A C2 Hidden Profile Experiment

Friday, June 26, 2009

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The Johns Hopkins University
APPLIED PHYSICS LABORATORY

C2 Hidden Profile Experiment Overview

Problem: ICCRTS 2008, “A Review of Cognitive Metrics for C2” (Natter, Ockerman, & Baumgart) identified a research gap in team information sharing, interaction and collaboration metrics

Study Approach: Apply a well-established paradigm in communications and group dynamics research, hidden profile tasks, to the C2 domain

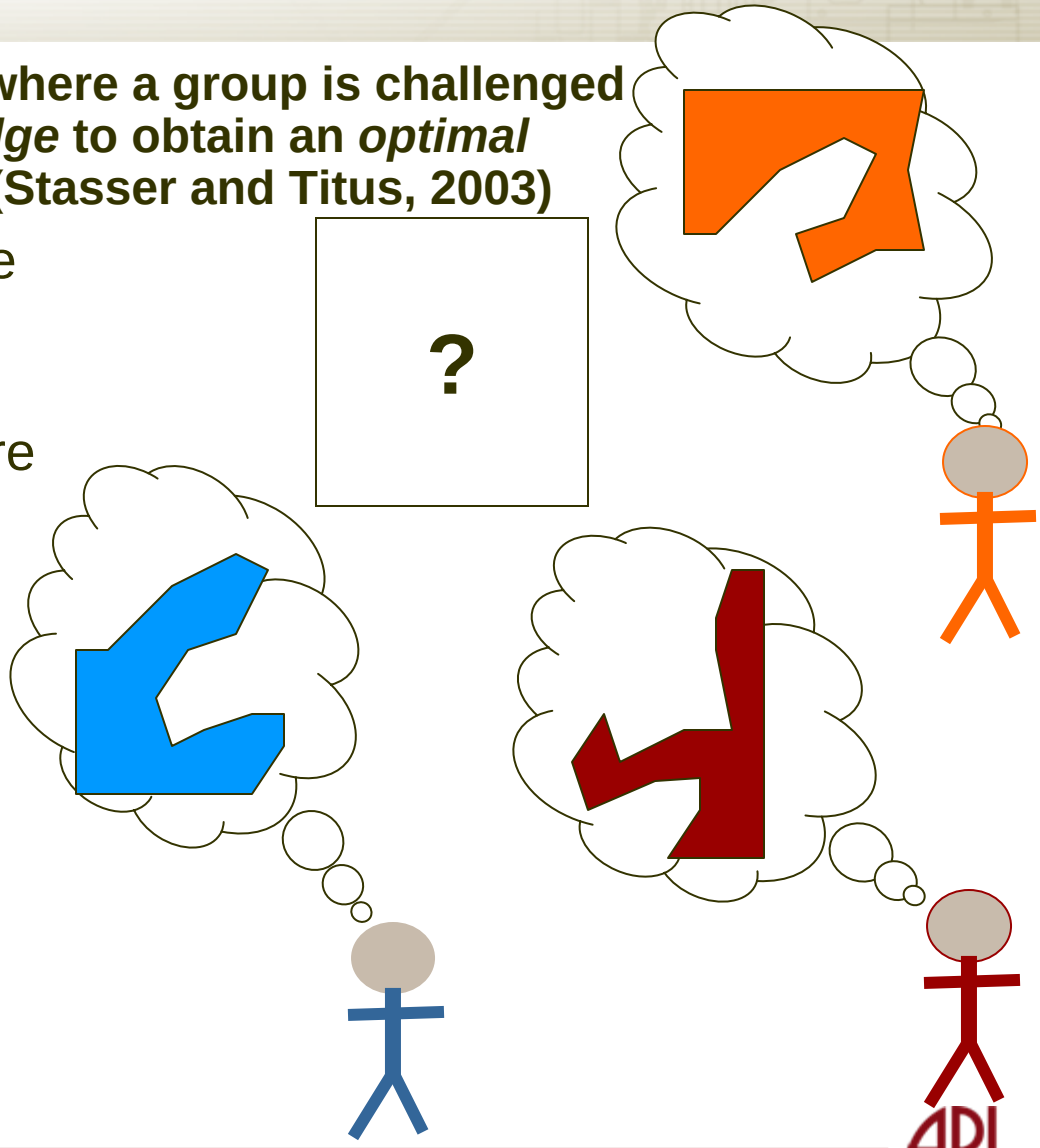
- Create a methodology and task to evaluate collaboration processes
- Compare performance of 3 person teams collaborating to develop a high-level multi-mission course of action (COA)
- Conducted three runs; so no statistical significance

What is a Hidden Profile?

Type of collaboration experiment where a group is challenged to *combine all available knowledge* to obtain an *optimal solution to a common problem*. (Stasser and Titus, 2003)

Factors that make a hidden profile more difficult include:

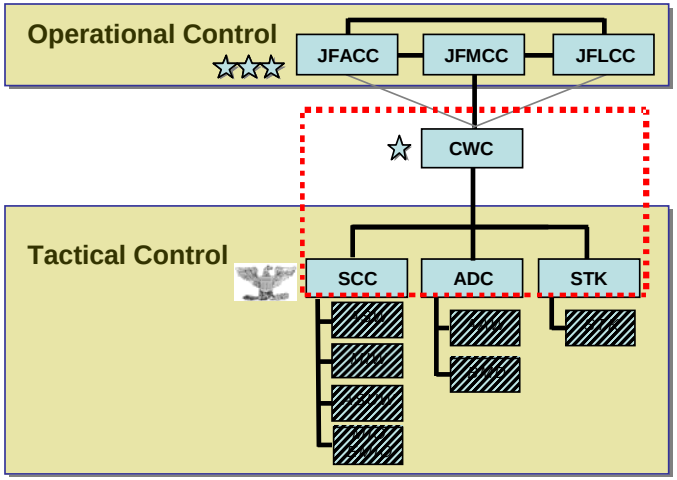
- *Distribution of information* no person can see the entire picture
- *Deceptive first impressions*
- *Share common knowledge* and ignore unique knowledge
- Time and resource pressures
- Poor knowledge-sharing *technology*
- Poor knowledge-sharing *practices*



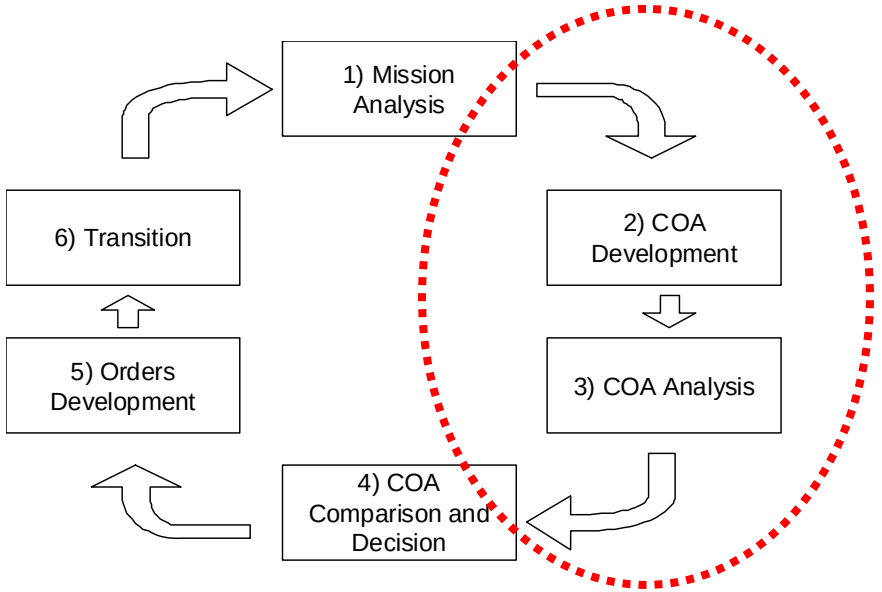
C2 Hidden Profile Task Description

Three navy tactical warfare commanders: Sea Combat Commander (SCC), Air Defense Commander (ADC), & Strike Commander (STKC) collaboratively conducting course of action (COA) development and analysis phases of the Naval Warfare Planning process for a simulated carrier strike group (CSG)

Command Structure



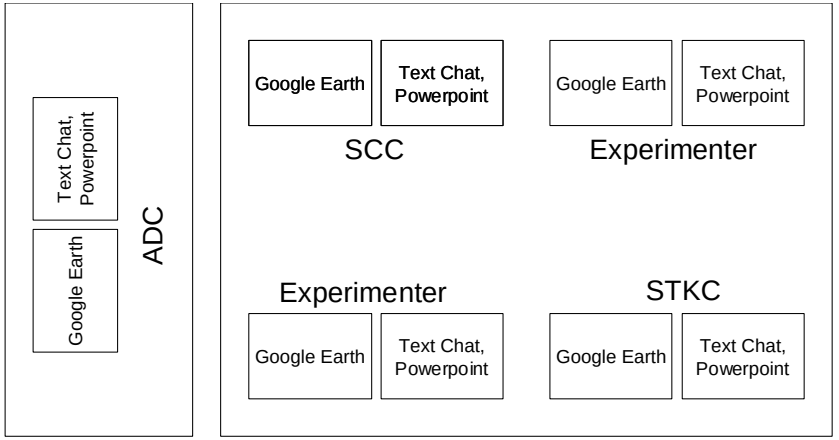
Naval Warfare Planning Phases



(Navy Warfare Development Command, 2007)

Fictional C2 Hidden Profile Task, But Operationally Realistic

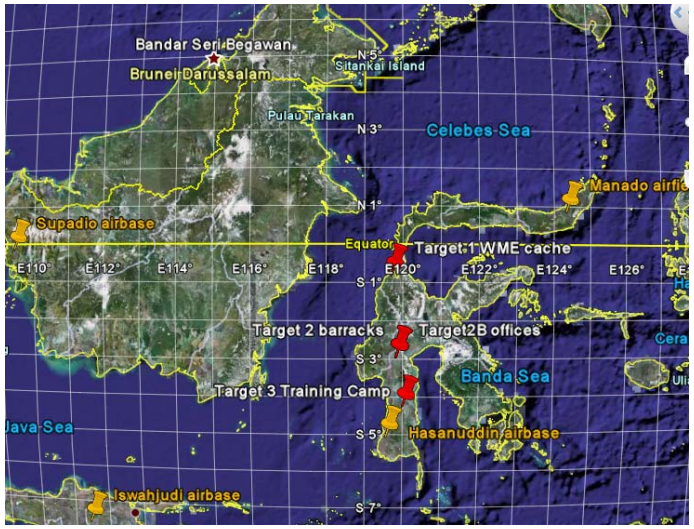
- Leveraged CSG planning observations: Nimitz (CSG-11) training workups, George Washington/CTF-70 underway
- Partially distributed (SCC/DESRON and STKC collocated and ADC distributed)
- Communicate via text chat and provided PowerPoint templates for products
- Provided Mission Analysis products as Read-ahead to start on COA development
- Experimenters acted as Composite Warfare Commander (CWC) or CSG Commander and provided information requests, guidance, etc.
- Little to no experience working together as a team



C2 Hidden Profile Task Details

Fictional Mission Sulawesi Deterrence: deter or neutralize three targets on Sulawesi (7th fleet area of responsibility around the Indonesian islands) while providing force protection

3 day-long studies of 3 groups of APL employees with naval planning experience developing a multi-mission COA (undersea-warfare and air-warfare in support of strike)



3 phases

- Phase I: Choose a carrier operating area (CVOA) in one of the three seas that surround Sulawesi (Java, Celebes, or Banda)
- Phase IIA: determine strike method for targets 1, 2, and 3 and a specific CVOA within the Celebes Sea
- Phase IIB: force protection plan, with position of ships around carrier, strike timeline and key risks to mission and own forces, and exit plan from Celebes Sea

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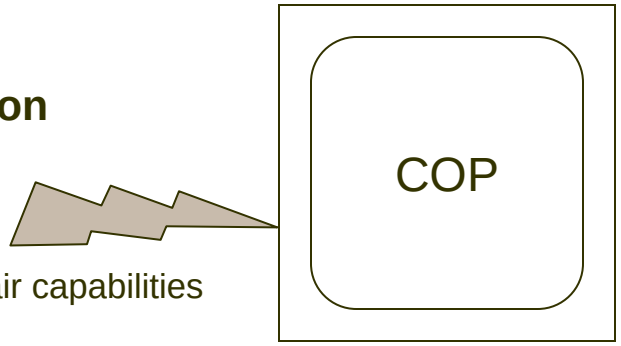
Information distribution



Common information
Warning Order
Commander's Intent
Enemy Order of Battle
- including missile, sub, air capabilities
Blue Force capabilities
Weather updates
Maps, including ranges

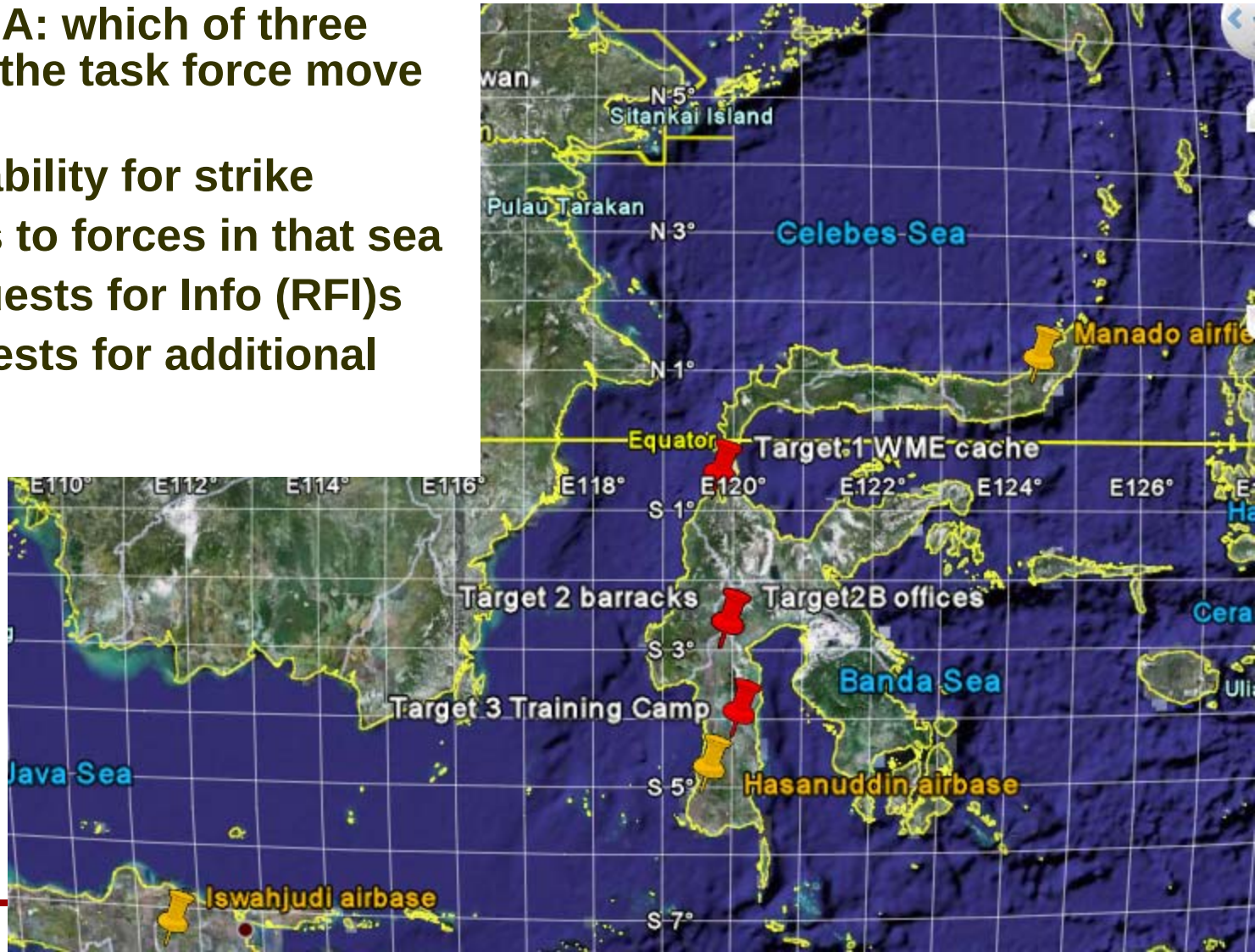
ASW only
Detection ranges and region maps
Brief on small boat threat
Brief on red sub tactics
Updates on blue, green, red sub positions

AW only
Brief on civilian air traffic
Brief on red missiles
Updates on red missile types and locations
Liaison to COCOM
Request for tankers
Request for P3

Strike only
Strike target info
SOF capabilities
Bunker-busting bomb brief
Updates on strike target situation

Phase I

- Choose CVOA: which of three seas should the task force move toward
- Identify suitability for strike
- Identify risks to forces in that sea
- Submit Requests for Info (RFI)s
- Submit requests for additional resources

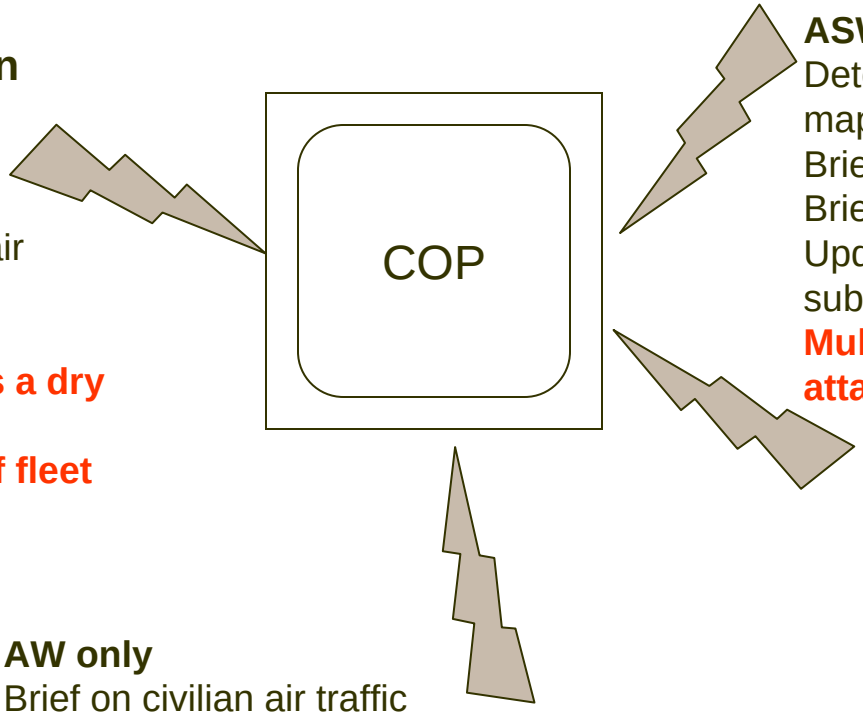


Roles' initial preferences for CVOA

	Strike	Strike	AW	AW	SCC	SCC
	Strike distance	SOF insertion & support	Air threat	Missile threat	Sub threat	Surface threat
Java Sea	Best (1)	Best (1) 1	Worst (3)	Worst (3)	Worst (3)	Worst (3)
Celebes Sea	Med (2)	Med (2) 2	Med (2)	Med (2) 2	Med (2)	Med (2) 2
Banda Sea	Med (2)	Worst (3)	Best (1) 1	Med (2)	Best (1)	Best (1) 1

‘Hidden profile’ distribution

Common information
Warning Order
Commander’s Intent
Enemy Order of Battle
- including missile, sub, air capabilities
Blue Force capabilities
Newport News includes a dry deck for SOF
SSN slower than rest of fleet
Weather updates
Maps, including ranges



ASW only
Detection ranges and region maps
Brief on small boat threat
Brief on red sub tactics
Updates on blue, green, red sub positions
Multiple red sub threats and attack vectors

AW only
Brief on civilian air traffic
Brief on red missiles
Updates on red missile types and locations
Liaison to COCOM
Request for tankers
Request for P3

Strike only
Strike target info
Target 3 has no exact location and needs thermobaric strike
SOF capabilities
Updates on strike target situation
CVOA requires lengthy transit

Phase I Rubric- example

Banda sea assessment	
Suitability for Strike:	
•Difficult to place SOF in Target 3 area by submarine UNLESS submarine is dispatched separately at this time to Makassar Strait. In this case, Sub would be unavailable for ASW.	3
•Strike aircraft and tankers en route also in range of Flankers	3
•Minimal interference with civil air. Only Manado- Hasanuddin route of primary consideration.	3
•Weather from SE may interfere with Strike operations	3
•SA-10's in Pulau Butung must be bypassed or neutralized	3
Shortest transit time	3
Known risks to forces:	
•Ships in range of SU-30MKI Flanker fighters based in Hasanuddin in most parts of Banda.	3
•Risk of submarine attack. Bottom geography suitable for Red submarines to hide.	3
Kilo 6 in Makasar could move into Banda	3
Kilo 5 in Manado could move into Banda	3
Other kilos have been unaccounted for	3
•Weather from SE may make submarine detection more difficult.	3
•*Risk of small boat targeting or attack in most of region*	3
•Small risk from surface navy. Houxin 2 in Makasar could move to within range. Houxin 1 from Manado could tail group.	3
•Risk from land-based cruise missiles can be mitigated by moving outside of range.	3
•Low risk of attacks using civil air as cover	3
•Low risk of attacks using civil shipping as cover	3

Phase I Scores

scoring- Phase 1	possible pts	Group1	Group2	Group3
SUM	**221**	**77**	**40**	**53**
Banda sea assessment	**54**	**11**	**12**	**13**
Suitability for Strike:	21	1	5	9
Known risks to forces:	33	10	7	4
Celebes sea assessment	**60**	**16**	**9**	**14**
Suitability for Strike:	24	7	0	6
Known risks to Forces:	36	9	9	8
Java sea assessment	**57**	**12**	**6**	**16**
Suitability for Strike:	21	3	0	7
Known risks to Forces:	36	9	6	9
Ranking	20	20	10	10
RFI's	21	9	3	0
Request for additional assets	9	9	0	0

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Focal issue 1: SSN deployment

- Target 1 required SOF targeting
- SSN was best available method of SOF insertion and extraction
- SSN could not also provide ASW unless Celebes sea was chosen
- SSN had a very long transit time, possibly disrupting the mission timeline
- What made this difficult:
  - Issue would be best resolved in Phase I, in time to send SSN through Makasar instead of Celebes
  - Full understanding of the problem required input from multiple WA's: Strike and ASW

Focal issue 1: SSN deployment

- How did the groups solve this issue?
- None of the groups addressed or resolved this issue in Phase 1
- Group 1 did not plan to use SOF targeting, partly due to difficulty of insertion
- Group 2 planned for SSN insertion, SOF targeting, but did not include in timeline
- Group 3 integrated SSN transit time into timeline

Focal issue 2: Broken helo

A broken helicopter was on the single launch pad of the DDG Ramage. This greatly degraded Ramage's capability to conduct ASW and guard against small boat threats. Ramage and Mason could not longer be viewed as interchangeable.

- **What made this difficult? Information was distributed unevenly and require inference beyond information given**
- **AAW was alerted at 1410, (10 minutes into Phase 2) that there was a broken helicopter on the deck of the Ramage**
- **Tendency to process the information about one broken helo (insignificant) but overlook the unusable launchpad**
- **SCC was alerted to this at 1500, 60 minutes into Phase 2**

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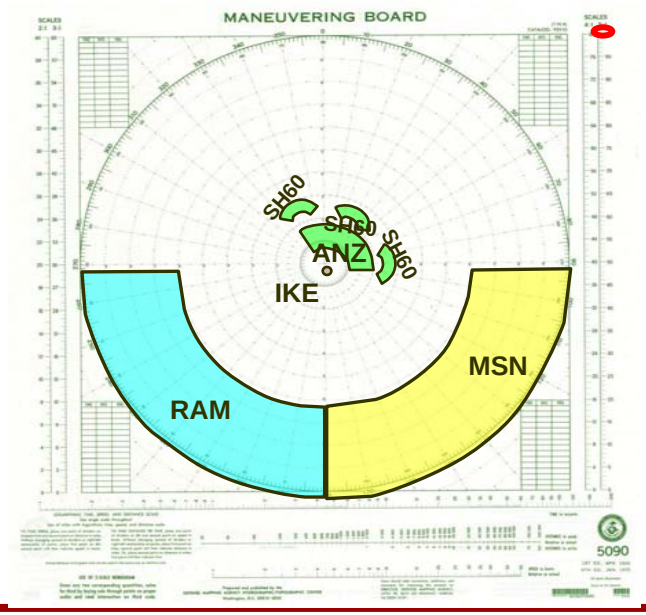
Focal issue 2: Broken helo

What happened?

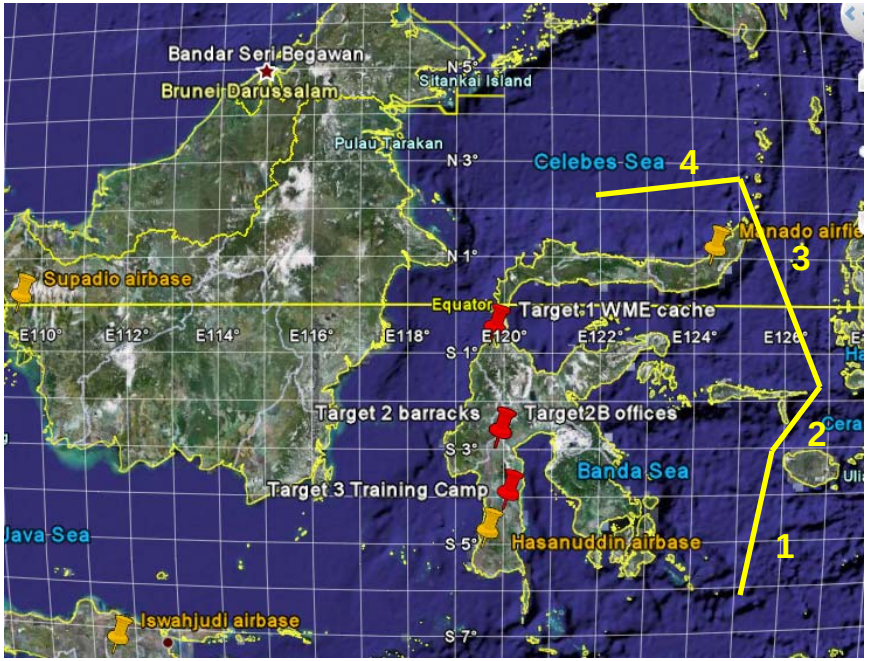
- ***None*** **of the Phase 2 force protection schemes made different accommodations for Ramage and Mason**
- **Group 1: AW did not report issue at 14:10; SCC reported issue to group ~15:00 "USS Ramage has HELO down will not be able to support helo ops to localize and launch on sub. Hull array and tail are still working to support the barrier on the CVOA"**



Possible visualization improvement:

What visual tools would help keep track of assets, current states, locations, and future allocations?

Asset	Capabilities	Warfare Commander	Track Leg
DDG 61	1 HELO down	ASW	1-3



Findings

- Successful pilot of new experimental task
- Successful pilot of scoring method
- Identified problem areas for further development

Study technology variations

	Phase I (morning)	Phase II (afternoon)	Phase I score
Session 1	Chatroom only Google Earth, Powerpoint on each station	Same as AM	77
Session 2	Chatroom only Google Earth, Powerpoint on each station	Phone conference + screen sharing	40
Session 3	Chatroom + Screen sharing Google Earth, Powerpoint on each station	Phone conference + screen sharing	53

Conclusion: don't run complex groups studies with N=1

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Weak agreement between groups

	Group1	Group2	Group3
Group1		0.13	0.17
Group2			0.55

- **Little agreement between Group 1 (highest scoring) and others**
- **Moderate correlation between groups 2 and 3, meaning they identified the same issues and missed the same issues**
  - **This could mean that the agreed on the irrelevance of many rubric issues; could also mean they both identified most obvious subset**

Participants judged the toolset to be inadequate

- All groups felt that Phase 1 chat was a hindrance and was unrealistic
  - "Communications channels poor for Phase I. Warfare commanders got focused on own tasks and delayed answering questions some times."
  - "Lack of voice comms hampered coordination."
- Available tools were not suited to the task.
  - "Electronics once mastered seemed to enhance displays and prep of briefing slides, but not necessarily planning process."

Process observations- collaboration

- Timeline construction was an individual activity by Strike in 2 of 3 sessions. Strike was often overwhelmed at this point while others had little to do.
- WA specialists used ‘divide and conquer’ strategy. “That wasn’t my job.” This was likely due to 1) poor comms tools, 2) short timeline, and 3) lack of familiarity with each other
- Little debate, conflict throughout. Very few instances of challenging assumptions. Some double-checking of information.
- Task should have included the verbal brief-out. Much of the tacit knowledge in WA’s heads would have been communicated at that time

What did we learn?

Groups performed poorly according to the pre-set rubrics

Didn't do very well with asset allocation and identifying risks to mission and own forces

This could be the fault of the test, rubric, or available support tools

OR

It could mean we identified potential areas where new tools & procedures might dramatically improve the planning process

Further analysis is warranted to determine just what mechanisms are operating here and where technology can be applied to improve performance

Summary of Hidden Profile Task Application to C2

- Hidden profile tasks are well suited for C2:
  - Inherent interdependence
    - Warfare commanders have different offensive and defensive priorities and distinct areas of expertise, yet need to work collaboratively to mitigate risks to mission and own forces
  - Inundated with info and have to filter and prioritize what to share and what to withhold from team
  - Predicament not unique to CSGs, and hidden profile tasks generalize to many other aspects of C2
- Provide “ground truth” and an associated scoring rubric to define and quantify team performance
- Provides baseline information to compare with future collaboration tools, other system capabilities, and other variables to evaluate the impact on team performance
- Requires further testing and verification and validation- very difficult to define “good enough”