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A System Dynamics Model of the Essential Tension Between Self-Synchronization and C2

CCRTS June 20 - 22, 2006

Bob Wiebe
Dan Compton
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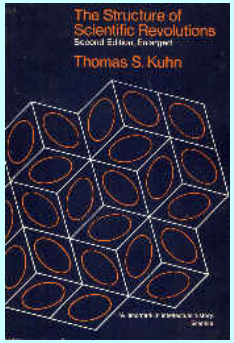
An Essential Tension Definition

In Structure of Scientific Revolutions, Thomas Kuhn characterized



"normal science" as current and generally accepted (traditional) research programs where new information is consolidated into existing theories

and

"revolutionary science" as new (innovative) research programs that emerge to cope with information that could not be assimilated into or accommodated by current research programs or theories

He states that science usually manifests an essential tension between tradition and innovation.

It is time to recognize that, if we are to be successful in meeting the 21st century challenges that we face, there will be major discontinuities between the Command and Control concepts and practices being taught and practiced today and those of tomorrow.

Dave Alberts, Dick Hayes: Understanding Command and Control, preface

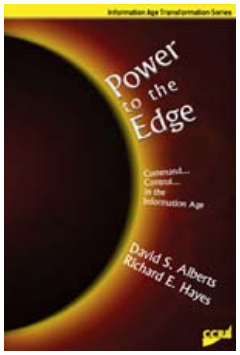
Background Sources and Modeling

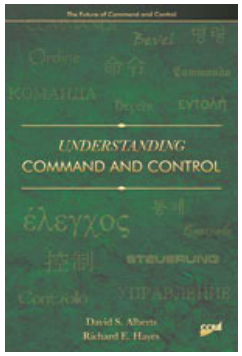
Model Based on the CCRP books

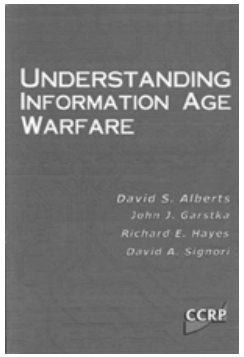
Power to the Edge

Understanding Command and Control (Chapter 9)

Understanding Information Age Warfare







Syntheses and Model Building

Complex Systems Analysis and Simulations

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Essential Tension

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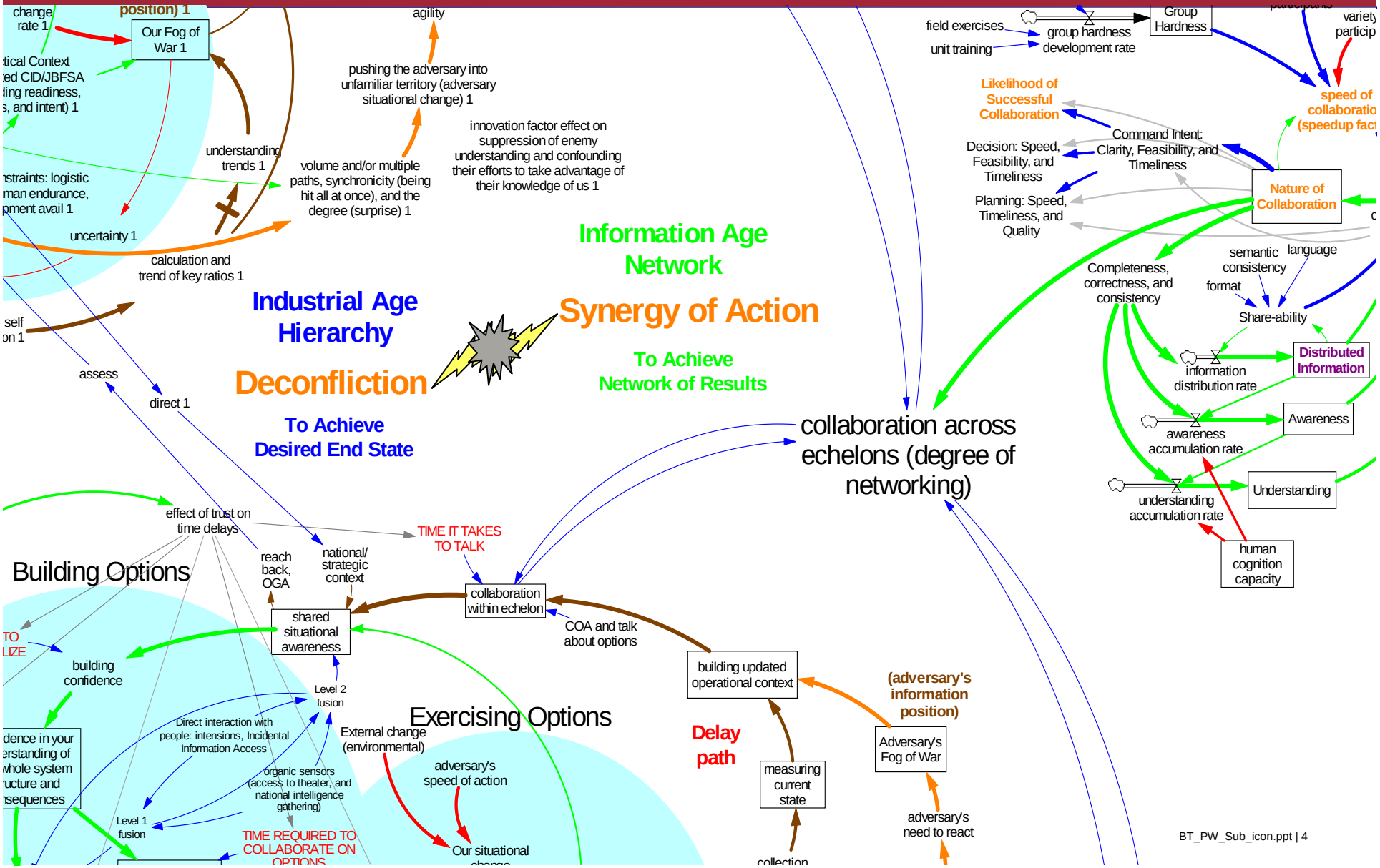
NCO Op's Analysis



Choosing a C2 Alternative

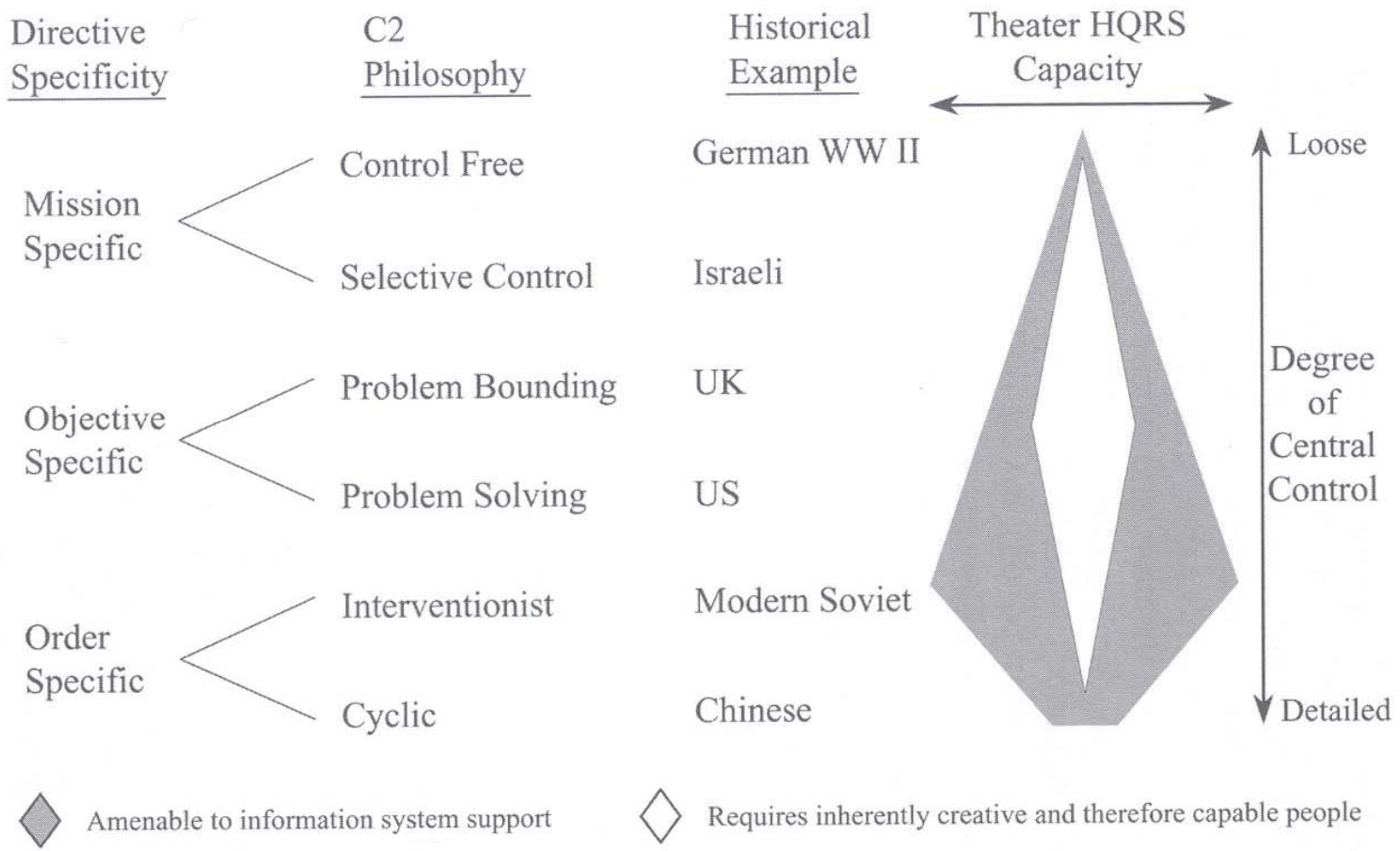
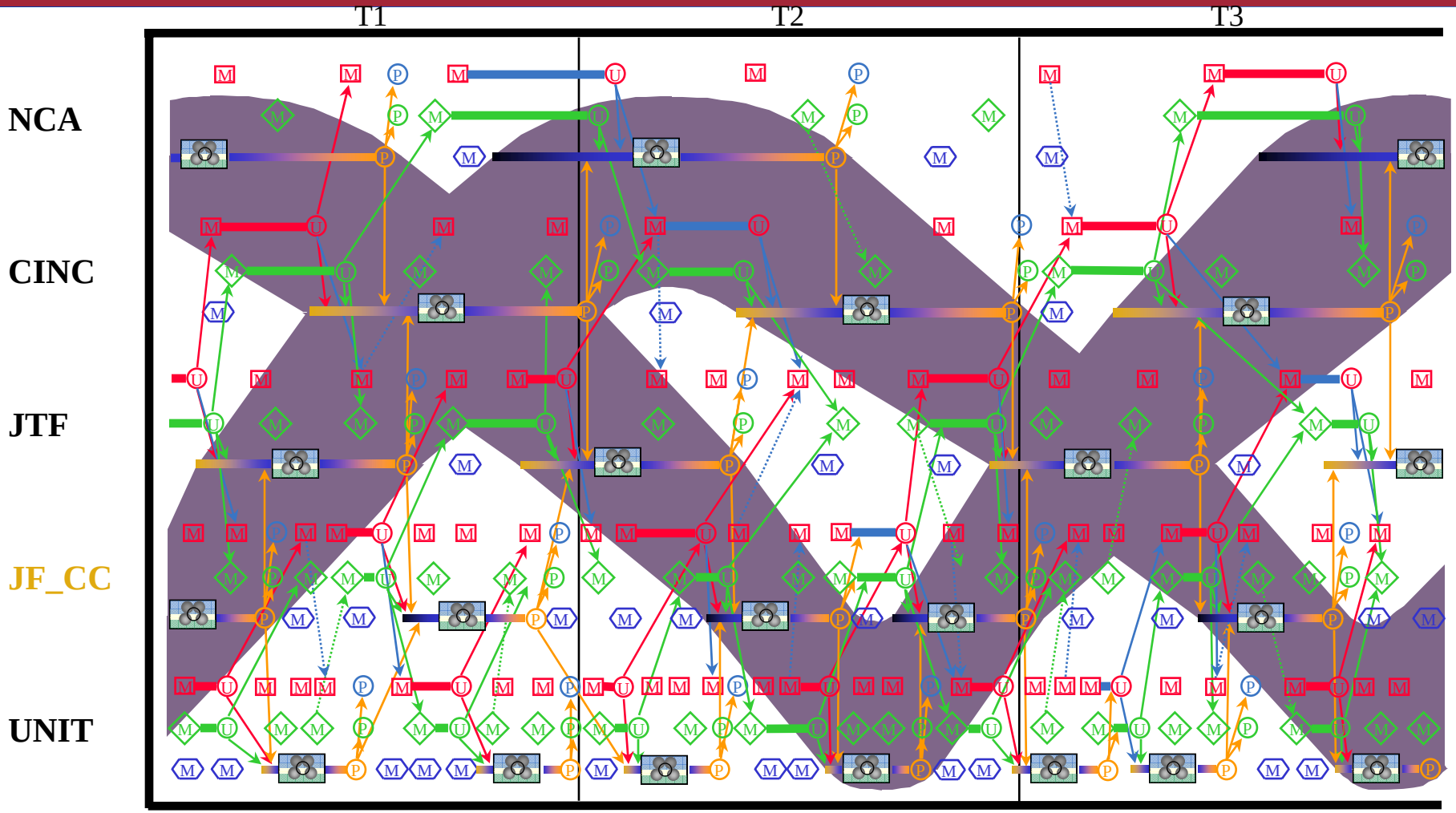


Figure 64. Historical Choices Among C2 System Philosophy

C2 Philosophy or Approach

- **Control Free** – initial intent, provide information and resources necessary for force elements to succeed
- **Selective Control** – establish initial conditions for success and then monitors for major threat/opportunity detection. (Assumes that subordinates respond promptly and effectively to new command intent.)
- **Problem Bounding** – missions offered to subordinates as problems (rich in contingencies and thin in detail)
- **Problem Solving** – specifying the objectives from operational headquarters (within constrains imposed by senior commanders)
- **Interventionist** – specific orders from theater level with changes at irregular intervals
- **Cyclic** – detailed orders from central command on a regular schedule

Joint Hierarchical and Cyclical Operational Activity Model



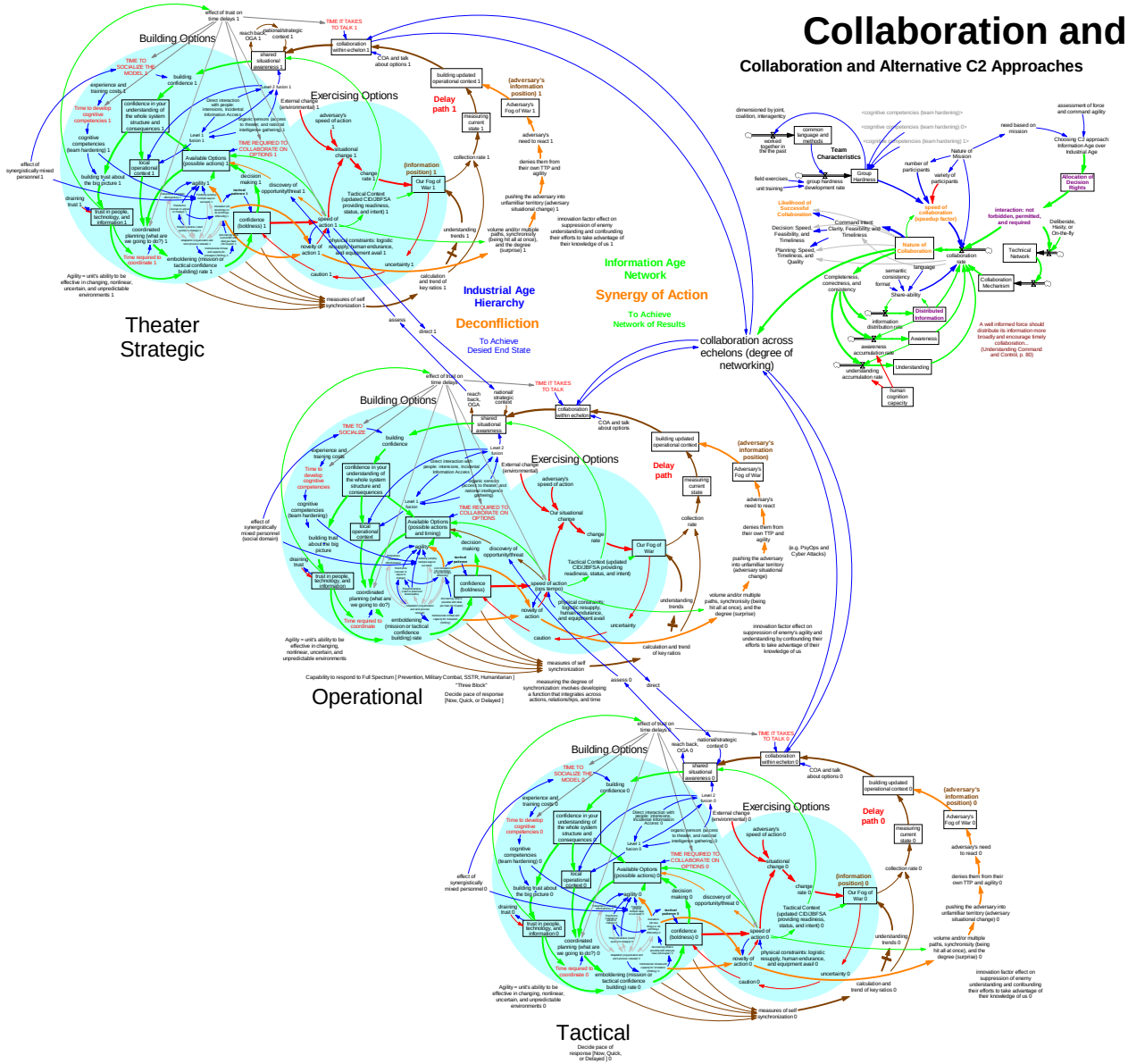
Legend

- M - Intelligence Monitoring
- M - Logistical Monitoring
- M - C2 Monitoring
- - Intelligence Fusion
- - Logistical Fusion
- ····➤ - Spot Reports
- U - Intelligence Understanding
- U - Logistical Understanding
- P - Intelligence Plan
- P - Logistical Plan
- P - C2 Plan
- - C2 Fusion Process
- - C2 Planning Process
- - OODA Loop

Information Delays Drive Oscillations

- **Goal**
  - **Tell the same story outlined in the previous slides (taken from Understanding Information Age Warfare) using causal loop diagrams**
- **Discovery**
  - **The longer the information delays (collaboration, coordination, and communication), the longer period of oscillation**
- **Insight**
  - **Delays are central to the behavior of the system**
- **Recommendation**
  - **Come to an understanding of the sources and consequences of information delays both within and among echelons**

Net-Enabled Command Capability is Coordination Across Echelons



Collaboration and Alternative C2 Approaches

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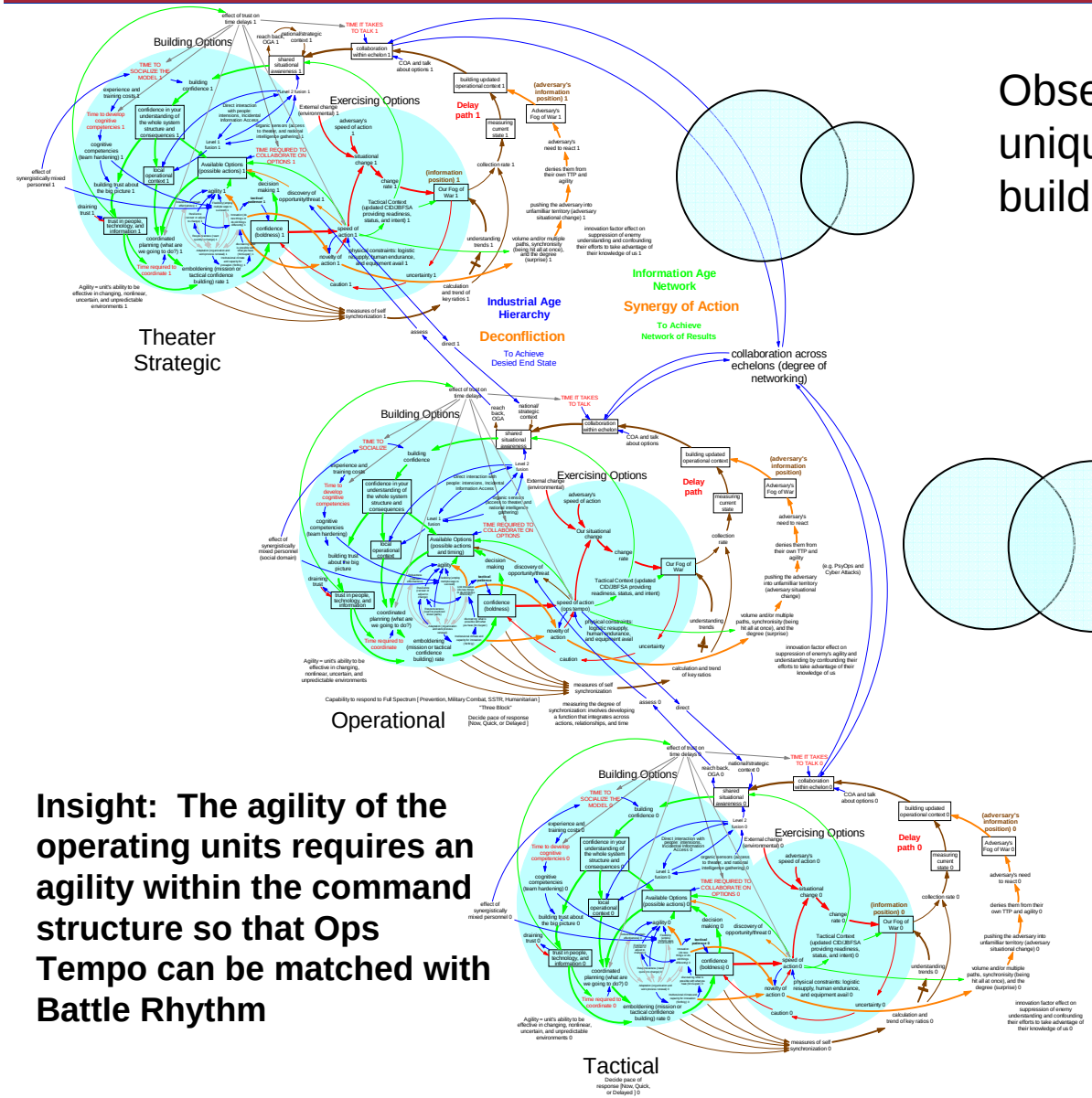
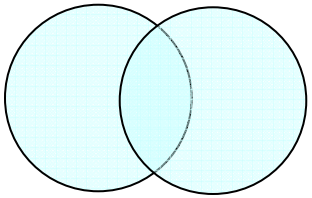
Exploring the importance of Agility

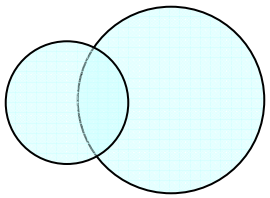


Observation: Each layer has a unique balance between building and exercising options

Discovery: This dictates differences in time delays to perform a function



Insight: To maintain momentum, the regeneration of options becomes the constraint



Insight: The agility of the operating units requires an agility within the command structure so that Ops Tempo can be matched with Battle Rhythm

Agility in Context

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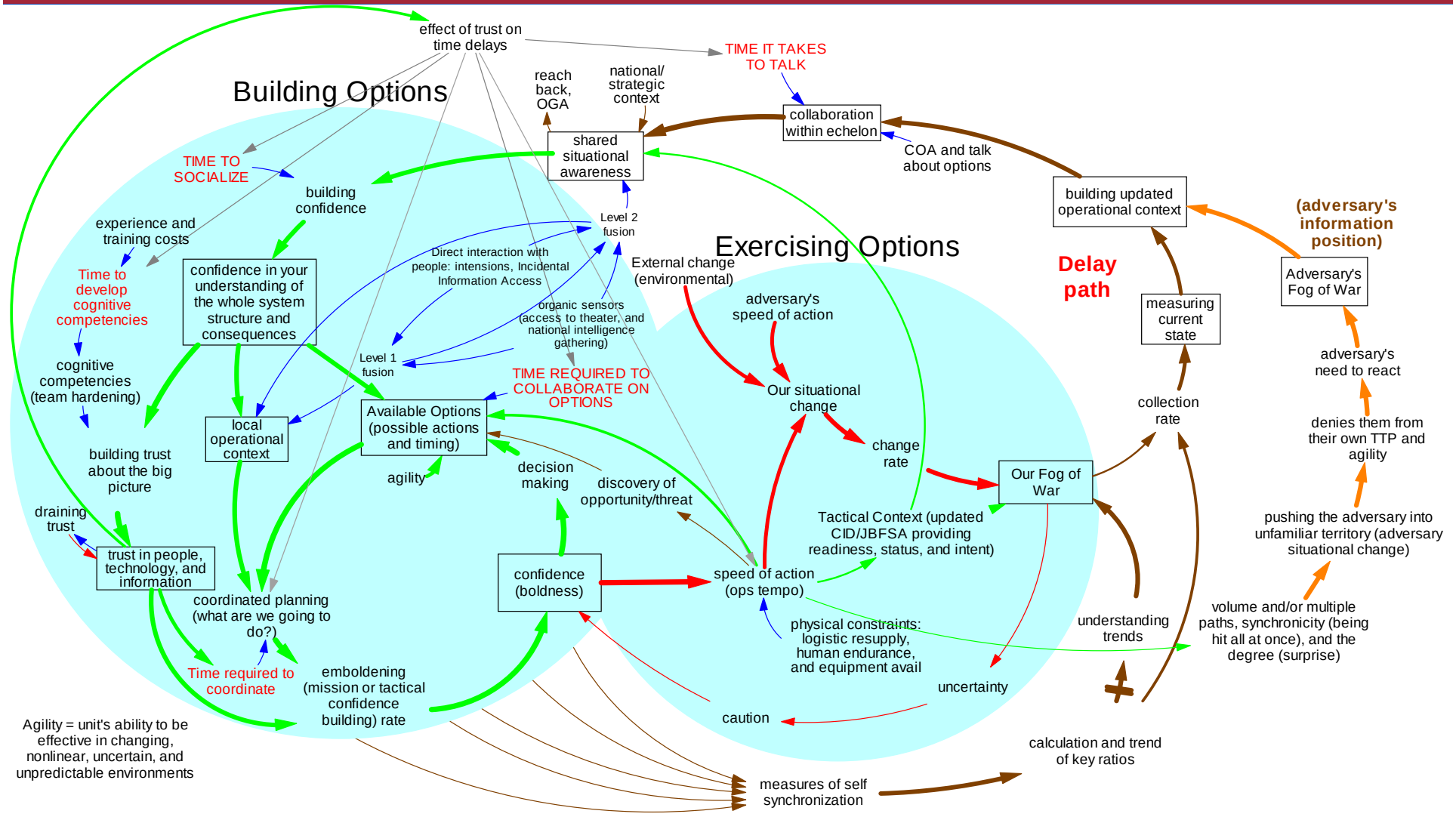
NCO Op's Analysis



Operational

Agility in Focus

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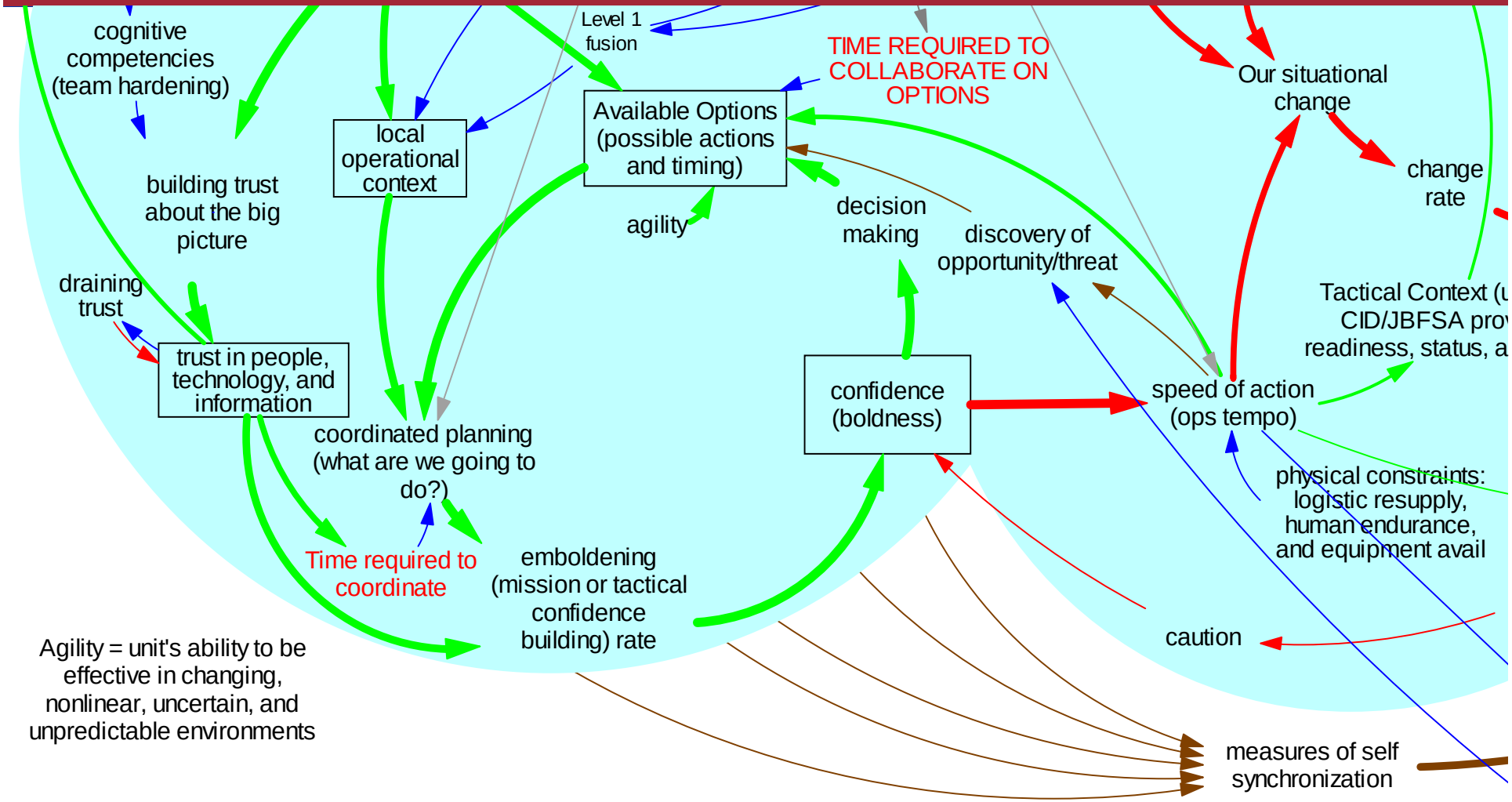
NCO Op's Analysis



Operational

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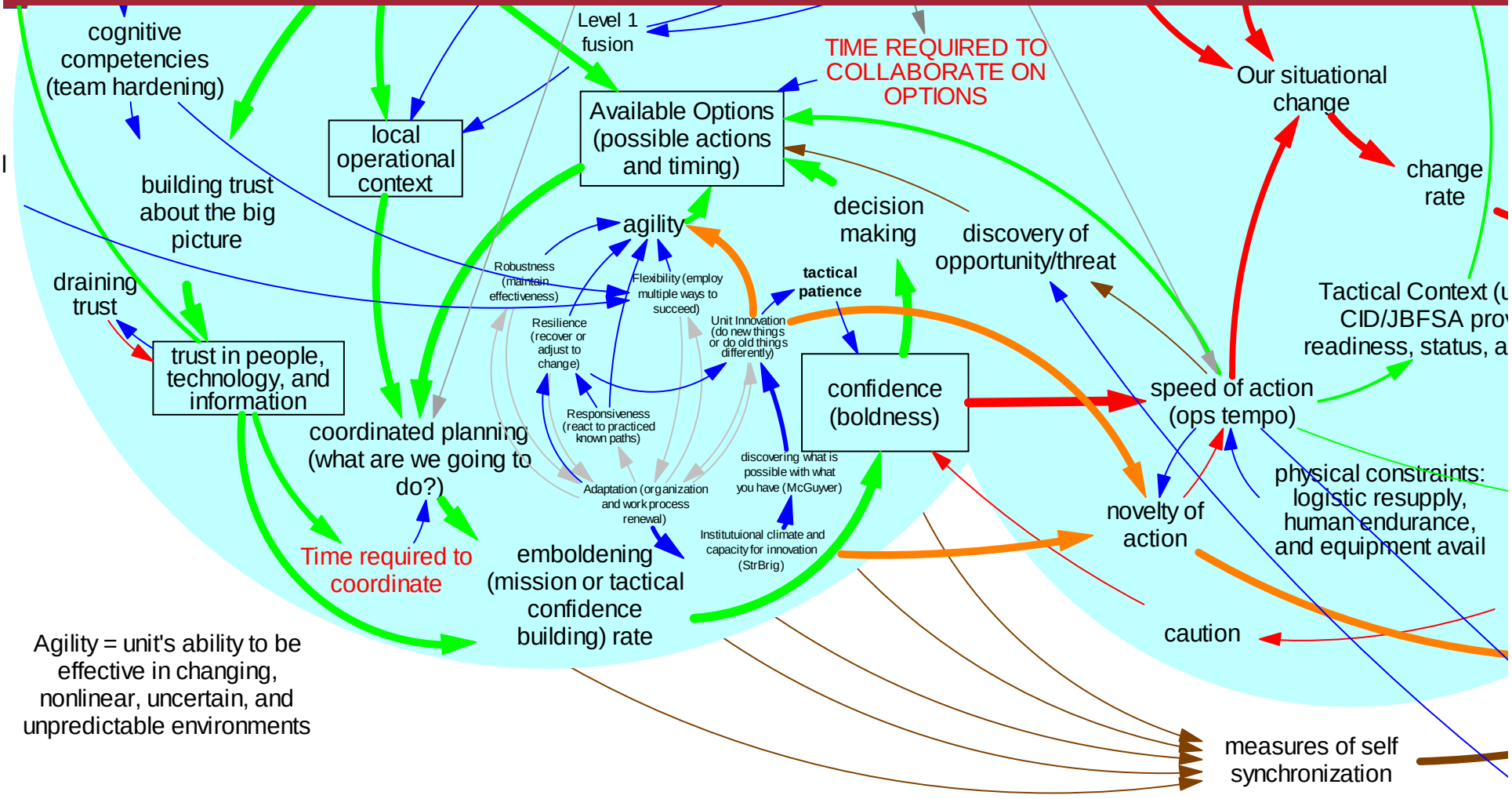


Agility = unit's ability to be effective in changing, nonlinear, uncertain, and unpredictable environments

Capability to respond to Full Spectrum [Prevention, Military Combat, SSTR, Humanitarian]

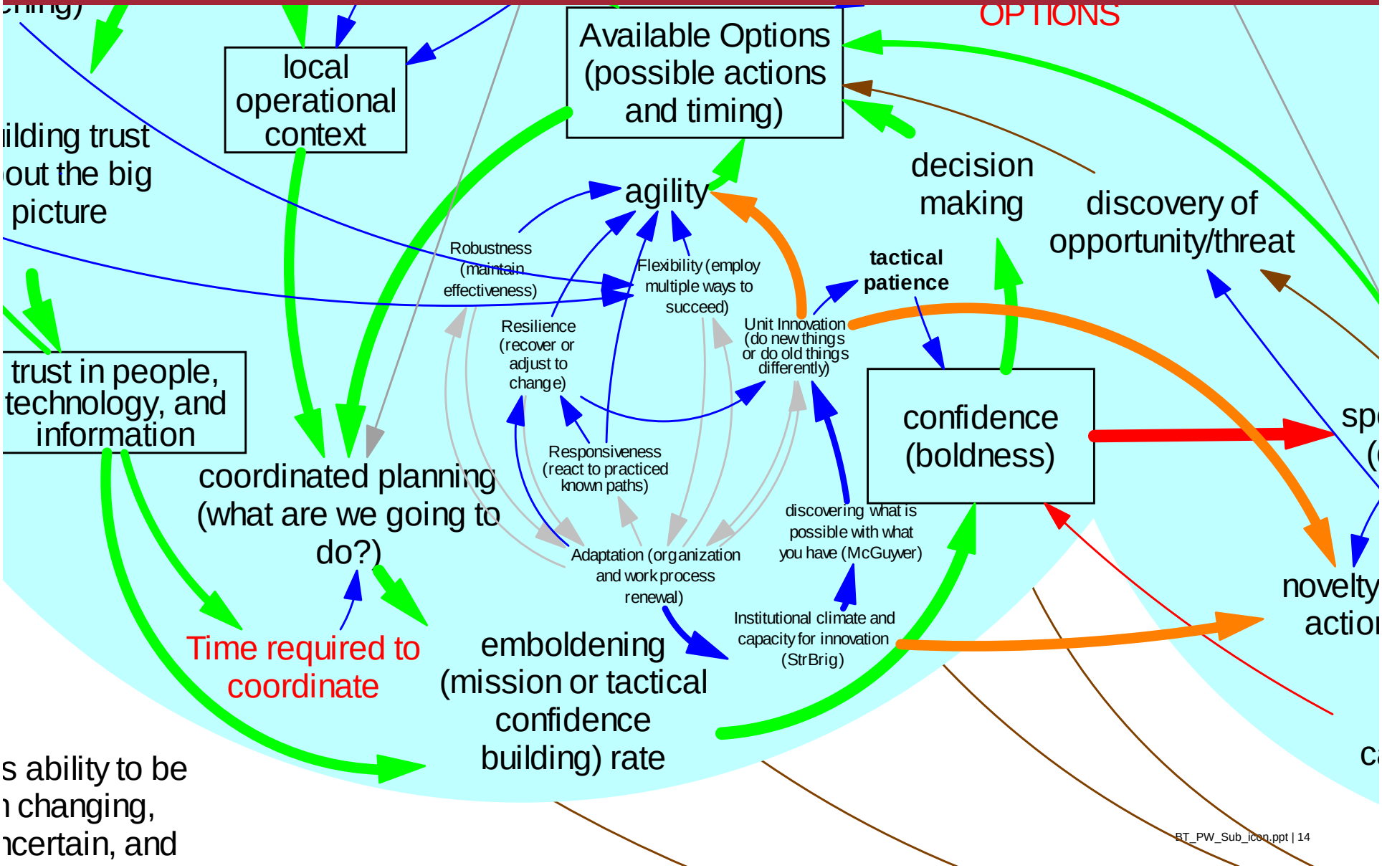
"Three Block"

Decide pace of response [Now, Quick, or Delayed]

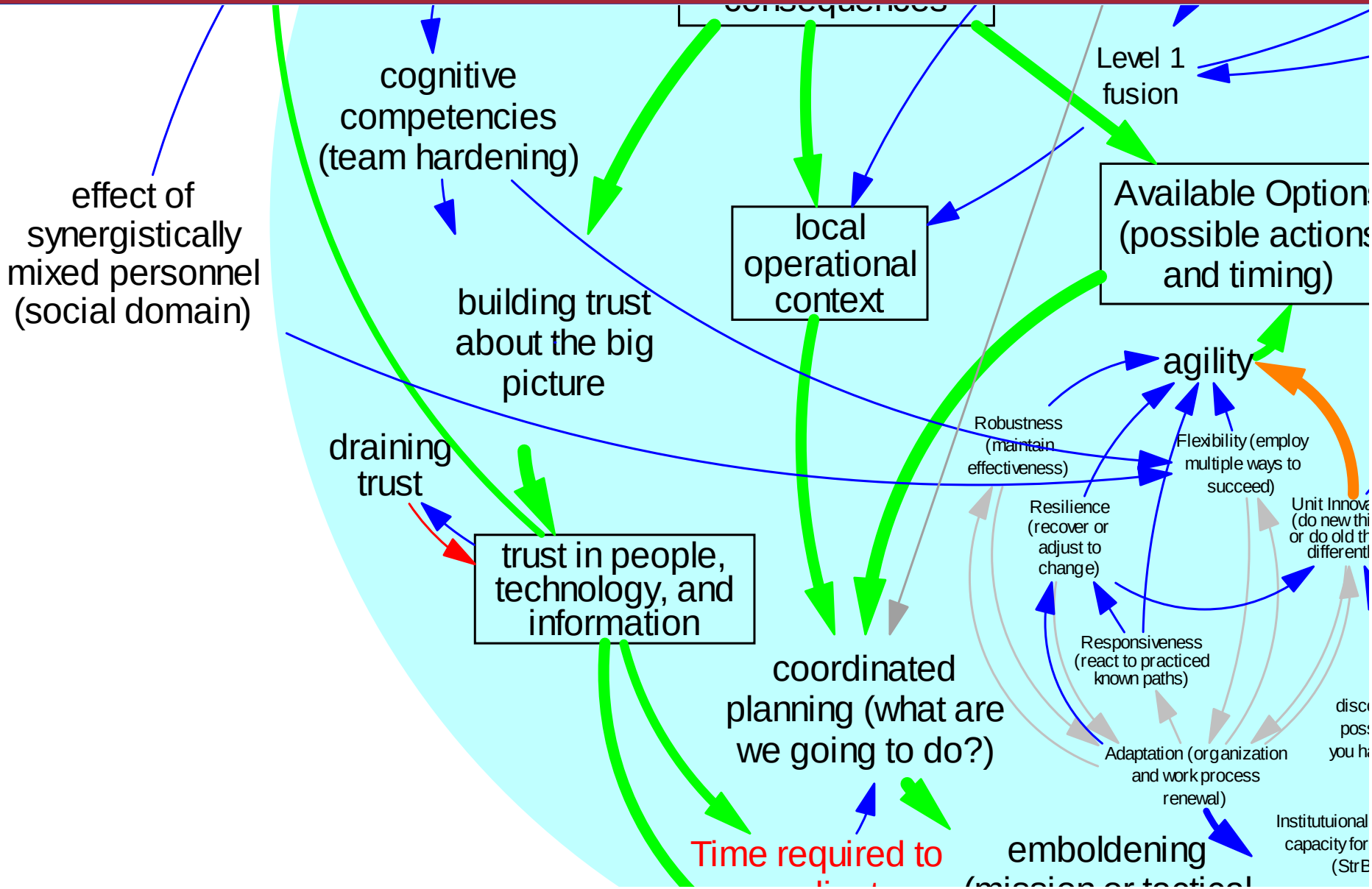
measuring the degree of synchronization: involves developing a function that integrates across actions, relationships, and time

Operational

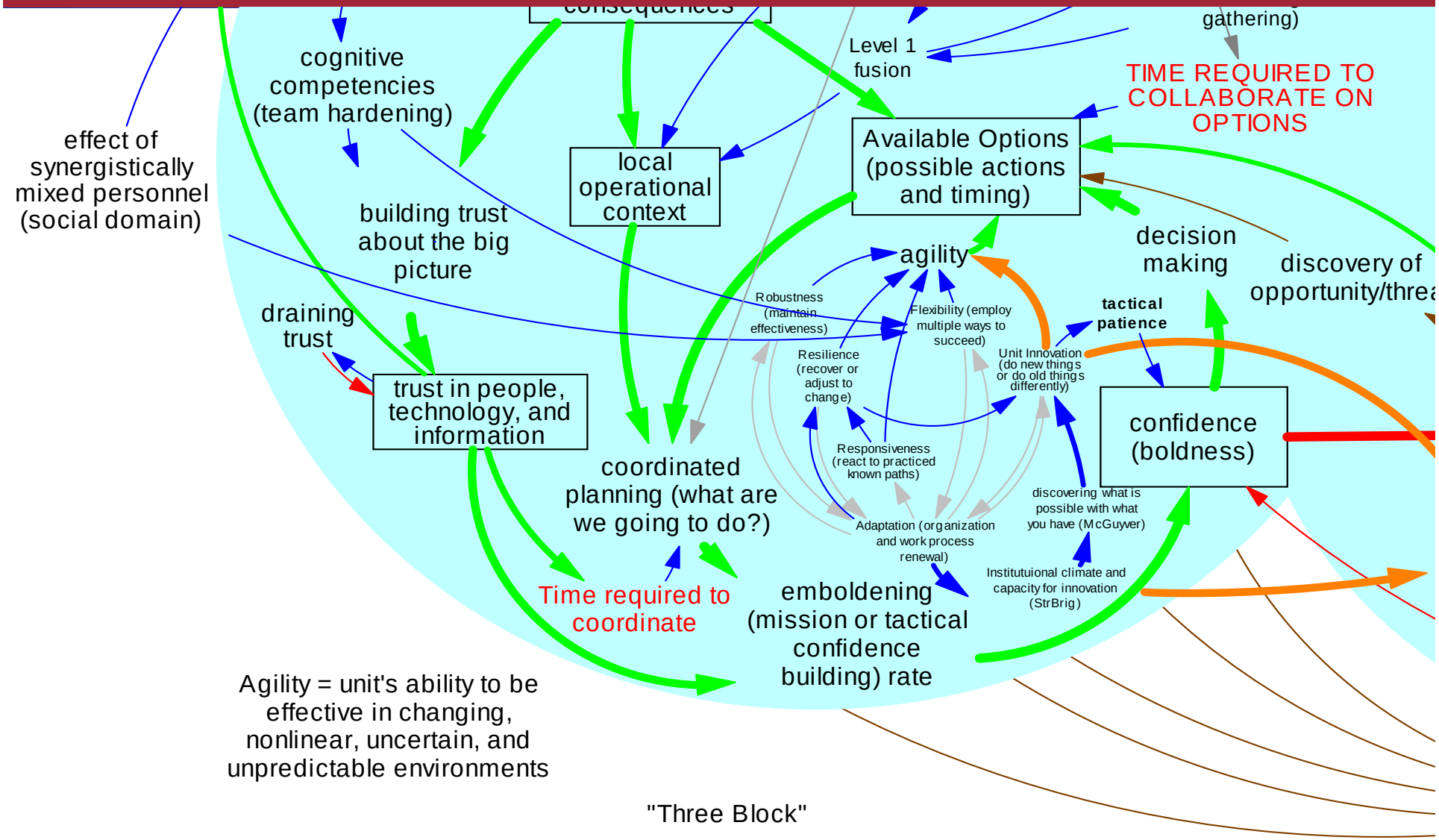
Agility: Characteristics and Influences



Social Diversity and Team Hardening



Social Diversity and Innovation Fuel Agility



"Three Block"

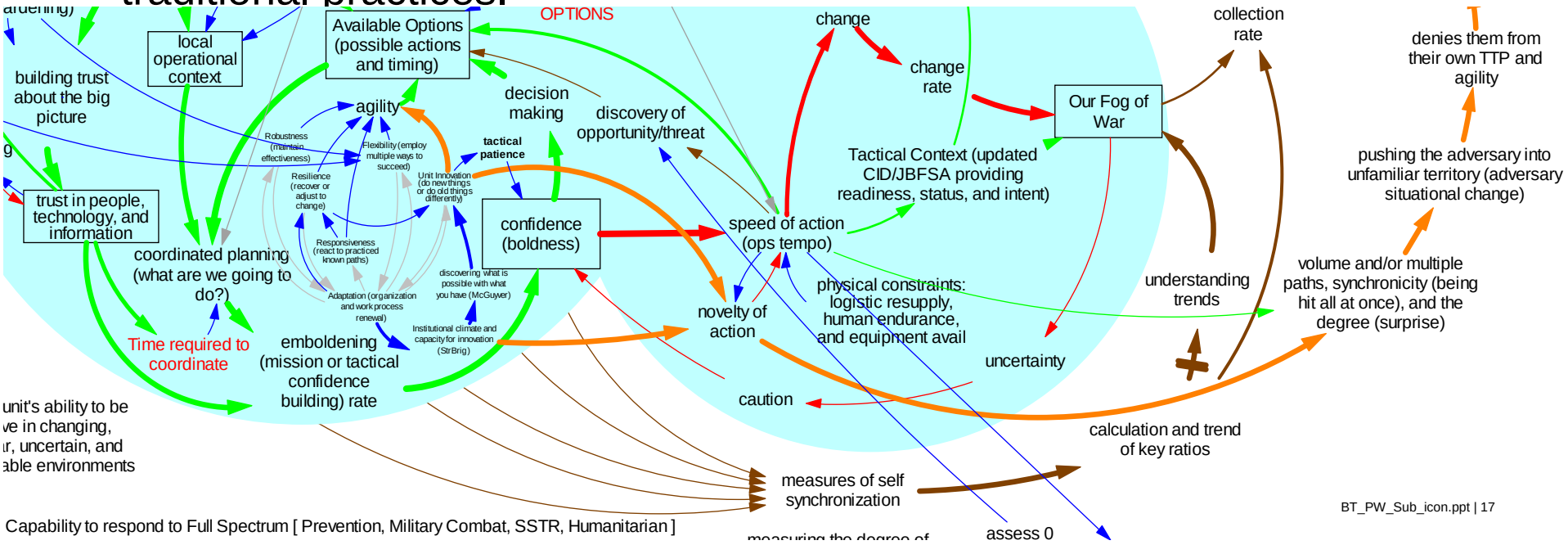
Capability to respond to Full Spectrum [Prevention, Military Combat, SSTR, Humanitarian]

Decide pace of response [Now, Quick, or Delayed]

Global Impact of Unit Innovation

- Observation: Agility is an essential for building, maintaining, and acting on options. Robustness, Resilience, Responsiveness, and Flexibility synergistically work toward increased agility. Adaptation and Innovation operate at a different time scale from the others.

- Discovery: Adaptation and Innovation unlike the others influence the novelty of action, which puts them into a class apart, and at odds with traditional practices.



Discovering Connectivity with Novelty of Action and Impact to Adversary

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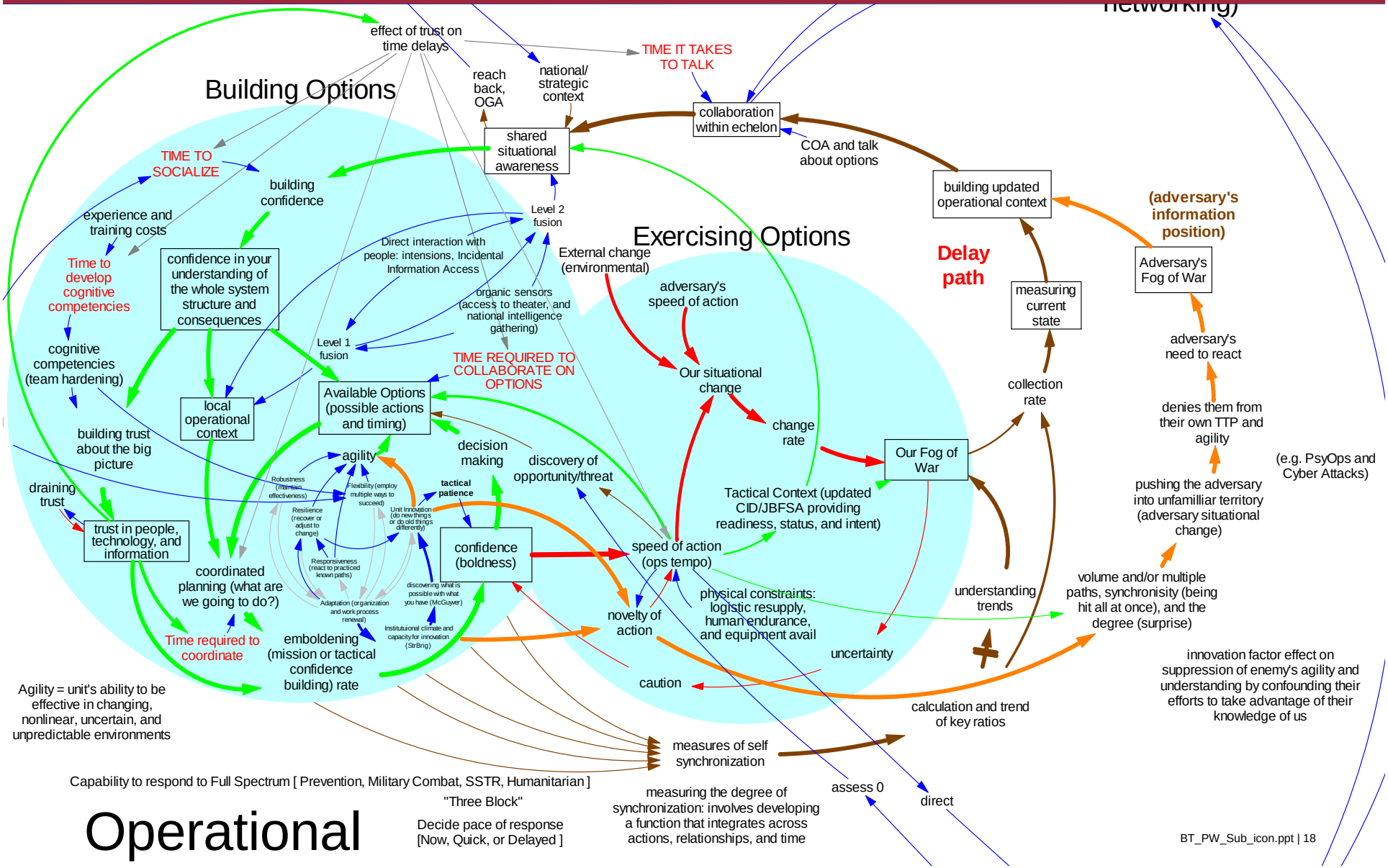
NCO Op's Analysis

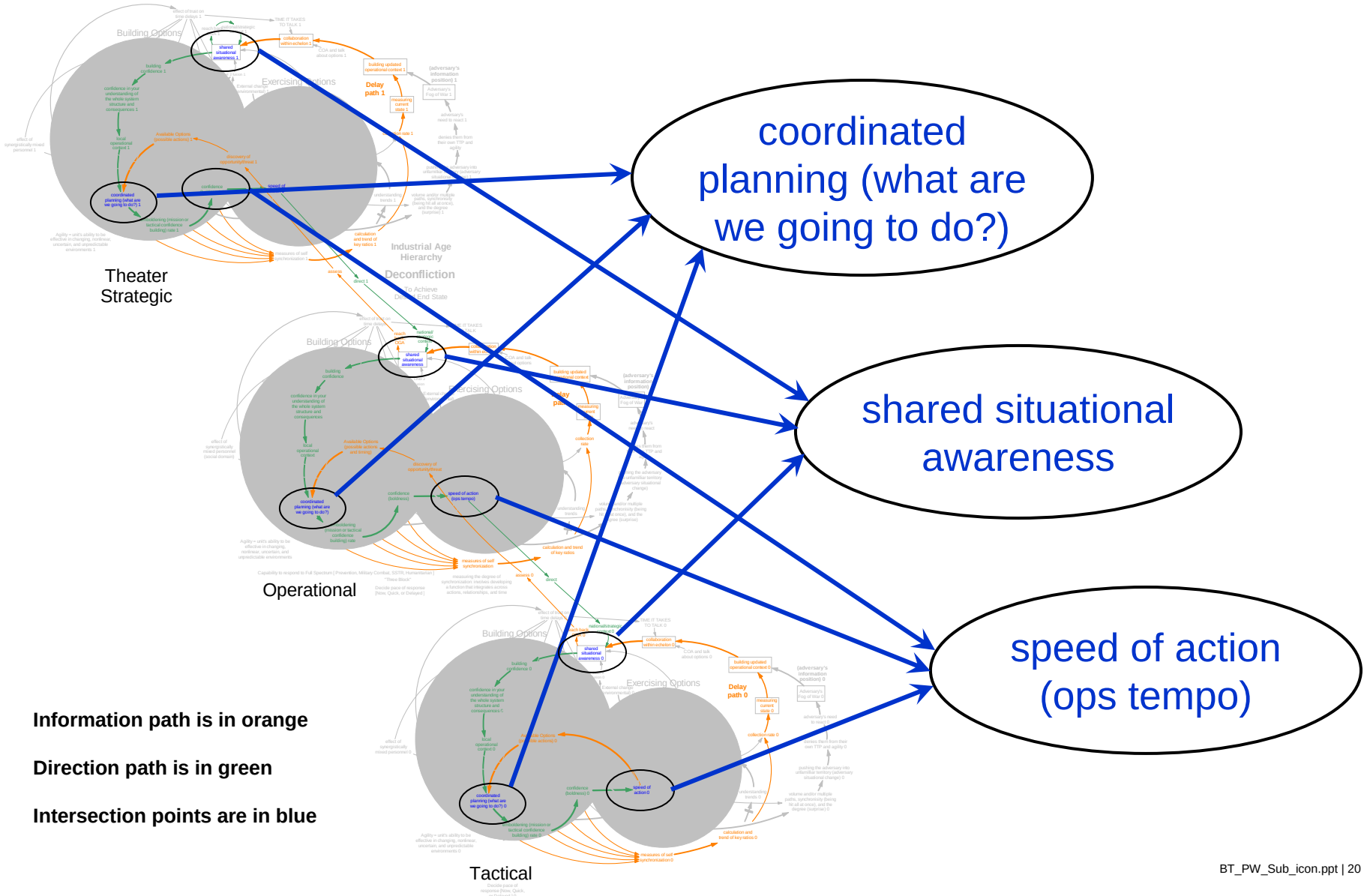


Self-Coordination

Some current military parlance employs the term self-coordination in place of self-synchronization. The DoD Transformational Planning Guidance issued in April 2003 defines self-coordination as an effort to "increase freedom of low level forces to operate near-autonomously and re-task themselves through exploitation of shared awareness and commander's intent." This definition is consistent with our concept of self-synchronization.

Rumsfeld, Donald H. Transformational Planning Guidance. Department of Defense. April 2003.

Confluence of Information and Direction



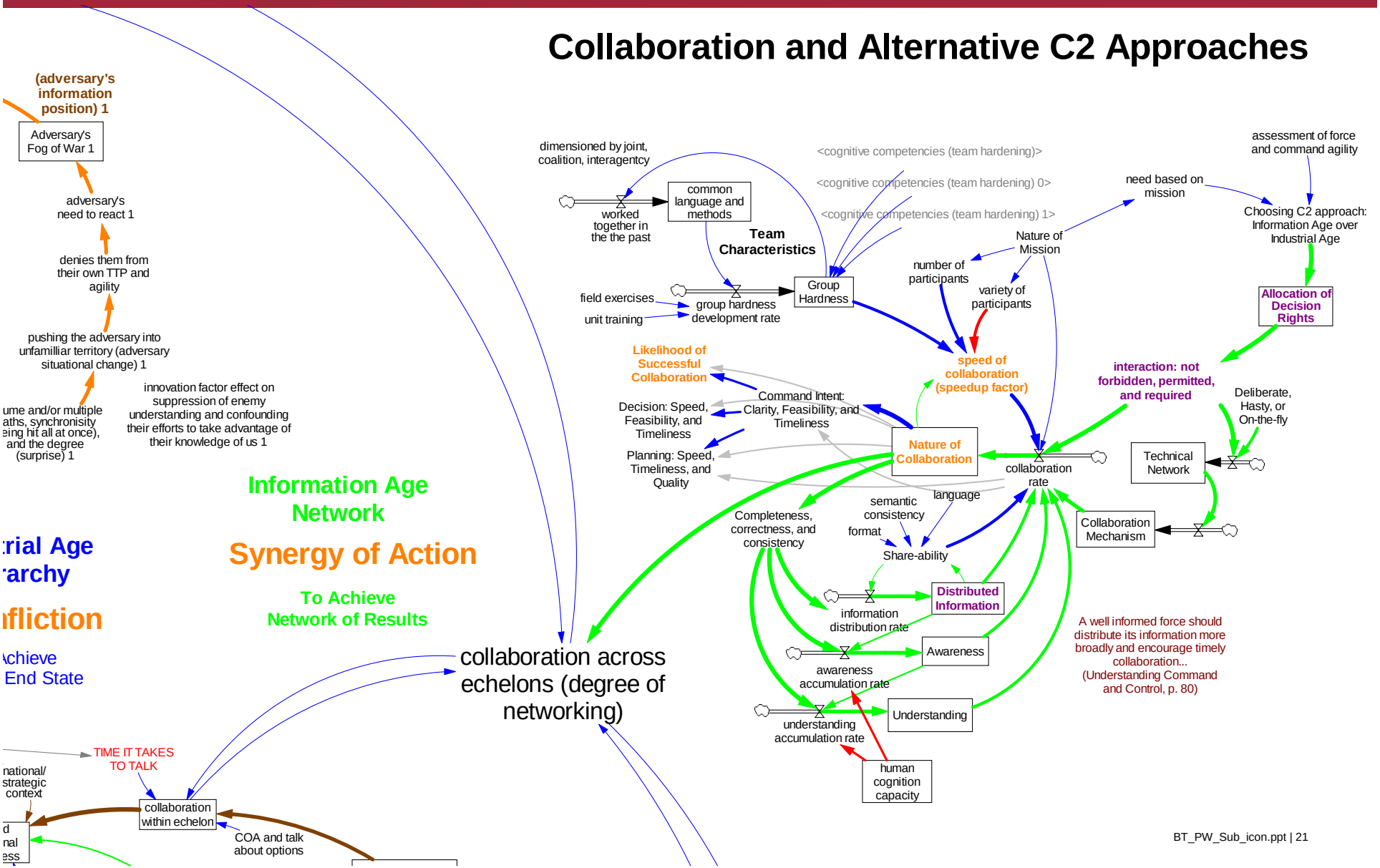
Information path is in orange

Direction path is in green

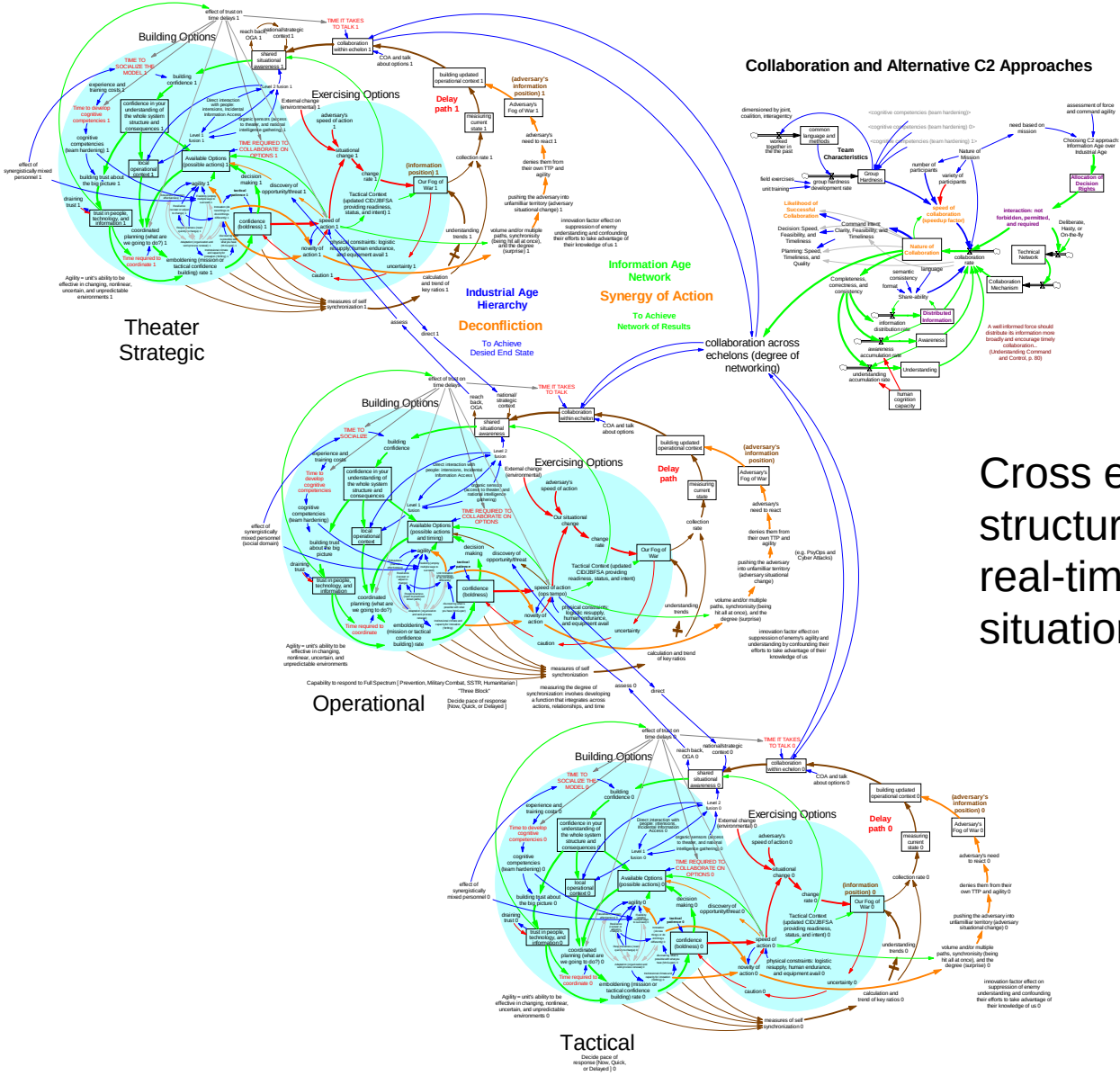
Intersection points are in blue

Collaboration and Alternative C2

Collaboration and Alternative C2 Approaches



Net-Enabled Command Capability is Coordination Across Echelons

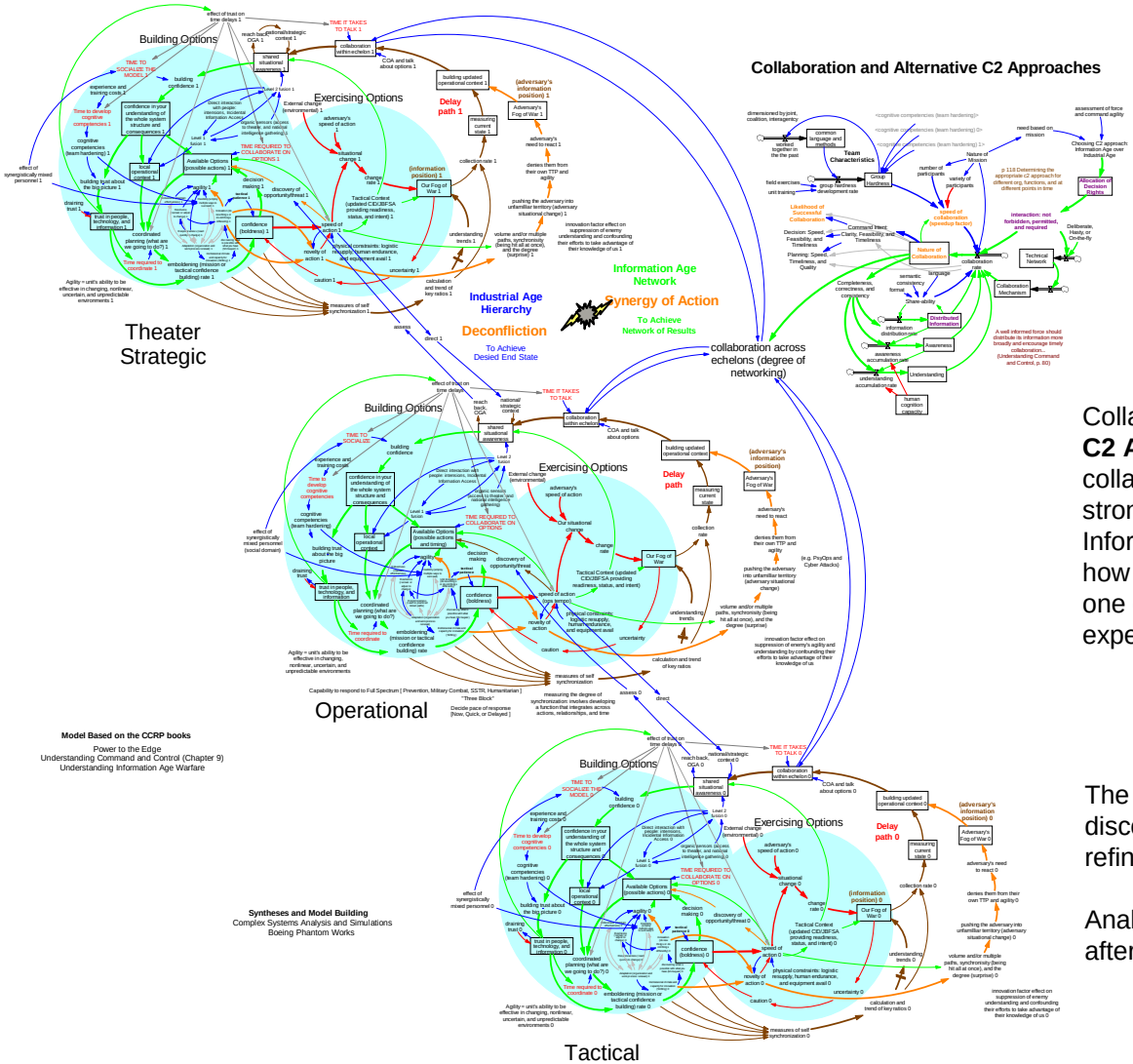


Cross echelon network structure results in near real-time shared situational awareness

Information age collaboration creates options for new and more effective C2 Approaches

Net-Enabled Command Capability is Coordination Across Echelons

Choosing a C2 Approach



Collaboration and C2

Collaboration…is one of the cornerstones of any **C2 Approach** and the extent and role of collaboration is one of the factors that most strongly differentiates Industrial Age from Information Age approaches. Research into how to best organize and use collaboration is one of the areas where future research and experimentation should focus. (pp. 185,186)

Exploring the knowledge landscape

The three purposes for experiments are discovery, hypothesis testing (preliminary and refined), and then demonstration. (pg. 73)

Analysis needs to take place before, during, and after the conduct of each experiment. (pg. 76)

Collaboration Differentiates C2

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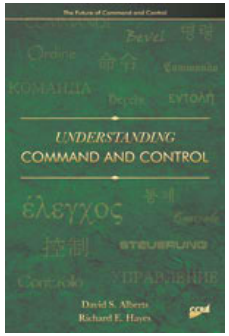

Campaigns of Experimentation – Value of System Dynamics

Exploring the knowledge landscape

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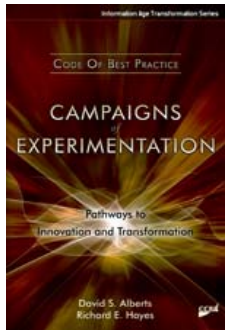
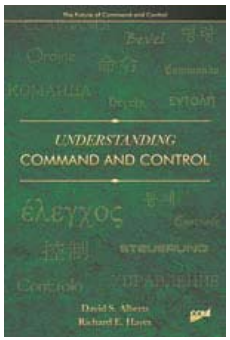


Capturing the Knowledge

These networks of influence could be used as the basis for the experimentation and observation necessary to construct such influence models and capture them in formal tools such as System Dynamics … (pg 179)



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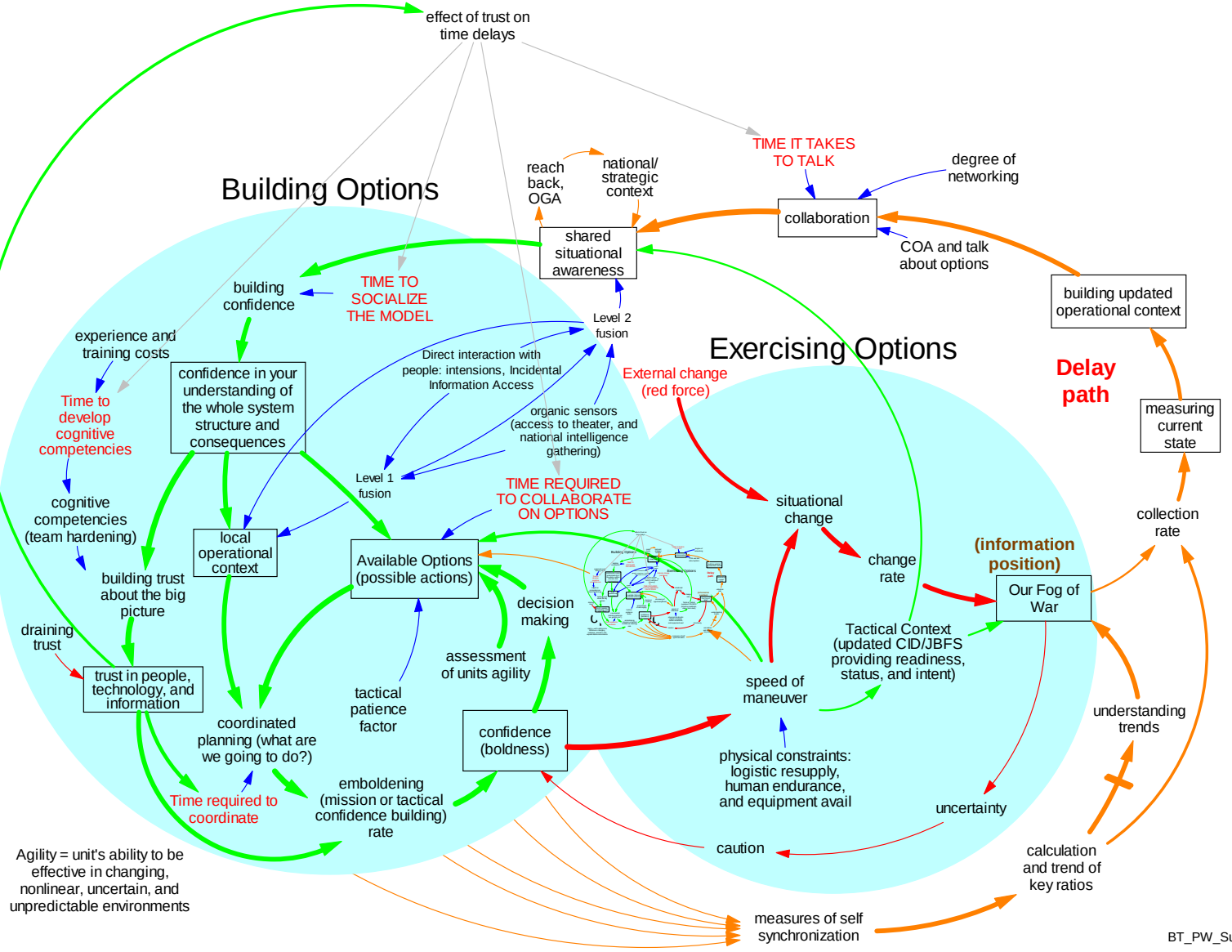
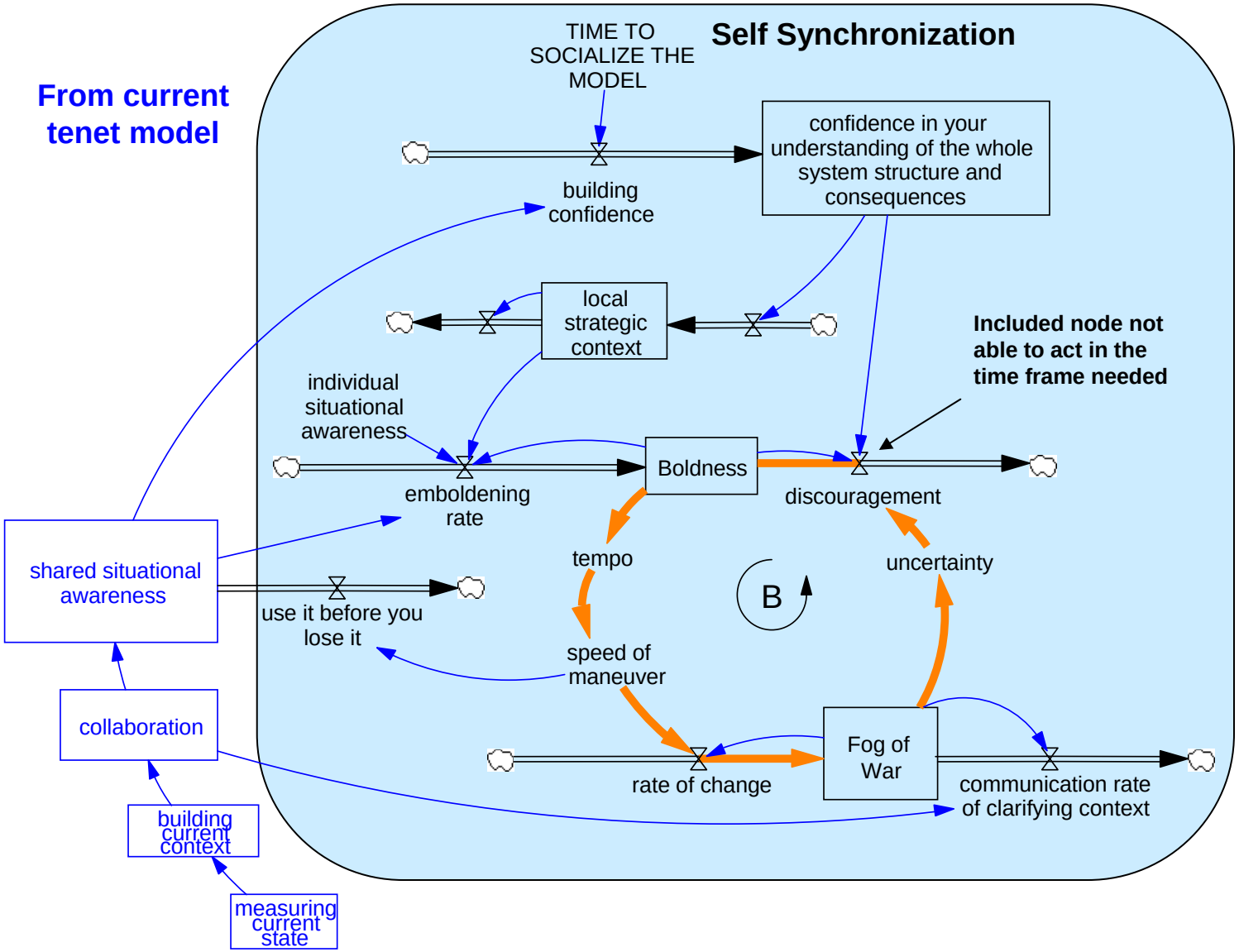
Backup Slides

Loop diagram with fractal definition

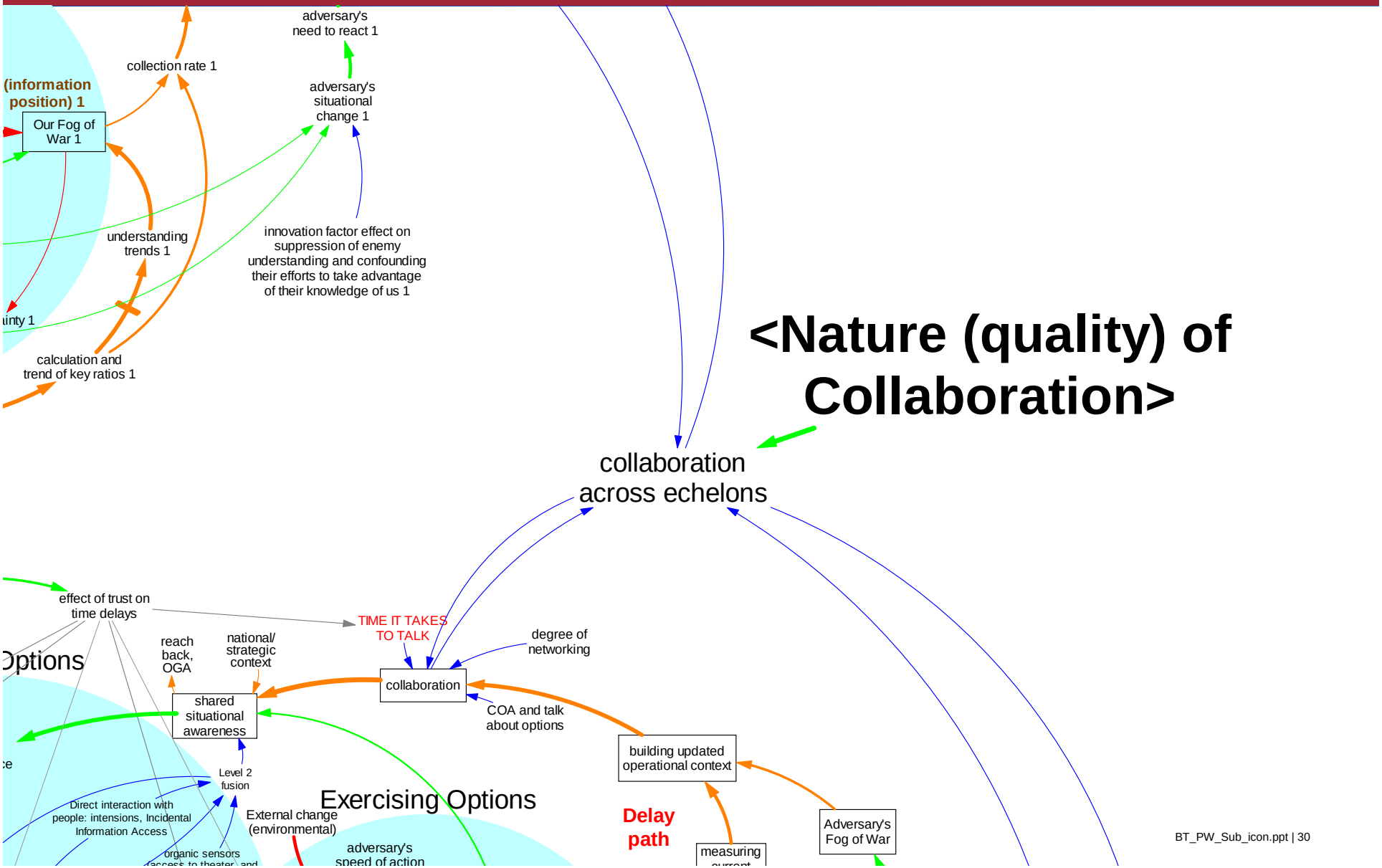


Self-Synchronization Tenet



Understanding the consequences and the perspective of the big picture...

Collaboration Drives Alternative C2 Approaches



Discovering Connectivity Among Echelons

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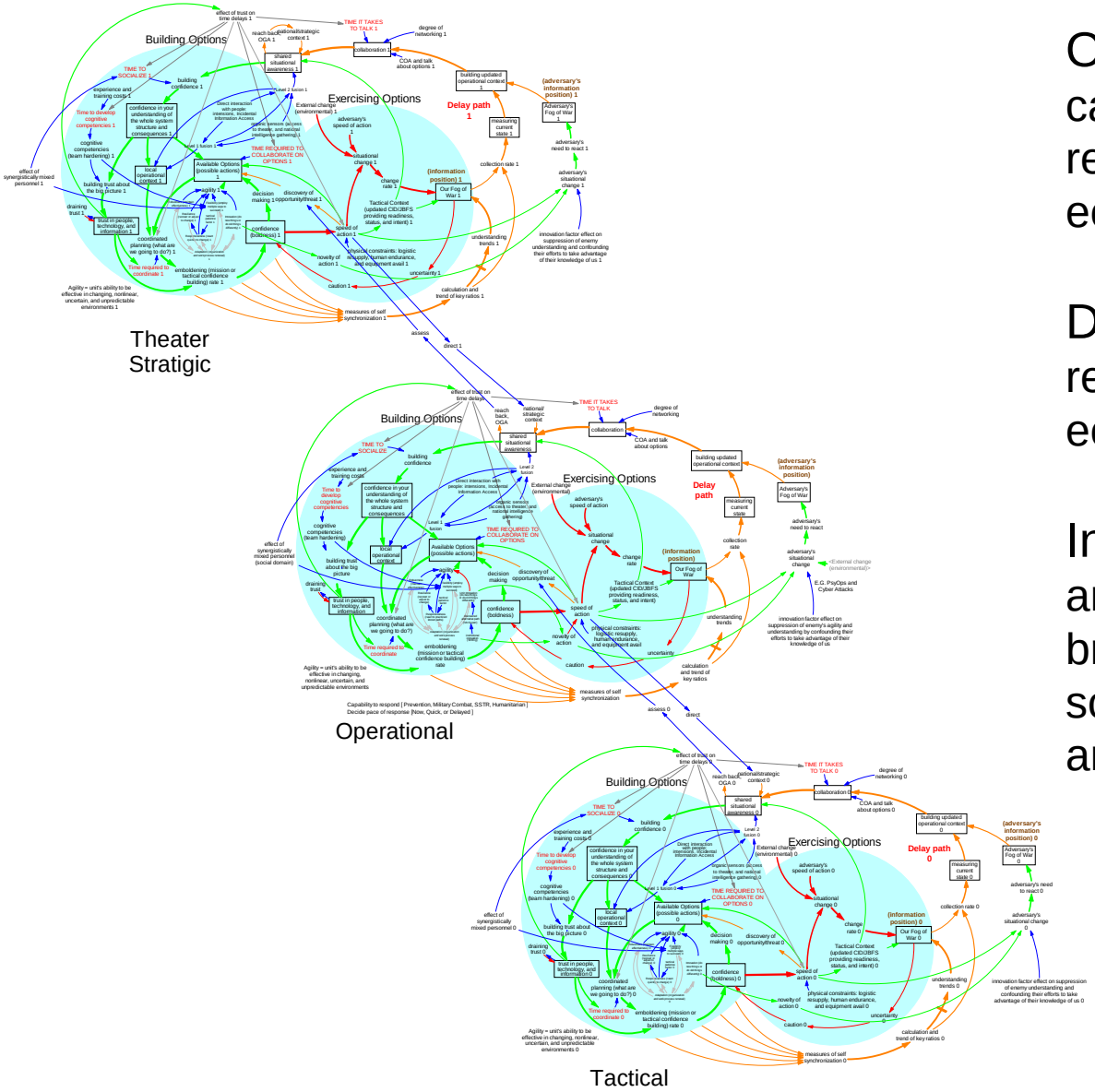
NCO Op's Analysis



Observation: Consistent stories can be told with defined relationships within and among echelons

Discovery: The same pattern of relationships exist at each echelon layer

Insight: Each echelon is analogous to the others with broadening or narrowing of scope, focus (mission definition and roles), and time horizon

Discovering Connectivity Among Echelons

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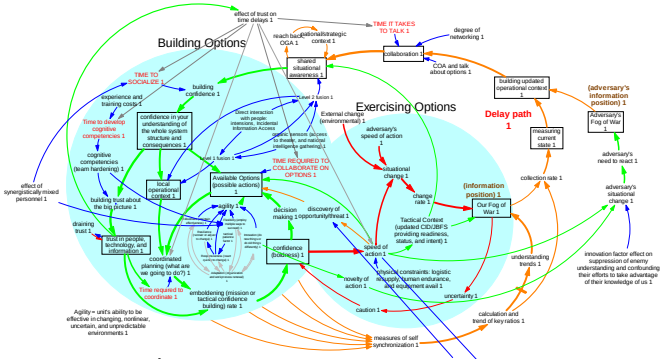
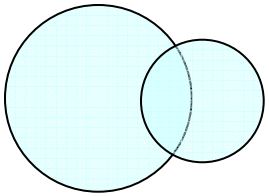


Theater Stratigic



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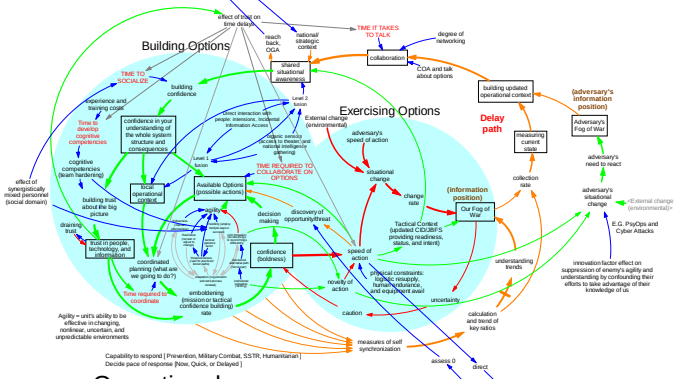
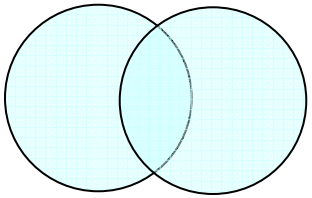


Operational



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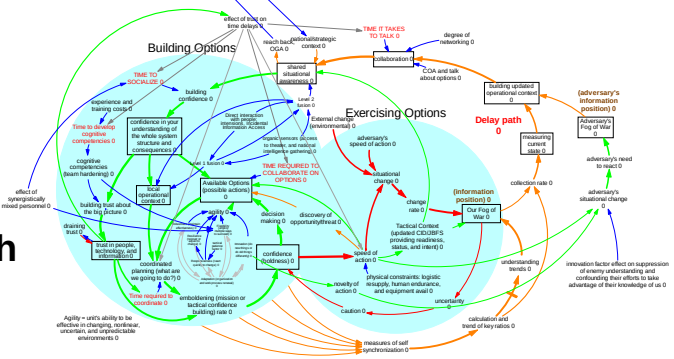
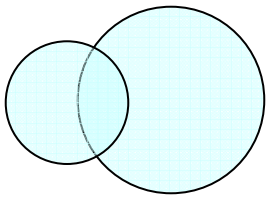
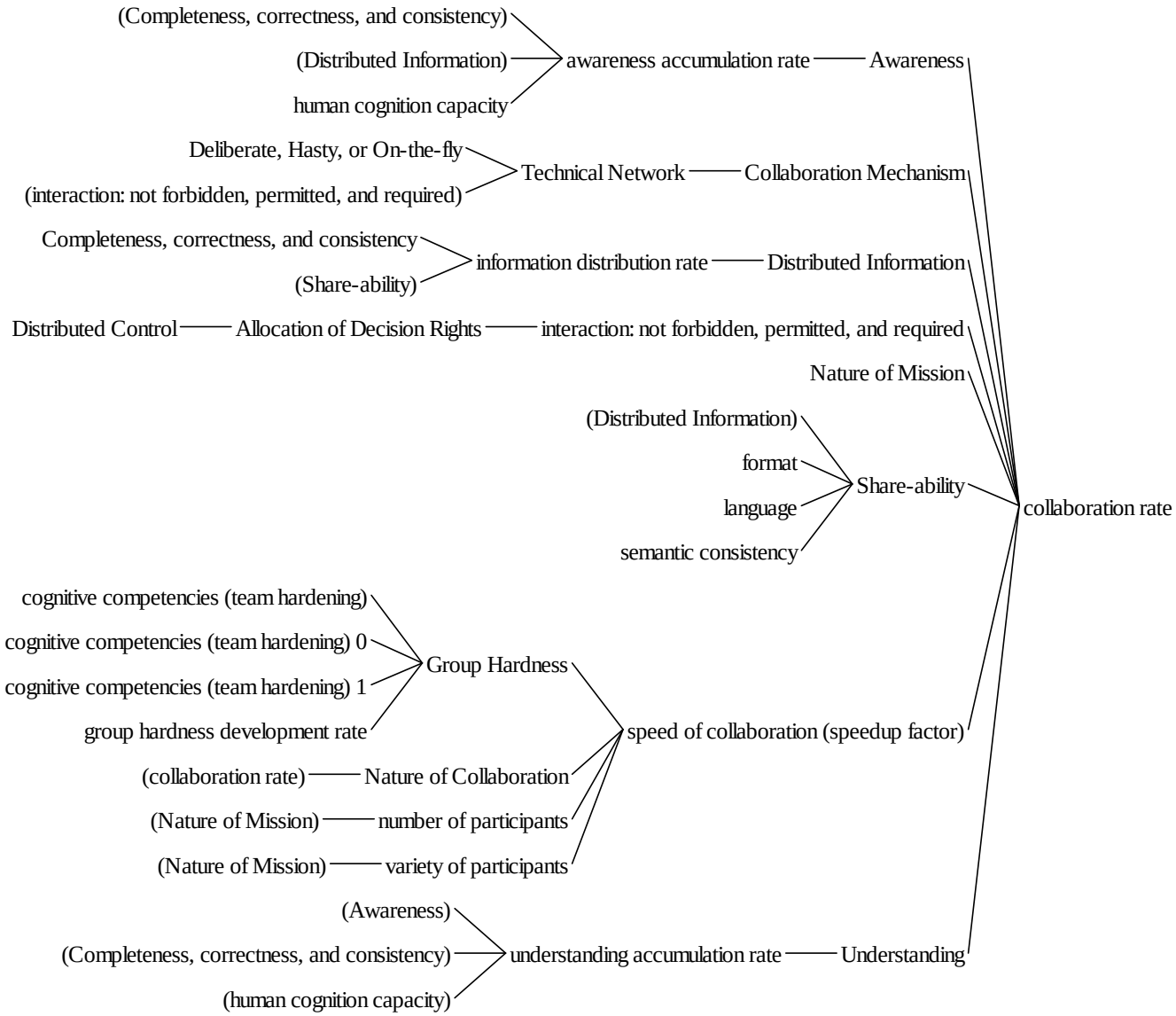


Tactical



Connectivity and Influence Analysis



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