agent awareness?
- Delays associated with different actions

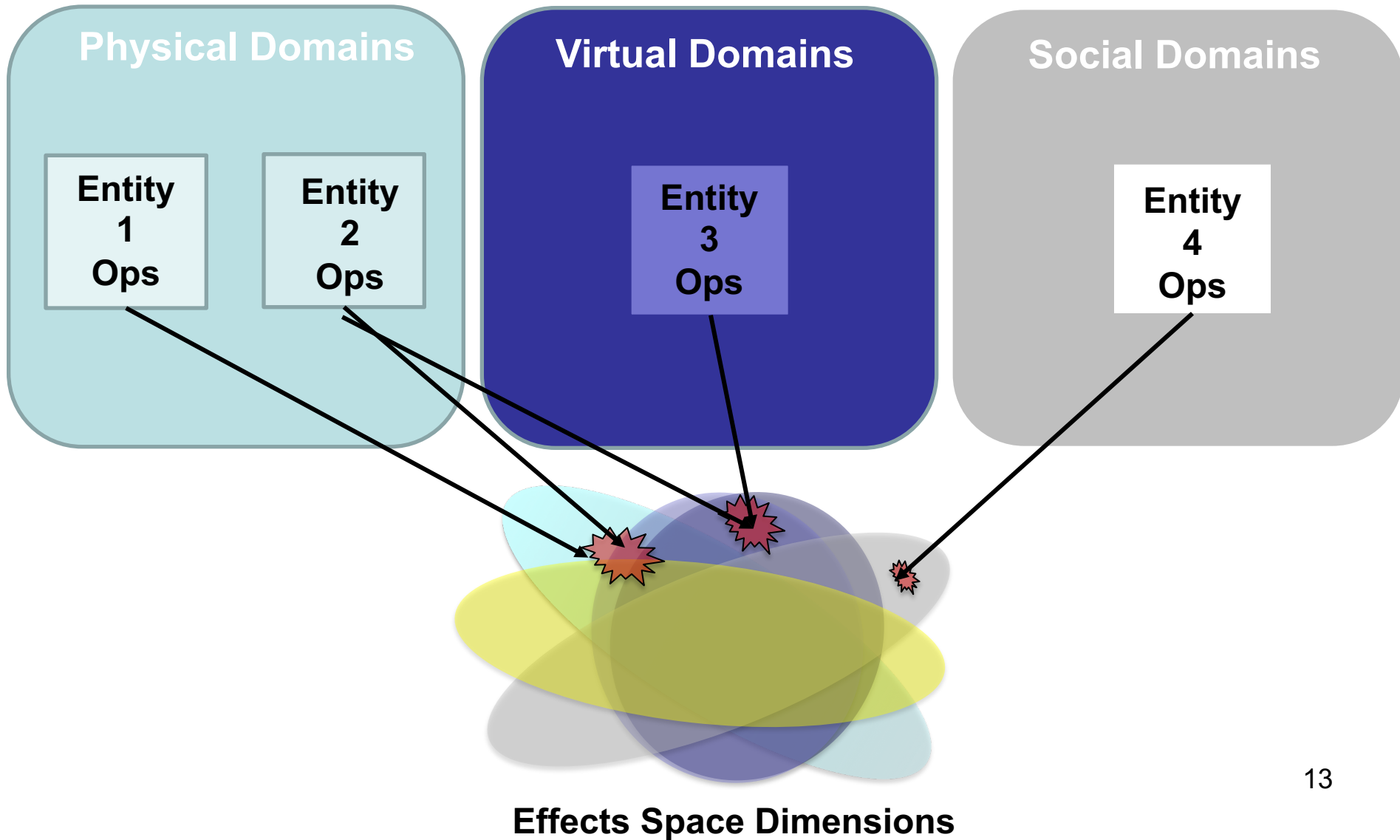
Agent Parameters (2)

- Information and Social Processing
 - Propensity to share
 - Sharing modality
 - Must share/post lists
 - Share or Process First?
 - Propensity to seek
- Conditions necessary to identify
 - Time before first ID attempt
 - Number of factoids agent must see before first ID attempt
 - Number of different focus area(s) must the agent have knowledge of before first ID attempt
 - ID Confidence
- and more...

NATO SAS-143 ELICIT Experiments

- Designed to explore C2 for Multi-Domain Operations involving multiple entities without a single chain of command where there are dependencies between and among domain operations
- Instantiate a set of 'off-the-rack' C2-Harmonization Arrangements as well as Bespoke Arrangements designed for specific situations
- Developed eight scenarios to represent different regions of an Endeavor Space whose dimensions are Dynamics, Complexity, and Dependencies
- Used, along with Case Studies and other research findings, to see if there is empirical support for a set of MDC2-H related hypotheses

Multi Domain Operations



Multi-Domain C2-Harmonization (MDC2)

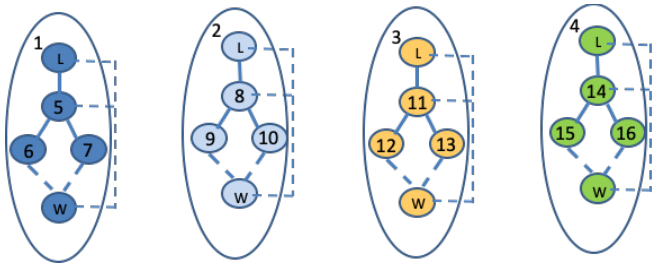
Multi-Domain C2 seeks to avoid conflicts and enable synergies within, between, and among entities conducting operations in multiple domains, and the effects that these operations create

Multi-Domain C2 involves both

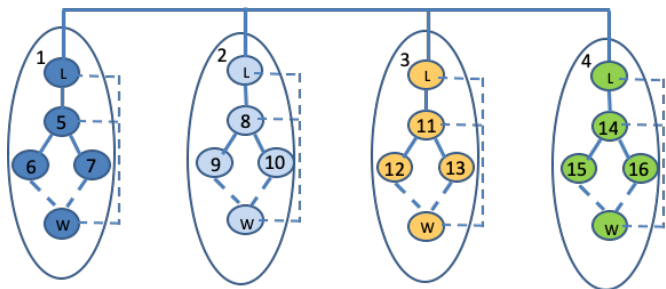
- C2 Approaches that are adopted by each of the entities in each of their operating domains
- Harmonization Arrangements that govern behaviors between and among the set of entities participating in a MDO

'Off-the-Rack' MDC2-H Arrangements

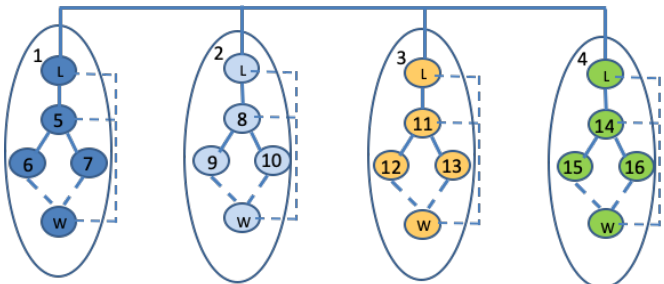
Hierarchy – Level 0



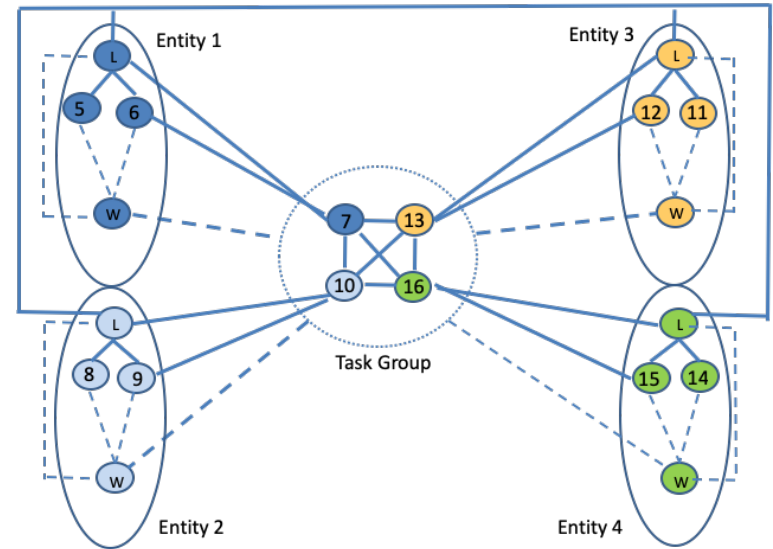
Hierarchy – Level 1



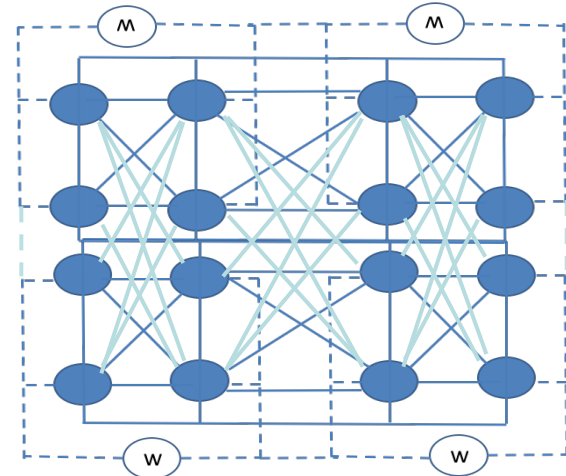
coordinated – Level 2



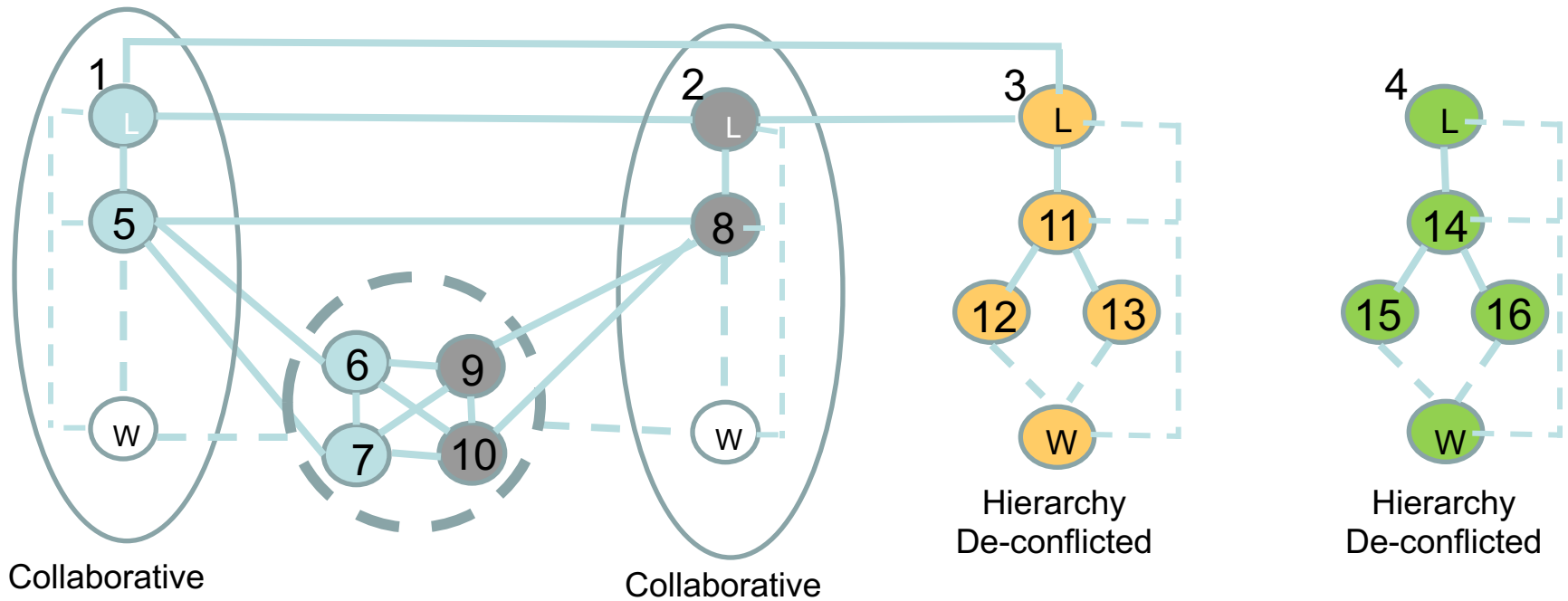
Collaborative – Level 3



Edge – Level 4



A Bespoke MDC2-H Arrangement



Scenario 8

most challenging scenario

Dependencies (High)

- Shared Situation Awareness required across dependent entities
- Significant amount of non-organic information required by entities
- Planning and/or Operations undertaken by different entities in the same or different domains are constrained or sequenced
- The effects created by an operation in one domain impacts the success of an operation in another domain one domain (success dependencies)

Dynamics (High)

- Less time available to complete plan – operation


Complexity (High)

- Extra time required to plan and execute
- More Situation Awareness within entities are required to plan and execute
- Extra time required for to ‘think’ – perform required cognitive tasks
- Small amount of non-organic information required
- Requires more effort to extract necessary information (a lot of noise) ¹⁷

Initial Results (All Humans – No Cyber Damage)

Scenario (Dynamics, Complexity, Dependencies)

MDC2/H 'off-the-rack' Arrangement	Scenario (Dynamics, Complexity, Dependencies)							
	1 LLL	2 HLL	3 LLH	4 HLH	5 LHL	6 HHL	7 LHH	8 HHH
Hierarchy/Level 0	31.7	31.7	A	A	A	A	A	A
Hierarchy/Level 1	31.7	31.7	A	A	A	A	A	A
Co-ordinated/Level 2	31.9	31.9	A	A	A	A	A	A
Collaborative/Level 3	39.2	39.2	A	A	121.5	T	A	A
Collaborative/Level 3+	33.4	33.4	47.1	47.1	183.1	T	A	A
Edge/Level 4	43.3	43.3	46.9	46.9	77.5	T	127.5	T

 Satisfies all constraints and meets-exceeds all success criteria

 Lacks timeliness or shared awareness requirements

ELICIT can explore CRM Related Topics

- How can we design C2 Approaches to minimize CRM?
- Can we reduce/mitigate CRM by employing NIC?
- What is the impact on C2 and CRM of having team members remotely located?
- How much autonomy should be delegated to NIC?
- Should we adopt different C2 Approaches for different levels of team hardness, level of expertise?
- What the relationship between team expertise and CRM?
- How much damage to cyber and cyber-enabled capabilities can we sustain before the mission fails?
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