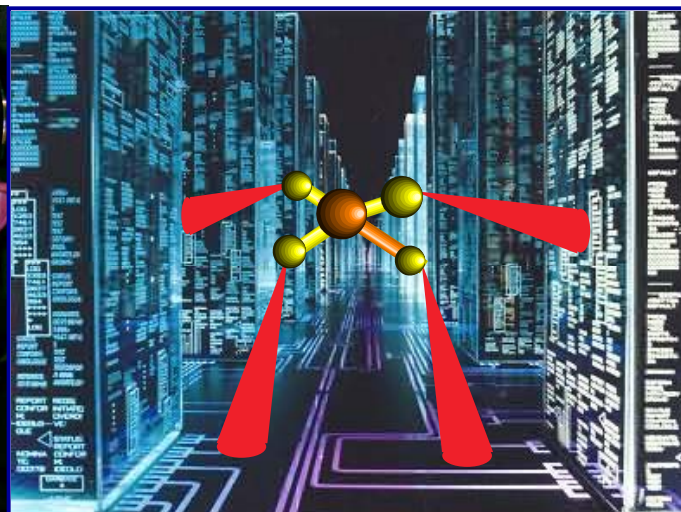AIR FORCE RESEARCH LABORATORY

Humans and their Impact on Cyber Agility
-- Concepts, Theory, and Policy --
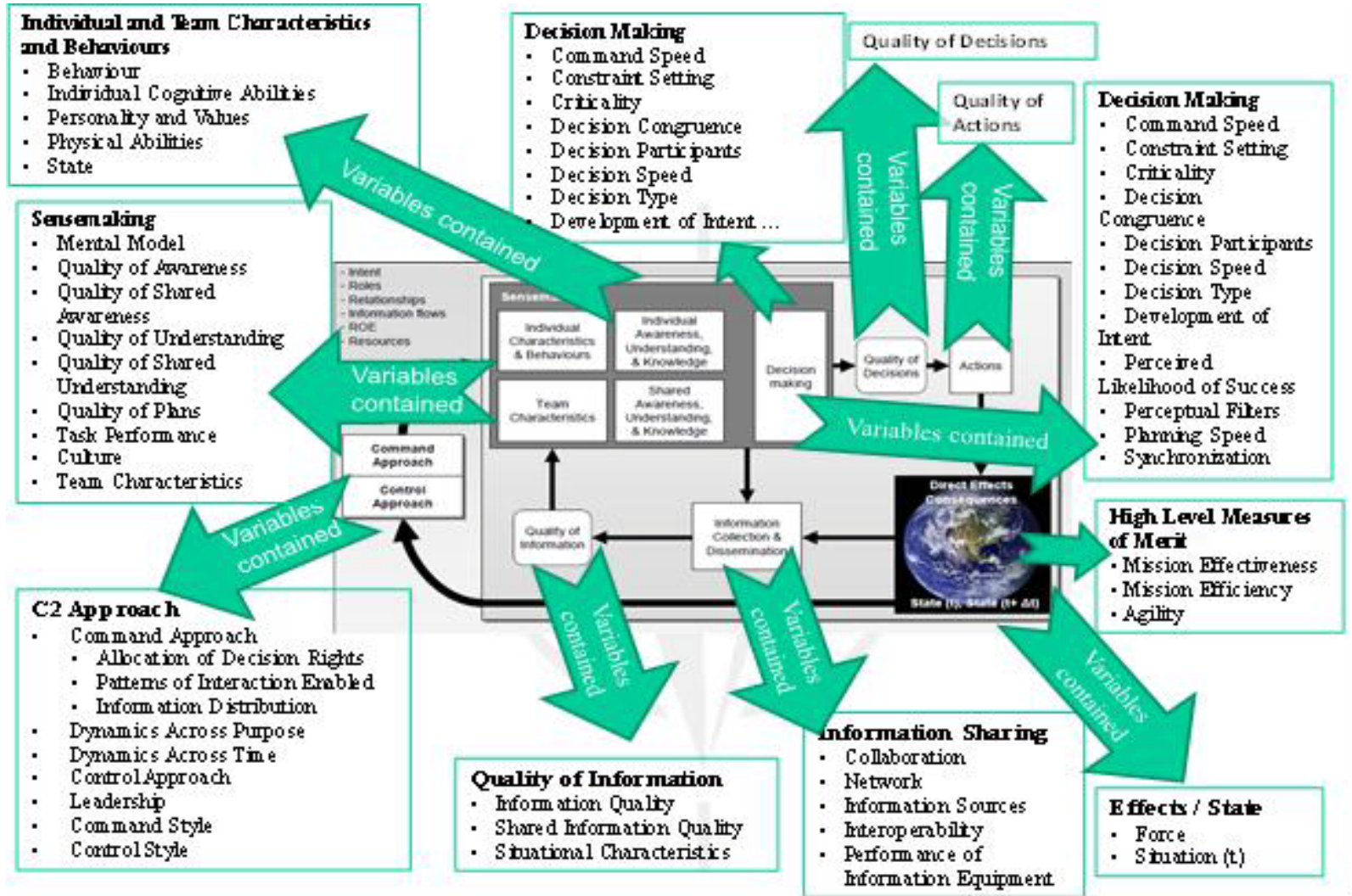
Dr. Paul W. Phister, Jr., P.E.

AF Research Laboratory's Information Directorate, Rome, NY
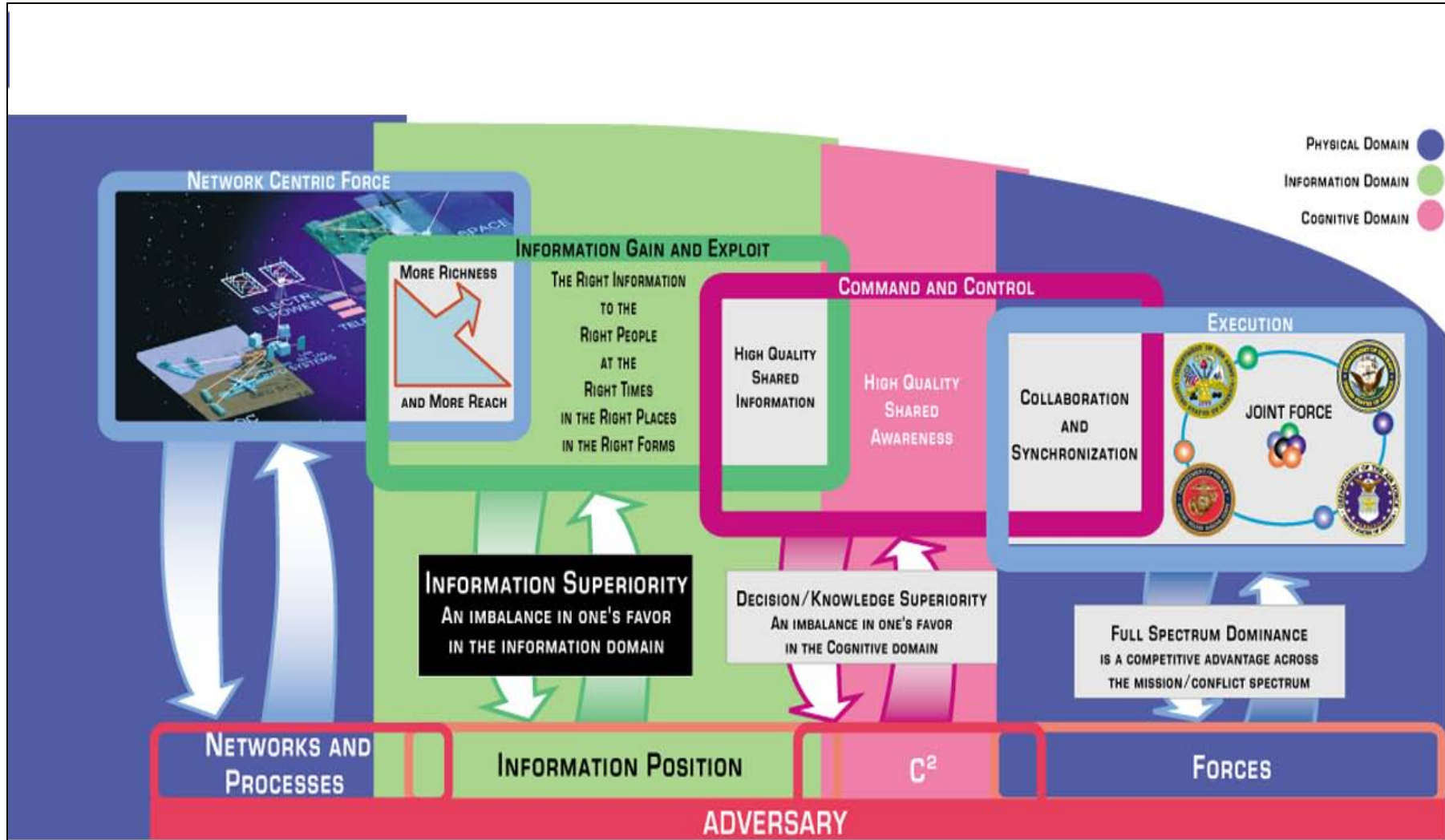
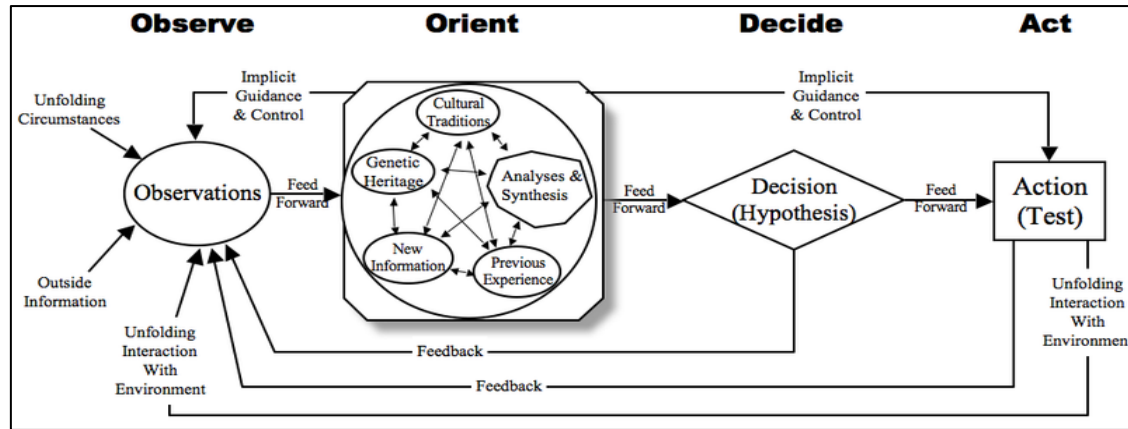# Network Centric Warfare
- C2 Conceptual Reference Model -

Individual and Team Characteristics and Behaviours
- Behaviour
- Individual Cognitive Abilities
- Personality and Values
- Physical Abilities
- State

Sensemaking
- Mental Model
- Quality of Awareness
- Quality of Shared Awareness
- Quality of Understanding
- Quality of Shared Understanding
- Quality of Plans
- Task Performance
- Culture
- Team Characteristics

C2 Approach
- Command Approach
  - Allocation of Decision Rights
  - Patterns of Interaction Enabled
  - Information Distribution
- Dynamics Across Purpose
- Dynamics Across Time
- Control Approach
- Leadership
- Command Style
- Control Style

Decision Making
- Command Speed
- Constraint Setting
- Criticality
- Decision Congruence
- Decision Participants
- Decision Speed
- Decision Type
- Development of Intent ...

Quality of Decisions

Quality of Actions

Decision Making
- Command Speed
- Constraint Setting
- Criticality
- Decision Congruence
- Decision Participants
- Decision Speed
- Decision Type
- Development of Intent
- Perceived Likelihood of Success
- Perceptual Filters
- Planning Speed
- Synchronization

High Level Measures of Merit
- Mission Effectiveness
- Mission Efficiency
- Agility

Quality of Information
- Information Quality
- Shared Information Quality
- Situational Characteristics

Information Sharing
- Collaboration
- Network
- Information Sources
- Interoperability
- Performance of Information Equipment

Effects / State
- Force
- Situation (t)

Network Centric Warfare
- Value Chain -

Human-Centric Loops

Observe-Orient-Decide-Act
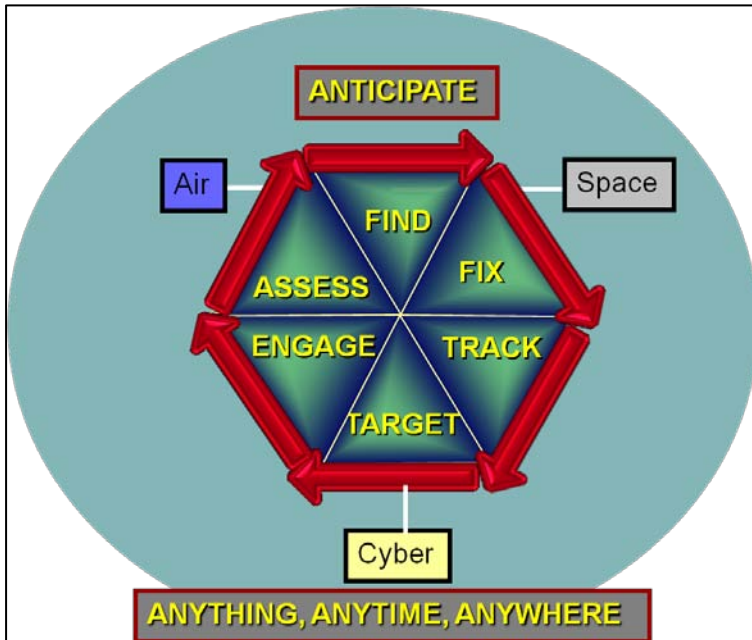
AFRL-F2T2EA4
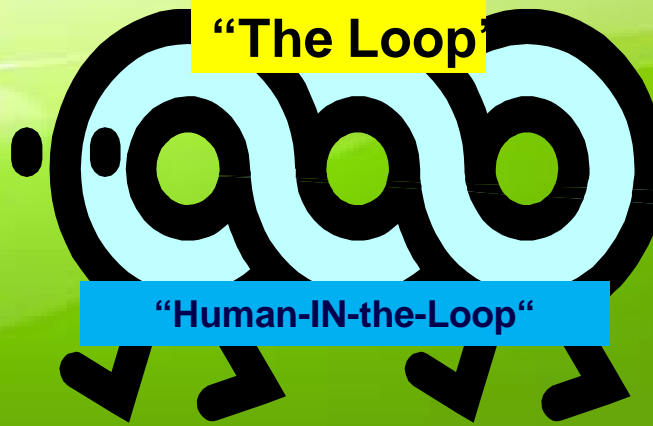
Network Centric Warfare
- Humans and "The Loop" -

Network Centric Operations

Network Centric Infrastructure

Human – BEFORE – the – Loop

-- Predictive Agility
-- Discovery Agility
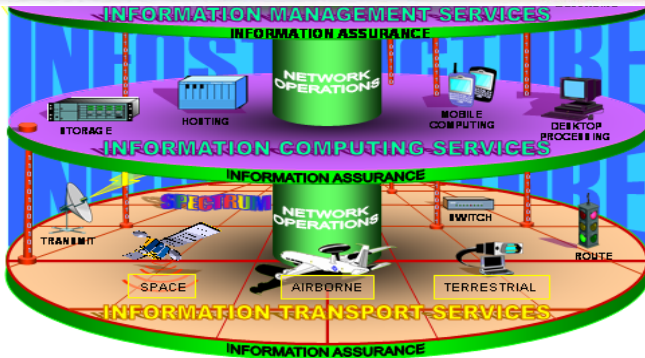-- Information Agility

Human – ON – the – Loop

-- Cognitive Agility
-- Synchronized Agility
-- Organization Agility

Human – IN – the – Loop

-- Execution Agility
-- Synchronized Agility
-- Organizational Agility

Human – AFTER – the – Loop

-- Assessment Agility

Metrics: Robustness, Resilience, Responsiveness, Flexibility, Innovation, Adaption

Mathematical Representation
- Cyber Agility and "The Loop" -

MOE (cyber agility) = f(belief) + f(disbelief) + f(uncertainty)

Scoring Metric:

0.00 = Detrimental to Mission Operations,
0.25 = Unacceptable to Mission Operations,
0.50 = Acceptable to Mission Operations,
0.75 = Very Acceptable to Mission Operations,
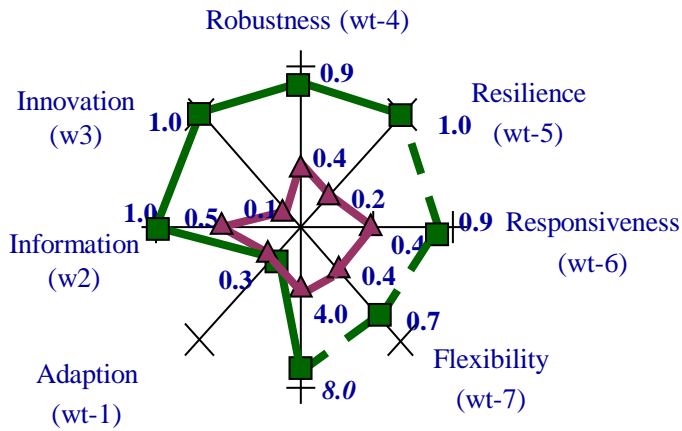1.00 = Significantly Acceptable to Mission Operations

Denny, Nathan,

"Mission Profiles and Evidential Reasoning for Estimating Information Relevancy in Multi-Agent Supervisory Control Applications,"
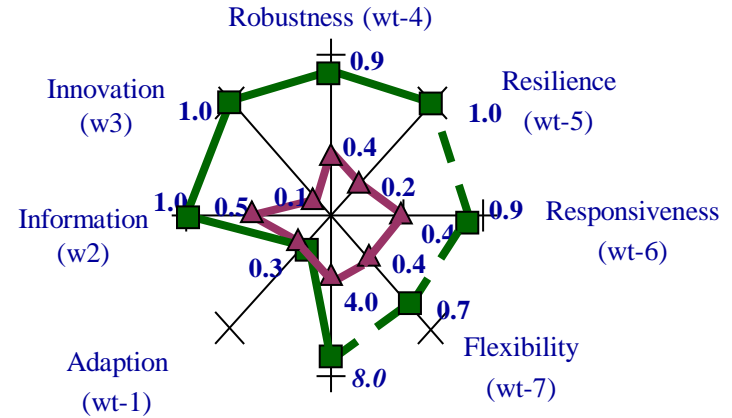15th ICCRTS, Paper 113, June 2010, page 4, 10, and 13.
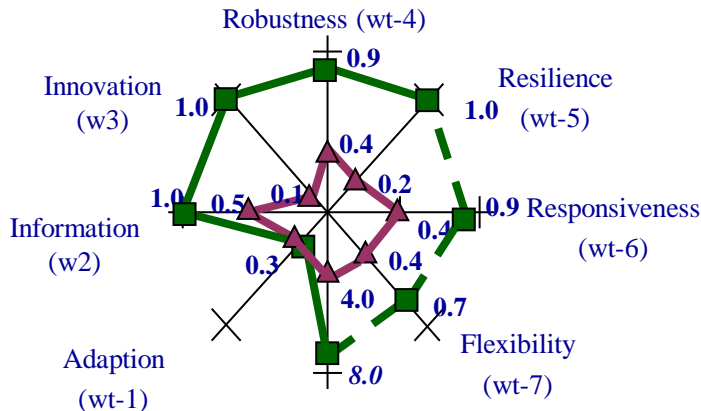
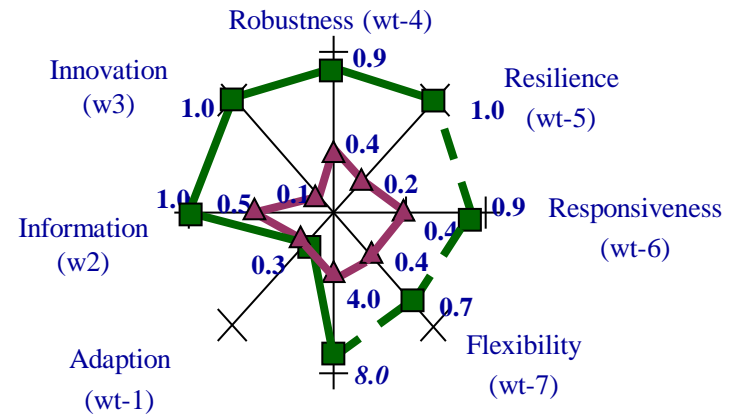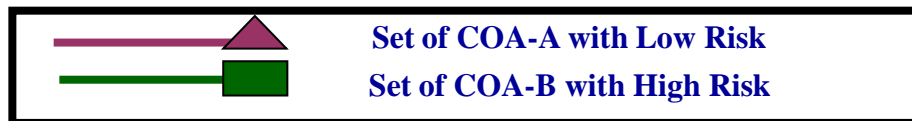# Mathematical Representation
- Cyber Agility and "The Loop" -

a) Resultant "BEFORE" Effectiveness With Risk

b) Resultant "AFTER" Effectiveness With Risk

c) Resultant "ON" Effectiveness With Risk


d) Resultant "IN" Effectiveness With Risk

Set of COA-A with Low Risk
Set of COA-B with High Risk

Conclusions

- **Human-BEFORE-the-Loop performs better:**

  - **When conducting Discovery and Prediction**

- **Human-ON-the-Loop performs better:**

  - **When periodic "Decision Injections" are required**

- **Human-IN-the-Loop performs better:**

  - **When Time is not a critical factor**

- **Human-AFTER-the-Loop performs better:**

  - **When conducting detailed Assessments**
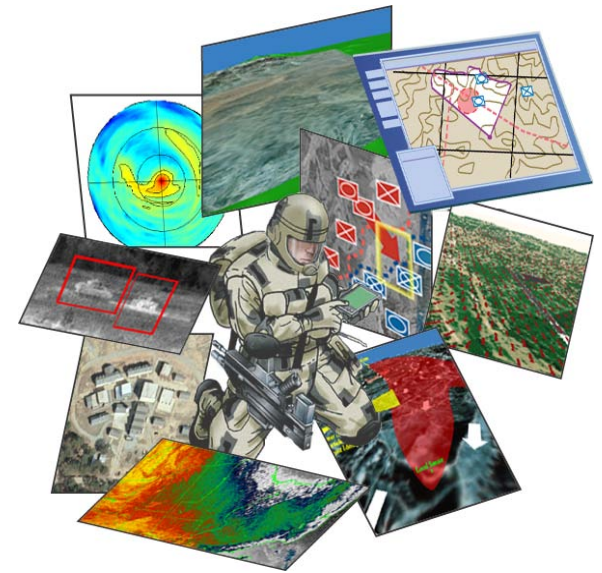
Human-IN-the-Loop is worst case for optimal "Cyber Agility"

Questions?

AFRL "Inside"