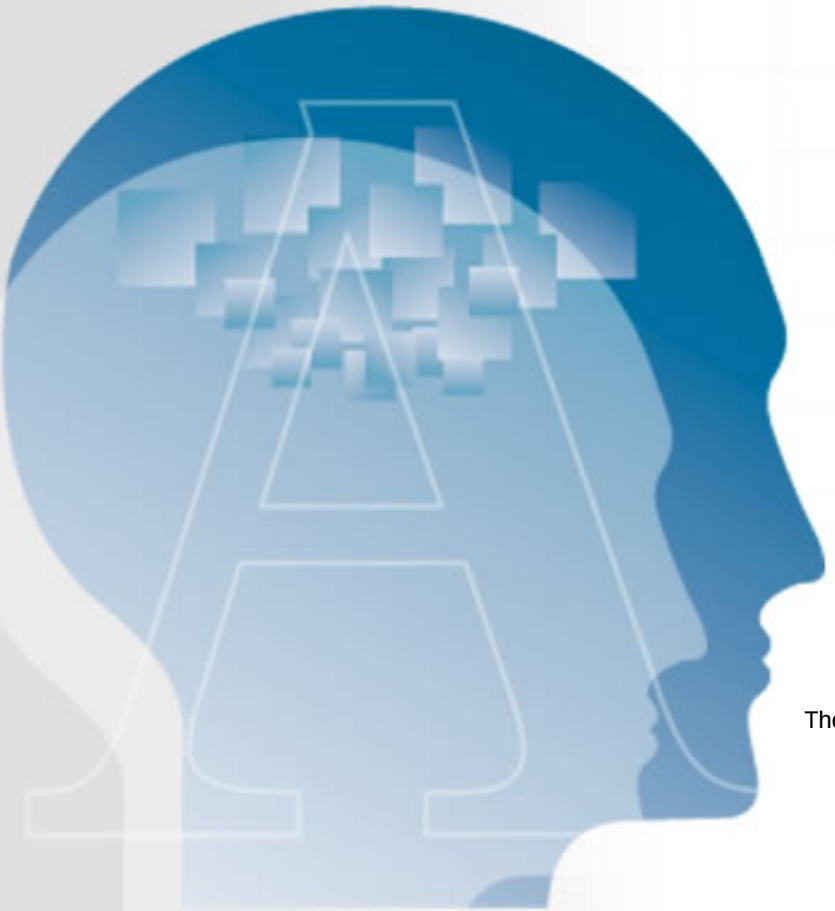

# Collaborative Critical Thinking

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Michael Coovert, Ph.D., **U. South Florida**
**Pacific Science & Engineering**

Collaboration and Knowledge Management Workshop
January 13 – 15 2004

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The opinions expressed here are the authors' and do not necessarily reflect the views of the Navy or Department of Defense.

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# Report Documentation Page

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# Agenda

I. Objectives
II. Experiments conducted and empirical findings
III. Expected Final Products/Tools being developed
IV. Planned demonstrations/validations of technology developed
V. Potential fit/contribution to Knowledge Building or Collaborative Processes
VI. Publications
VII. Lessons Learned

# I. Objectives

- Overall Objective
  - Effective collaboration through improved collaborative critical thinking (CCT)
- Objectives for this year
  - Complete development of
    - CCT tool
    - CCT Training
  - Collect validity evidence for both tool and training

# II. Experiments

- Currently on-going at USF

## Approach

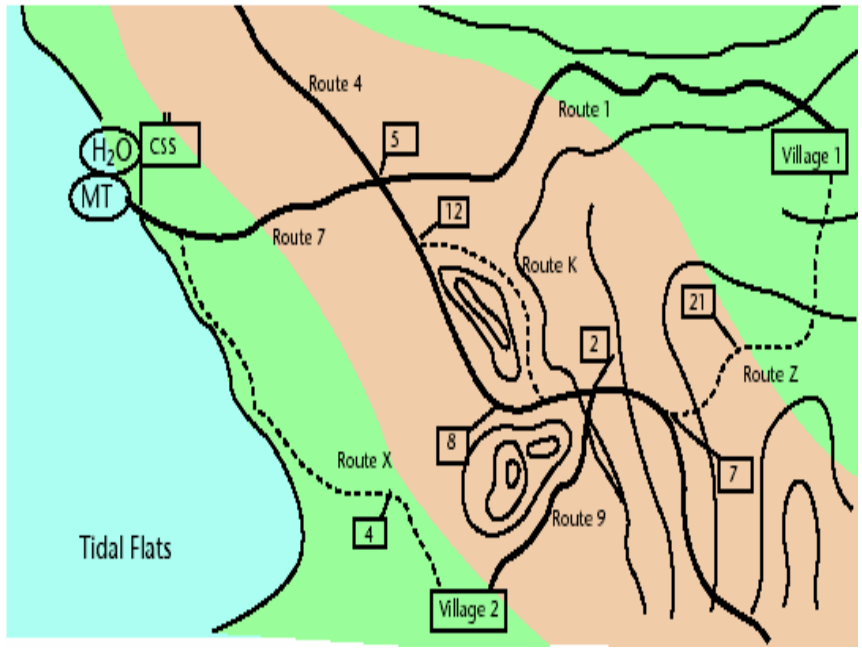
- To test the hypothesis:
  - CCT enhances collaboration and $C^2$ performance
- We need to:
  - Understand CCT at the cognitive and dispositional levels
  - Develop technology and training that supports CCT
  - Measure improvements in CCT and their effect on $C^2$ performance
- We will:
  - Better understand CCT
  - Develop measures of CCT, and
  - Strengthen CCT w/ tools and training

## Most Recent Experiment

- Objective:
  - To increase our understanding of CCT
    - Determine the relative importance of cognitive and dispositional factors in CCT.
    - Determine the impact on C2 and mission outcomes of
      - Training cognitive factors and
      - Sensitizing dispositional factors
- Method:
  - Each of 3 team members receive
    - Training in several cognitive aspects,
    - Sensitization to several dispositional aspects
    - Both, or
    - Neither
  - Team building exercise
  - Teams execute 2 TDGs

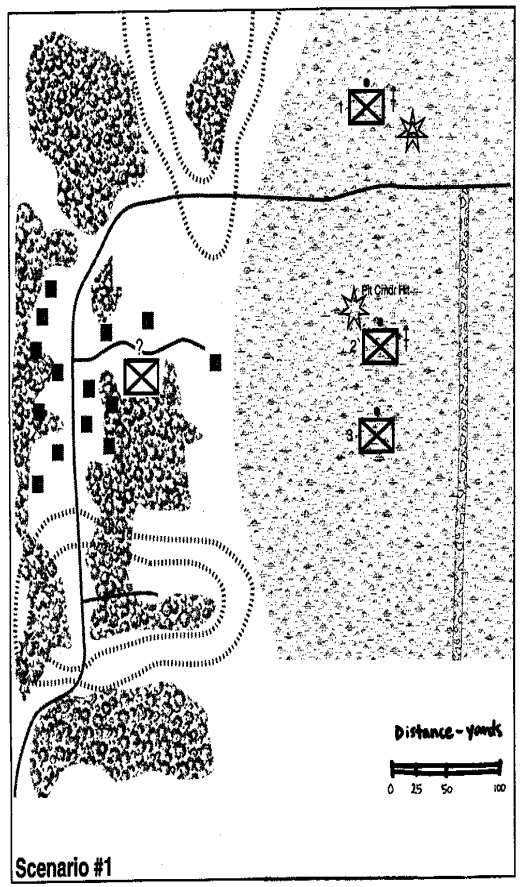
# TDG #1: Command and Control Fog

- You are commanding a group of soldiers assigned to a joint task force conducting humanitarian relief operations in the drought stricken country of …



# TDG #2: Ambush at Dusk

- You are the leader of the 1st Squad within the 1st Platoon of Company C. You are fighting in a tropical area against rebel forces armed with handguns, light machineguns, and some rocket-propelled grenades …



## Some Details

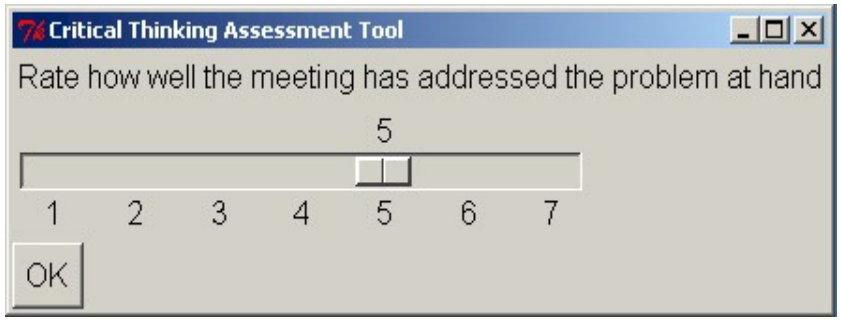
- Pre- & post- task discussions for each task.
- Solution sheets and maps w/ transparencies for each TDG.
- Second TDG task is video taped.
- Final questionnaire for each participant.

## Analyses

- Measures
  - Counts of skills observed in dialogues
  - Self-reported use of skills
  - Correctness of solutions
    - Goals (do they make sense? i.e., does this violate tactical procedures; will they kill themselves by doing this)
    - Orders (do they make sense? i.e., does this violate tactical procedures; will they kill themselves by doing this)
    - Map (does it it portray what they said?  does it made any sense?)
- Analyses (ongoing)
  - Evaluate impact of training & sensitization on outcomes
  - Estimate unique contributions of cognitive and dispositional factors using hierarchical regression

# Planned Experiments

- Usability testing for the tool's pop-up feature
  - Planned for early February 2004
  - Many vs Few probes




- Usability testing for the tool's "facilitator" interface
  - Planned for late February/early March
- Validation of the tool and training
  - Planned for March, April, May

# III. Expected Final Products

- CCT Tool
- CCT Training

Potential impact

- Both process and products
  - Improved collaboration
  - Better team decisions

Applications

- Any distributed, synchronous team trying to agree on an optimal solution.

# CCT Tool

- The setting
  - A geographically distributed team in a long working session
  - The team leader wants to monitor CCT activity
  - Team members need reminders to engage in CCT
- Two components
  - Participants' tool –
    - Elicits data concerning team member monitoring, assessments, critiques, actions
    - Cues team members to monitor, assess, critique, act
  - Coordinator's tool
    - Helps leader or aid plan, poll for, and analyze collaborative critical thinking activity
      - Setup element
      - Monitoring element

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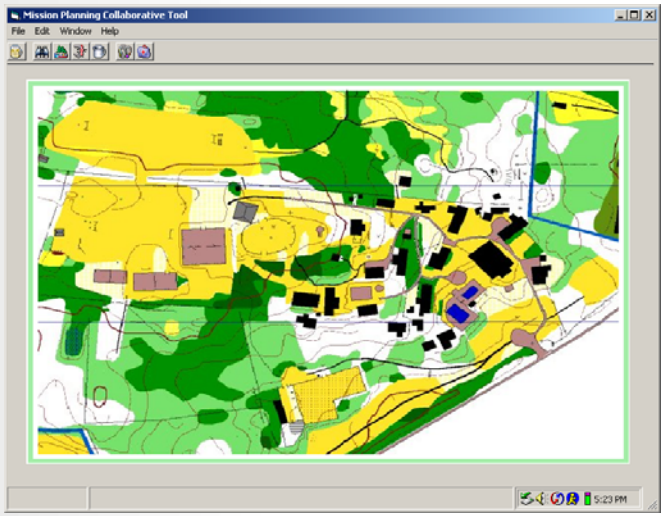
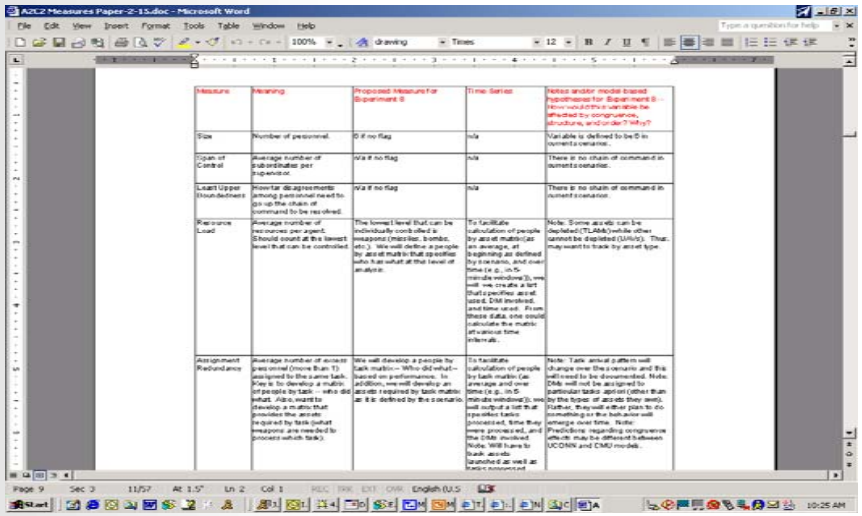
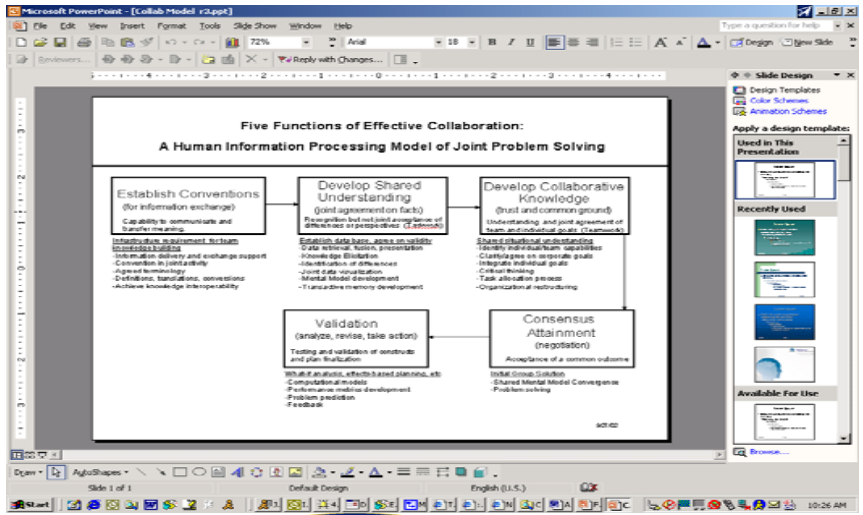
# Workspaces in a Distributed Team





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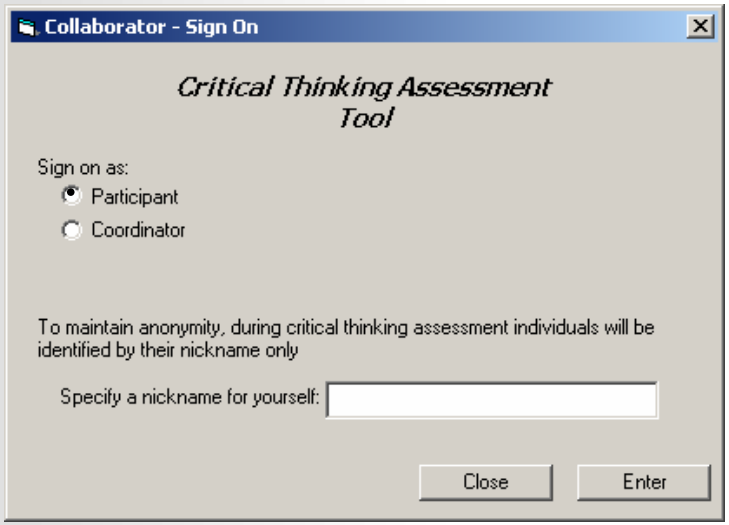
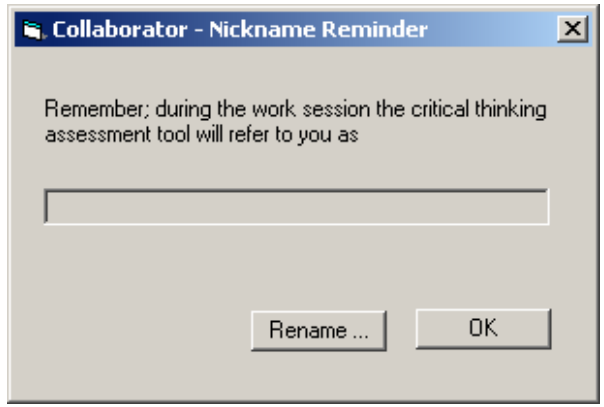
# Sign on dialog




Note; When signing on to the CCT Tool the participants are already logged onto the collaborative application.



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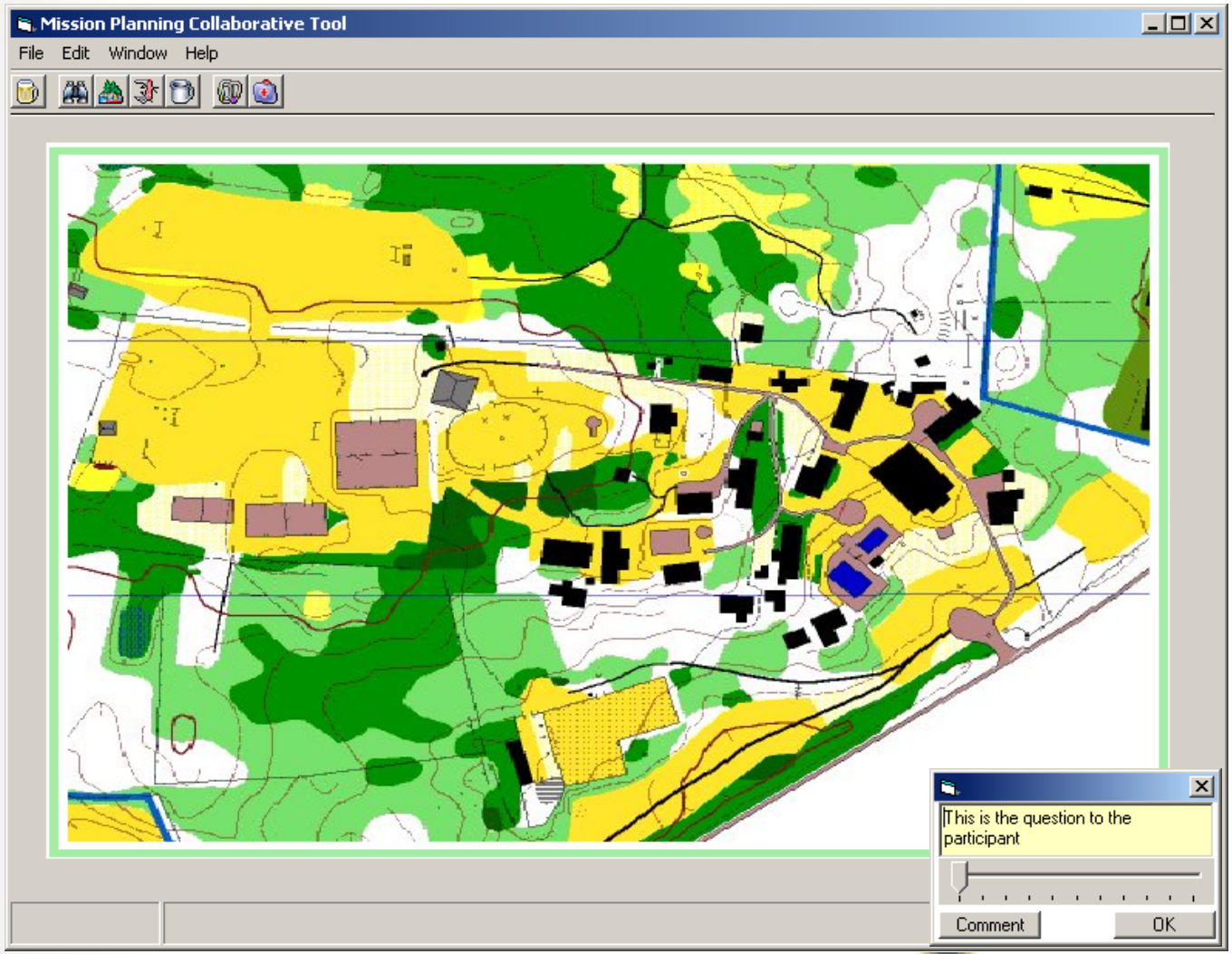
# A Pop-Up Probe



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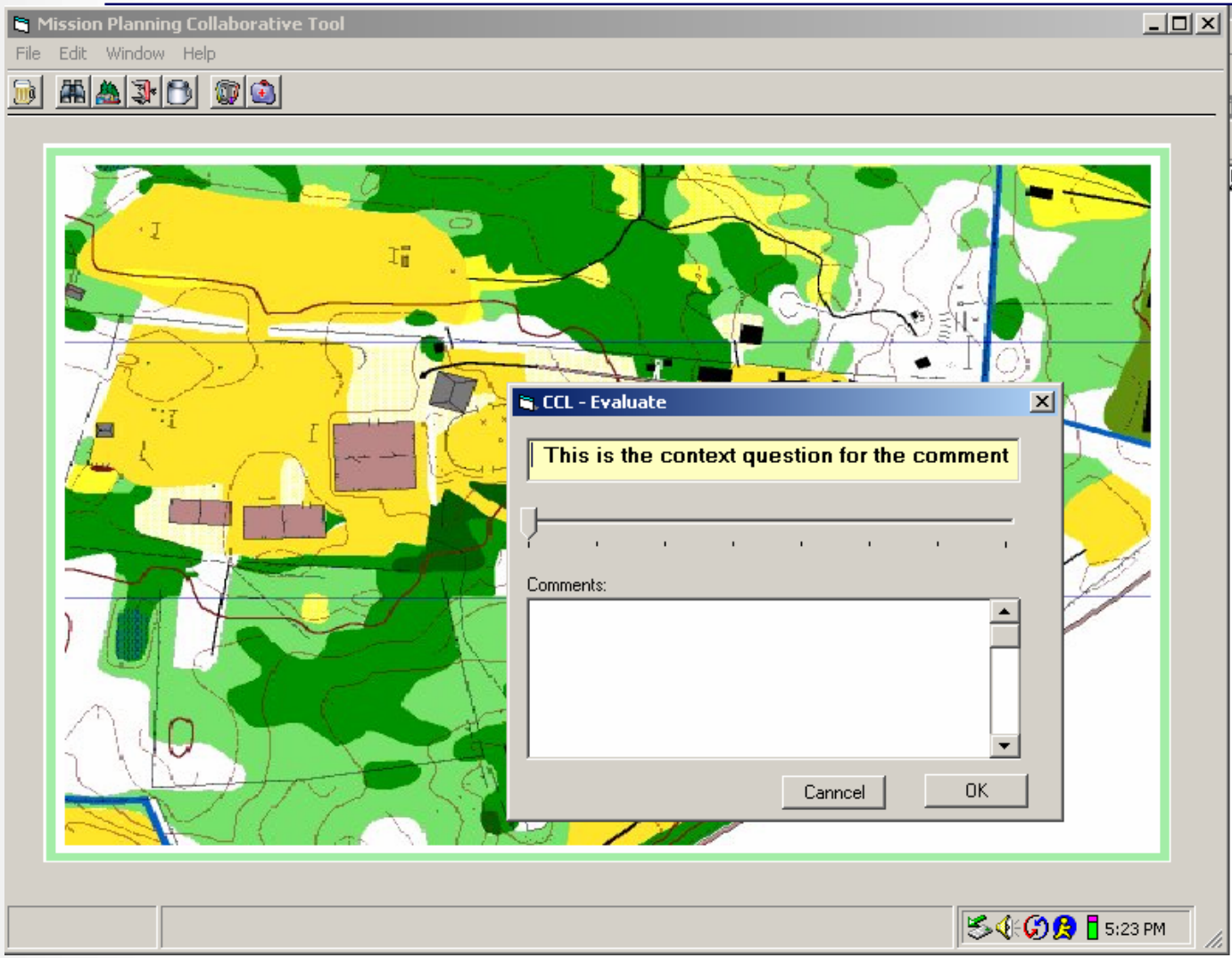
# Opportunity to Rate and Comment



# Pop-up "Probe" Development

- Probes were developed to elicit information concerning (at least)
  - Whether the team is engaging in CCT
  - To what topics it should apply CCT
  - When it should do so
- In the probe development we were mindful of
  - 3 classes of CCT constructs
    - CCT Behaviors
    - Cognitive skills and dispositions that enable CCT
    - Phases of collaboration
  - CCT objectives
    - Process
    - Products

Analysis: Identify different suggested solutions or unmentioned assumptions
Evaluation: Assess credibility of statements, compares strengths/ weaknesses
Explanation: Justify one's reasonings, write clear plan of action
Inference: Identify elements to make reasonable conclusions
Interpretation: Recognize and summarize a problem, organize info to comprehend significance
Self-regulation: Apply analysis and evaluation to own judgments

Monitoring of the need for CCT
Assessment of the time and priority
Critiquing to find information and reasoning faults
Action to get information or fix faults

Inquisitive: Eager to get knowledge and explanations
Judicious: Deliberate and careful
Truthseeking: Pursues accurate and complete factual knowledge
Confident in reasoning: Trusts own reasoning/ critical thinking skills
Open-minded: Open to different ideas
Analytical: Anticipates consequences; makes decisions based on evidence
Systematic: Careful and resonable in developing solution

- he probe dev opme
  - classes of CCT const
    - CCT Behaviors
    - Cognitive skills and dispositions that enable CCT
    - Phases of collaboration
- CCT objectives
  - Process
  - Products

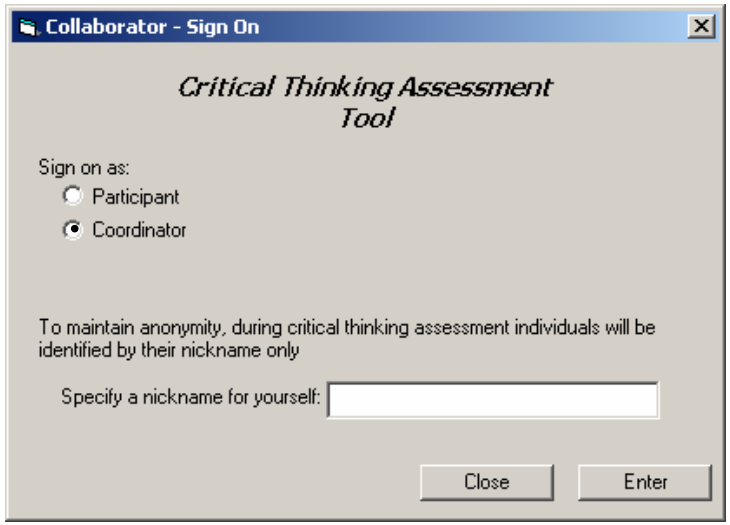
Establish conventions
Develop shared understanding
Develop collaborative knowledge
Consensus attainment
Validation

## Form of Probes

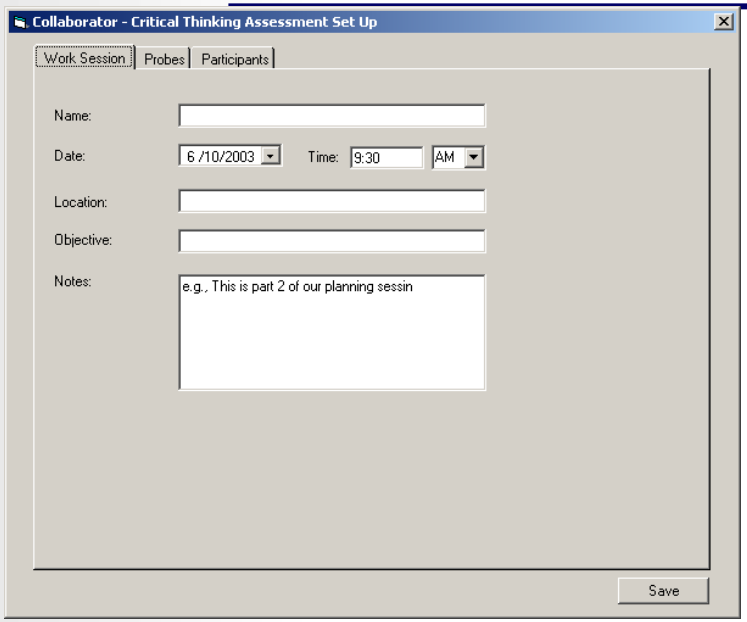
- Elicit a continuous numeric rating
- Short
- Templated
- Time sensitive

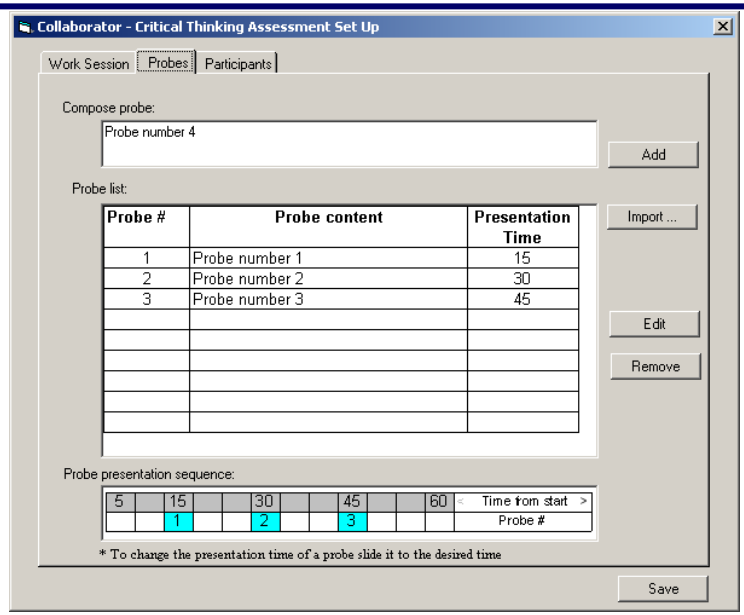
- In your opinion, is the team's assessment of the current situation correct?
- Does your team have all of the critical information needed to solve the problem?
- Has the team addressed the plausible alternatives for solving the problem?
- In your opinion, are the team members working toward the same goal?
- To what extent have the advantages and disadvantages of the solution been discussed?
- In your opinion, have all feasible solutions been considered?
- How realistic is the time line for the plan?
- How appropriately is responsibility allocated among team members?
- How much are team members communicating about the task at hand?
- How successful have team members been with their roles?

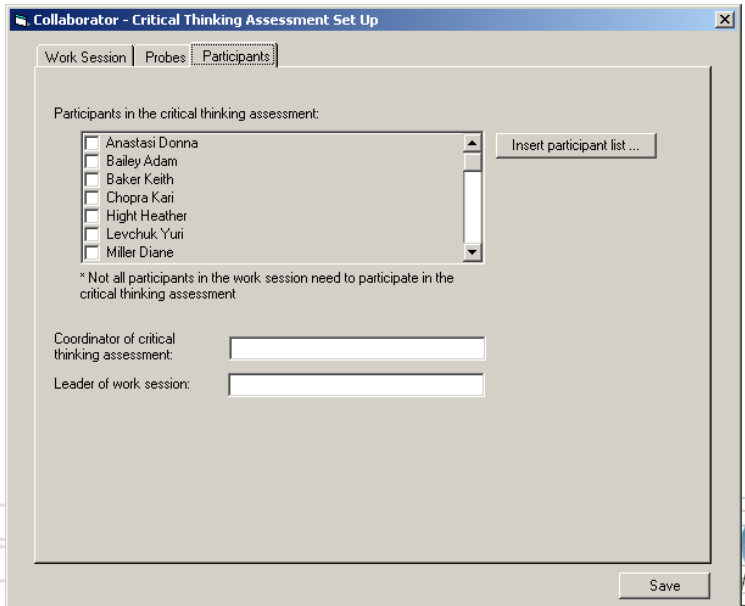
# Sign on dialog for coordinator/facilitator



# Coordinator's Configuration Interfaces

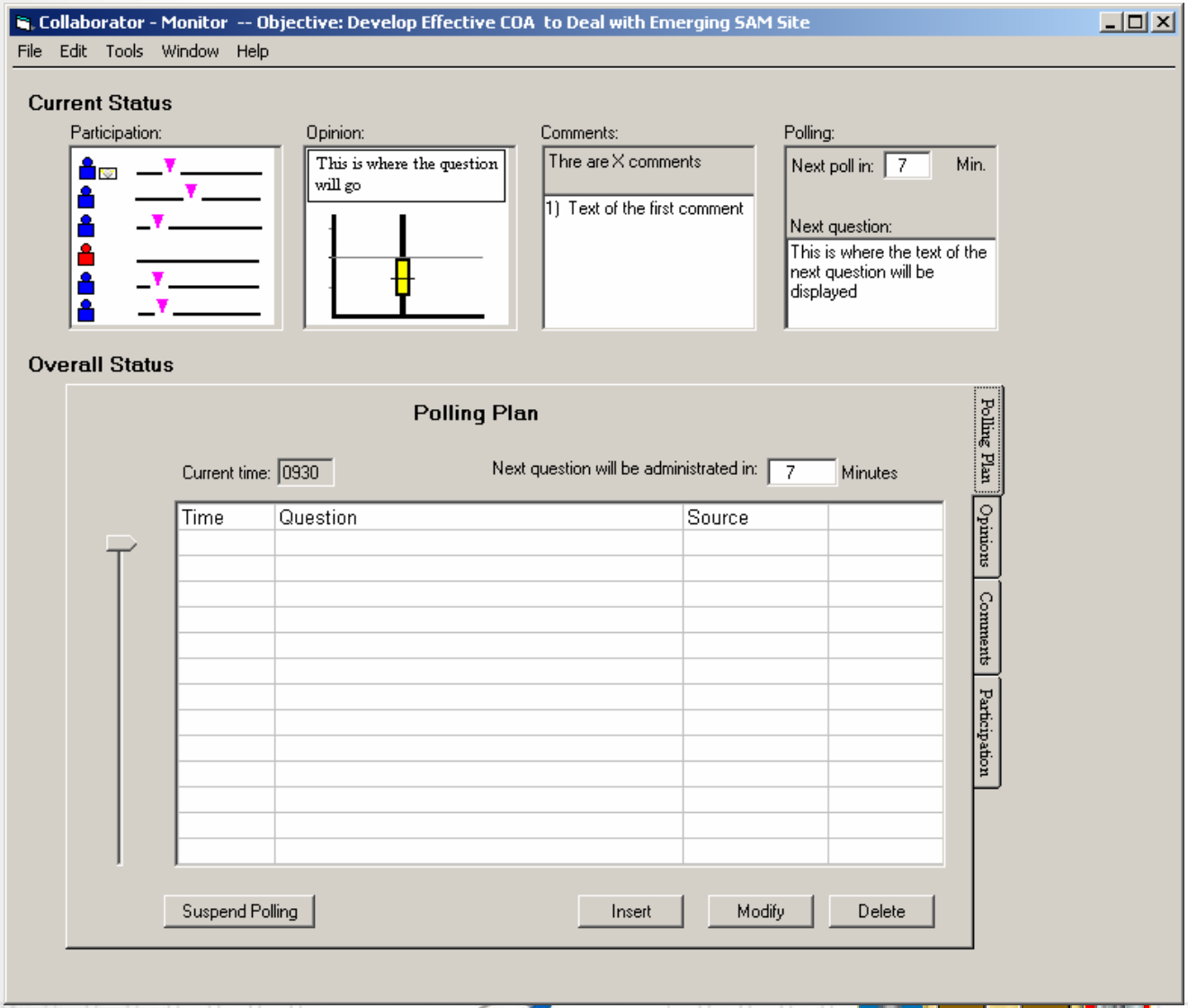



- Configure (clockwise)
  - Work session
  - Probes & schedule
  - Participants

# Response Monitoring Component – Polling Plan Tab



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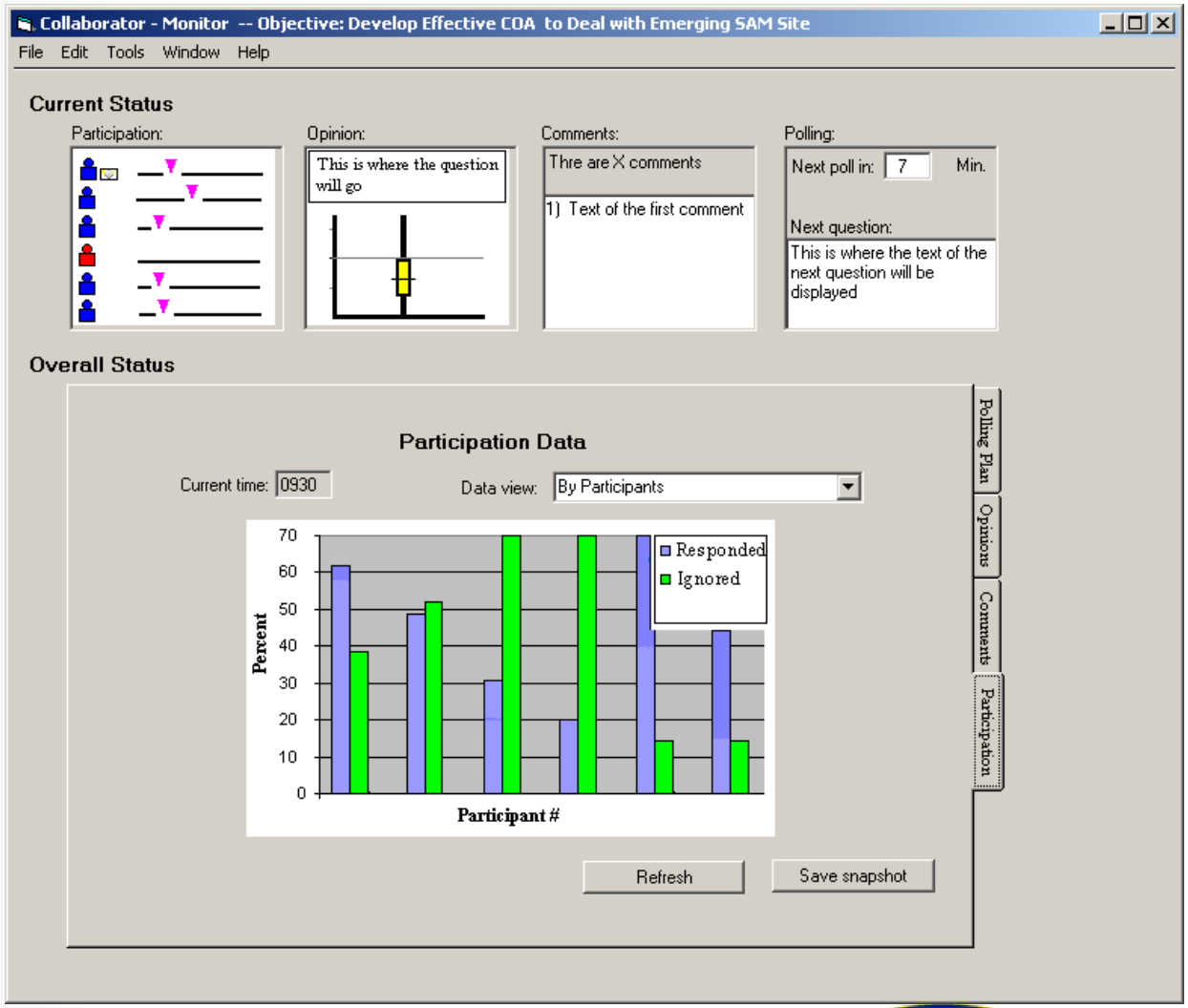
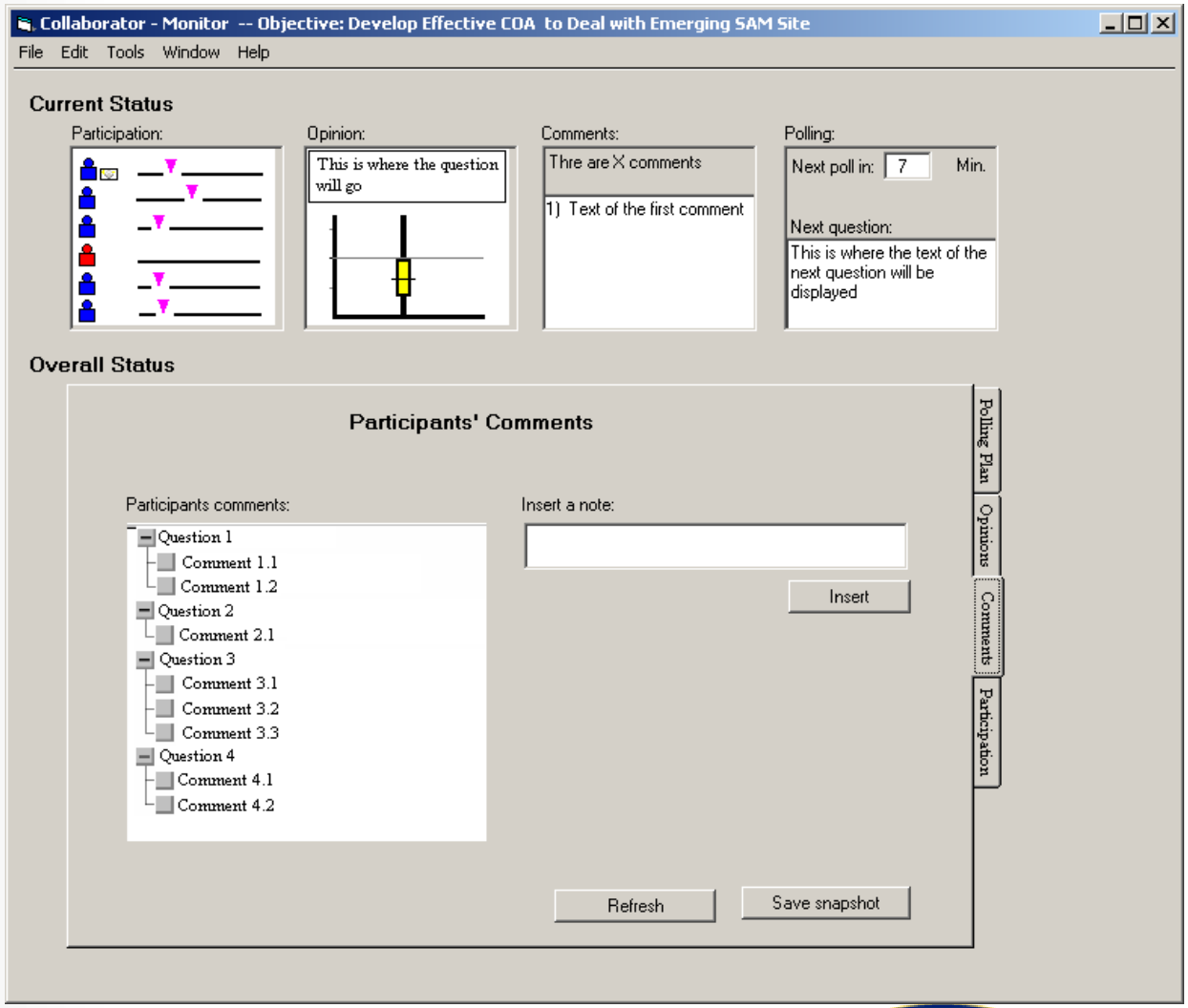
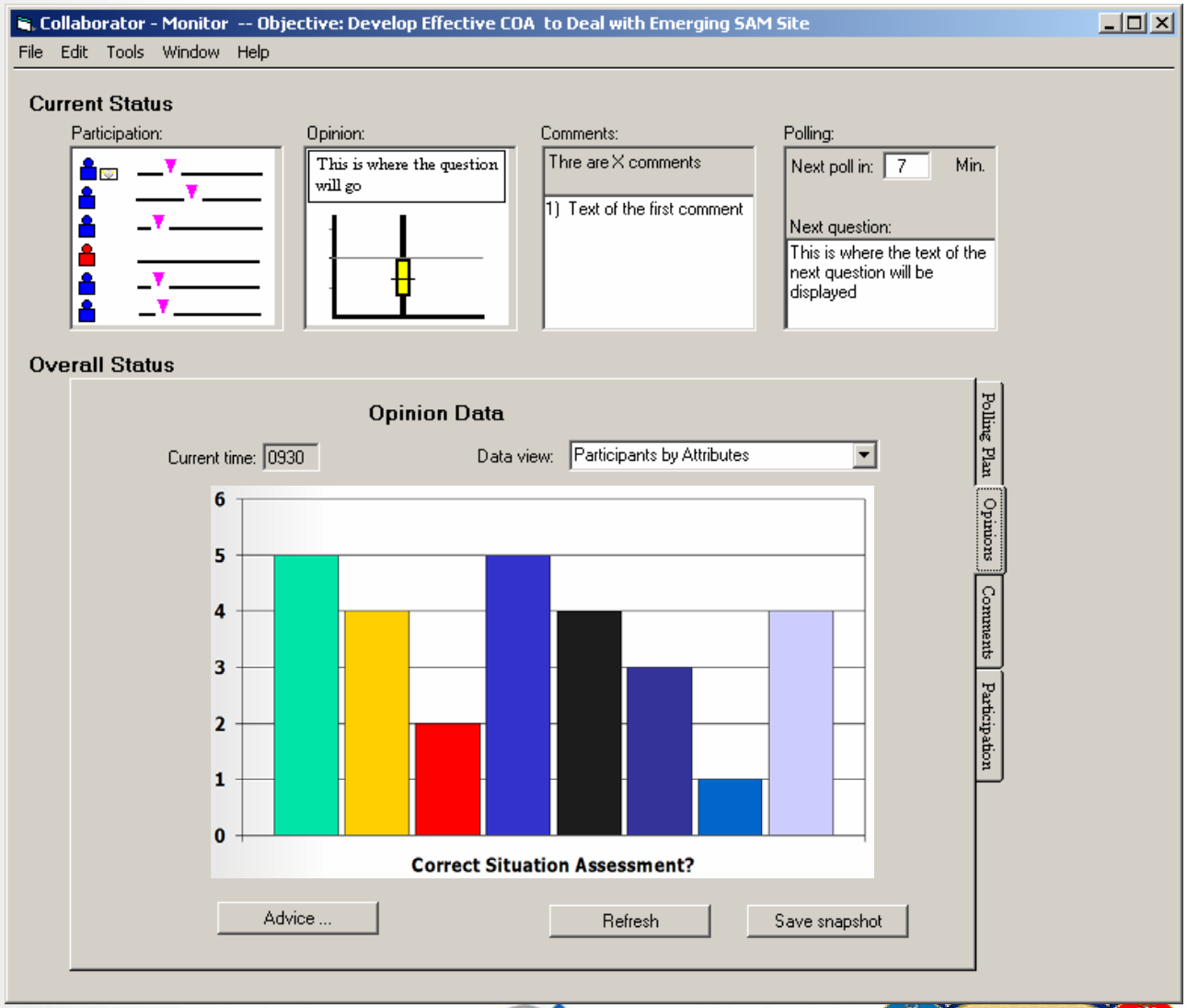
# Participation Statistics



# A Summary of Comments



# Response Monitoring Component – Opinion Tab



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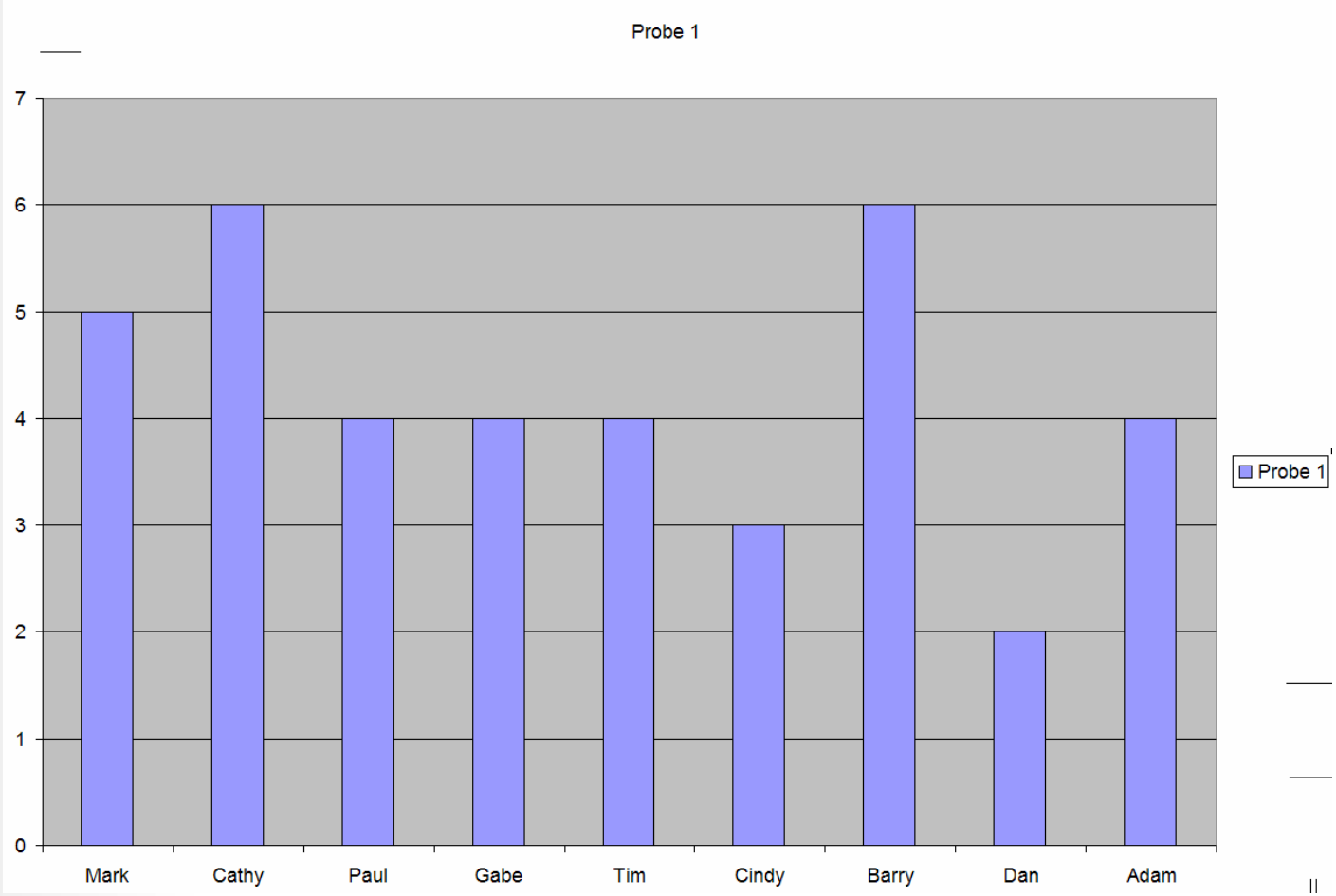
# Work-In-Progress; ideas for data visualization



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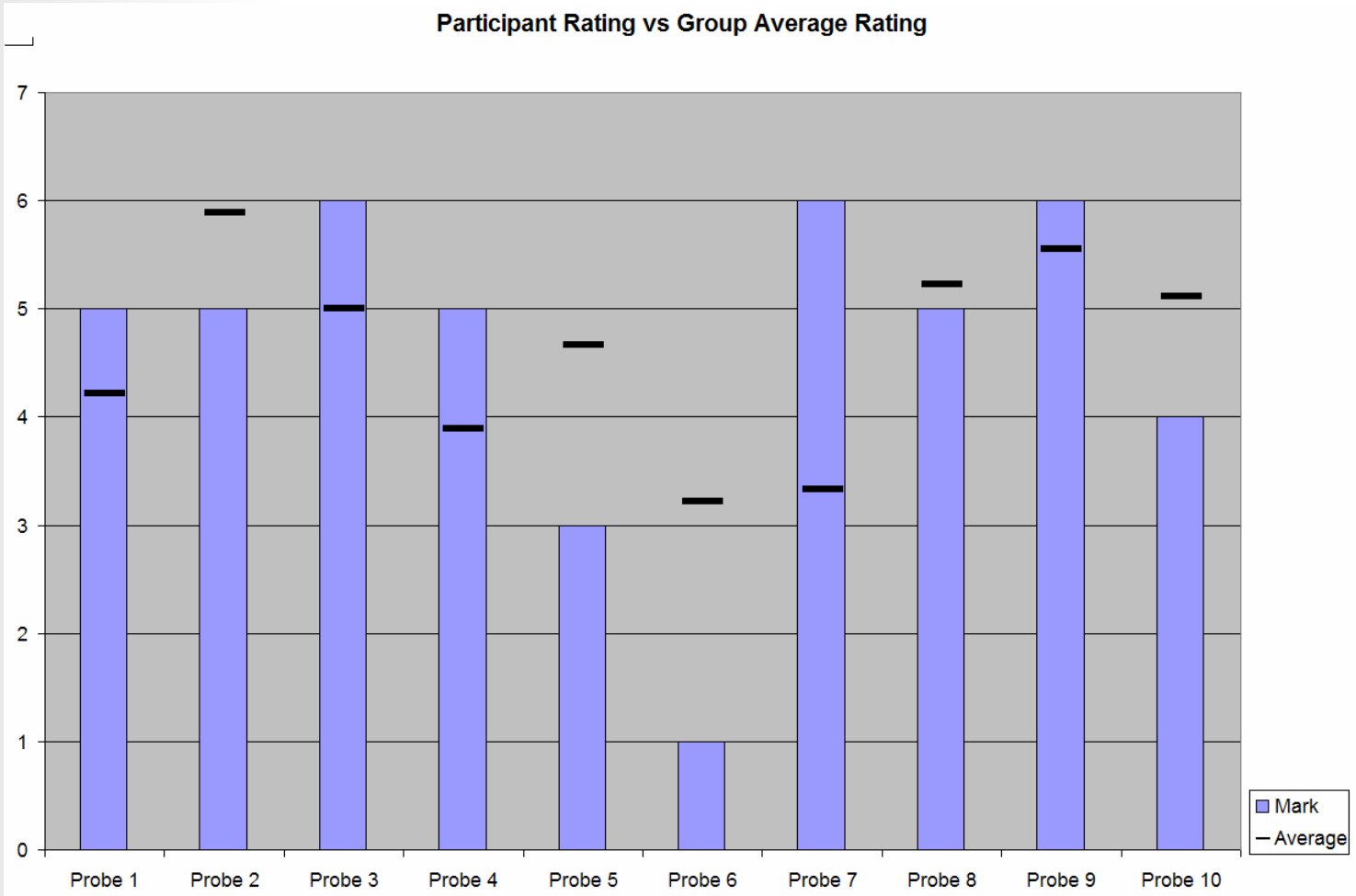

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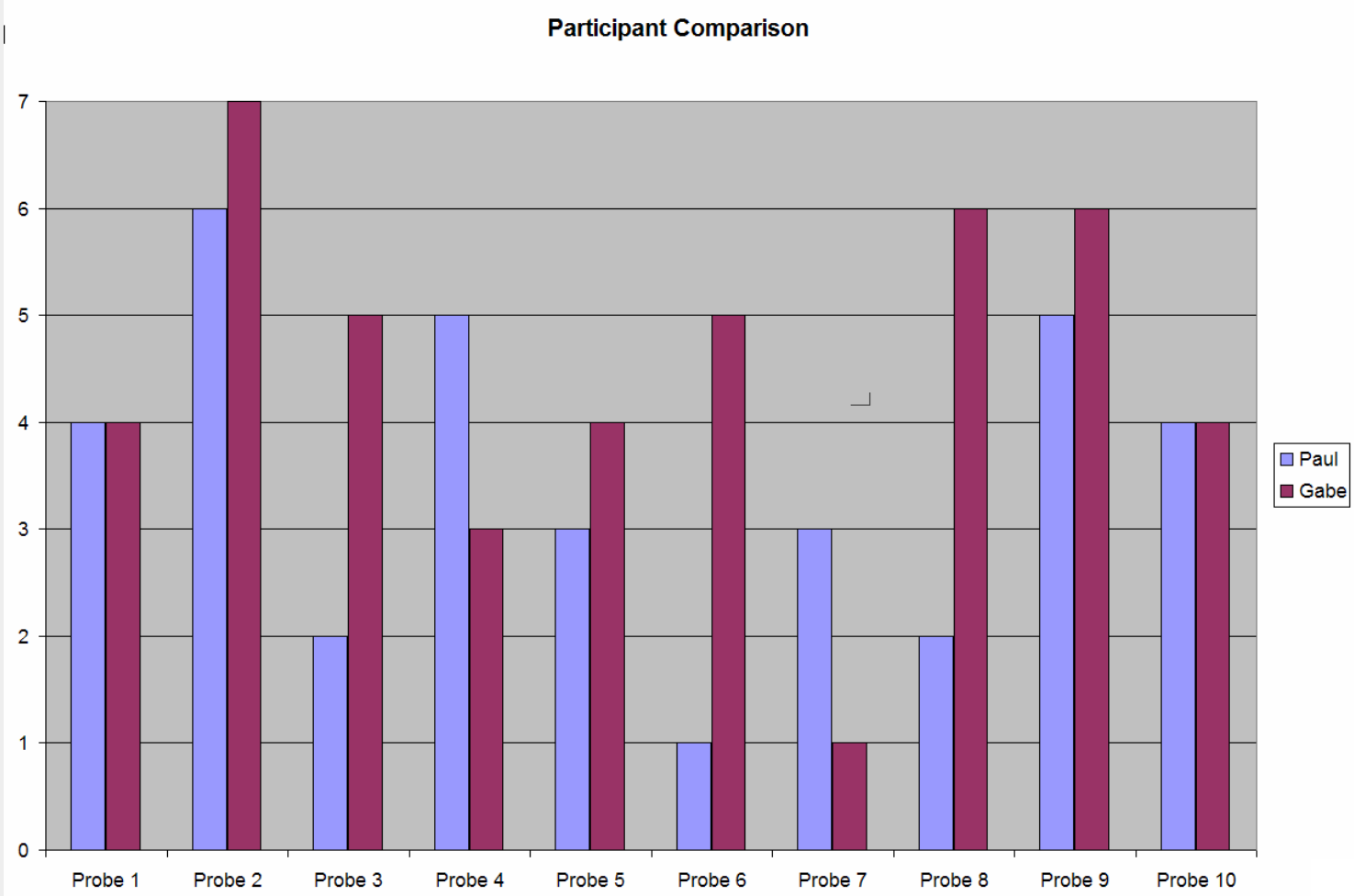

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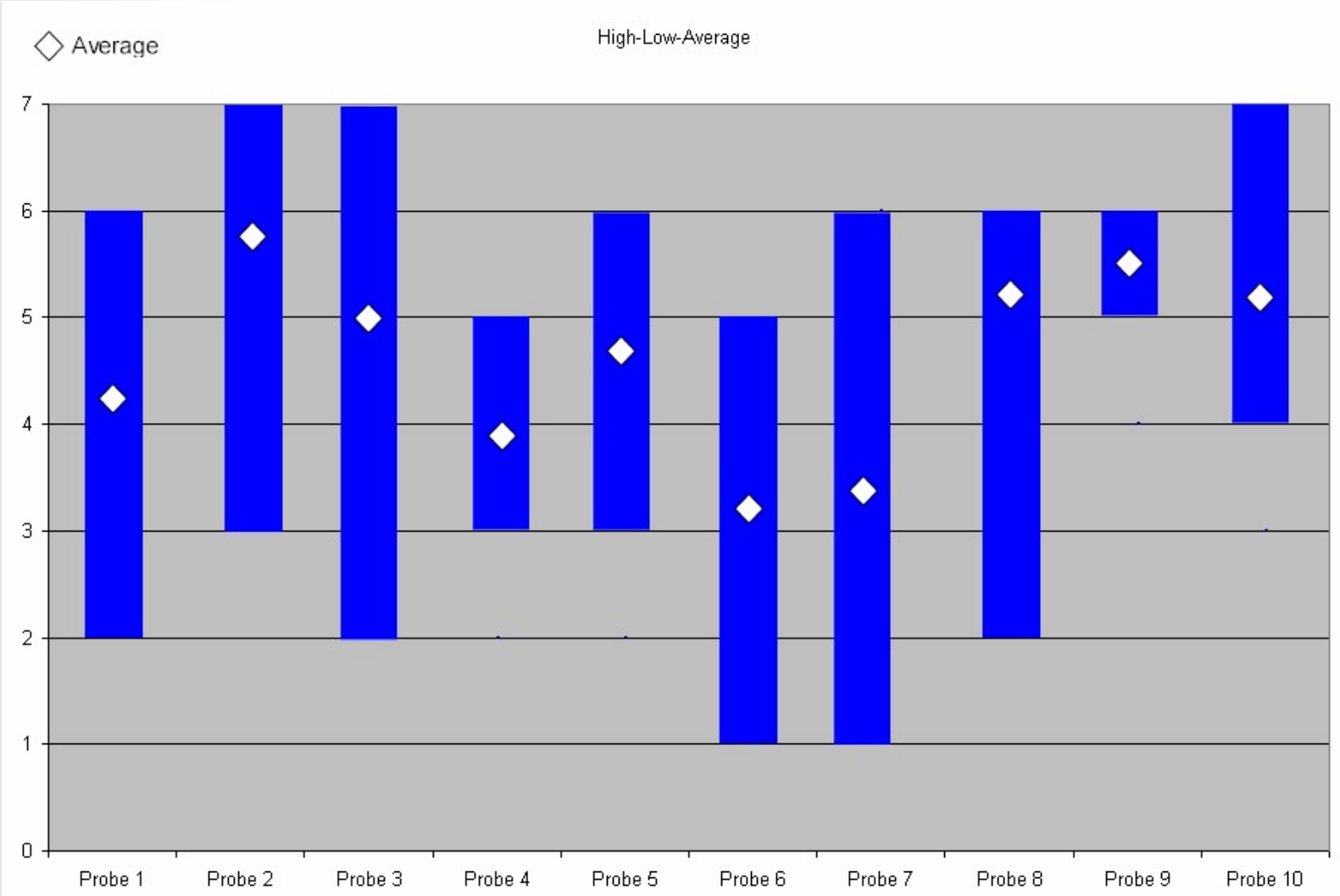


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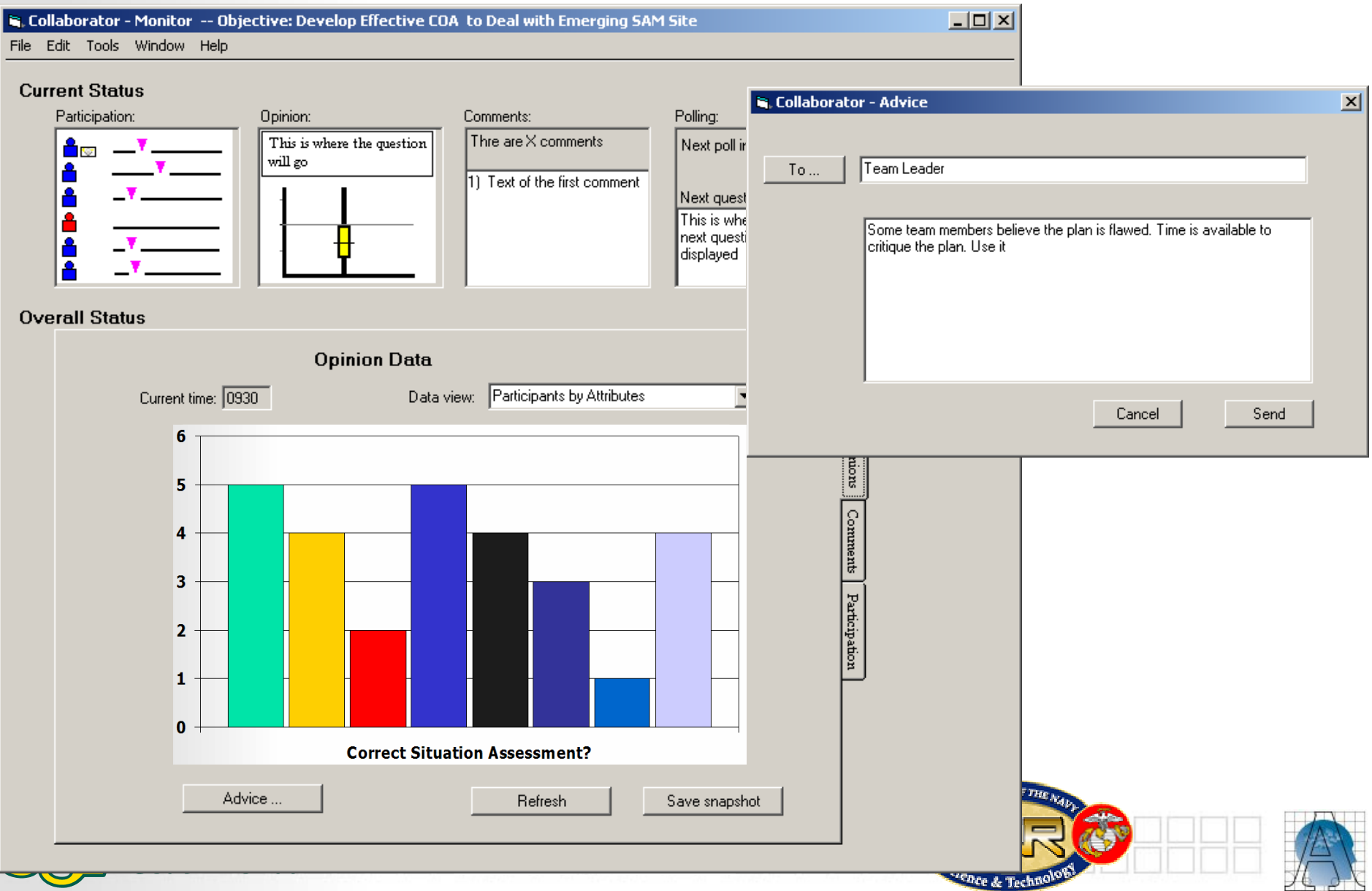
# Rating Results + Advice



## Tool Development Specifics

- Python programming language.
  - An interpreted, interactive, object-oriented programming language
  - Comparable to TCL, Perl, Scheme, or Java.
  - Can run in any operating system.
- The CCT tool has a client/server architecture and uses MySQL for the back-end database.
- The tool is designed to run over the Internet.
- The users of the tool do not have to be using the same operating system when the tool is running.
  - i.e some users can be in Windows and some can be in Linux and still communicate and pass information seamlessly.

# CCT Training

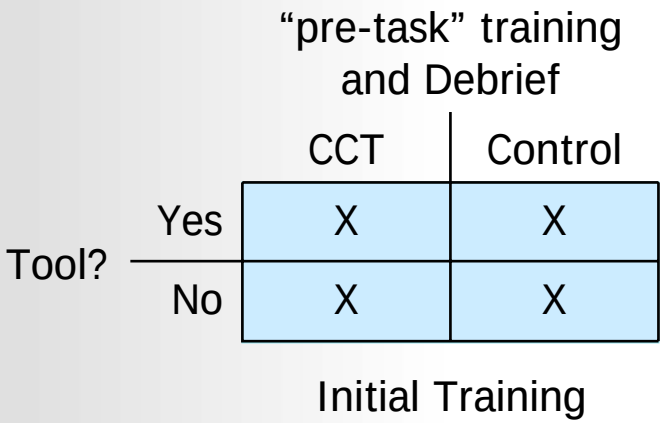
- Define CCT and improve the basic framework for understanding what CCT is
  - Understand the elements of CCT
  - Understand the barriers to CCT
  - Facilitate the process of CCT

- Initial Trainin
  - Cognitive
  - Affectiv
- 10-15 mi
  - CCT
  - Control
- 10 minute Ta
solve)
- Debriefing
  - CCT
  - Control
- Simulation/T

- CCT Training
  - Content
    - CCT Defined

      A group process in which people work together toward a common goal, whereby goal accomplishment requires an active exchange of ideas, purposeful self-regulatory judgment, reasoned and systematic consideration of evidence, counterevidence, and context, in an environment that commonly can be characterized as uncertain, or where judgments are made under uncertainty, and there is limited knowledge and time.
    - What do you need to do to make it happen
  - Process (“hands-on” task)
  - Content
    - Ensure shared understanding of CCT – definition and process

# IV. Planned Validation



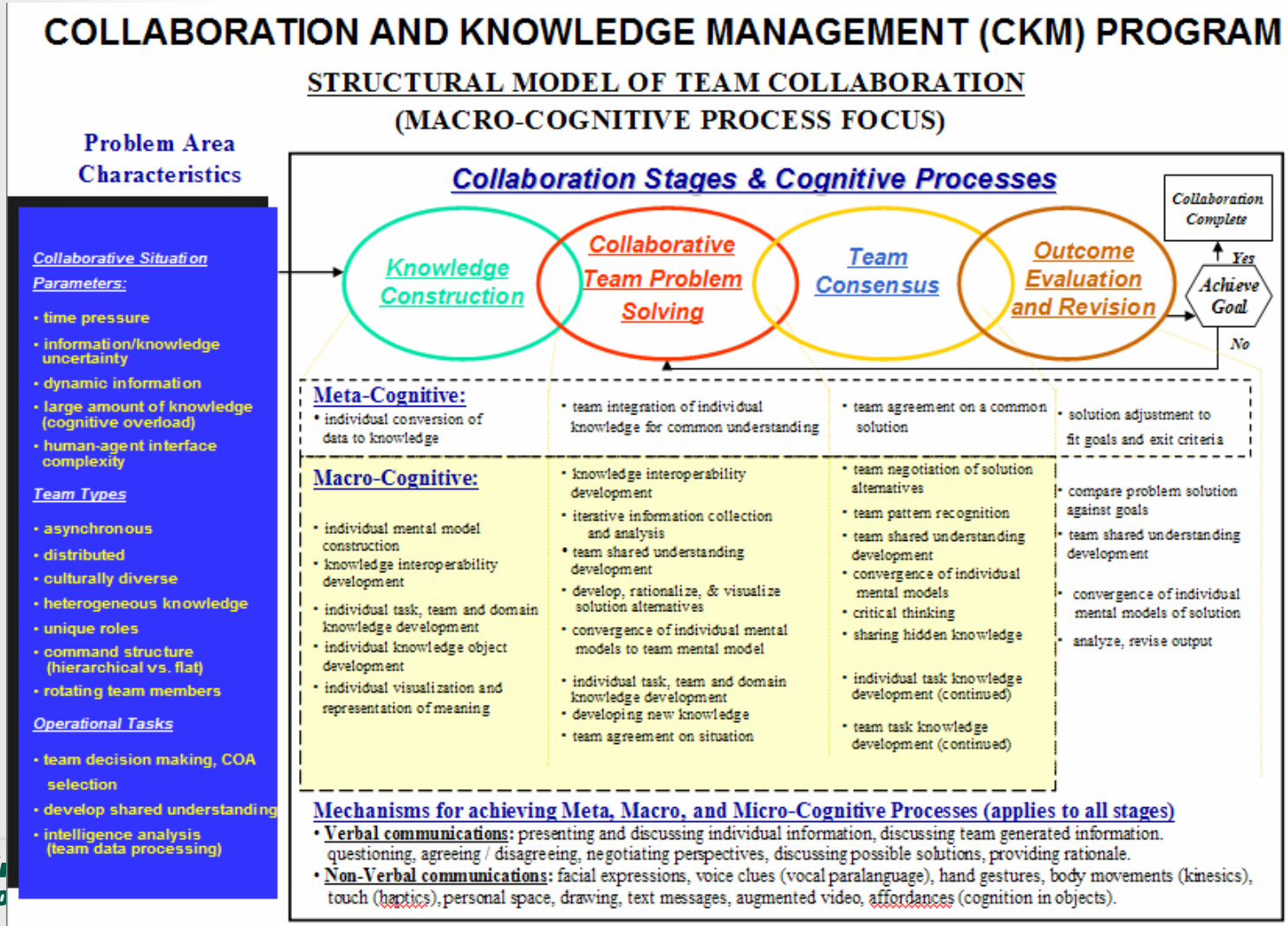

- Training as previously outlined
- Participants will then engage in a team task
  - Team must locate and rescue a lost party
  - Team must critically collaborate to allocate resources and make plan
    - Tool
    - No tool
  - Team will then participate in a simulated environment to enact plan

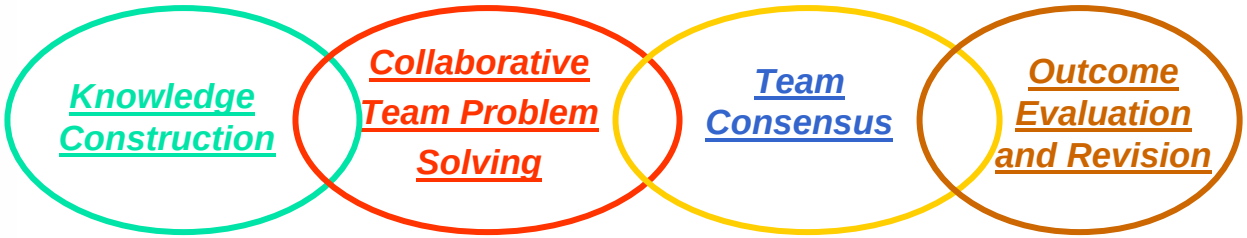
# Draft Experiment

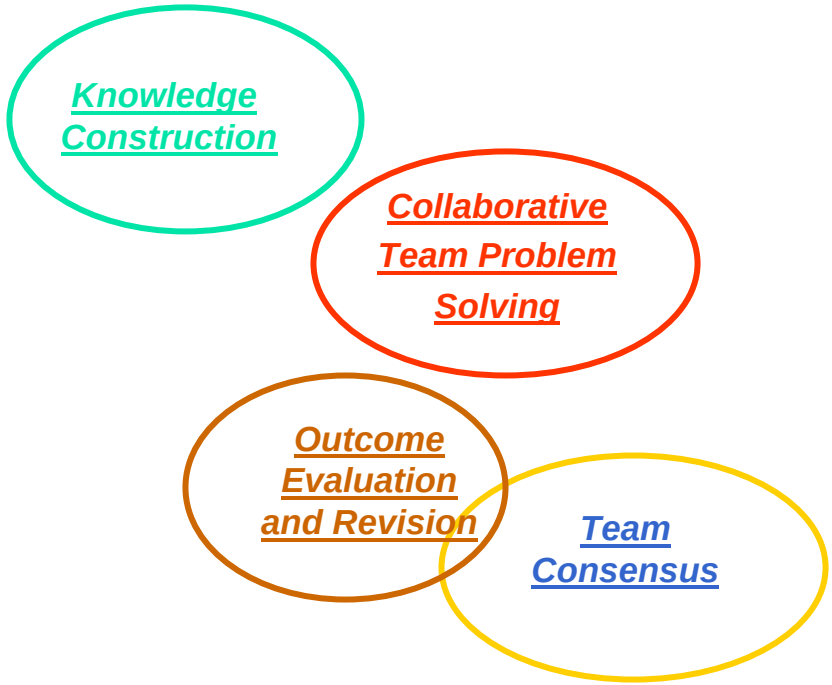
- Hypotheses
  - H1: CCT tools and/or training **improve shared awareness of uncertainty and risk**. (Ability/Process)
  - H21: CCT tools and/or training **increase the incidence of CCT behaviors.** (Ability/Process)
  - H3: CCT tools and/or training **improve the team plans**. (Products)
  - H4: CCT tools and/or training **improve mission execution and outcomes**. (Effects)
- Materials: Military scenario in which
  - some aspects of the situation are well defined, others are not.
  - some risks can be reduced by information gathering or probing
  - some risks cannot be reduced and require contingency plans
- Testbed: Distributed Dynamic Decision-making (DDD) Simulation
  - Team research testbed
  - Collaboration measurement capability
  - Developed at U.Conn, freely available, used at 25 labs
- Subjects: ROTC and undergraduate students
- Method:
  - Pretest domain knowledge & critical thinking ability
  - Scenario (re)planning phase ←→ execution phase
  - Real time measures of CCT
  - Posttest measures of CCT
- Analysis: Multi level modeling supports analysis of group, individual, their interaction (individual on this team), and error for group and individual

# V. Fit

- CCT is an integral part of the "Collaboration Stages and Cognitive Processes"




Knowledge Construction
Collaborative Team Problem Solving
Team Consensus
Outcome Evaluation and Revision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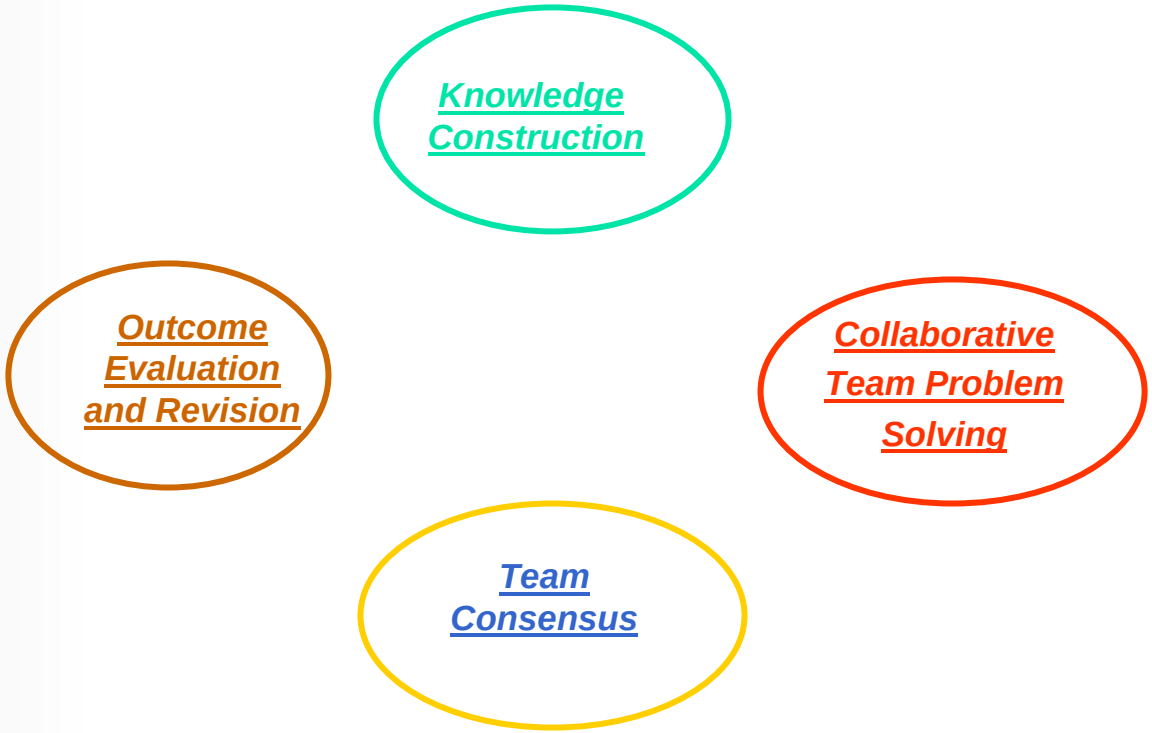
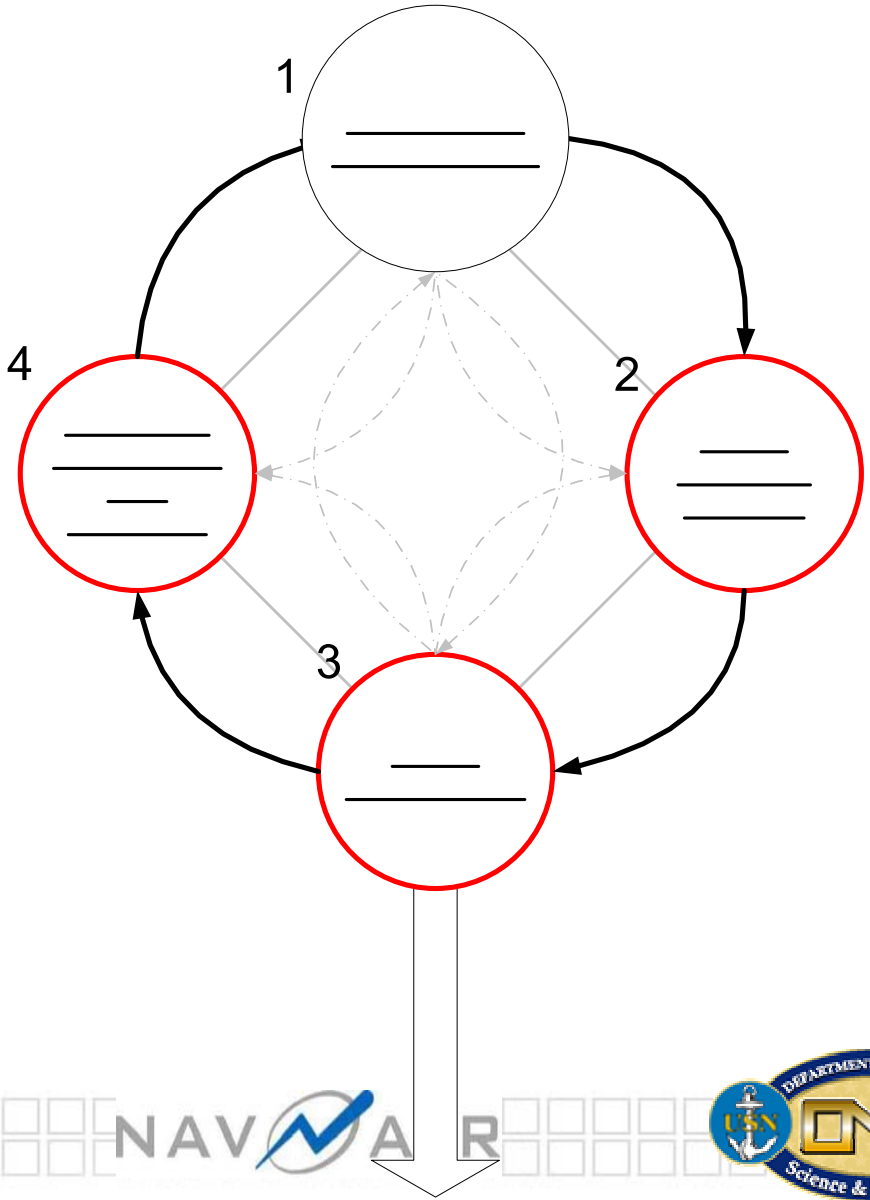
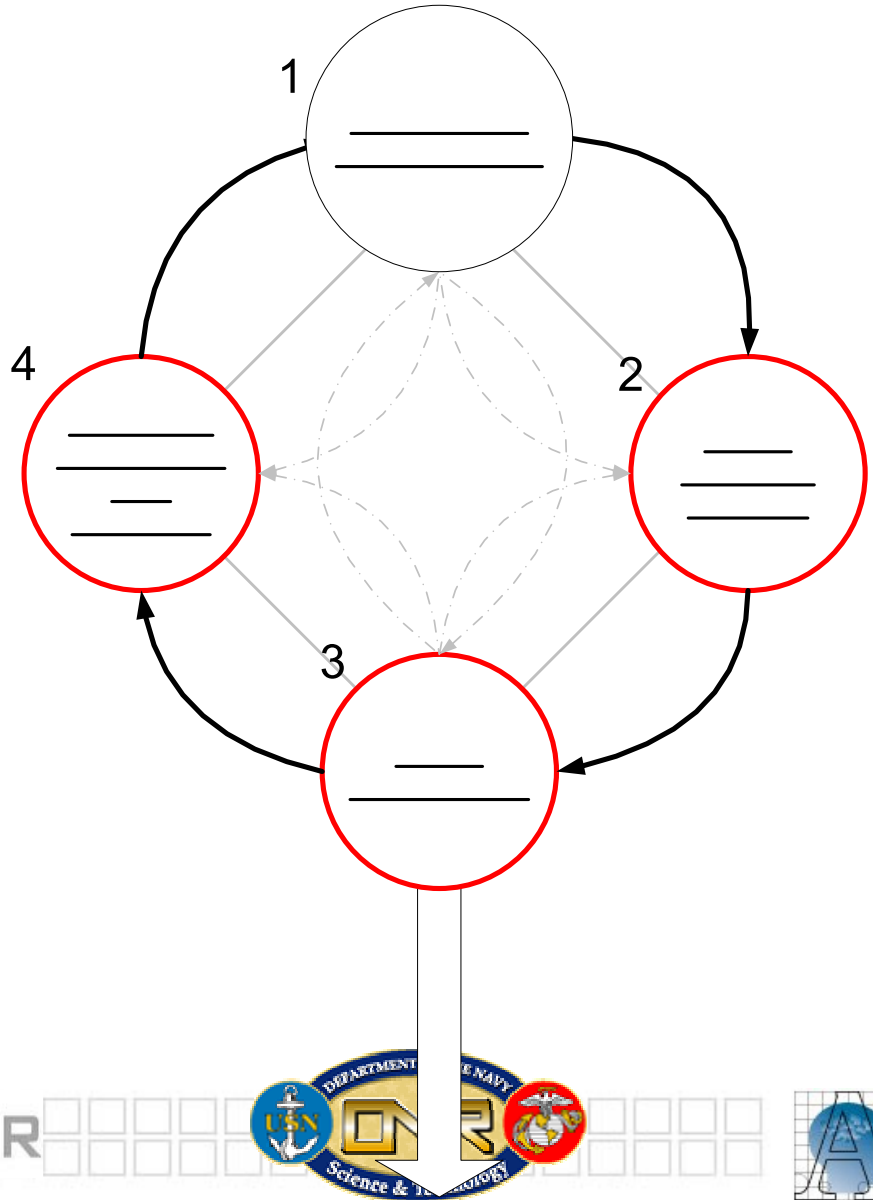

Knowledge Construction
Collaborative Team Problem Solving
Team Consensus
Outcome Evaluation and Revision

# Framework 1: Collaboration

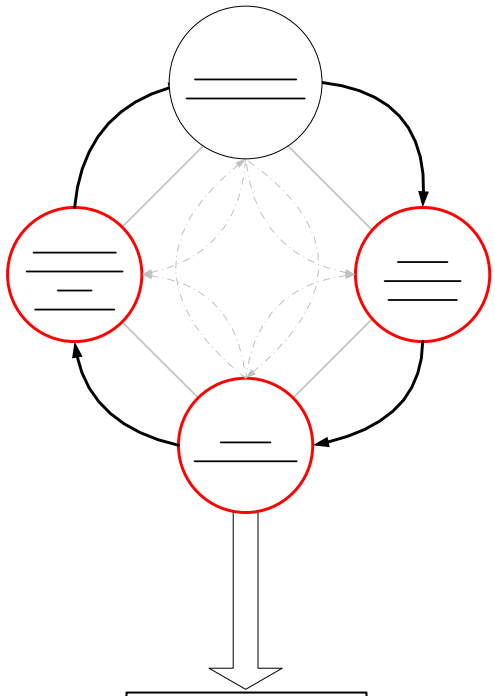


# Framework 1: Collaboration

- Collaboration phases*
  1. Individual build knowledge
  2. Team integrates individual knowledge
  3. Team negotiates solution
  4. Team tests & revises solutions



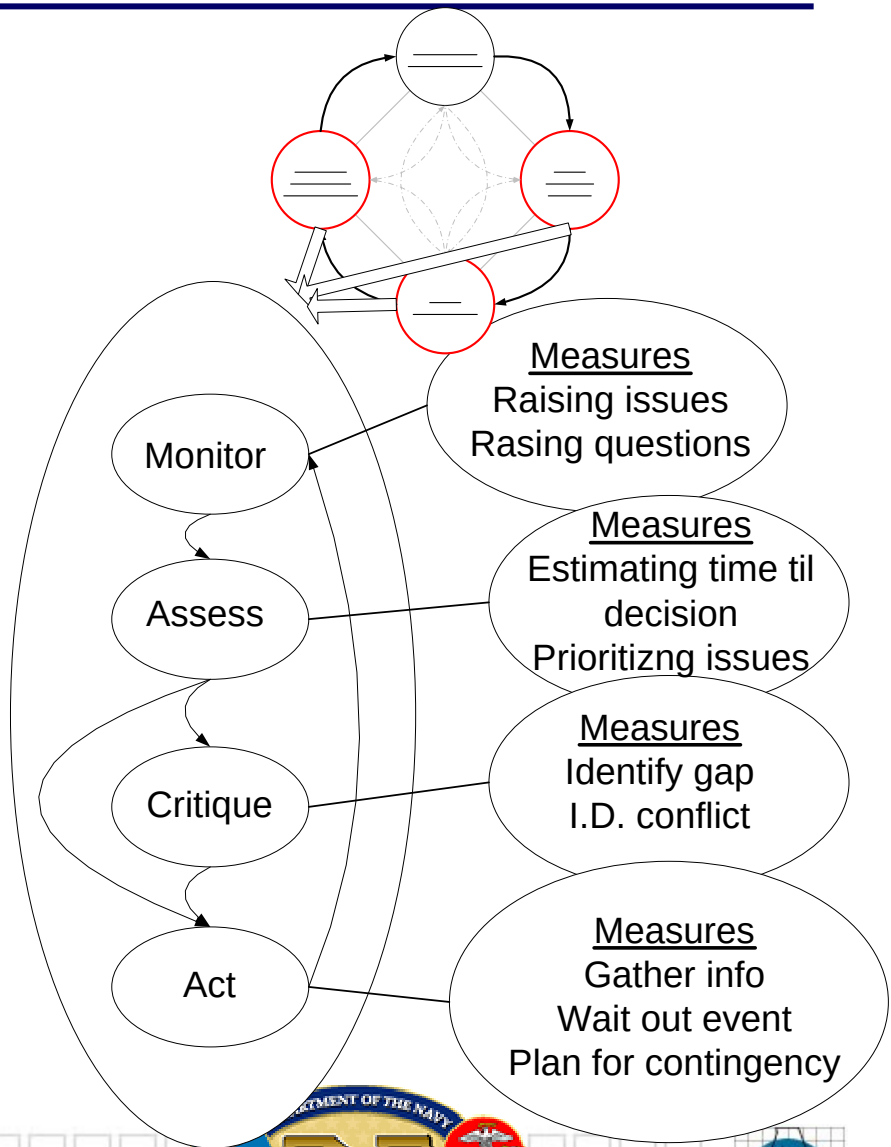

*(Letsky et al., 2002)


Collaboration/
C2 Effects
Mission Effects

# Framework 2: Collaborative Critical Thinking

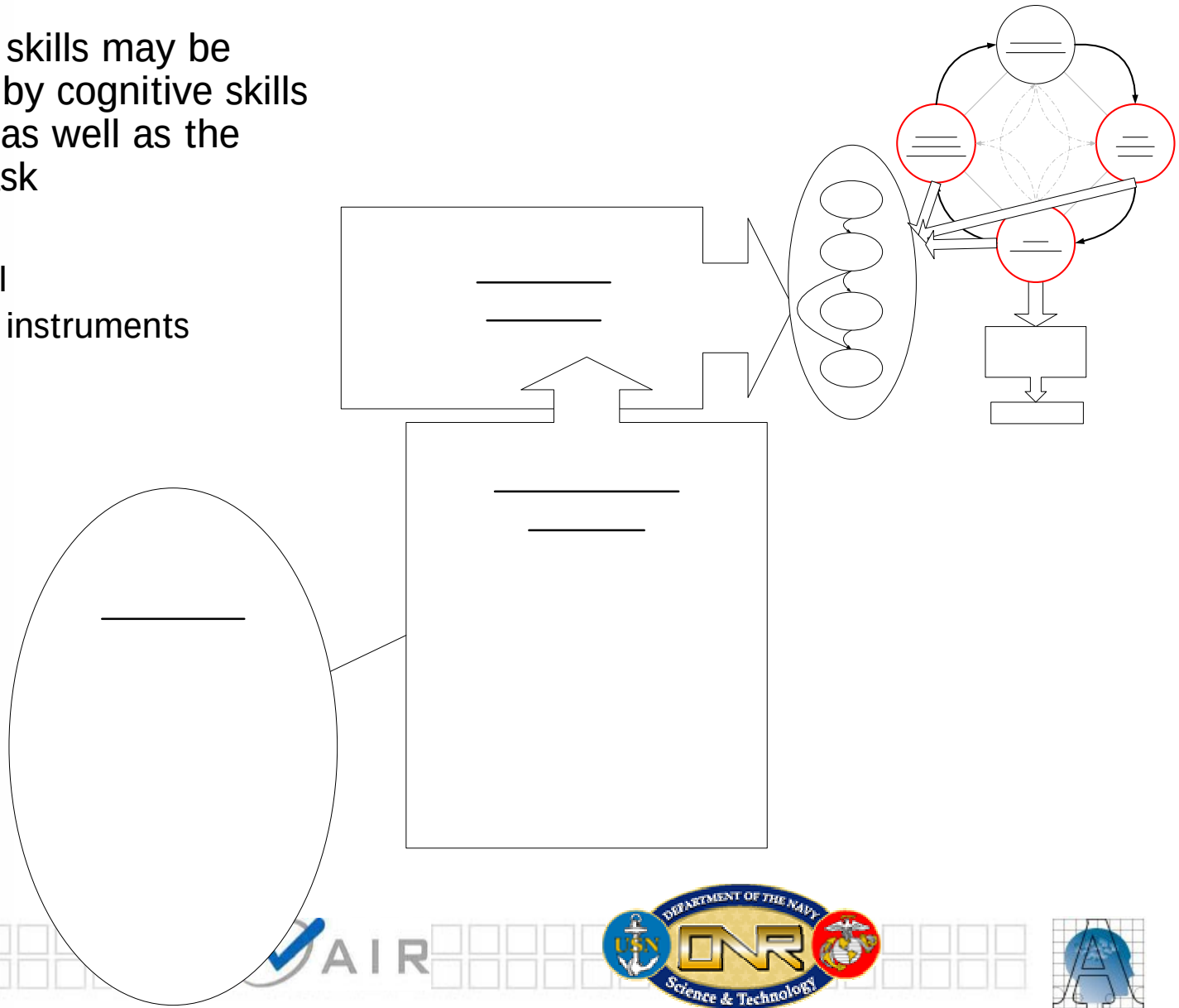
- Collaborative critical thinking* behaviors
  - Monitoring for uncertainty
  - Detecting opportunities to handle it
  - Specifying problems
  - Solving problems & gathering info

*Freeman, et al., 2001, 2002; Cohen, et al. 1997, 1998



# Framework 3: Dispositions Support Critical Thinking

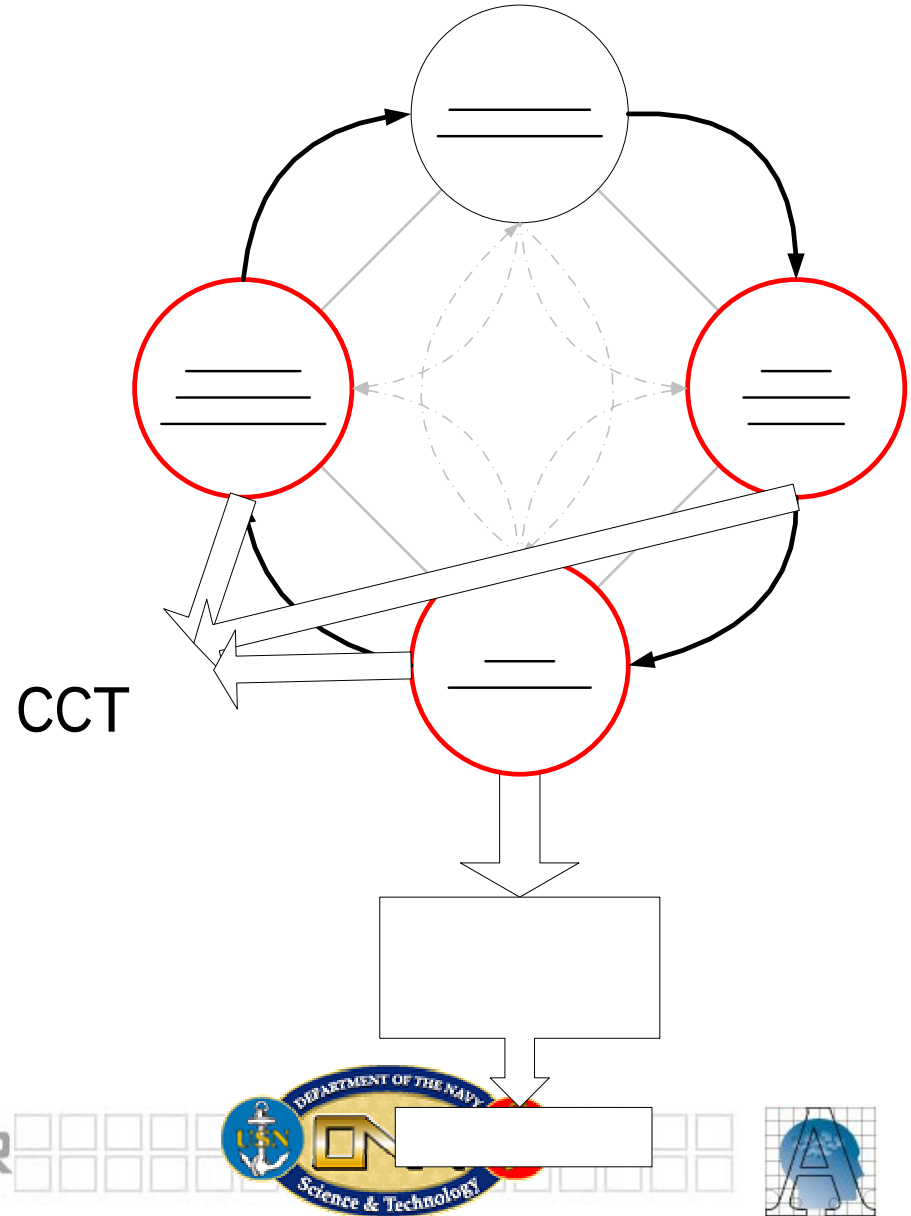
- Critical thinking skills may be driven (in part) by cognitive skills & dispositions* as well as the nature of the task
- Measures
  - Observational
  - Standardized instruments
  - Self report



* Facione, 1998

# Collaborative Critical Thinking

- Define, Measure, Train and Support Collaborative Critical Thinking
- Measure its effects on C2 & Mission outcomes



# VI. Publications planned, technical contributions

- Active participants of the Transition Assistance Program
  - Selected to participate in the May Opportunity Forum
- Presented at the ICCRTS conference
- Possible panel on collaboration tools for HFES 2004
- Possible Hawaii International Conference on Systems Science – January 2005
- Possible Society for Industrial and Organizational Psychologists 2005

# VII. Lessons Learned

- CCT is a difficult construct to define
  - “you know it when you see it”
- CCT is difficult to measure objectively

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# Project Summary

- Title: Collaborative Critical Thinking (CCT)
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- Objectives
  - Better understand CCT
  - Develop validated training and tools to improve CCT
  - Improve the process and products of collaboration through improved CCT
- Research Questions
  - What are the relative importance of cognitive and dispositional factors in CCT?
  - Can CCT behaviors and their effects be reliably measured in a semi- or fully-automated fashion?
  - Can we promote CCT behaviors with training and job aids?
  - Does improved CCT result in improved collaboration?
- Project Status
  - Experiments are on-going to 1) better understand CCT and 2) begin the initial validation of the CCT tool interface.
  - Development of the tool and training are well underway
  - Validation studies are planned for later in this quarter
  - Preparations are on-going for the Navy Transition Assistance Program May Opportunity Forum

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