



Modernizing Our Cognitive Model

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Command Effectiveness & Behaviour

DRDC Toronto



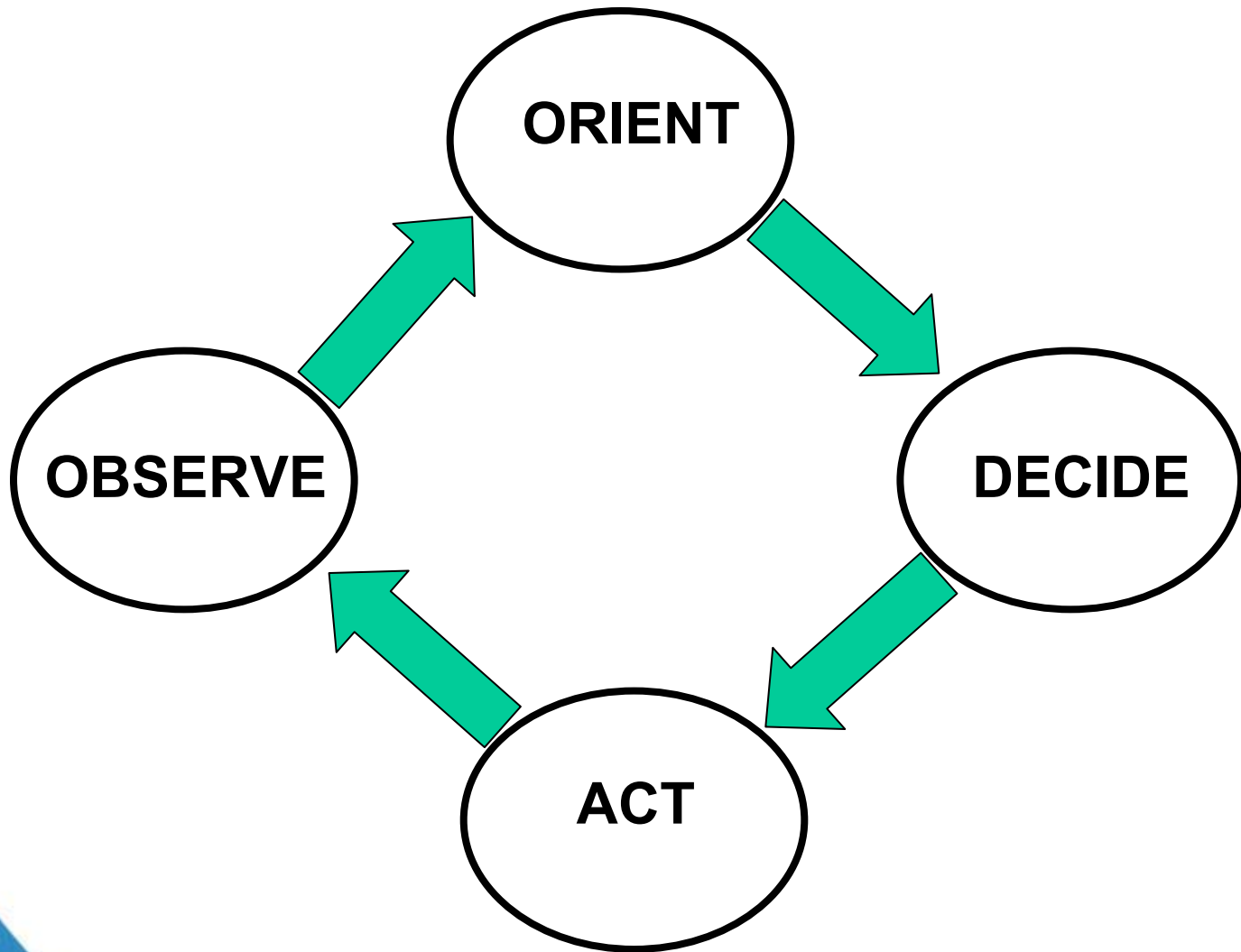
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The OODA Loop



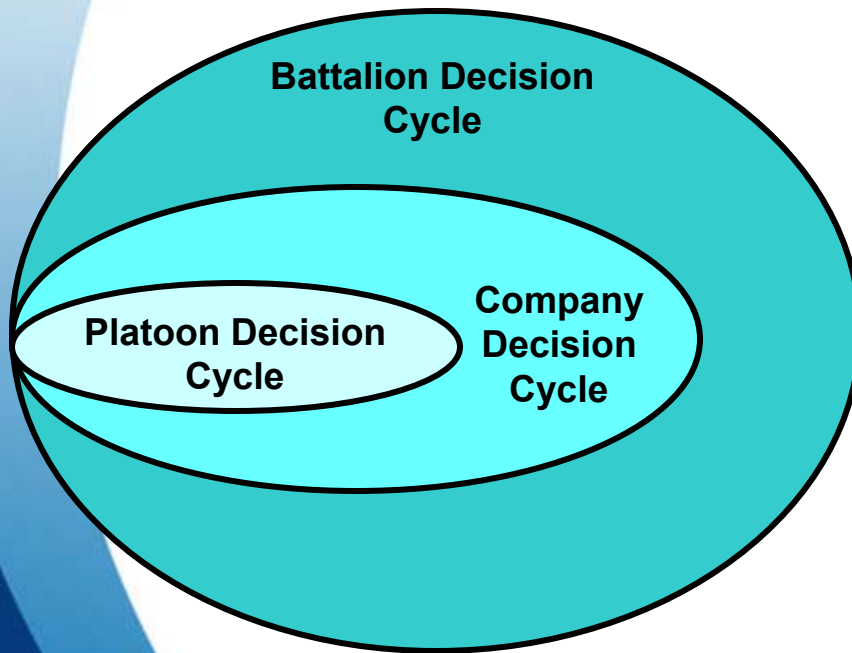


The OODA Loop

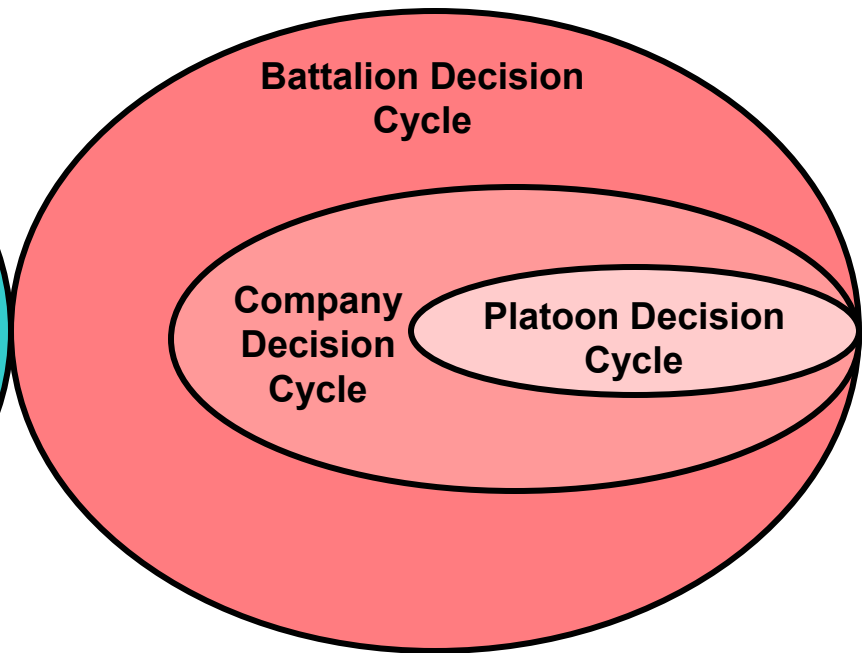
- Familiar tool for talking about decision making
 - Boyd analysis of fighter-pilot decision making
 - Information processing model
- Seems intuitively accurate
 - Applied to all C² without critical review
 - Open to interpretation
- Emphasizes:
 - Criticality of time
 - Competitive nature of C²



OWN FORCES



OPPONENT FORCES





What's Wrong with OODA?

- OODA is outdated
 - Significant progress in cognitive science since the 1950s
 - Shift from information processing to ecological approach
- OODA obscures important issues
 - How to define information
 - How to seek and process information
 - How to represent the underlying battlespace

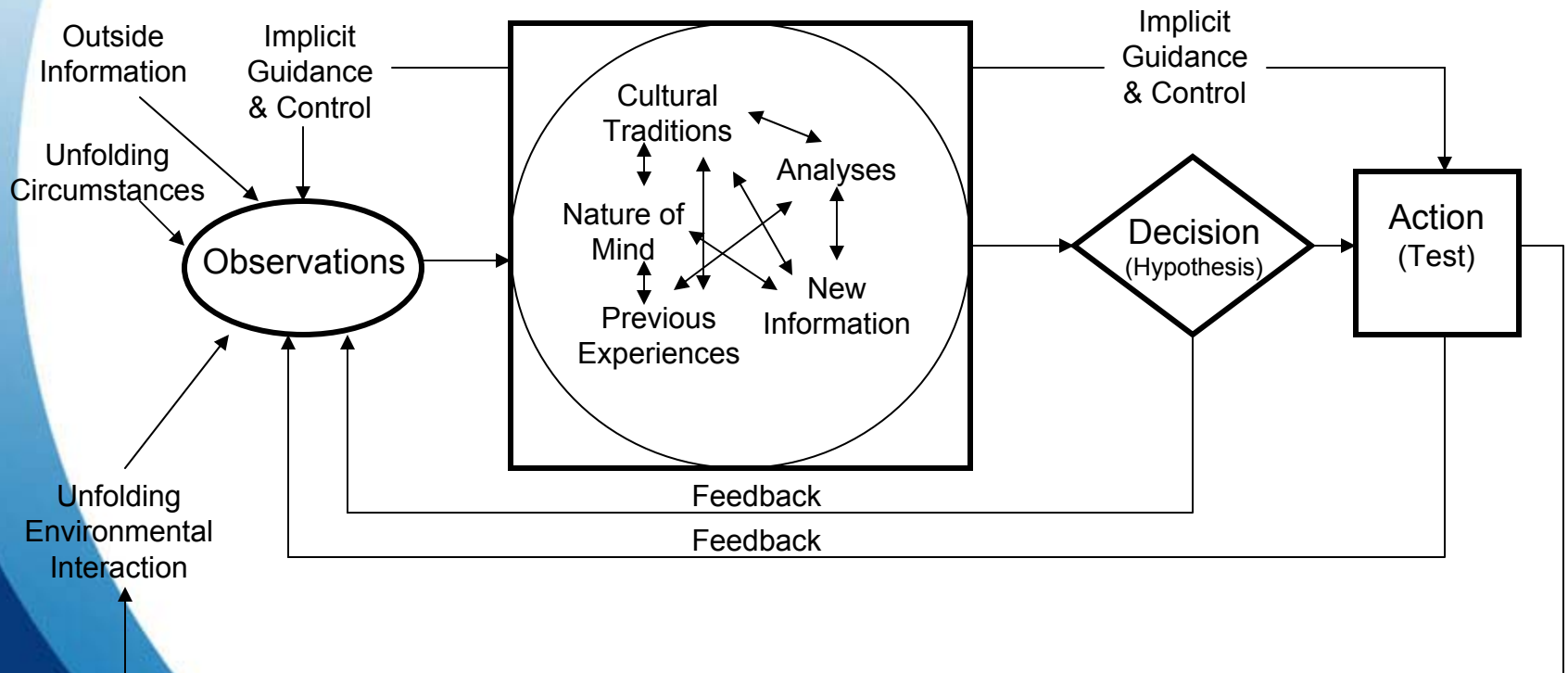


Observation

Orientation

Decision

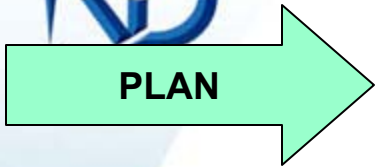
Action





A New Model for Command Decision Making

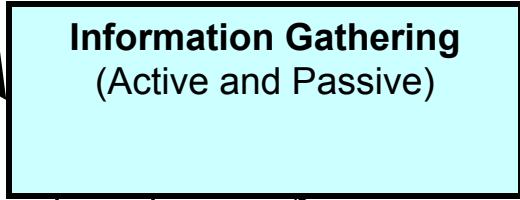
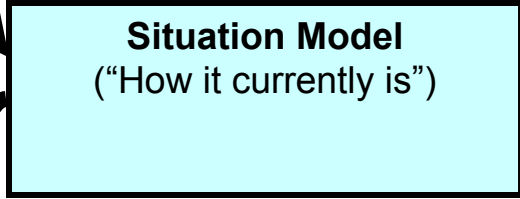
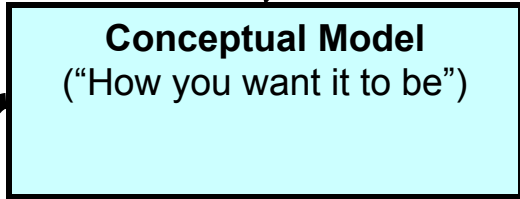
- Modern perspectives on cognition:
 - Goal-directedness
 - Constructive perception & understanding
 - Mental models
 - Critical thinking
- Description of natural decision making
 - Consistent with recognition-based decision making
 - Allows for analytic procedures



CRITIQUE

Formulate Questions

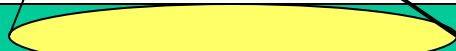
Identify Information Needs



Relevant Information

Sensor Outputs

Battlespace



ADAPT

COMPARE

CECA:
Critique
Explore
Compare
Adapt

Update

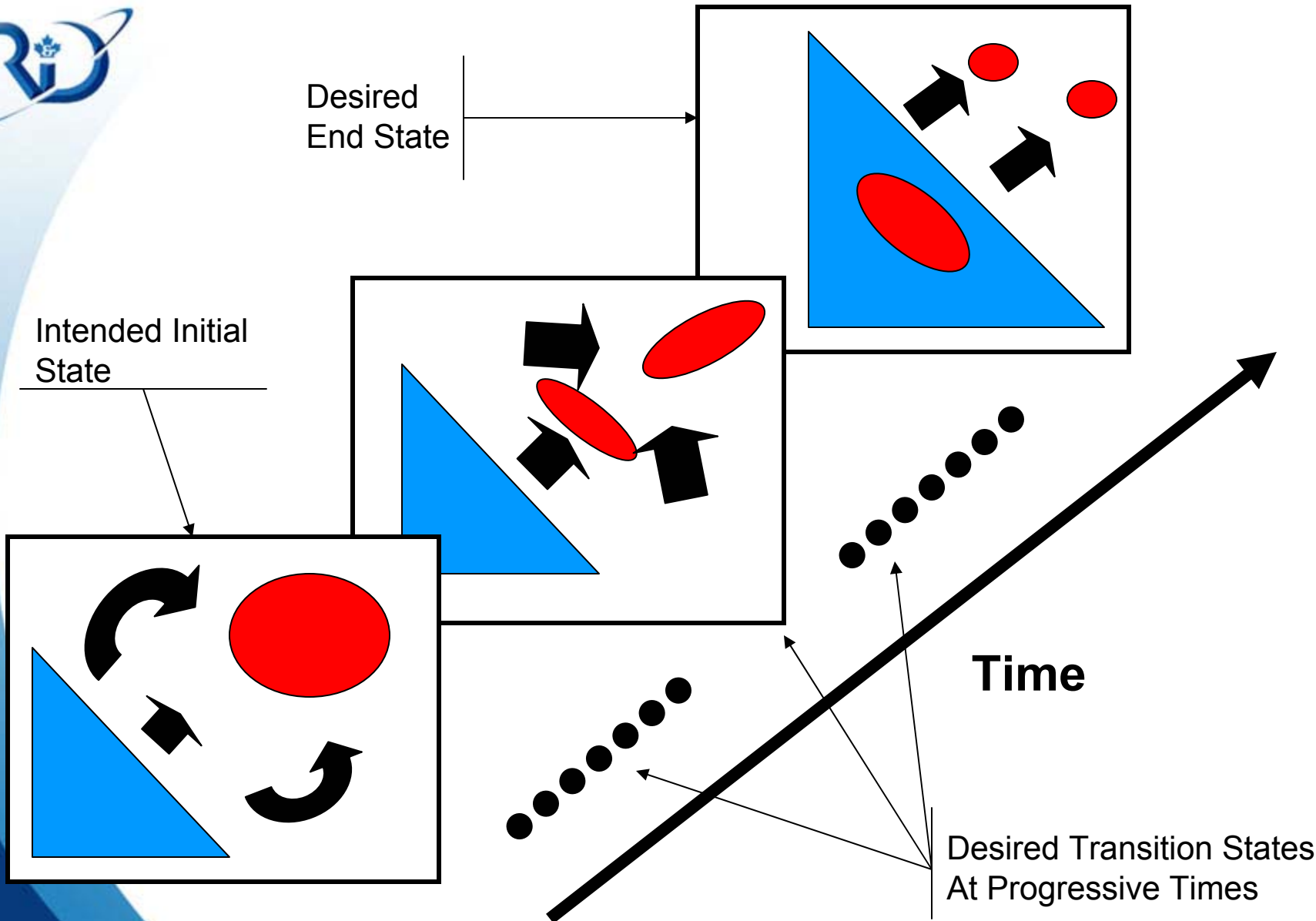
EXPLORE

"Directed Telescope" -
Search for Needed
Information



The Conceptual Model

- Time-based description of battlespace
 - Formulate in terms of goal states
 - Like a “solution path”
- Functional as well as physical environment
 - Not just a spatial model or picture
 - Critical objectives, constraints, affordances, etc.
- Makes “intent” concrete





Putting the CECA Loop into Action

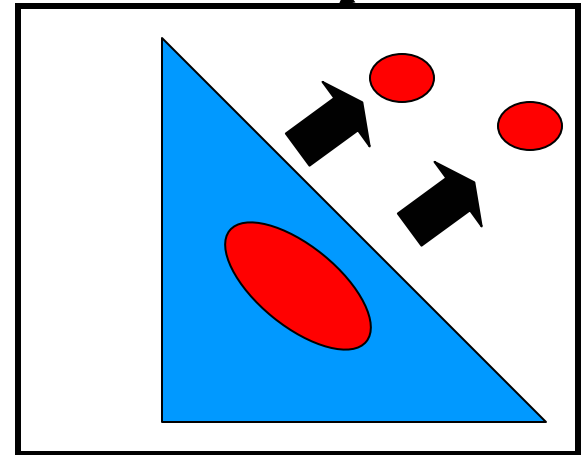
- Distinguish observation from action
 - Observation aimed at understanding the battlespace
 - Action aimed at changing the battlespace
- Interaction
 - Conceptual model drives actions
 - Action affects battlespace
 - Situation model necessitates adaptation of the conceptual model



Feedback from Monitoring Leads to Adaptation of The Conceptual Model

Intended Future State

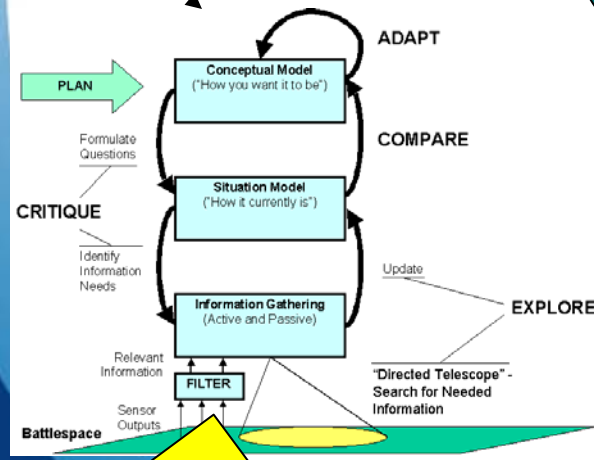
Monitoring of the Battlespace



Current State of the Conceptual Model

Time

Actions Affect the Battlespace



Battlespace

Canada - Toronto

Canada - Toronto



Is This New Model Needed?

- Advantages of CECA
 - Identifies previously ignored issues (e.g., representation, top-down observation)
 - Clarifies link between planning and deciding
 - Explicit role for critical thinking
 - Explicit assumptions can be empirically tested
- Modern concepts of warfare demand attention to modern cognitive concepts
- Data is not information and information is not knowledge



Network-Centered Warfare

- NCW (a.k.a.. NCO, NEC)
 - Shared awareness/
shared intent
 - Information sharing/
full information
availability
 - Synchronization
 - Decentralization of
decision making
 - CECA Loop
 - Conceptual model
 - Situation model
 - Action coordinated by
conceptual model
 - Intent is basis of
planning
- Four red arrows point from the NCW list to the CECA Loop list, indicating a mapping or relationship between the two concepts.



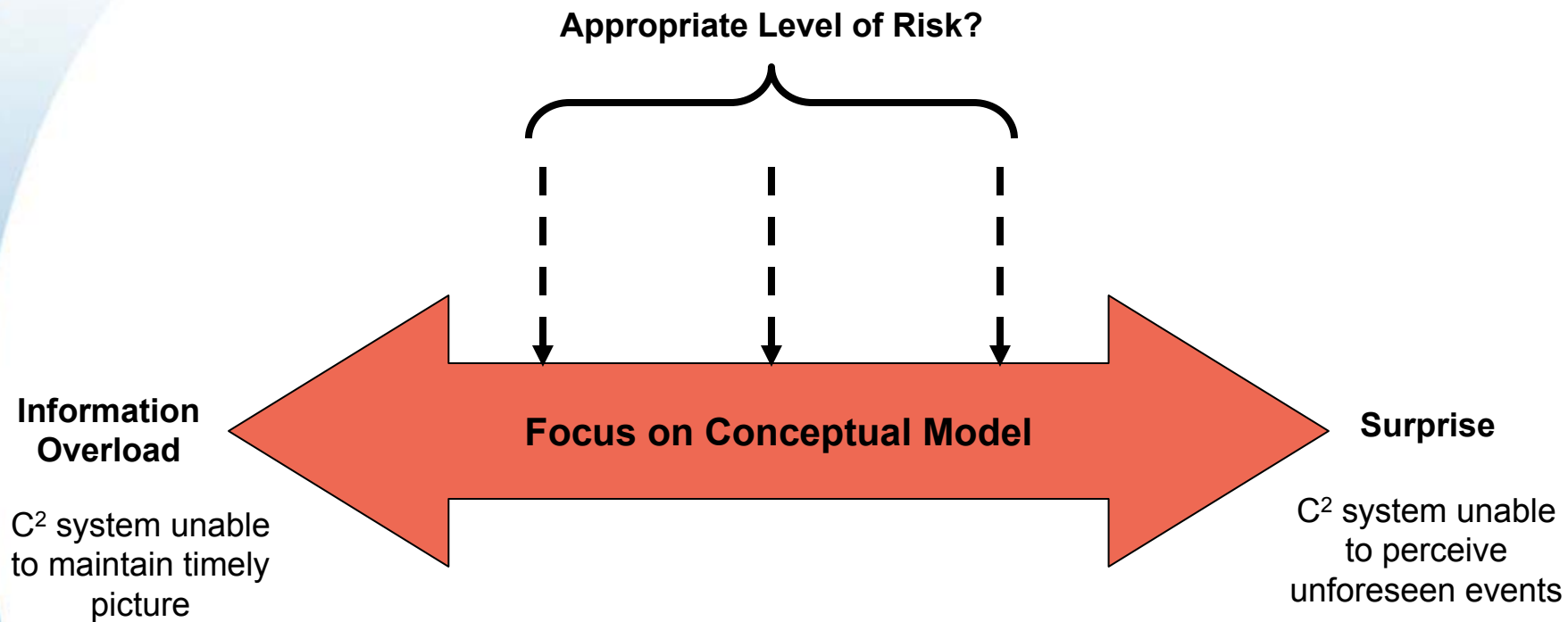
Unity of Mind & Distributed Decision Making

- Requires more than sharing of data
 - Shared intent
 - Shared mental models
- Must be based on shared mental models
 - Shared awareness applies to contents of consciousness
 - Awareness is very limited
 - Individuals have different awareness needs
 - Shared mental models provide bases for cognition, common ground



Constructive Perception in C²

- Information is not infinitely valuable
 - Humans require coherent mental models
 - Full information availability likely will be chaotic
- Common conceptual model directs search of battlespace
 - Focus on disconfirming evidence
 - Technology can be a means to shared understanding via a common conceptual model





Where to Next?

- Some questions that arise:
 - How do we create an organizational conceptual model?
 - What are the criteria for comparing situation and conceptual model?
- Some avenues for exploration:
 - “Intent-based” planning
 - Collaborative decision making
 - Critiquing and adaptation support