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Collaborative Critical Thinking

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Research and Technology Symposium

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A UNIQUE FOCUS ON HUMAN-CENTERED ENGINEERING

- A Collaborative Critical Thinking framework for
 - understanding
 - measuring
 - training and
 - supporting
- Technology
- Experimentation



Collaborative Critical Thinking Framework



Foundations in Science & Theory

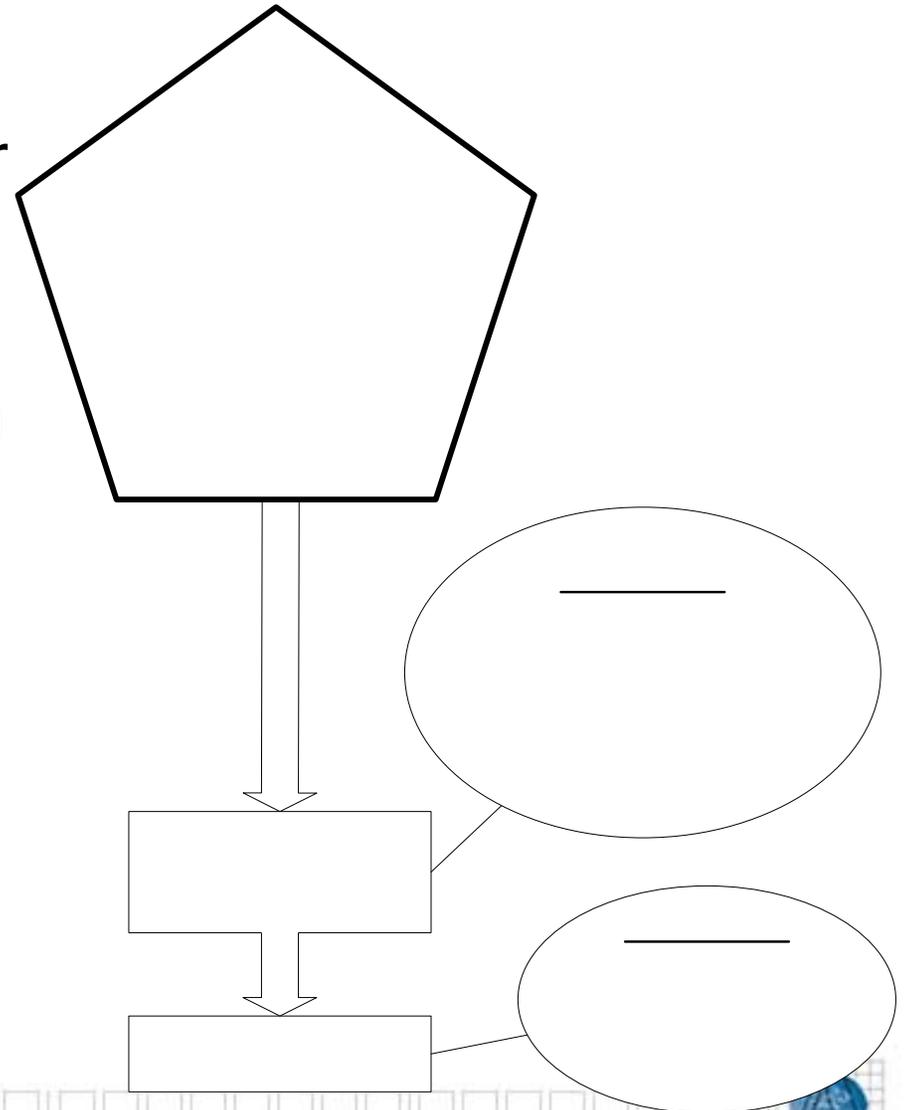
- Information age warfare
 - Teams are distributed, ad hoc, multi-disciplinary, mission-critical
 - Teams require coordination & collaboration
 - Manage forces & information
 - Achieve effects
 - Supporting coordination & collaboration requires measurement
- Coordination & collaboration processes can be measured
- Collaboration often involves critical thinking. For individuals, CT
 - Is found in transcripts of planning
 - Can be trained
 - Improves mission performance in Air Defense scenarios
- Alberts, Garstka, Hayes, and Signori (2001)
- Letsky et al. (2003)
- Macmillan, et al., 2001
- Miller, Price, Entin, & Rubineau, 2001
- Moon, et al., 2000
- Cohen, Freeman, and Thompson, 1998
- Cohen and Freeman, 1997



Overview: Collaboration

- Collaboration
 - Consists of functions (or processes) ...
 - That effect C2 ...
 - Which produces mission effects

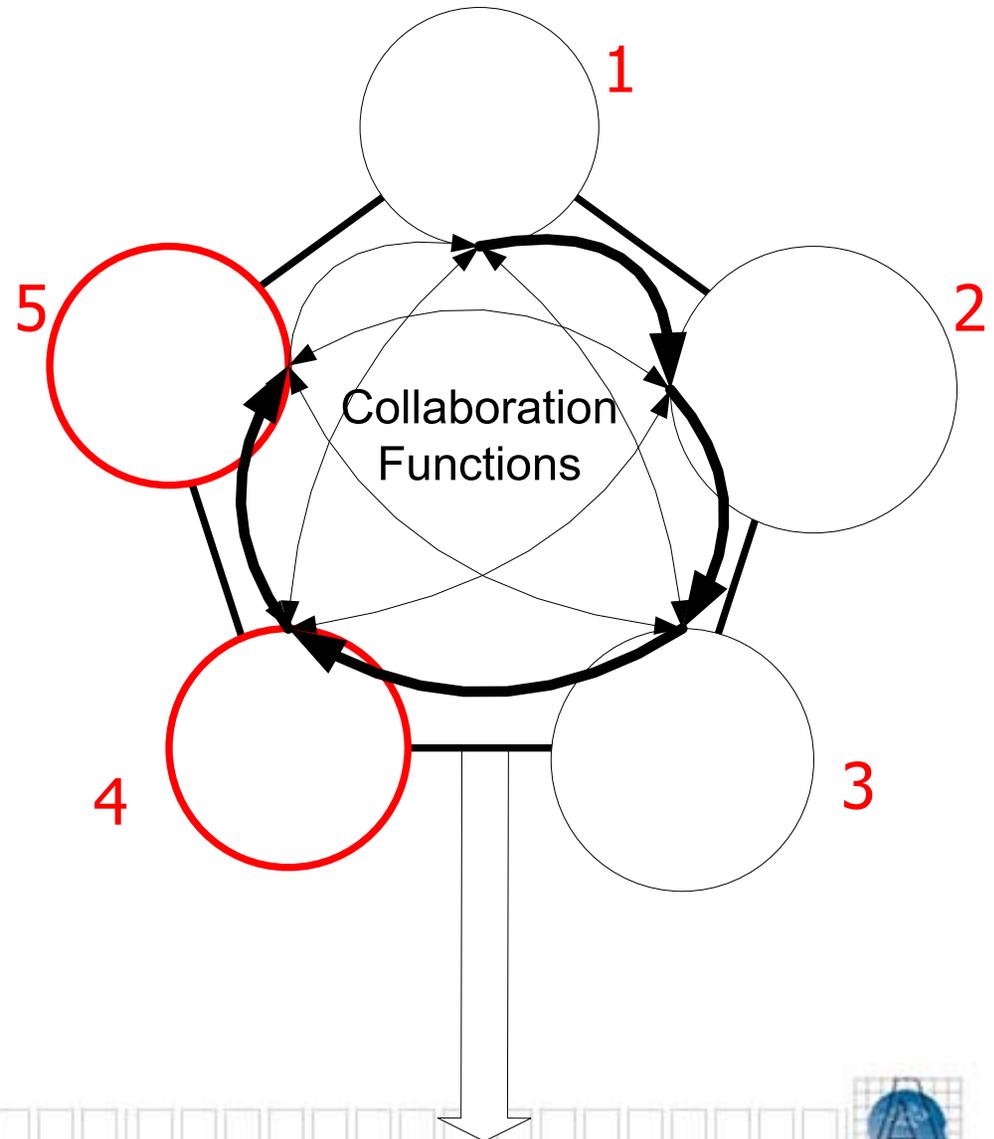
- What are collaboration functions, particularly Collaborative Critical Thinking?



Framework 1: Collaboration

■ Collaboration involves*

1. Process knowledge
2. Domain knowledge
3. Team knowledge
4. Negotiating solutions
5. Testing & revising solutions

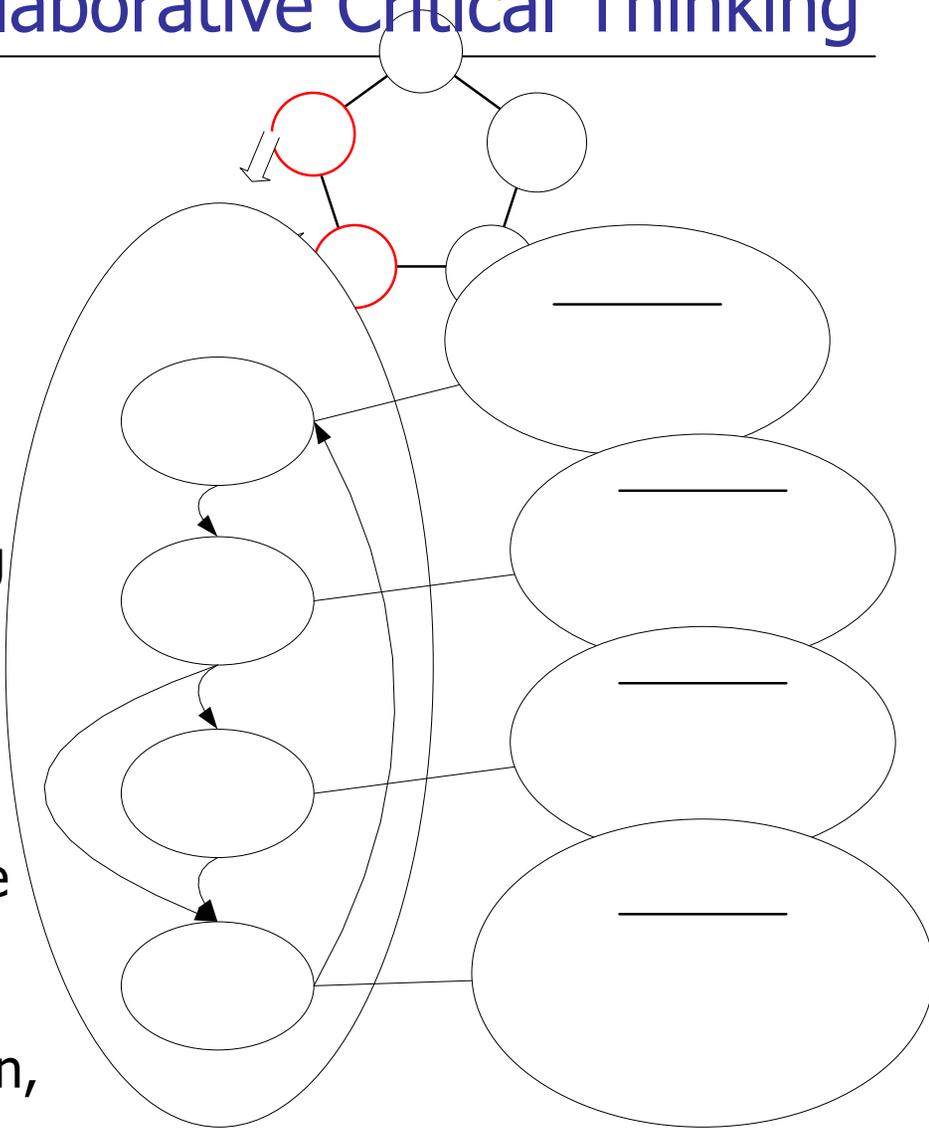


*(Letsky et al., 2002)



Framework 2: Collaborative Critical Thinking

- Collaborative critical thinking* engages multiple team members in
 - Monitoring for uncertainty
 - Detecting opportunities to handle it
 - Specifying problems
 - Solving problems & gathering info
- CCT can be applied to
 - Assessments
 - Plans
 - The team process & structure

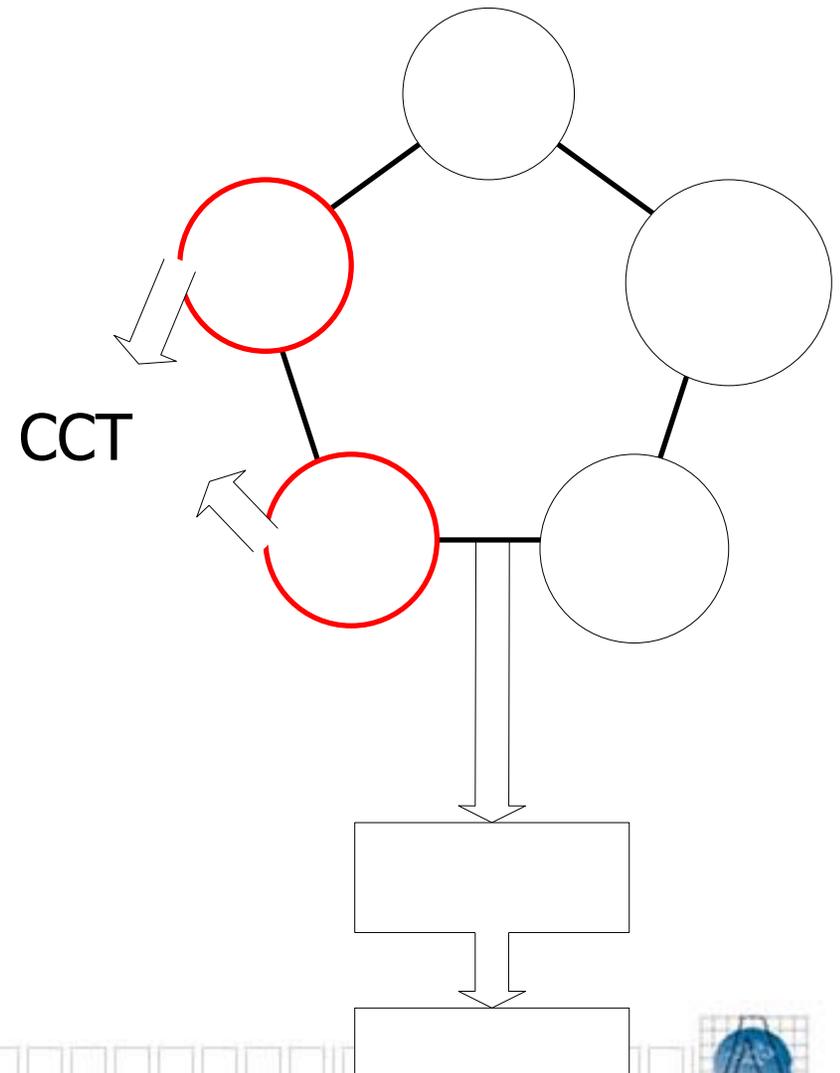


*Freeman, et al., 2001, 2002; Cohen, et al. 1997, 1998



Collaborative Critical Thinking

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



CCT Decision Support

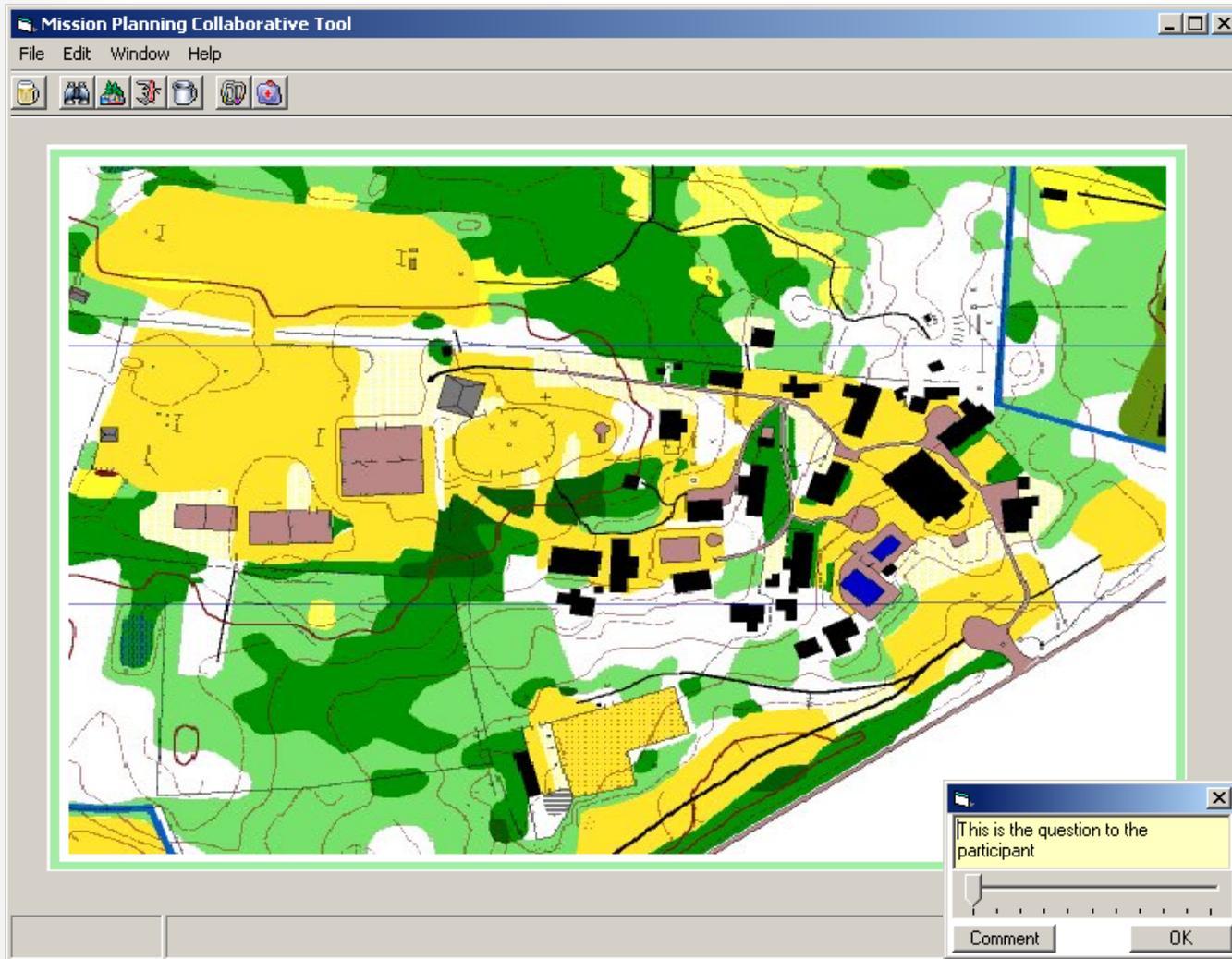


Concept for a CCT Support Tool

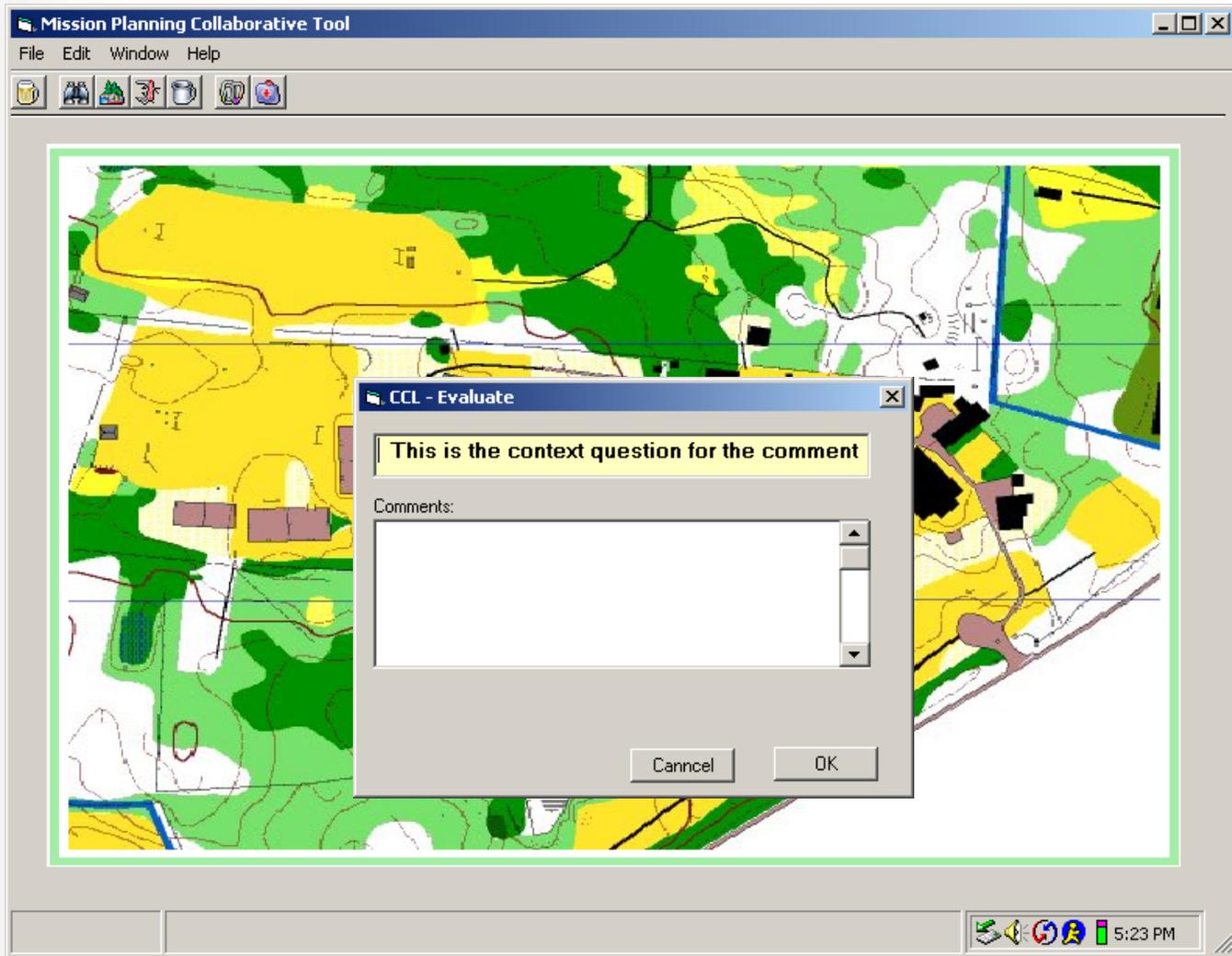
- The setting
 - A geographically distributed team in a long working session
 - The team leader wants to monitor CCT activity
 - Team members need reminders to engage in CCT
- Two components
 - Respondents' tool –
 - Elicits data concerning team member monitoring, assessments, critiques, actions
 - Cues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



A Pop-Up Probe



Opportunity to Rate and Comment



Rating Results + Advice

Collaborator - Monitor -- Objective: Develop Effective COA to Deal with Emerging SAM Site

File Edit Tools Window Help

Current Status

Participation:

Opinion:

This is where the question will go

Comments:

There are X comments

1) Text of the first comment

Polling:

Next poll in

Next question

This is where the next question displayed

Overall Status

Opinion Data

Current time: Data view:

Team & Leader Status re: Plan A

Perceived uncertainty

1

0.5

0

Action plan

Time available

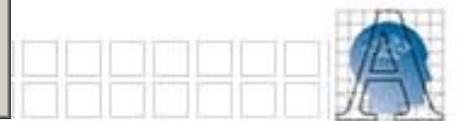
Sources of uncertainty

- Team: Low
- Team: High
- Leader(s): Low
- Leader(s): High

Collaborator - Advice

To ...

Some team members believe the plan is flawed. Time is available to critique the plan. Use it

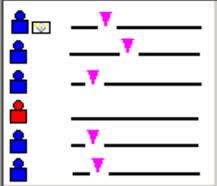


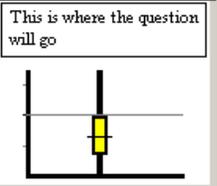
A Summary of Comments

Collaborator - Monitor -- Objective: Develop Effective CDA to Deal with Emerging SAM Site

File Edit Tools Window Help

Current Status

Participation: 

Opinion: 

Comments: There are X comments
1) Text of the first comment

Polling: Next poll in: Min.
Next question:
This is where the text of the next question will be displayed

Overall Status

Participants' Comments

Participants comments:

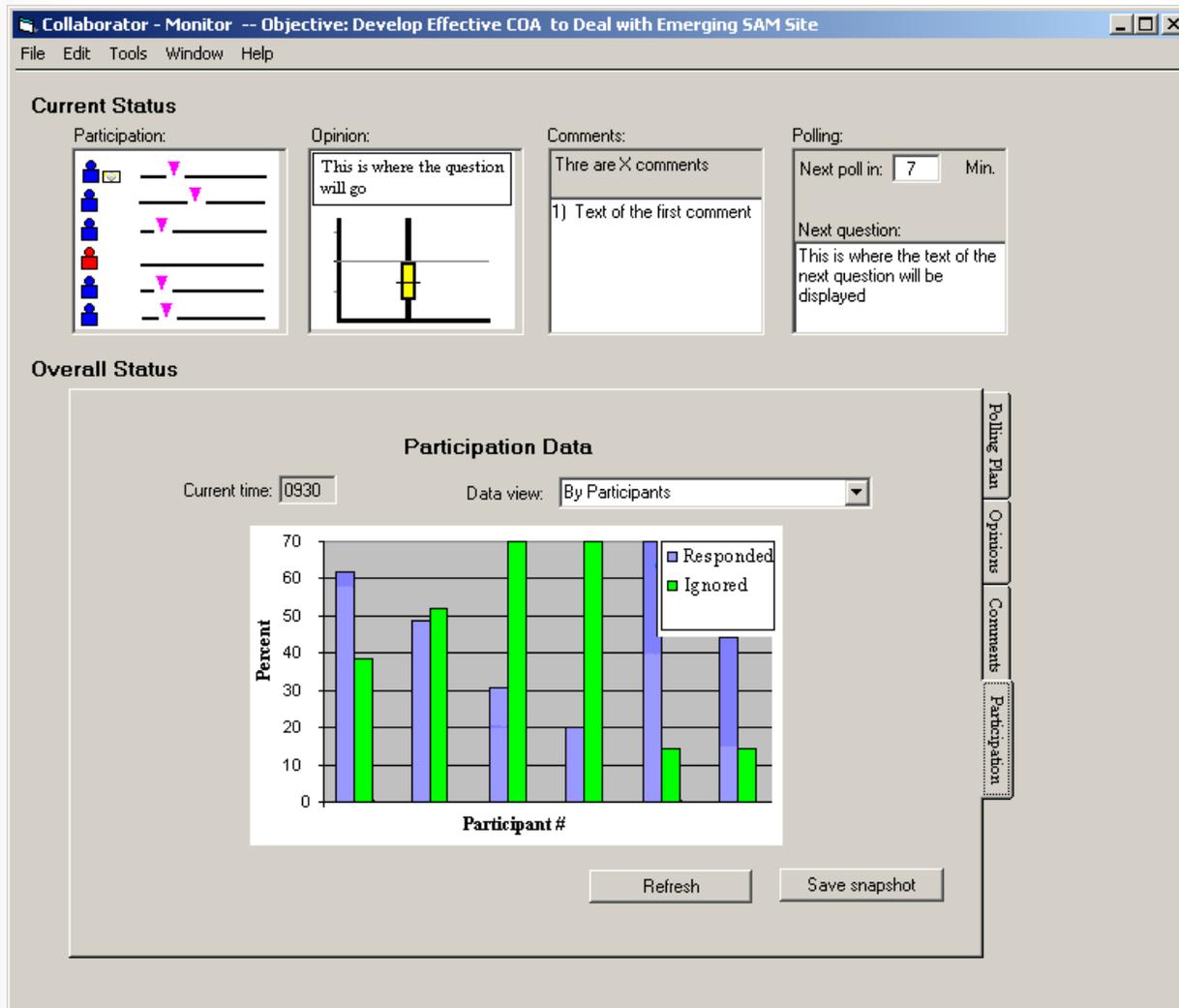
- Question 1
 - Comment 1.1
 - Comment 1.2
- Question 2
 - Comment 2.1
- Question 3
 - Comment 3.1
 - Comment 3.2
 - Comment 3.3
- Question 4
 - Comment 4.1
 - Comment 4.2

Insert a note:

Vertical navigation tabs: Polling Plan, Opinions, **Comments**, Participation



Participation Statistics



Leader's Configuration Interfaces

Collaborator - Critical Thinking Assessment Set Up

Work Session | Probes | Participants

Name:

Date: Time:

Location:

Objective:

Notes:

Save

Collaborator - Critical Thinking Assessment Set Up

Work Session | Probes | Participants

Compose probe:

Probe list:

Probe #	Probe content	Presentation Time
1	Probe number 1	15
2	Probe number 2	30
3	Probe number 3	45

Probe presentation sequence:

5	15	30	45	60	Time from start >
	1	2	3		Probe #

* To change the presentation time of a probe slide it to the desired time

Save

Collaborator - Critical Thinking Assessment Set Up

Work Session | Probes | Participants

Participants in the critical thinking assessment:

Anastasi Donna
 Bailey Adam
 Baker Keith
 Chopra Kari
 Hight Heather
 Levchuk Yuri
 Miller Diane

* Not all participants in the work session need to participate in the critical thinking assessment

Coordinator of critical thinking assessment:

Leader of work session:

Save

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



CCT Probes



- Probes consist of
 - CCT template: “Are you confident in the plan...”
 - Mission-specific content: “*to use ground observers to assess battle damage?*”
- Probes measure CCT with quick ratings re:
 - Monitoring, Assessing, Critiquing, Action
- Probes elicit CCT
 - Comments
- Team CCT states → diagnosis & action



Monitoring for Uncertainty

- Team: "Are you confident in the plan *to use ground observers to assess battle damage?*" (0=No 10=Yes)

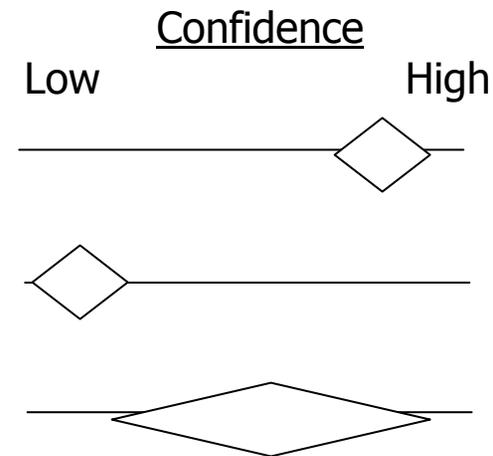
- Low variance = Consensus. Don't invest time in critiquing this plan unless the situation changes.
- High variance = Little agreement, high uncertainty. If time is available to critique the plan, focus here.



Range of team ratings of confidence in plan

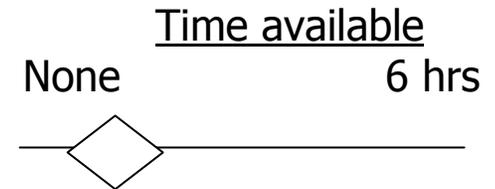
Analysis & Advice

- High confidence, strong consensus
 - Advice: Do not invest time in critiques on this issue unless the situation changes significantly.
- Low confidence, strong consensus
 - Advice: Critique this issue if time allows.
- Weak consensus
 - Advice: Poll team members with low and high confidence to identify misperceptions or problems



Assessing Available Time

- “How much time is available before the team must commit to *a decision concerning use of ground observers for BDA?*”
 - Low estimates, low variance
 - No time to critique plans. Don't do so.
 - High variance
 - Advice: Some team members have time constraints not understood by their team members. Have team members discuss their time constraints.
 - Advice: Some team individuals misperceive the time course of the mission. Talk with the team members with the tightest time constraints to understand if their constraints are realistic. Correct this.



Experiment

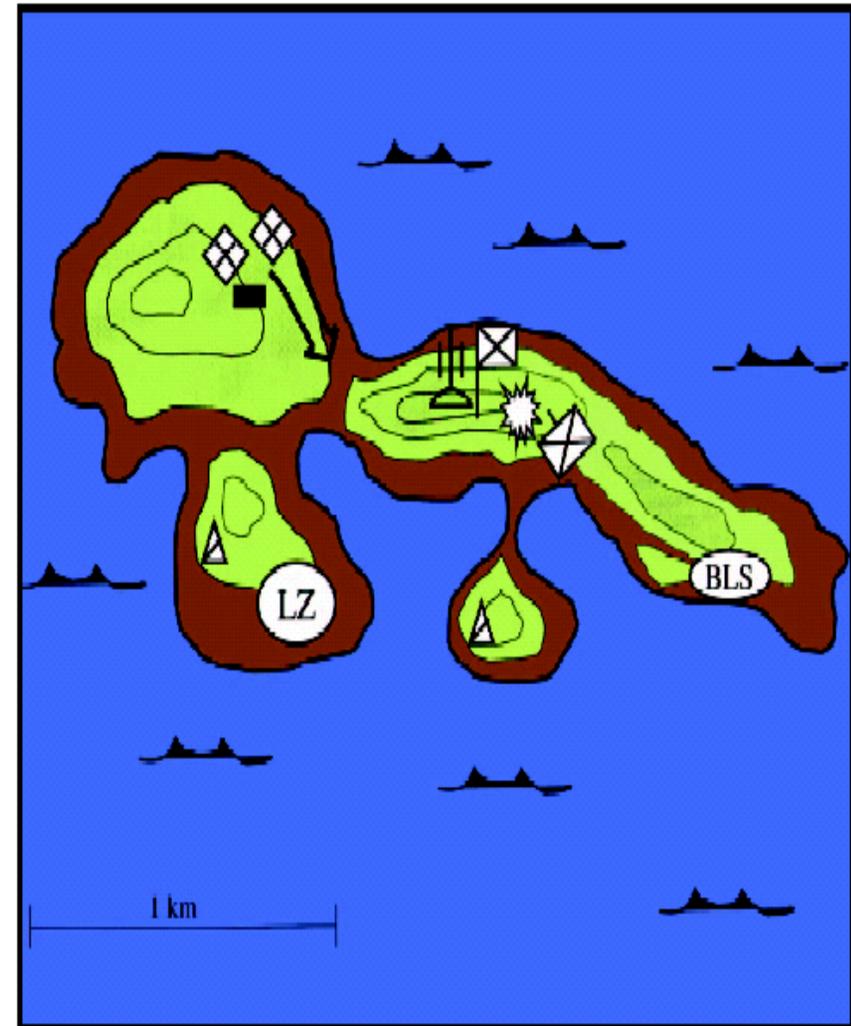


- Objective:
 - Determine the relative importance of cognitive and dispositional factors in CCT.
 - Determine the impact on C2 and mission outcomes of
 - Training cognitive factors and
 - Sensitizing dispositional factors
- Method:
 - Each of 3 team members receive
 - Training in several cognitive aspects,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



Tactical Decision Games*

- You are the commanding officer of Company G, Battalion Landing Team 2/2, the small boat company of the 26th Marine Expeditionary Unit (Special Operations Capable).
- Your company is currently embarked aboard the USS Austin, and it is part of a combined U.S.-Baklavian amphibious task force responding to an escalation of arms smuggling in the Adriatic Sea.
- Arms smugglers continue to use the small, uninhabited islands along the central Baklavian coast as transshipment points for weapons to insurgent groups operating in the southern Astorian Sea.
- Etc...



*Marine Corps Gazette



- Measures
 - Counts of skills observed in dialogues
 - Self-reported use of skills
 - Correctness of solutions
- Analyses
 - Evaluate impact of training & sensitization on outcomes
 - Estimate unique contributions of cognitive and dispositional factors using hierarchical regression

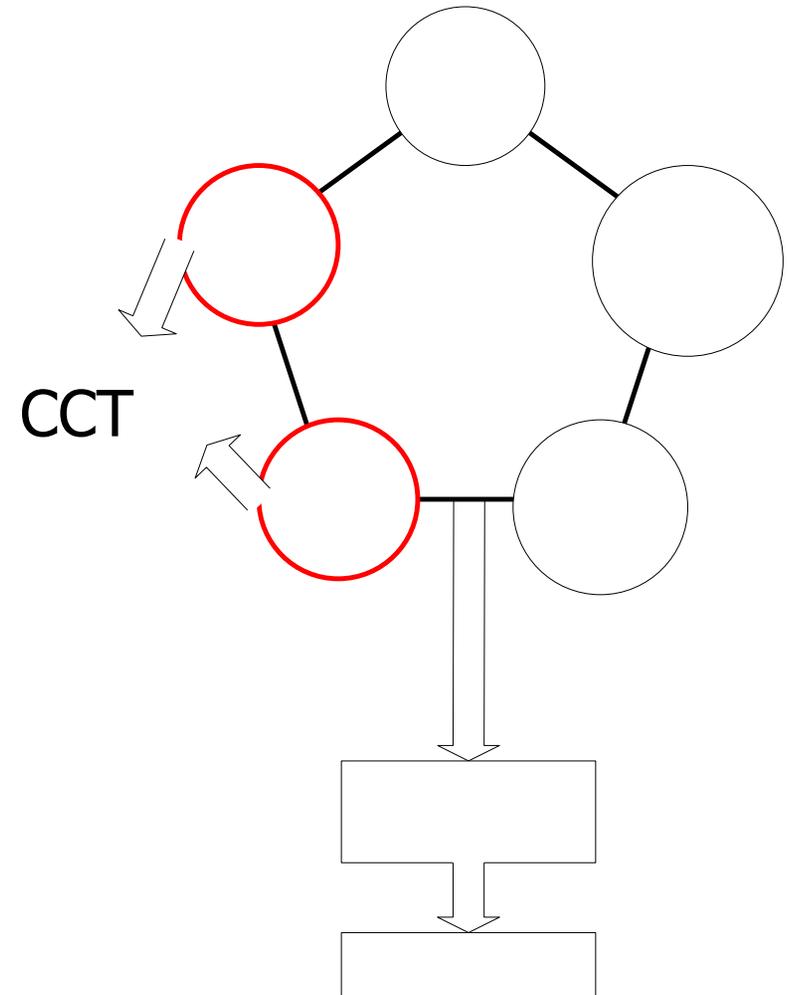


Conclusion



Collaborative Critical Thinking

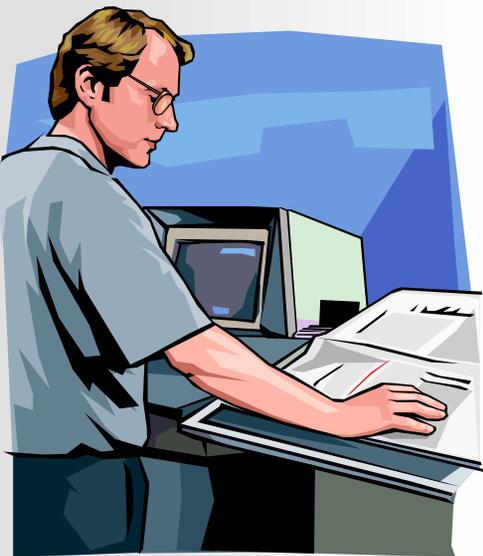
- Objective
 - Define
 - Measure
 - Train and
 - Support
- Collaborative Critical Thinking for teams
 - Multi-expert
 - Distributed
 - Ad hoc
 - High stakes





Theory Development: Example of Collaborative Critical Thinking

- Mike: JFACC Rear (CONUS Junior Analyst) calls Gavan to discuss the current situation. They are using NetMeeting to share information.
- Gavan: JFACC Forward Analyst in charge of mission planning



Theory Development: Example of Collaborative Critical Thinking

The Situation: A long-range mission is in progress to attack pre-targeted areas in Ichtar and West Ichtar and is scheduled to commence at 0800. One of the specific targets which impacts the entire mission is a fortified SAM site. Electronic Intelligence has reported that the site has remained stationary for over a year. In addition, Imagery out of Langley reports the absence of any support vehicles necessary to facilitate relocation. Four hours before the attack begins, Communications Intelligence out of NSA reports that the fortified SAM site is indeed on the move.

A group of JFACC analysts is required to make sense of all this information. The location of the SAM site influences both allocation of friendly resources and the protection of friendly forces. One of them is concerned that the location of the SAM has become uncertain.

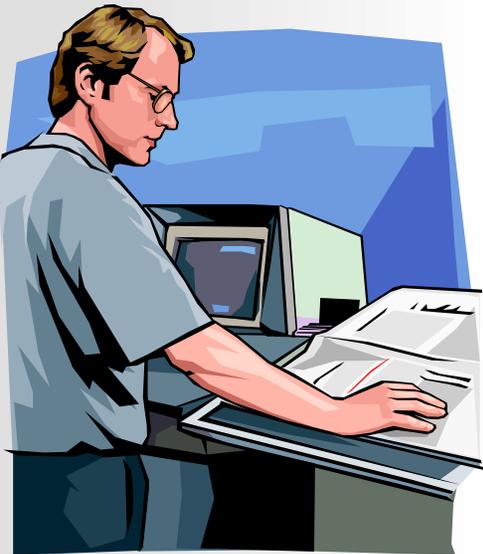
Mike monitors for uncertainty concerning the situation and plan.



Theory Development: Example of Collaborative Critical Thinking

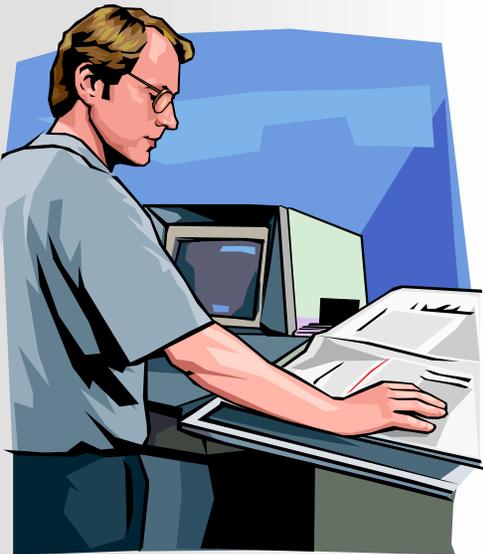
- Mike: Gavan we need to redirect our friendlies to account for SAM A34's relocation.
- Gavan: If there's a new threat, yes we do. Which SAMs, briefly?

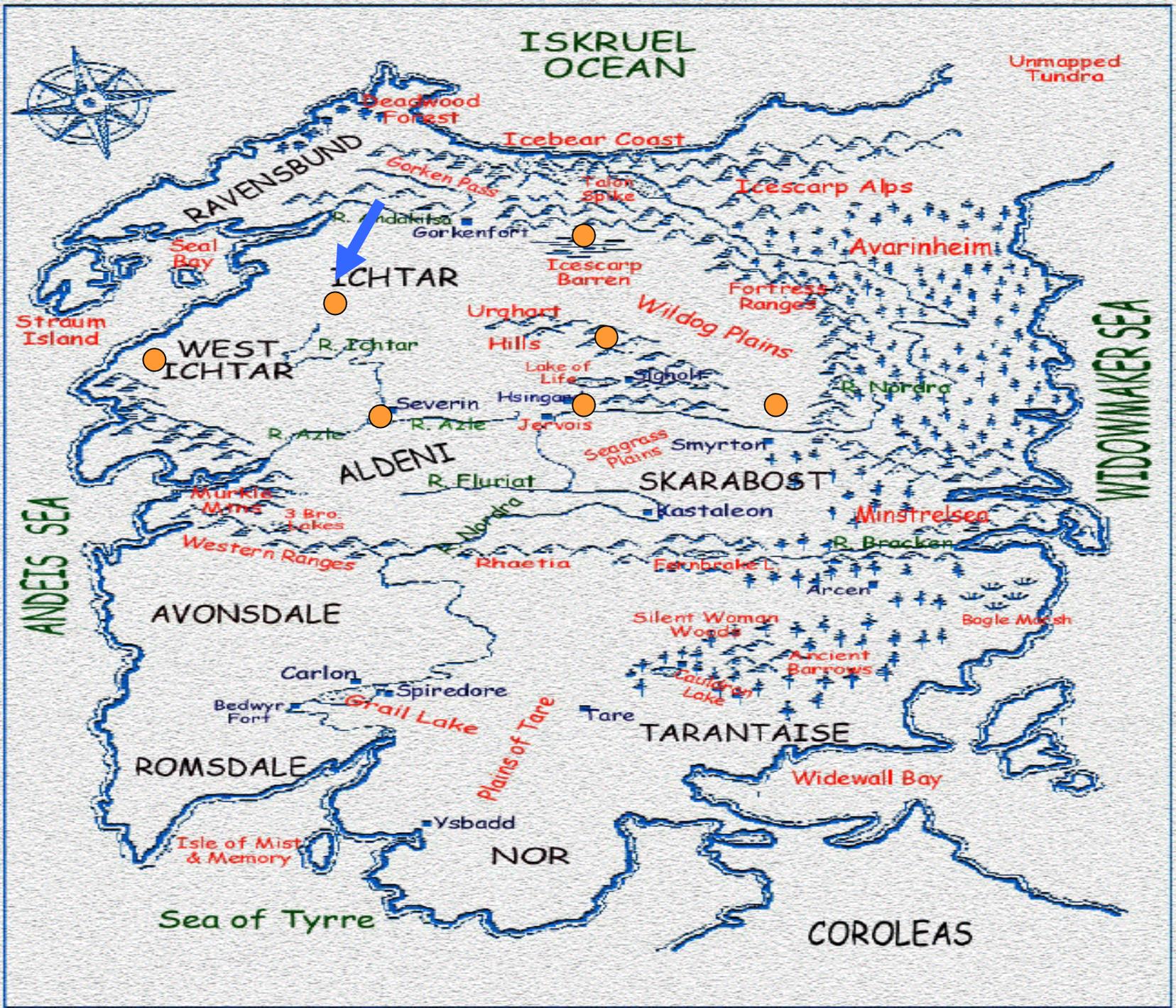
Mike & Gavan assess the importance of resolving this uncertainty



Theory Development: Example of Collaborative Critical Thinking

- Mike: Blue arrow, due north of the river Ichtar.





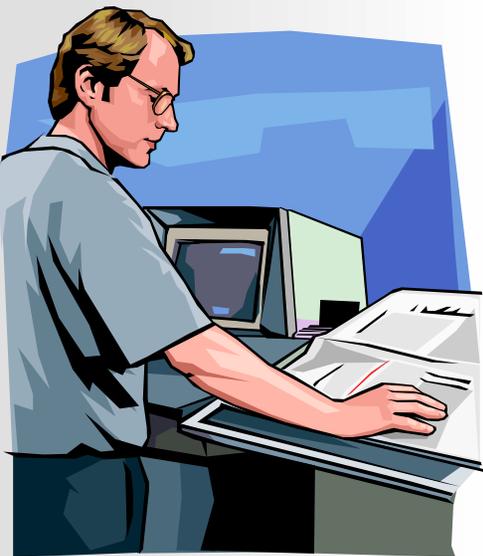
Theory Development: Example of Collaborative Critical Thinking

- Gavan: Ok. I thought this SAM was fortified, stationary?



Theory Development: Example of Collaborative Critical Thinking

- Mike: Negative.
COMINT has just reported that the SAM is moving. Here is a copy of that report.

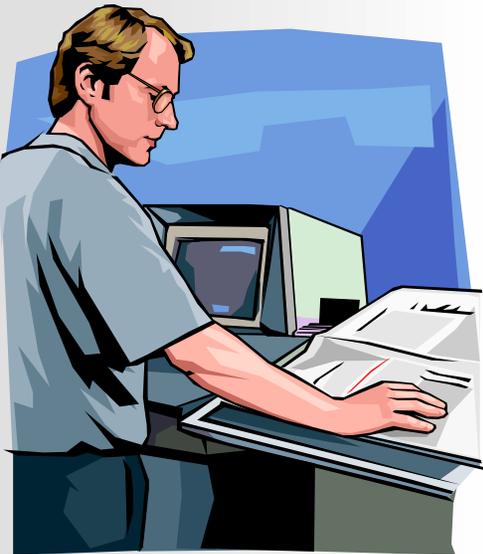


UUUUFM: NSA/CSSTO: JFACCSUBJ: POSSIBLE SAM MOVEMENT(U)
THE SA-6 LOCATED AT 32U345098 IS POSSIBLY PREPARING TO
MOVE LOCATIONS. VOICE COMMUNICATIONS BETWEEN
OPERATORS INDICATE THAT PREPARATIONS NECESSARY FOR
THE MOVEMENT MAY HAVE BEGUN AS EARLY AT 0030Z.



Theory Development: Example of Collaborative Critical Thinking

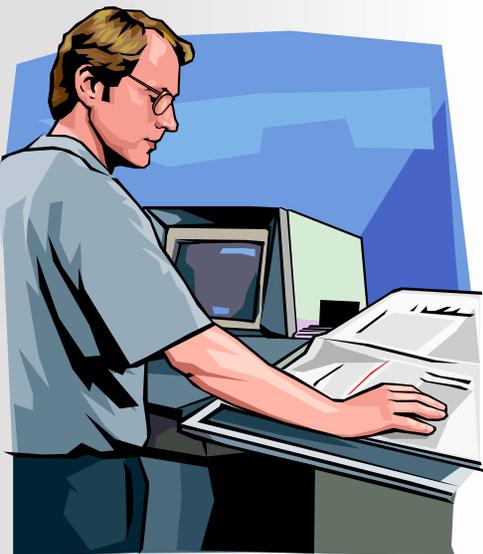
- Gavan: I see it. Didn't ELINT and IMINT report no movement and no support.



Theory Development: Example of Collaborative Critical Thinking

- Mike: Roger.
- Gavan: That doesn't make sense. Doesn't COMINT get their information from the other two?

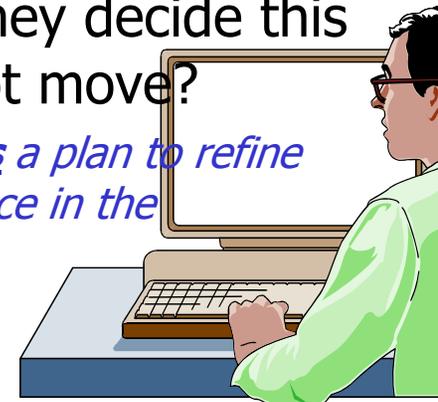
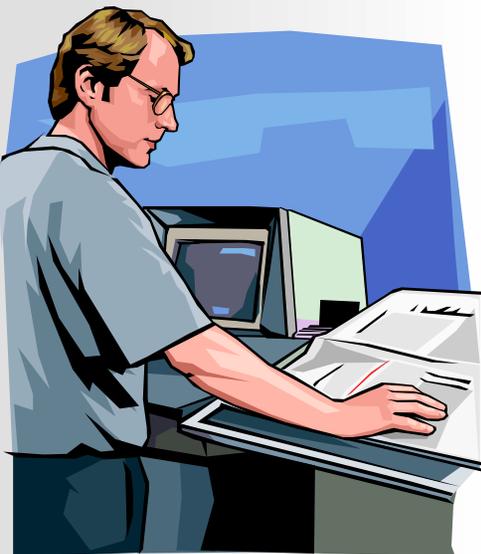
*Gavan **identifies** a source of uncertainty.*



Theory Development: Example of Collaborative Critical Thinking

- Mike: That's my understanding, but I will confirm that.
- Gavan: So, we should check back to make certain these reports are correct. Why don't you check back with IMINT and I'll check back with ELINT to verify this information. We still have a bit of time. Ask them how conclusive their information is. How did they decide this SAM would not move?

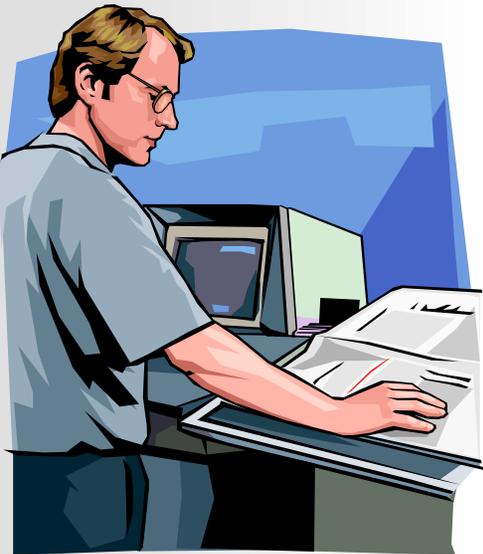
*Gavan **produces** a plan to refine their confidence in the information.*



Theory Development: Example of Collaborative Critical Thinking

- Mike: Shouldn't we decide on a time to abort the mission or at least to make a final call?
- Gavan: Yes. Probably the safest thing to do would be to cancel the mission if we aren't certain. That way, no friendlies will be compromised due to a lost SAM. Let's huddle no later than 0500 and make a final call no later than 0600.

*Gavan & Mike will **produce** a contingency plan*



Theory Development: Example of Collaborative Critical Thinking

- Mike: But wouldn't we miss the opportunity to hit these other sites? Do we know why we are hitting these sites today?

*Mike **monitors** for sources of uncertainty and risk, and prompts Gavan to help **identify** them.*

