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

CCRTS June 20 - 22, 2006

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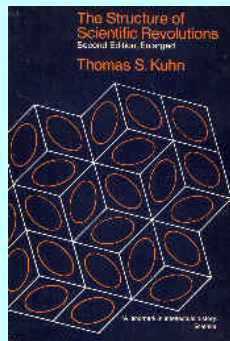


An Essential Tension Definition

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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

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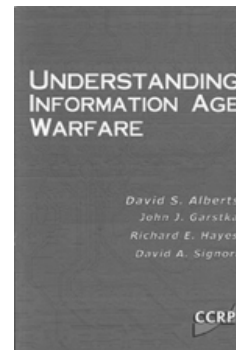
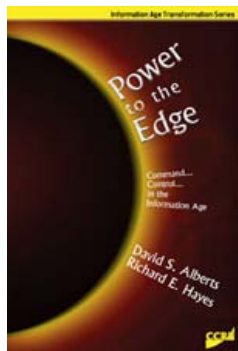
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Model Based on the CCRP books

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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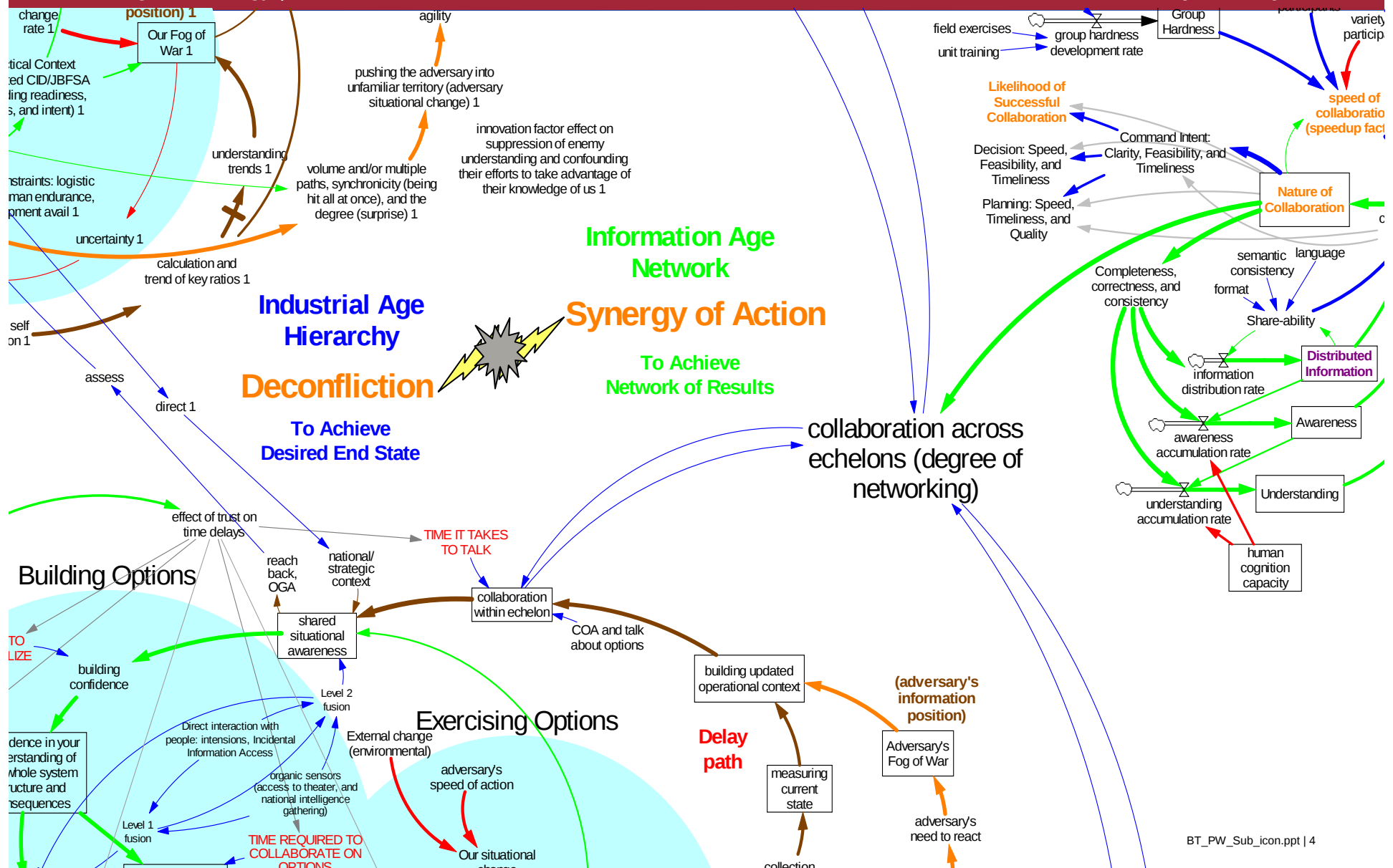




Essential Tension

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Choosing a C2 Alternative

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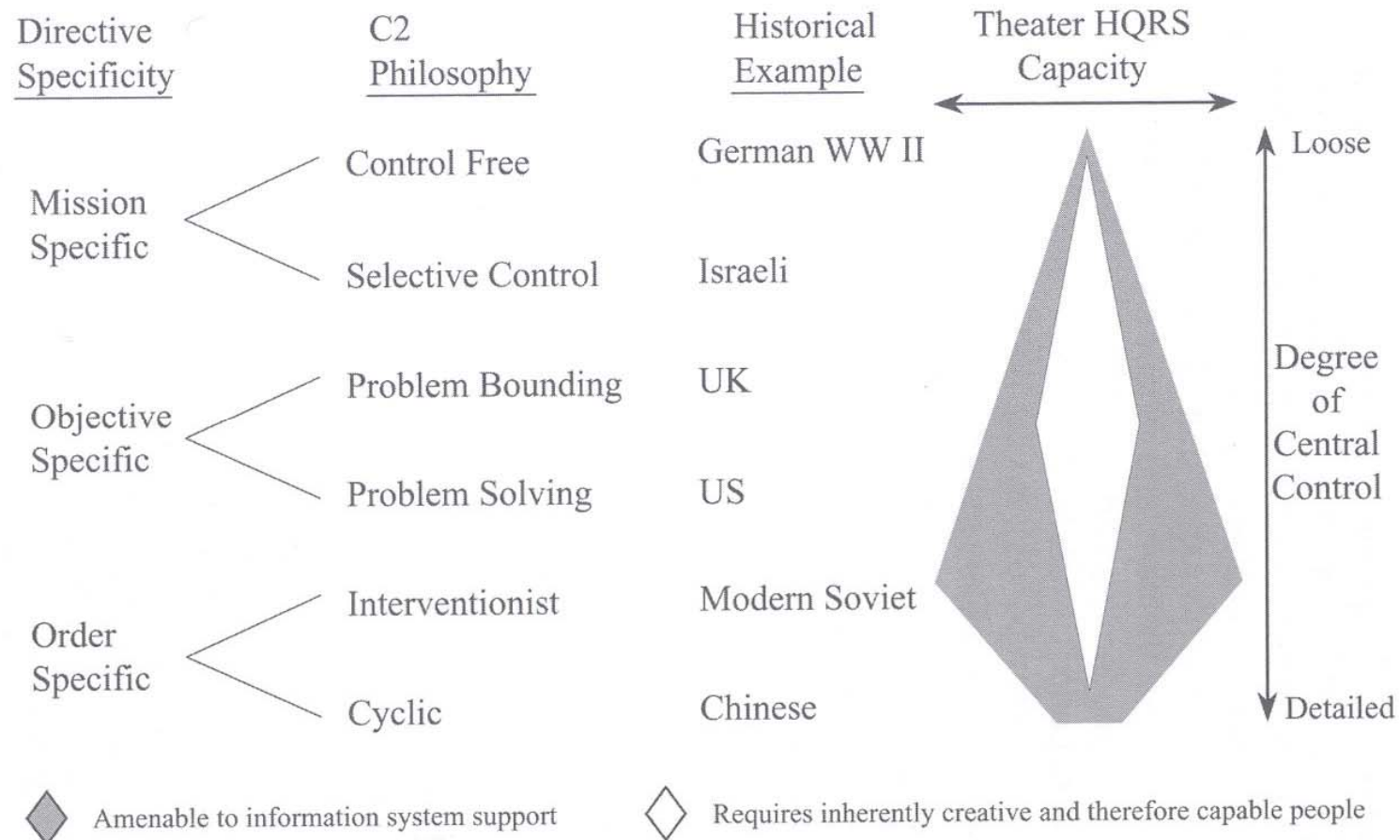


Figure 64. Historical Choices Among C2 System Philosophy



C2 Philosophy or Approach

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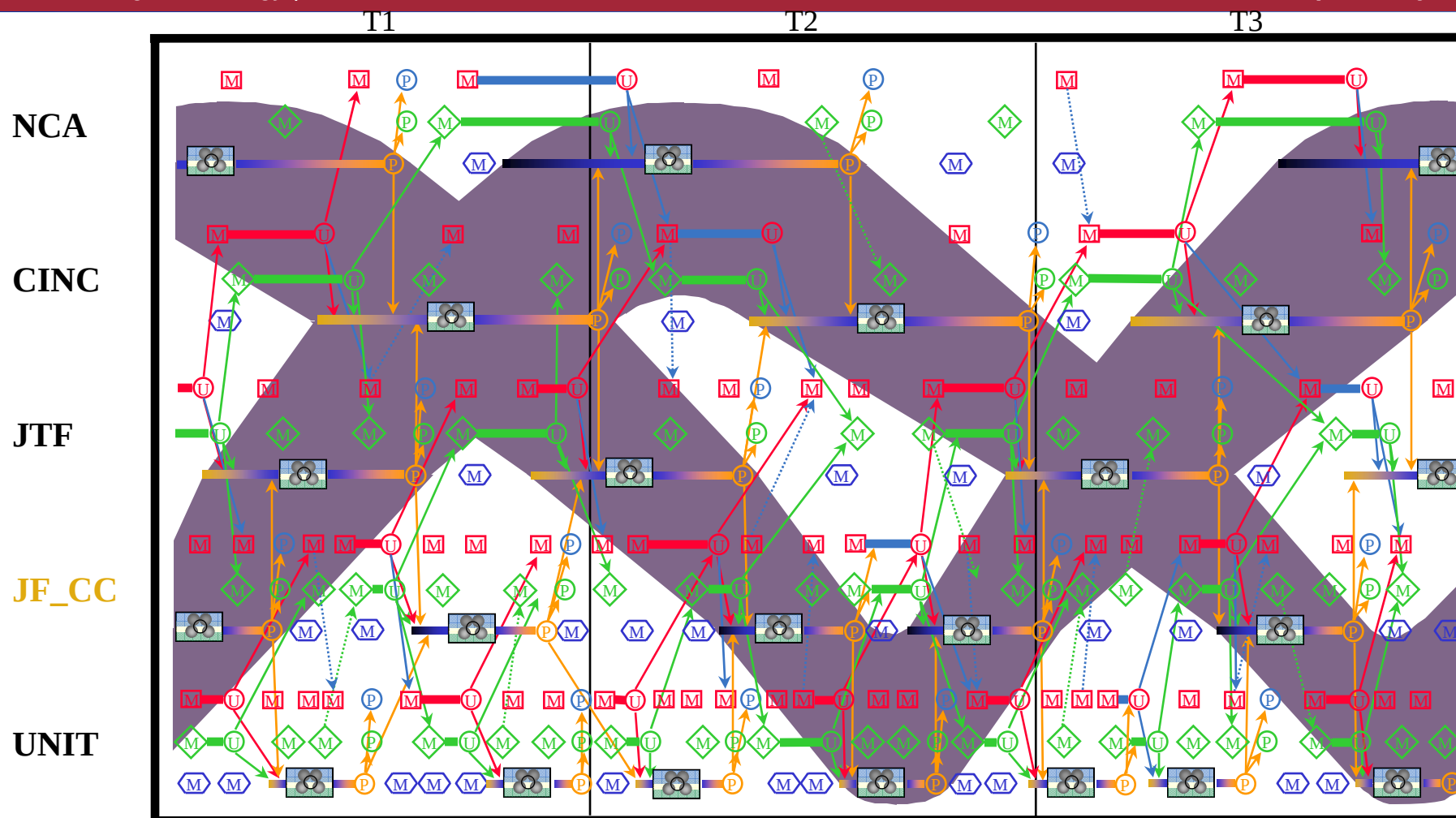
- **Control Free** – initial intent, provide information and resources necessary for force elements to succeed
- **Selective Control** – establish initial conditions for success and then monitors for major threat/opportunity detection. (Assumes that subordinates respond promptly and effectively to new 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 constraints 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



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Legend

- Intelligence Monitoring	- Intelligence Fusion	- Intelligence Understanding	- Intelligence Plan	- C2 Fusion Process
- Logistical Monitoring	- Logistical Fusion	- Logistical Understanding	- Logistical Plan	- C2 Planning Process
- C2 Monitoring	- Spot Reports		- C2 Plan	- OODA Loop



Information Delays Drive Oscillations

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- **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

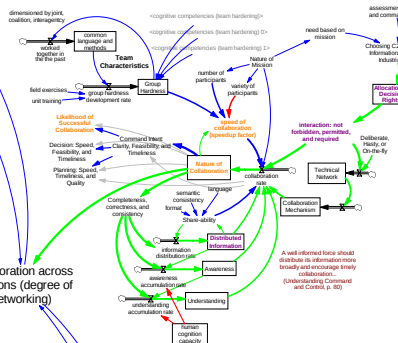


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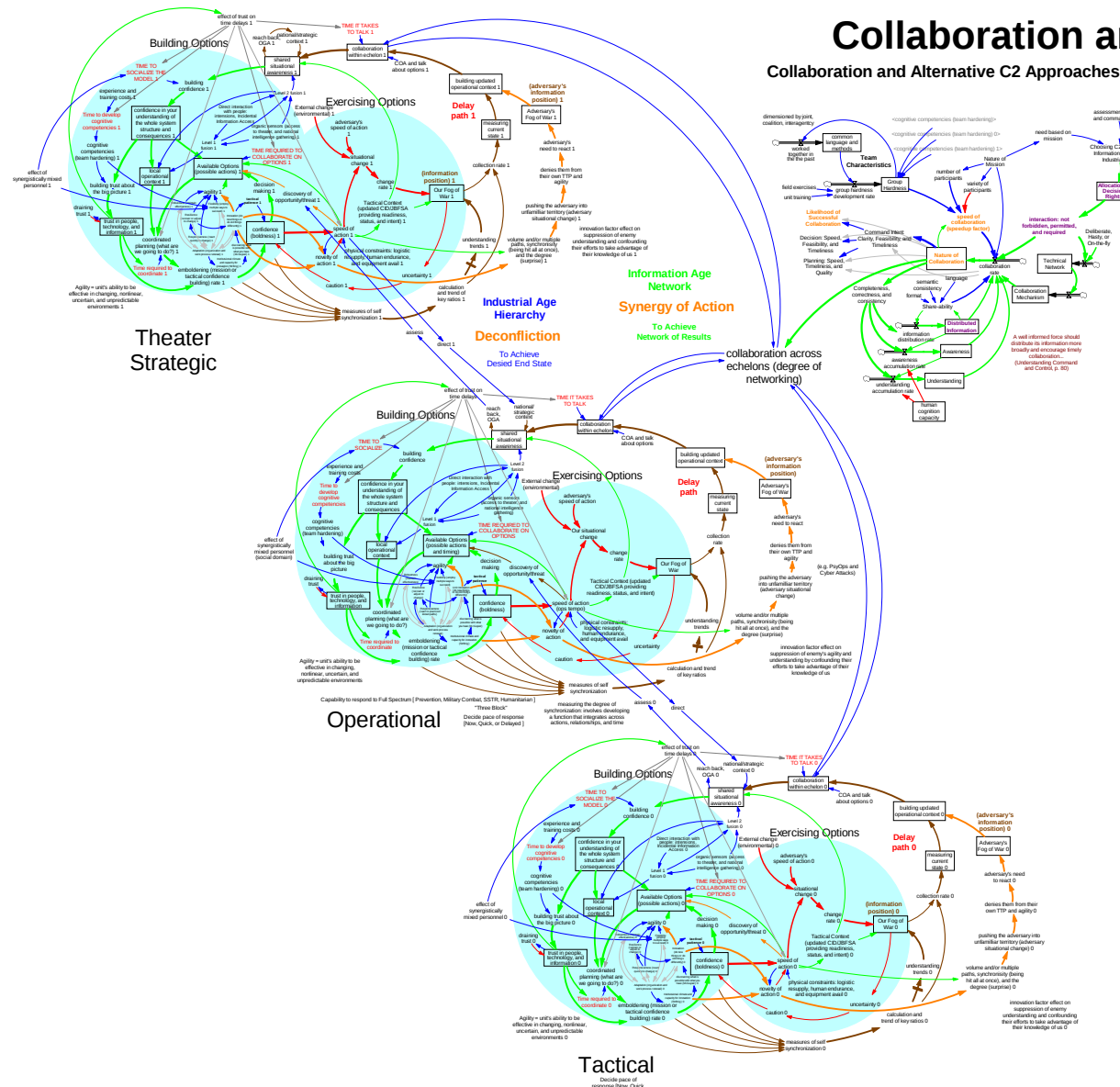
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Collaboration and Alternative C2 Approaches

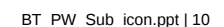
Collaboration and Alternative C2 Approaches



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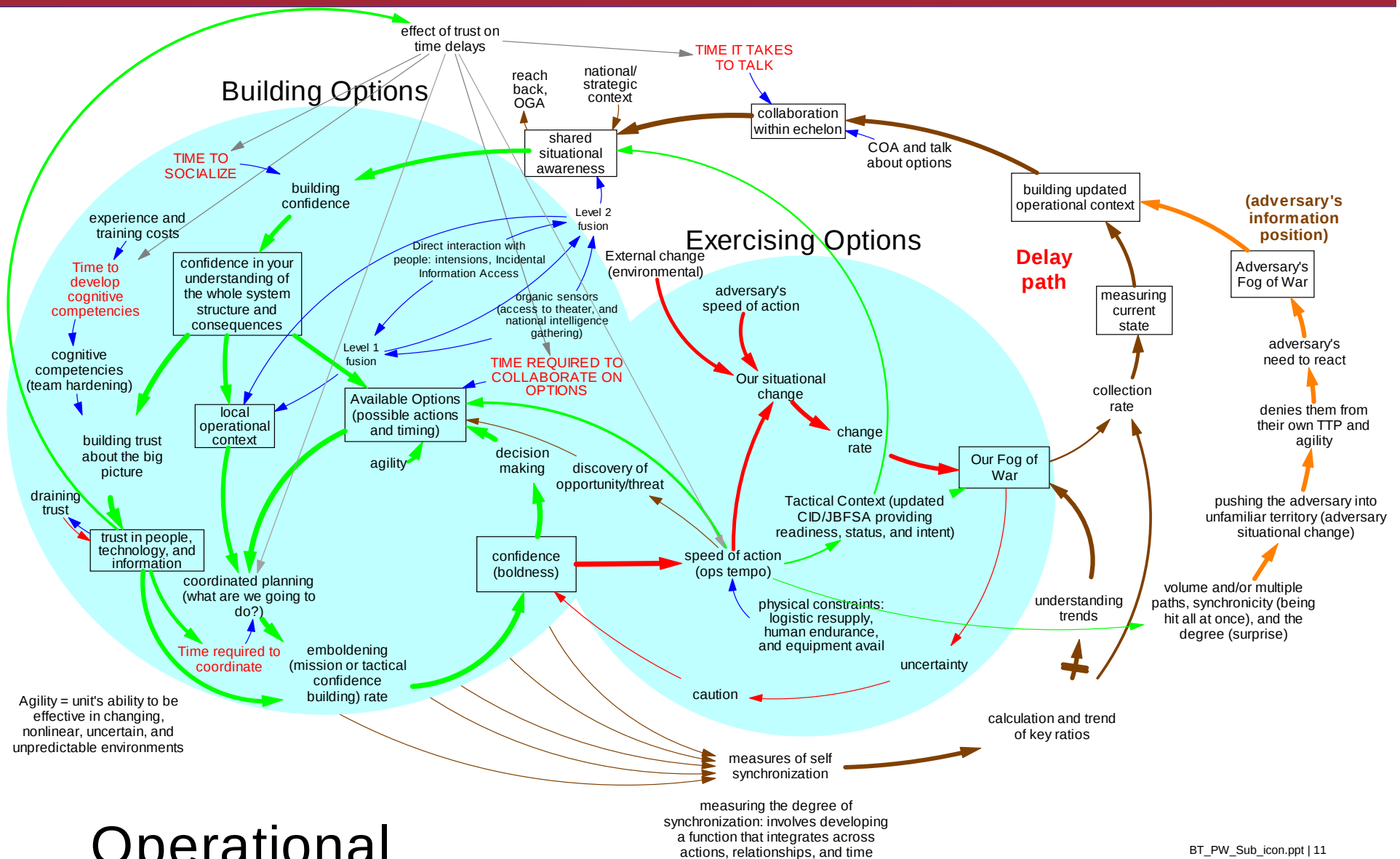




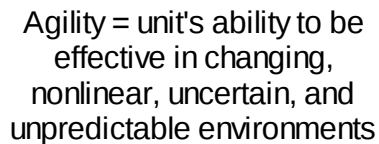
Agility in Context

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Operational

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

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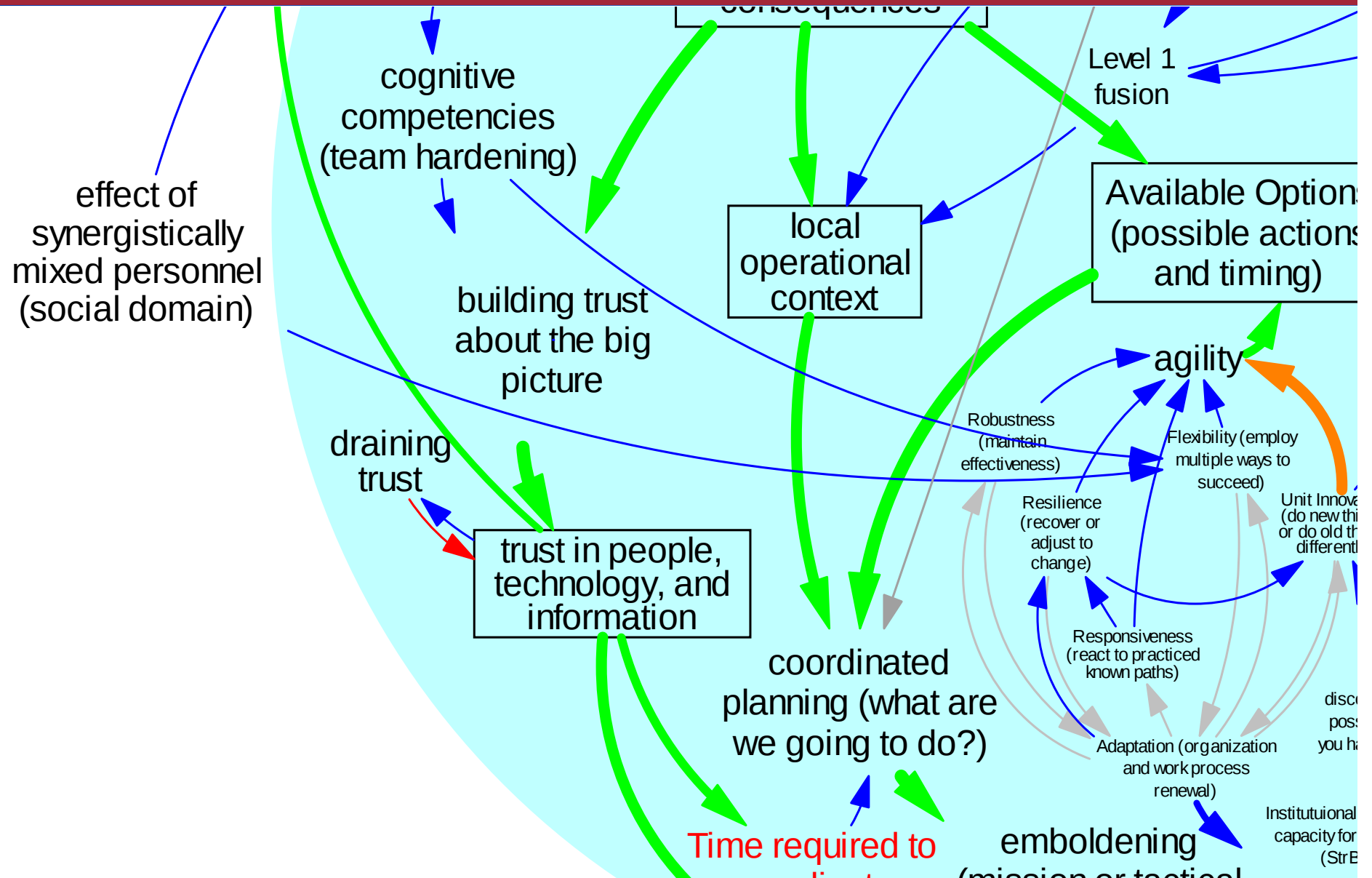
Decide pace of response
[Now, Quick, or Delayed]

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

NCO Op's Analysis



NCO Op's Analysis

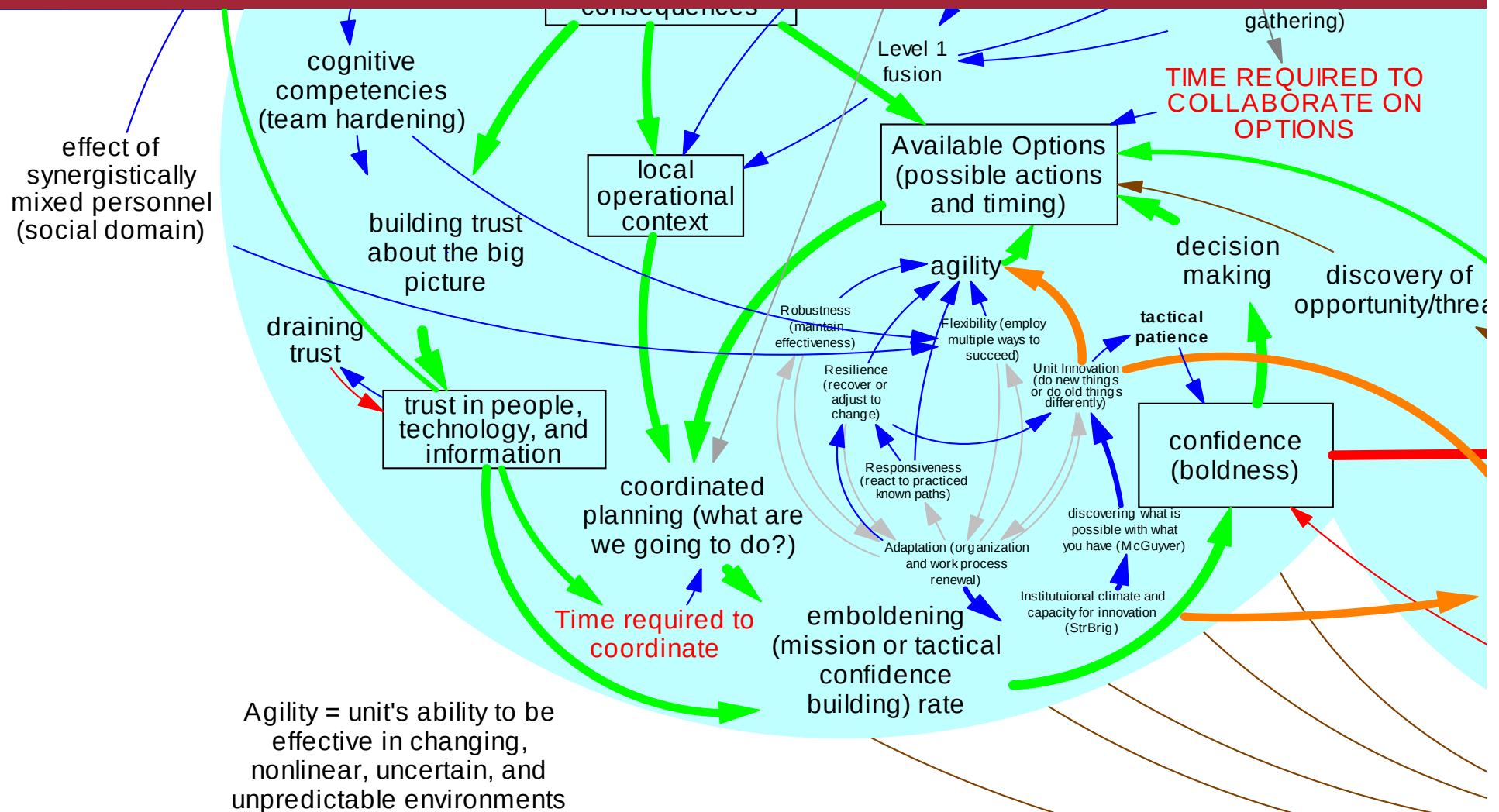


Social Diversity and Innovation Fuel Agility



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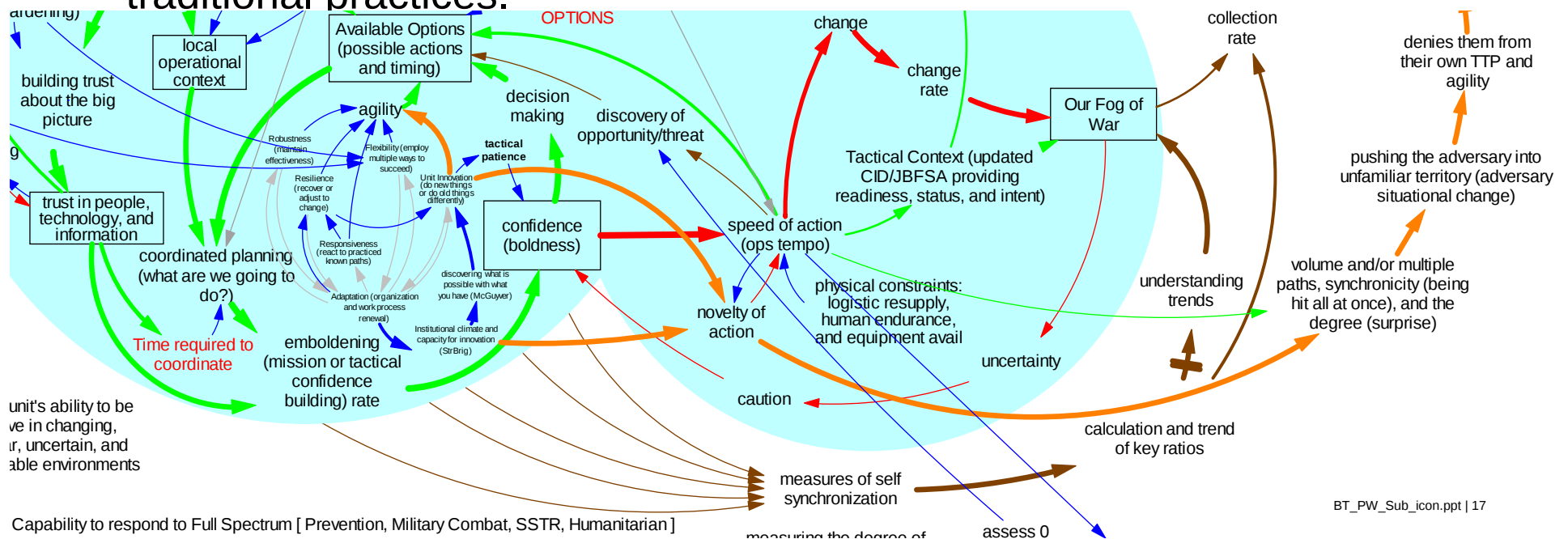


"Three Block"

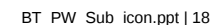
Capability to respond to Full Spectrum [Prevention, Military Combat, SSTR, Humanitarian]
Decide pace of response [Now, Quick, or Delayed]

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- traditional practices.



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Self-Coordination



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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.

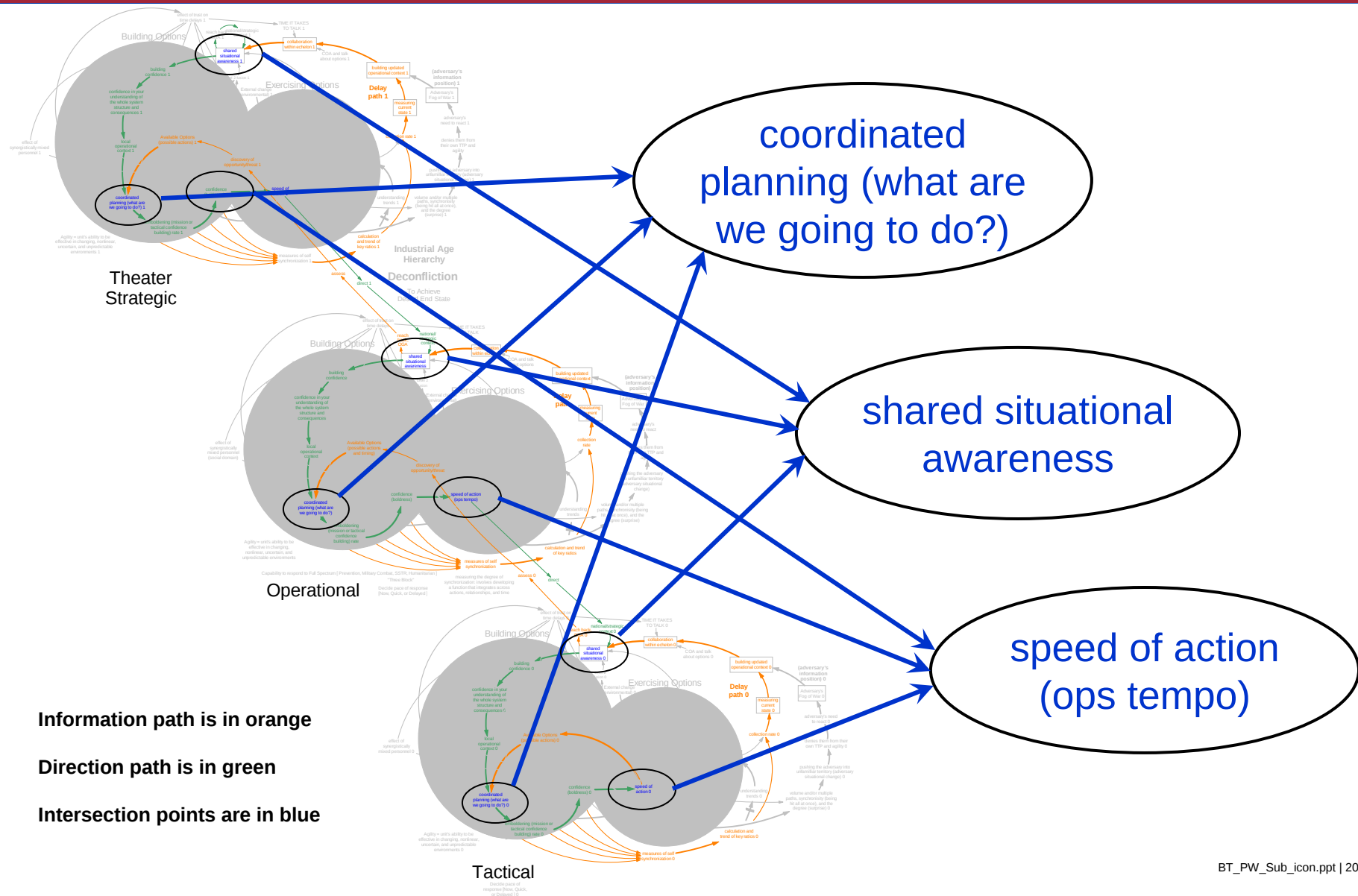
Rumsfeld, Donald H. Transformational Planning Guidance. Department of Defense. April 2003.



Confluence of Information and Direction

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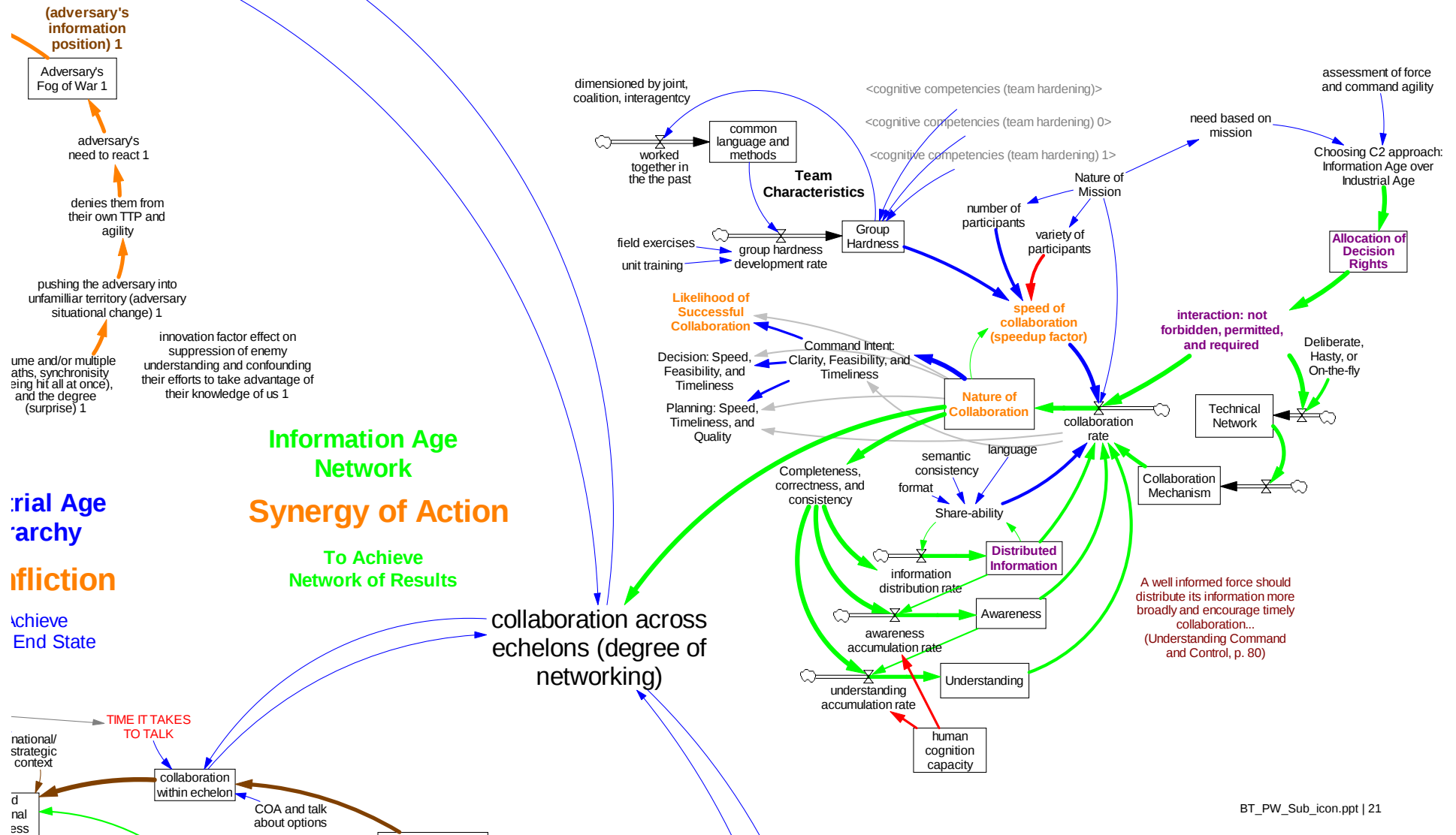


Collaboration and Alternative C2

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Collaboration and Alternative C2 Approaches



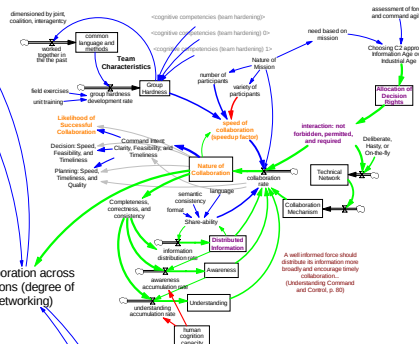
Net-Enabled Command Capability is Coordination Across Echelons



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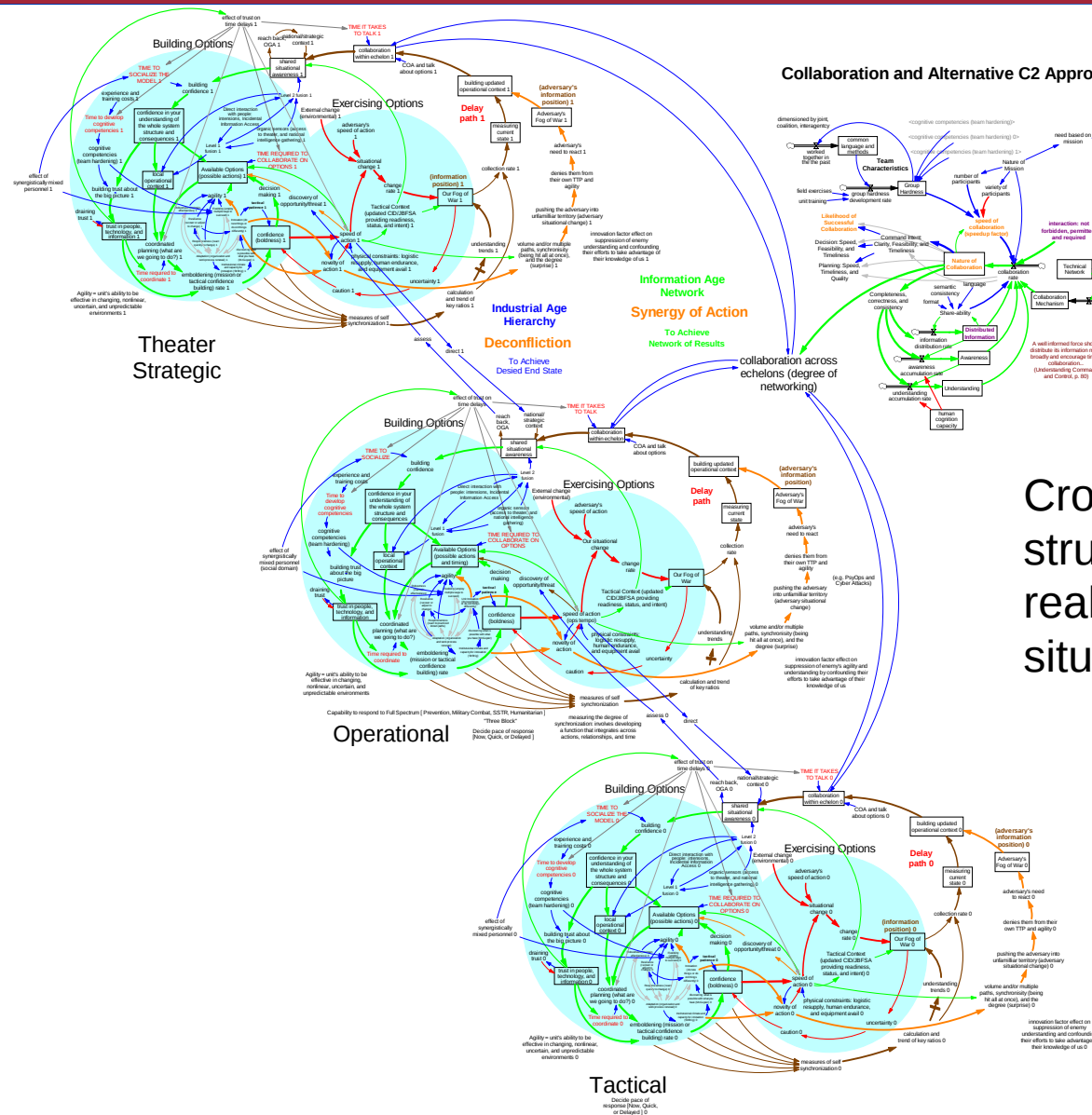
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Collaboration and Alternative C2 Approaches



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

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



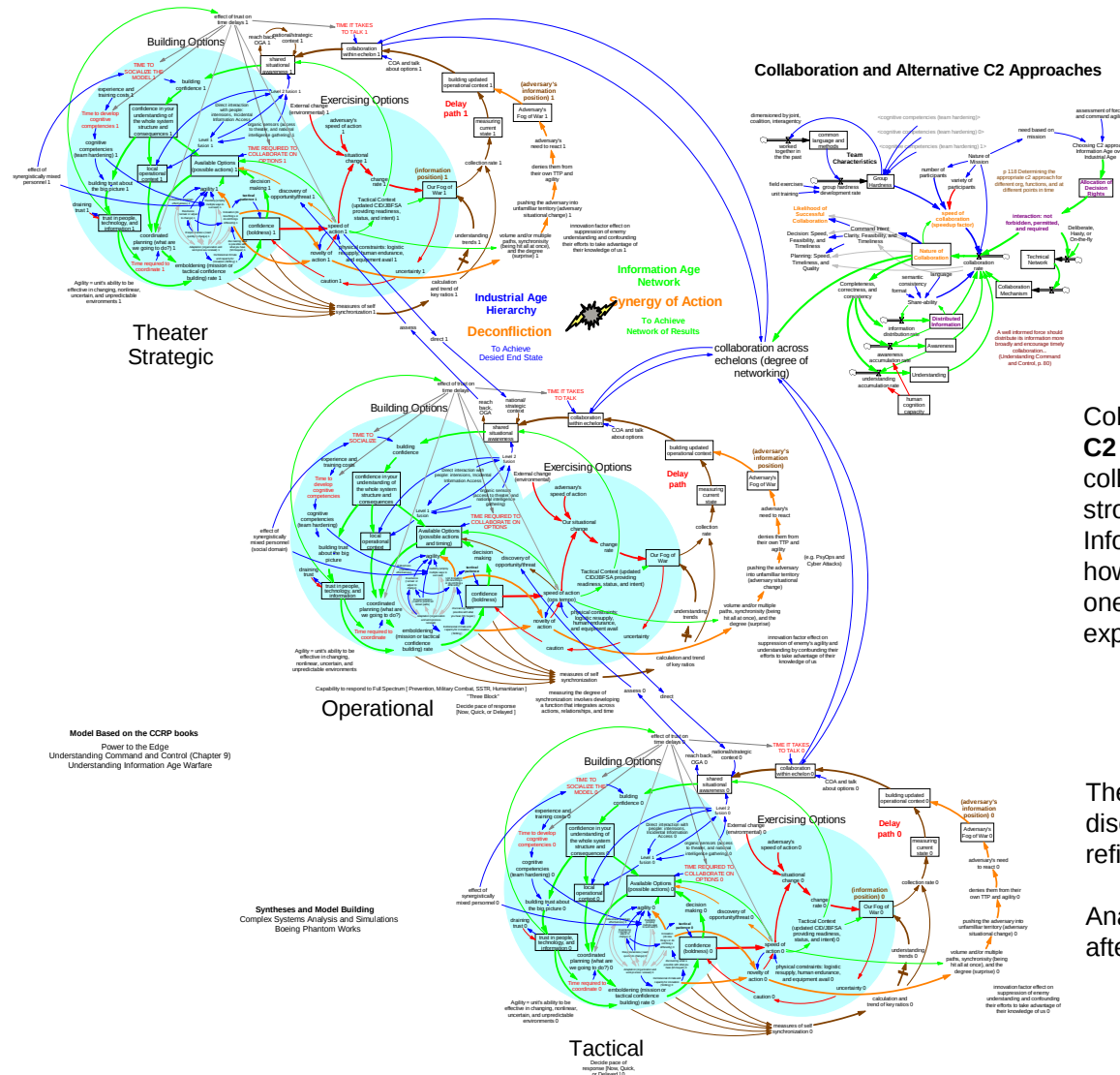
Net-Enabled Command Capability is Coordination Across Echelons



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Choosing a C2 Approach



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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Collaboration and C2

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Campaigns of Experimentation – Value of System Dynamics



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Exploring the knowledge landscape

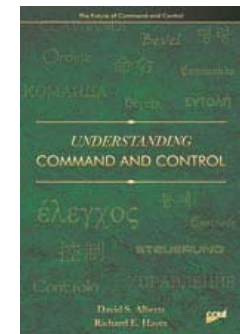
The three purposes for experiments are discovery, hypothesis testing (preliminary and refined), and then demonstration. (pg. 73)

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



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

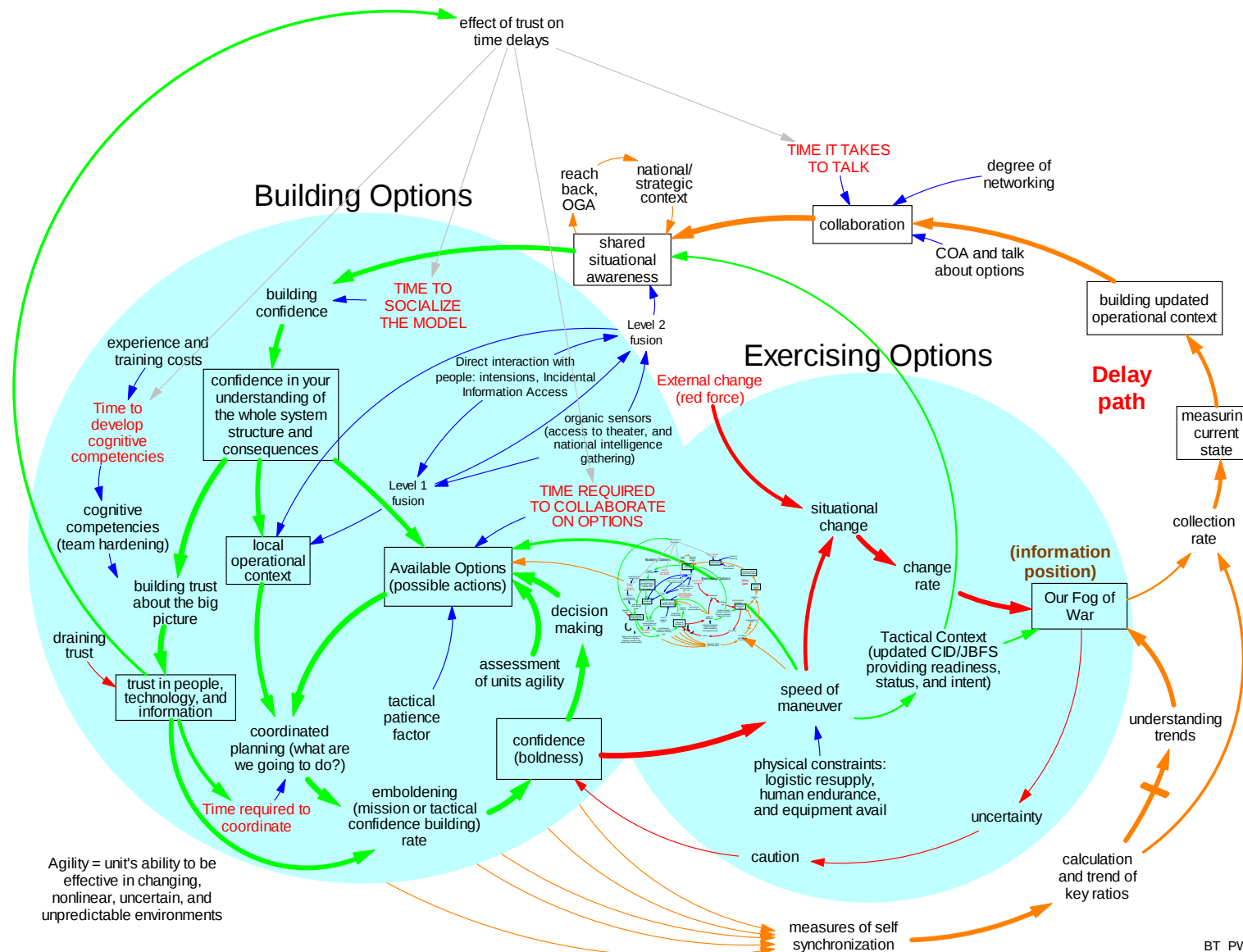




Loop diagram with fractal definition

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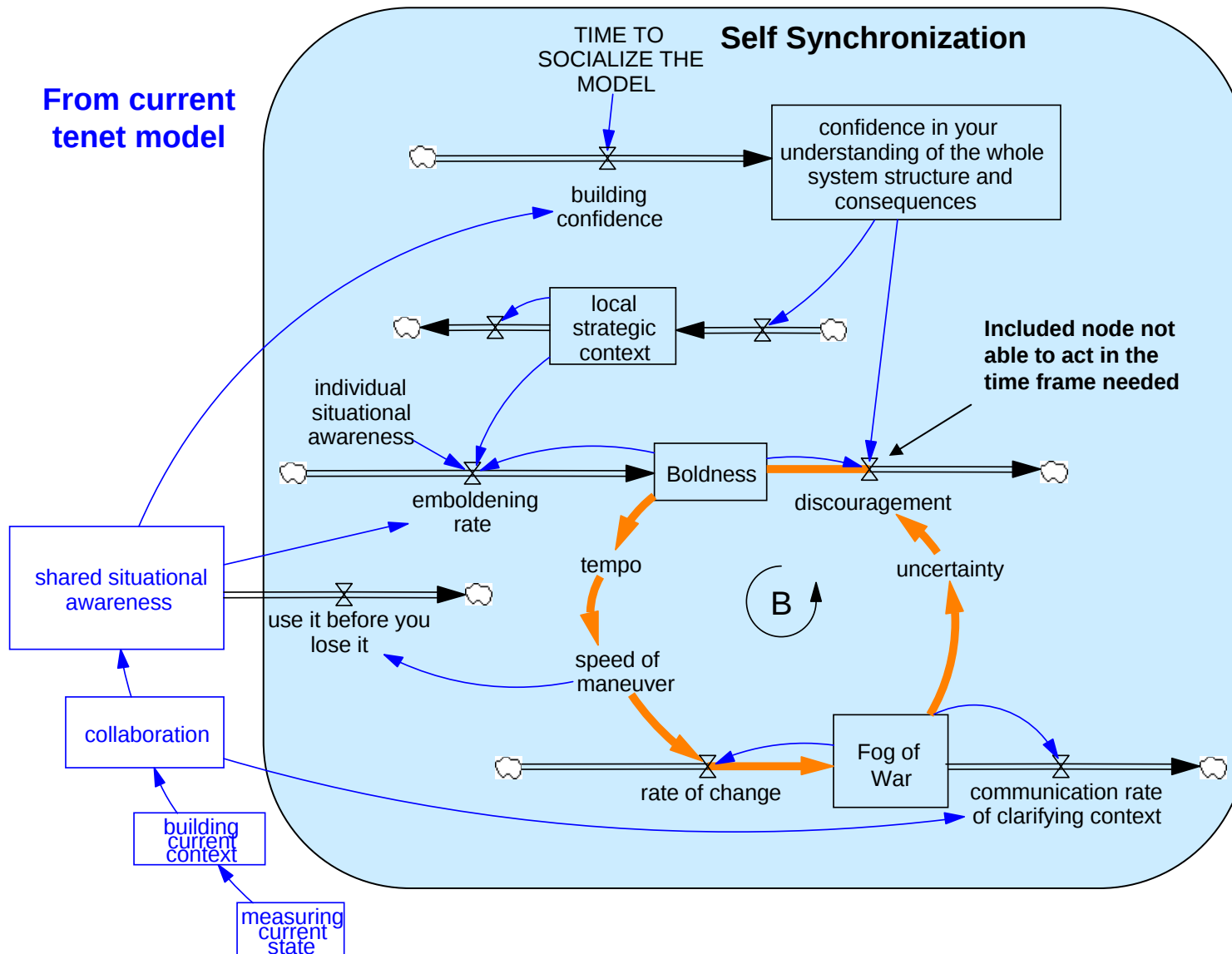




Self-Synchronization Tenet

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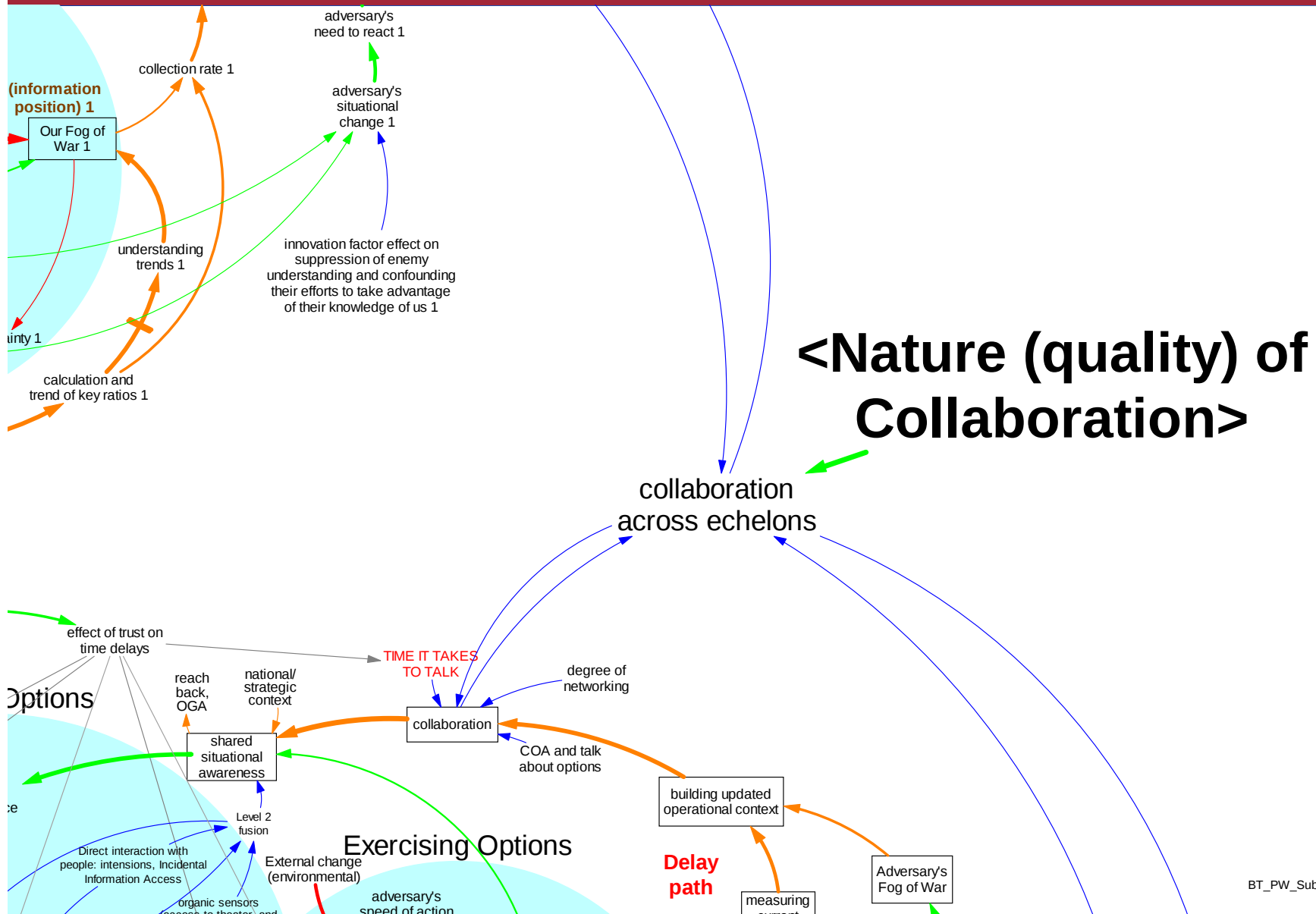
Understanding the consequences and the perspective of the big picture...

Collaboration Drives Alternative C2 Approaches

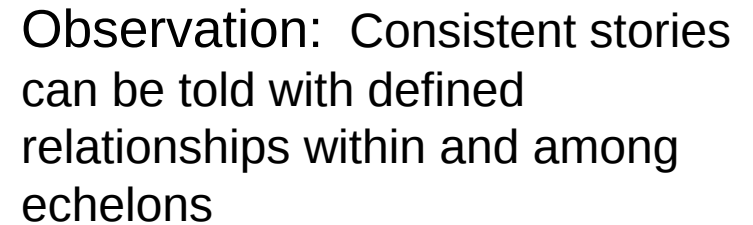


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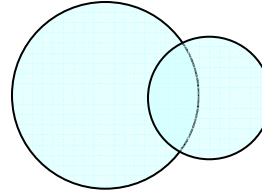
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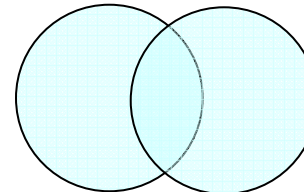
Discovery: The same pattern of relationships exist at each echelon layer

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

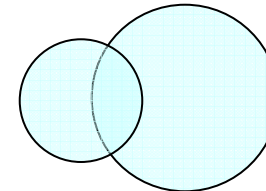
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Discovery: This dictates differences in time delays to perform a function



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

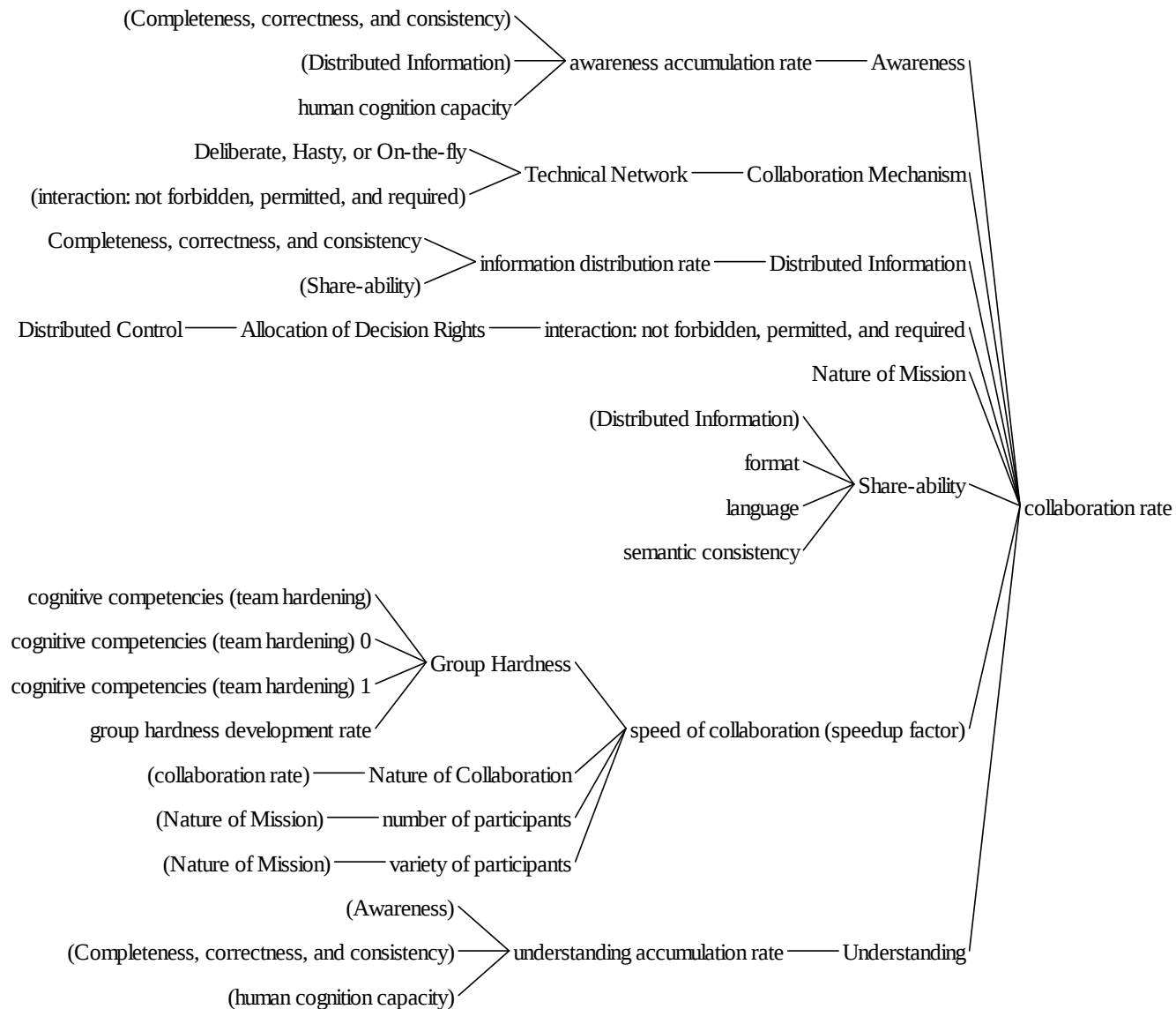




Connectivity and Influence Analysis

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Connectivity and Influence Analysis

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