# Collaborative Technology Alliance

# Advanced Decision Architectures CTA Overview

**CTAC**
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# Advanced Decision Architectures Collaborative Technology Alliance

## Consortium Partners

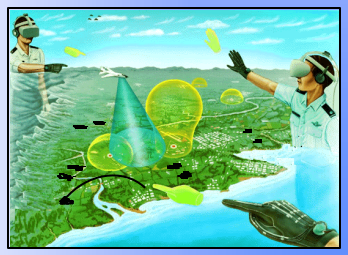
- ARL
- Micro Analysis & Design, Inc.
- Klein Associates
- SA Technologies
- ArtisTech, Inc.
- SAIC
- Ohio State Univ
- New Mexico State Univ
- Univ of West Florida
- Massachusetts Institute of Technology
- Carnegie Mellon Univ
- Univ of Central Florida
- University of Maryland

## Objectives

*To develop, validate, and transition new knowledge management and decision support technologies to facilitate soldier awareness and understanding of the tactical situation, thereby resulting in more effective and timely decisions.*

## Technical Areas

- Cognitive Process Modeling and Measurement
- Analytical Tools for Collaborative Planning and Execution
- User Adaptable Interfaces
- Auto-Adaptive Information Presentation



# Advanced Decision Architectures Collaborative Technology Alliance

**PM: Micro Analysis & Design, Inc., Ms. Susan Archer**
**CAM: ARL, Dr. Michael Strub**
**Deputy CAM: ARL, Dr. Melissa Holland**

## Cognitive Process Modeling and Measurement

Klein Associates, Dr. Gary Klein
ARL, Dr. Laurel Allender – Lead
USMA, COL Larry Shattuck - Deputy

- Conceptual Models of Cognition
- Computational Models of Cognition
- Methodologies: Cognitive and Information Requirements
- Decision-Centered Design: Principles, Methods, System Development Processes

## Analytical Tools for Collaborative Planning and Execution

SA Technologies, Dr. Mica Endsley
ARL, Dr. Rick Helfman - Lead
ARL, Dr. Linda Pierce - Deputy

- Research on Collaboration and Effectiveness in Human Teamwork and Human-System Teamwork
- Development of Tools to Support Collaboration and Decision Making in Collocated and Distributed Teams

## User Adaptable Interfaces

OSU, Dr. B. Chandrasekaran
ARL, Mr. Mike Barnes – Lead
ARL, Mr. Larry Tokarcik - Deputy

- Visual Representations in Decision Assistance
- Multi Modal Representations and Interactions
- Ontology and Inferencing for Natural Language Interfaces and Heterogeneous Databases

## Auto-Adaptive Information Presentation

OSU, Dr. David Woods
ARL, Mr. Rob Winkler – Lead
ARL, Mr. Rich Kaste – Deputy

- Human Interaction with Automated Assets
- Human Coordination with Autonomous Assets
- Auto-Adaptive Information Systems

# Cognitive Process Modeling and Measurement

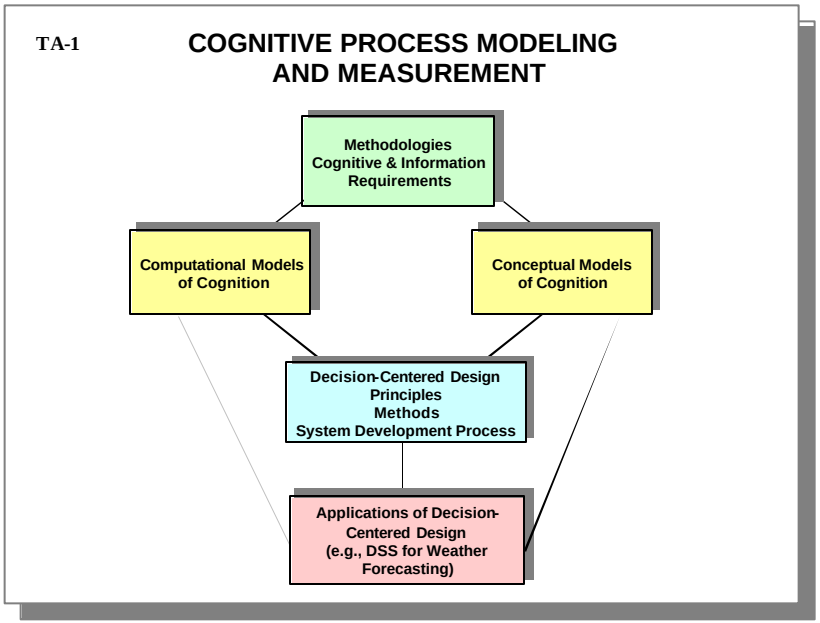
**Objective:** **Develop tools and methods to help the soldier understand the tactical situation, more thoroughly evaluate courses of action, and, ultimately, make better and more timely decisions.**

## Challenge:

- **Determine how information technologies can support critical aspects of cognition**

## Research Themes:

1. **Conceptual Models of Cognition**
2. **Computational Models of Cognition**
3. **Methods to Describe Cognitive and Information Requirements**
4. **Decision-Centered Design Principles, Methods, and Processes**



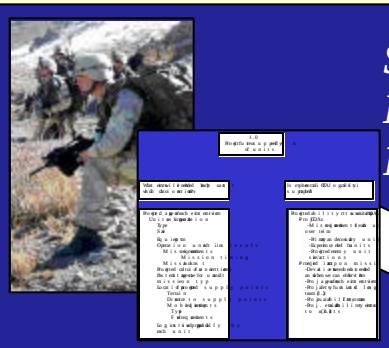

# INTENT CENTRIC OPERATIONS

Battle Command
Battle Lab
Ft Leavenworth, KS

# Design and Development of User-Centered Design Concepts for Army Operations

## Situation Awareness-Oriented Design Process

**SA Requirements Analysis** → **SA-Oriented Design Principles** → **SA Measurement**

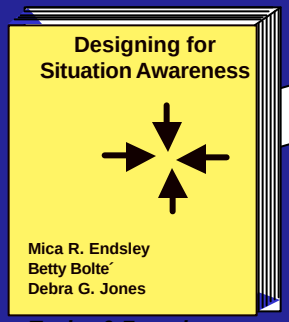


*Soldier Driven Requirements*

*Integrated Display Suites Tailored to Individual Needs*

*Objective Testing Of Design Concepts*

*SAGAT*




*Design Principles Based on Cognitive Science*

## Design and Development of User-Centered Design Concepts for Army Operations *(SA Technologies)*

# Analytical Tools for Collaborative Planning and Execution

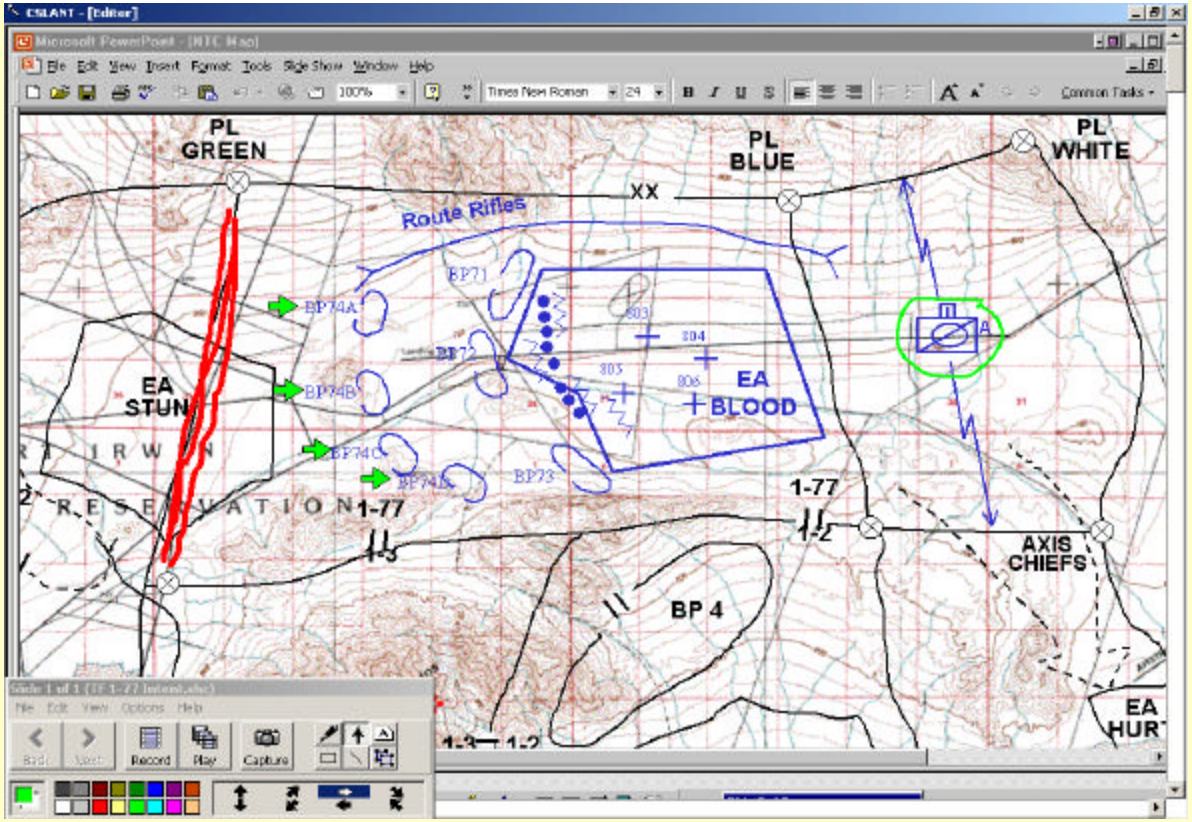
**Objective:** **To create tools that effectively support teams in coordinating and collaborating to achieve mission success in an environment of rapid deployment and operational tempos, diverse missions and distributed teams working across greater distances.**

## Challenge:

- **Determine how to prepare and support commanders and teams to operate in highly uncertain, dynamic environments.**
- **Exploit information operations for high levels of shared situation awareness and support coordination and adaptation among distributed and diverse teams.**

## Research Themes:

1. **Collaboration and Effectiveness in Human Teamwork and Human-System Teamwork**
2. **Development of Tools to Support Collaboration and Decision Making in Collocated and Distributed Teams**




**Continuous Distributed Planning: Interweaving Plan Development, Adaptation and Execution** *(OSU CSEL)*

# User Adaptable Interfaces

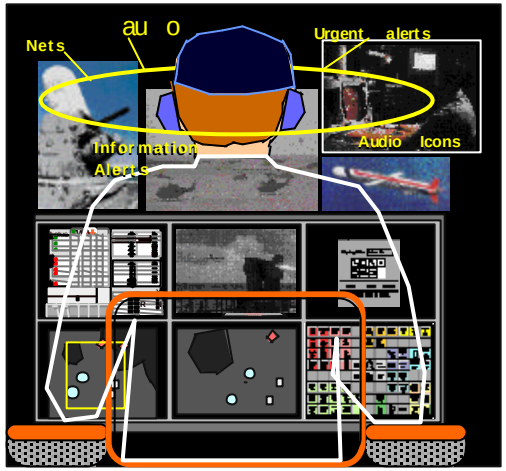
**Objective:** **Create effective user-adaptable interfaces for Army applications**

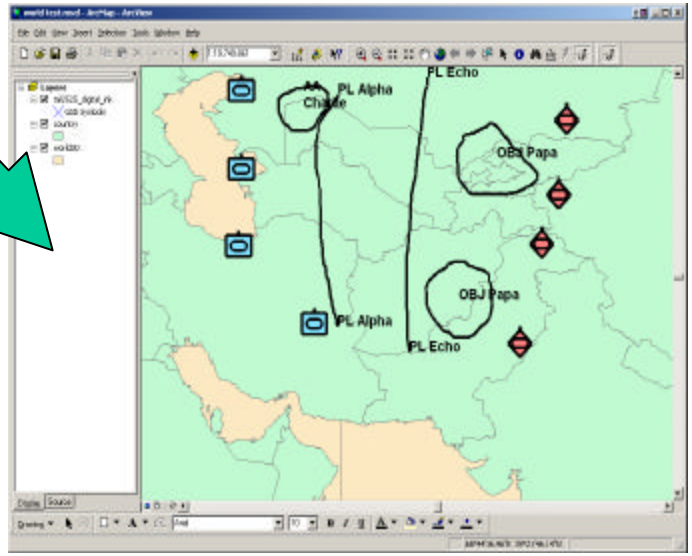
## Challenge:

- **Determine the conditions under which interfaces should be adapted**
- **Identify who should control the adaptation and the aspects that should be adapted**
- **Identify the optimal features that allow the user to control the adaptation**

## Research Themes:

1. **Visual Representations for Decision Assistance**
2. **Multi Modal Representations and Interactions**
3. **Ontology and Inferencing for Natural Language Interfaces and Heterogeneous Databases**






***Framework for combining information from a diagram with conceptual knowledge***. Includes a family of basic perceptual routines to identify emergent diagrammatic objects and relations. Supports situation understanding and plan critiquing.

# Auto-Adaptive Information Presentation

**Objective:** Determine how human and machine intelligence can be combined to form a coherent, joint cognitive system that fluently adapts to the changing demands of military operations

**Challenge:** Mix sophisticated human and machine capabilities while overcoming various limits on both kinds of processing

## Research Themes:

1. Human interaction with automated assets
2. Human coordination with autonomous assets
3. Auto-Adaptive information systems

# Human Coordination with Autonomous Assets

Projects and Partners:

- Dimensions of Human-Robot Coordination (OSU CSEL)
- Multi-Modal Control of Unmanned Vehicles (MA&D, ARL)

# FY02 ADA Selected Accomplishments

- Designed experiment at BCBL- L on Recognition Planning Model for UA C2
- Developed prototype architecture for integrating diagrammatic representation with conceptual representations to support a commander's reasoning about events on the battle field
- Enhanced a Java-based Multi-Criterial Viewer for viewing trade-offs among alternative COAs
- Conducted experiment to determine how to improve decision making and risk perception for Homeland Security
- Developed new architecture to support sharing and distributing visual data across multiple displays adapting to each display's capabilities
- Identified ways to enhance a computational model of decision making to improve realism in computer generated forces
- Developed a wearable tactile vest based on shape memory alloy fibers that can be used to present orientation, direction and threat information to soldiers
- Conducted Cognitive Task Analysis for Key C2 Positions
- Developed a 'habitability' framework for evaluating Natural Language interfaces

# Cross Consortia Projects

- C2 in Complex and Urban Terrain
- Robots in Confined Spaces
- Disposable Sensors

# C2 in Complex and Urban Terrain

- Coordination meetings:

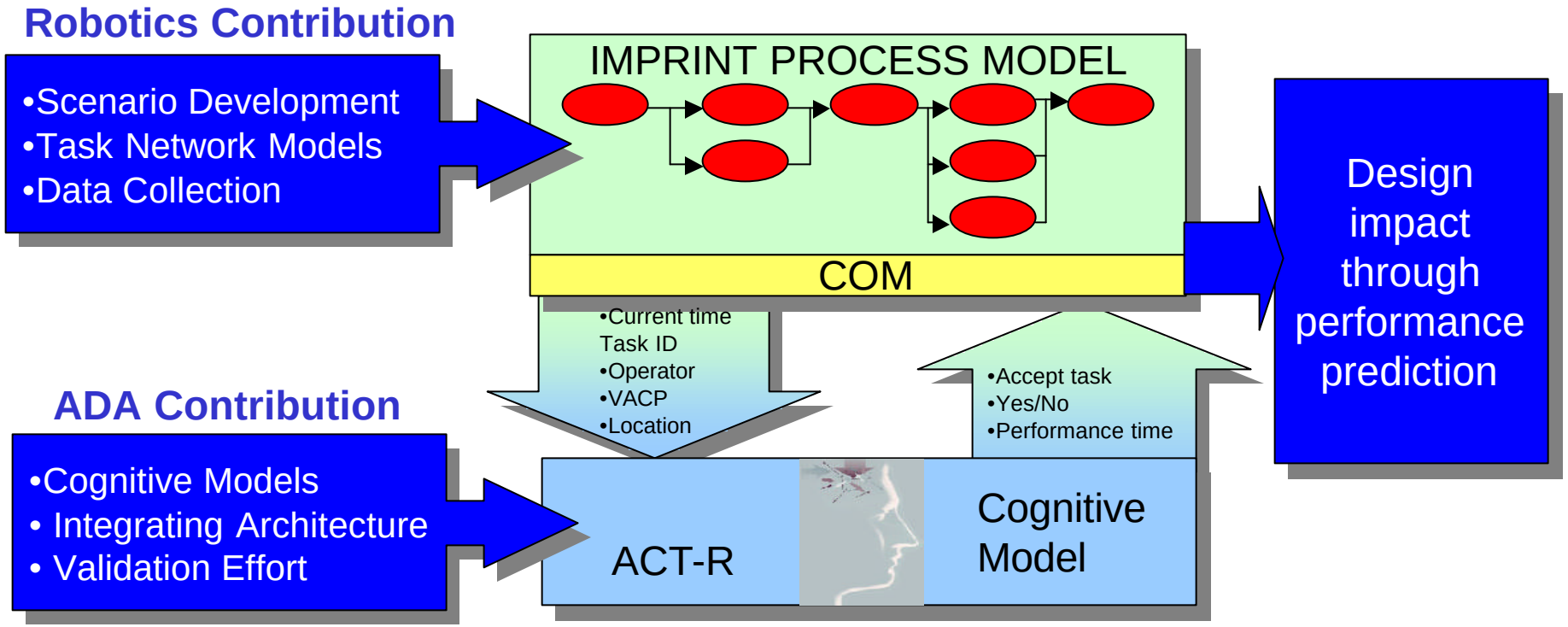
    1. ADA-Robotics Workshop on Trust in Automation (Oct 02)
    2. Army Science Conference (Dec 02)
    3. Cross Consortium Workshop (Jan 03)
    4. APG (Apr 03) - Gary Yerace (CISD), newly appointed POC

- CTA Crosswalk with C2 CUT (Dec 02)

# Current Project with Robotics CTA

## IMPRINT and ACT-R

*Research question:* *Do high-fidelity models of cognitive processes improve the predictiveness of models of human interaction with unmanned vehicles?*



# Disposable Sensors

- Keeping sensor reports in context, acknowledging constraints of limited bandwidth
- Tactics, techniques, and procedures for effective employment of low cost sensors
- Information flow protocols to enhance collaborative situation awareness

# FY03-05 Advanced Decision Architectures Key Products

## FY03

- Key effects on the military decision process of transitioning from plan centric to intent centric command and control
- C2 goal directed task analyses in the Objective Force
- Macrocognitive requirements for replanning in FCS

## FY04

- Prototype of dynamic display showing need for replanning
- Improved methods of displaying relevant information including multi-modal displays

## FY05

- Demonstrate prototype system for diagrammatic reasoning in situation awareness and planning
- Collaborative Tools for Distributed, On-the-Move, tactical decision making
- Evaluation of utility of C2 auto adaptive architectures

# ADA Major Thrusts

1. One of the biggest issues the CTA can support better and faster tactical decisions
2. Another equally big issue concerns pulling the “knowledge needle out of the information haystack”

# ADA Major Challenge

Making and communicating decisions faster than the enemy can react effectively creates a tempo with which the enemy cannot compete.

FM 6-0
Mission Command and Control of Army Forces
October 2002