# Design of an Experiment to Investigate ISR Coordination and Information Presentation Strategies in an Expeditionary Strike Group

## Combined A2C2 and CMD-21 Research

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# ADAPTIVE ARCHITECTURES FOR COMMAND AND CONTROL

## What we do:

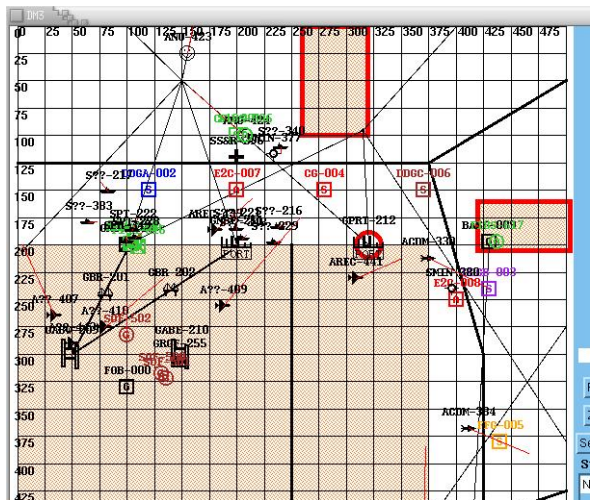
- Develop theories and models for C2 organizational analysis and:
  - org design for mission congruence
  - adaptation to changes in mission
- Validate theories and models via **team-in-the-loop experiments**
- Resource management in Joint Ops
  - **New: ISR in distributed orgs**

## How we do it:

- Field observations of relevant issues are codified for lab and model-based analysis
- Models and theories are developed and exercised to yield options for performance improvement
- Laboratory experiments test model-driven hypotheses
- Findings are brought out to the field

## Results:

- Proven algorithms for organizational design
- Requirements for facilitating adaptation
  - Overcoming “barriers” to adaptation
- State-of-the-art testbed for empirical studies
  - Combines DDD with KWeb/M3 (via CMD-21)
- Fleet applications
  - **ESG-1**, SSGs, COMCARGRU-1, N6, …



# Command 21 (2005-Present): Multi-Echelon Knowledge Management and Command Decision-Making Support for ESGs

## Identified ESG $C^2$ Challenges

(based on observations prior to and during '05-'06 deployment)

- Managing Battle Rhythm
- Understanding and incorporating the W5H (Who, What, Where, When, Why, and How)
- Maintaining and sharing Situation Awareness
- Understanding &incorporating PPRs / ZIPPO
- Translating desired outcome into desired effects into actionable EBO
- Understanding and incorporating ROE and changes into ongoing operations
- Establishing / disseminating a common lexicon

## Command 21 Approach

1. Developed Battle Rhythm Management (BRM) Tool to facilitate Situation Awareness and improve info exchange among Strike Group elements
   - Help users focus on operationally relevant information in evolving situations
   - Provide access to this information
   - Assist users in identifying the absence of information
   - List experts they should contact and/or bring into the organization
2. Analysis of Chat usage during ESG-1 operations

## Accomplishments / Results

- Installation, training, and assessment of BRM Tool

  - BRM tool used early in deployment and judged useful and easy to use
  - BRM tool usage discontinued in early August '05
    - CONOPs needed adjustment
    - Tool needed minor revisions
    - Not yet approved for general use (cert./accred. in process)
- Chat usage logging and subsequent analysis of '05 deployment

## Future Directions

- Develop / evaluate an improved version of the BRM decision support system
- Collaborative Research on ESG $C^2$
  - Collaborate on research focusing on understanding and improving ESG operations.
  - Support development of tools and models for multi-echelon Command decision-making and information transaction within and across command echelons.
  - Support outreach research with operational ESG C2 Commands.

# EXPEDITIONARY STRIKE GROUP (ESG)

- **Components:**
  - **ESG FO/GO with a staff of ~50**
  - **Amphibious Squadron (PHIBRON) Commodore and staff of ~35**
  - **Marine Expeditionary Unit (Special Operations Capable) Commander and staff of ~150+ and 2000+ marines**
  - **Surface Combatants and personnel**
- **Platforms:**
  - **Amphibious Assault Ship (LHA), Dock Landing Ship (LSD), Amphibious Transport Dock (LPD), Cruiser (CG), Destroyer (DDG), Frigate (FFG), [Fast Attack Sub (SSN)]**
- **Missions:**
  - **Expeditionary Warfare, MIO, MSO, SUW, USW, MIW, STRIKE, SOF, Air Defense, Disaster Relief/Humanitarian Ops…**

# EXPEDITIONARY STRIKE GROUP (ESG1) DRIVEN RESEARCH

**Field-Based Experimentation**:

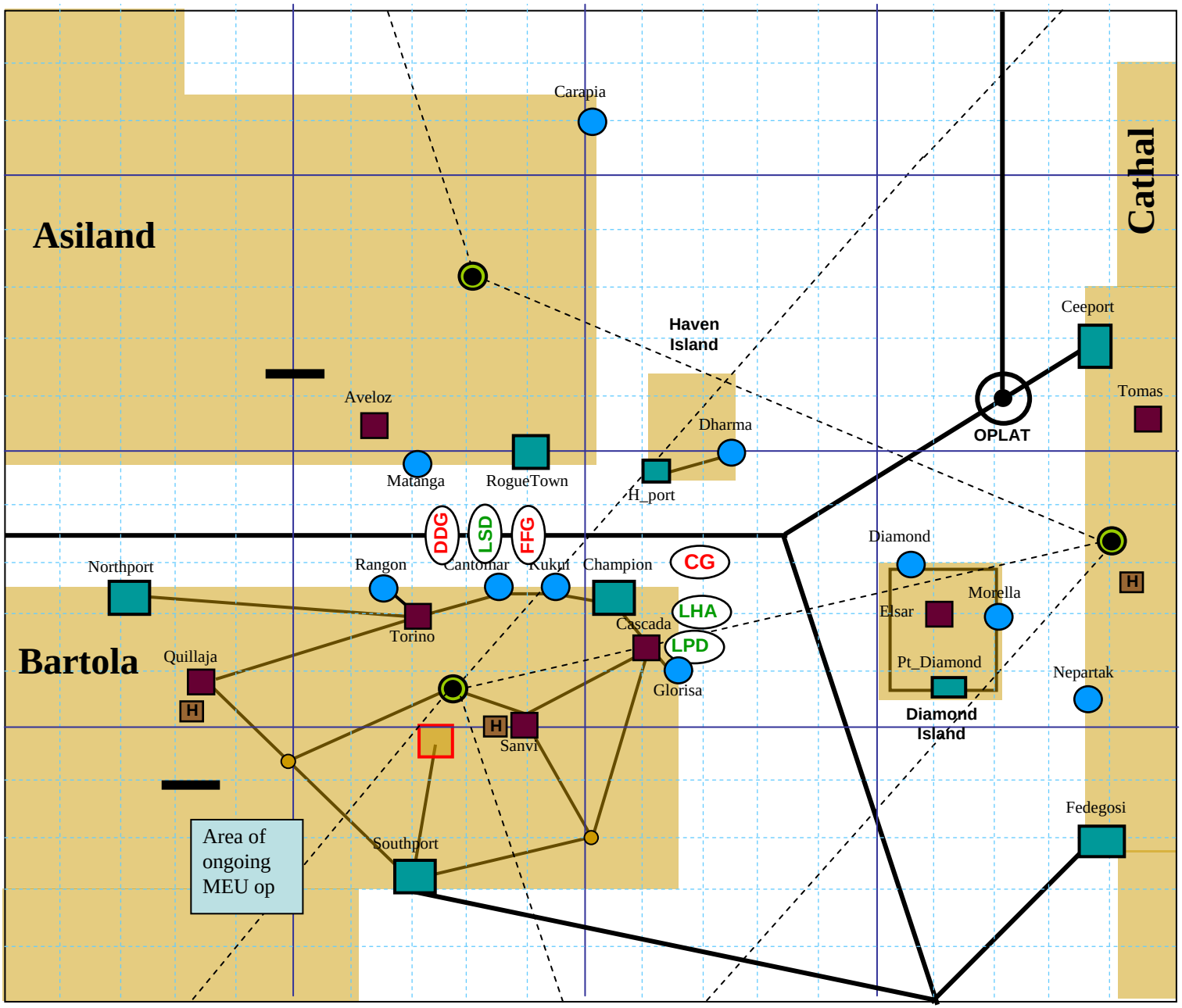
- Interactions with ESG-1 CDR and staff over an 18 mo period
  - Included in situ observations and interviews with high-level ESG-1 staff (pre and during deployment)
- A2C2 methodologies applied to address ESG-1 needs and priorities for adaptive C2 structures: developed "top 10" list

- Identified 3 major C2 organizational issues
  - **Highest priority topic was ISR coordinator/ commander role**
  - **Focus of current experiment**
    - **Impact of ISR/ Information Officer**
    - **Information Access & Structure**
- Developed environment for model-based experiments and conducted an initial experiment (analysis now underway)
  - **Scenario engineering and design**
    - **Includes HA/DR, MIO/MSO, insurgency**
  - **Focus: ISR in distributed organizations**
    - **A precursor for examining the C2 implications of introducing UAVs into the fleet, and total ISR asset management**
- State-of-the-art testbed for empirical studies
  - **Combined DDD-3 with CMD 21 tools**
    - **DDD: dynamic decisionmaking in distributed organizations**
    - **M3 Tool → second IV for experiment**

# ROADMAP TO AN EXPERIMENT

- **Driver: Current and anticipated mission sets for ESGs**
  - Limited offensive ops (limited AAW, ASW, ASuW capabilities)
  - Focus on VBSS, HA/DR, surveillance, insertion, direct action, …
  - Integrated Navy and Marine activities and assets
  - A2C2/CMD21 research team interactions with ESG-1 ➔ an 18mo effort!
- **Focus: Asset management for ISR – including UAVs**
  - Information gathering, task assessment, ISR and intel, SA, …
  - Broad scope of activities (HA/DR, MSO/MIO, search, insurgencies, …)
- **Highly interdependent information environment**
  - Inter-task information links (action on A yields info on B)
  - Inter-DM information flow (ground ops give intel on sea events)
  - Multiple attributes define task "state"
    - State is dynamic!!
    - Attributes measured by different sensors (possibly owned by different DMs)
- **Design of an experimental context and scenario**
  - C2 structures for ISR: number 1 on the "top 10" list
  - Include execution and planning dimensions

# CONCEPTUAL ENVIRONMENT FOR EXPERIMENT




## LEGEND

- Port
- Fishing Village
- Checkpoint
- Medical facility
- Refugee Camp
- Uncontrolled airfield/strip
- US Embassy
- Sea lane
- Air corridor
- Major road
- Controlled airfield

# ESG ORGANIZATION OF FORCES FOR EXPERIMENT

- **Bulk of MEU (incl ACE) off-loaded for a counter-insurgency operation in remote area of Bartola**

- **Remaining Forces:**

| Marine Expeditionary Unit (MEU): | Sea Combat Command (SCC): |
|---|---|
| 1 AV8B, 1 AH1, 2 UH1 (on the LHA) | 3 RHIB (on CG, DDG, FFG) |
| 2 MSPF (based on LSD and LPD) | 2 SH60 (based on FFG) |
| 2 RECC teams (deployed in Bartola) | 2 HH60 (based on LHA) |
| 2 SOF teams (deployed in Bartola) | 1 LCU and 2 LCAC |

- **4 UAVs**
  - **Ownership and management of UAVs are relevant issues**

# ELEMENTS OF AN ISR-CENTERED SCENARIO

- 40+ task classes with attributes that define their nature/state:

  **Refugee Camps: [weapons (y/n), crowd type (normal, protesters, insurgents)]**
  **Merchant Ships: [cargo type, status]**
  **Ground Patrols: [country]**
  **Truck Convoys: [cargo type, country]**
  **Medical Facility: [temperament, capability]**

- Attributes are dynamic – they change over time and with events
  - **persistent monitoring/ISR is needed for situation awareness**

- Task instances are woven into ~30 vignettes (times, locations, activities)

  ***Ex:* RC Sanvi starts with no weapons and a normal crowd, but protests start because promised food is late. In the meanwhile, the UN food convoy enroute from Southport is delayed by a rogue military ground patrol. If US forces arrive, the GP lets the food convoy continue to Sanvi. If the food does not arrive on time, insurgents take over the RC**
  - **compressed time scale: 18hrs into a 90min laboratory run**

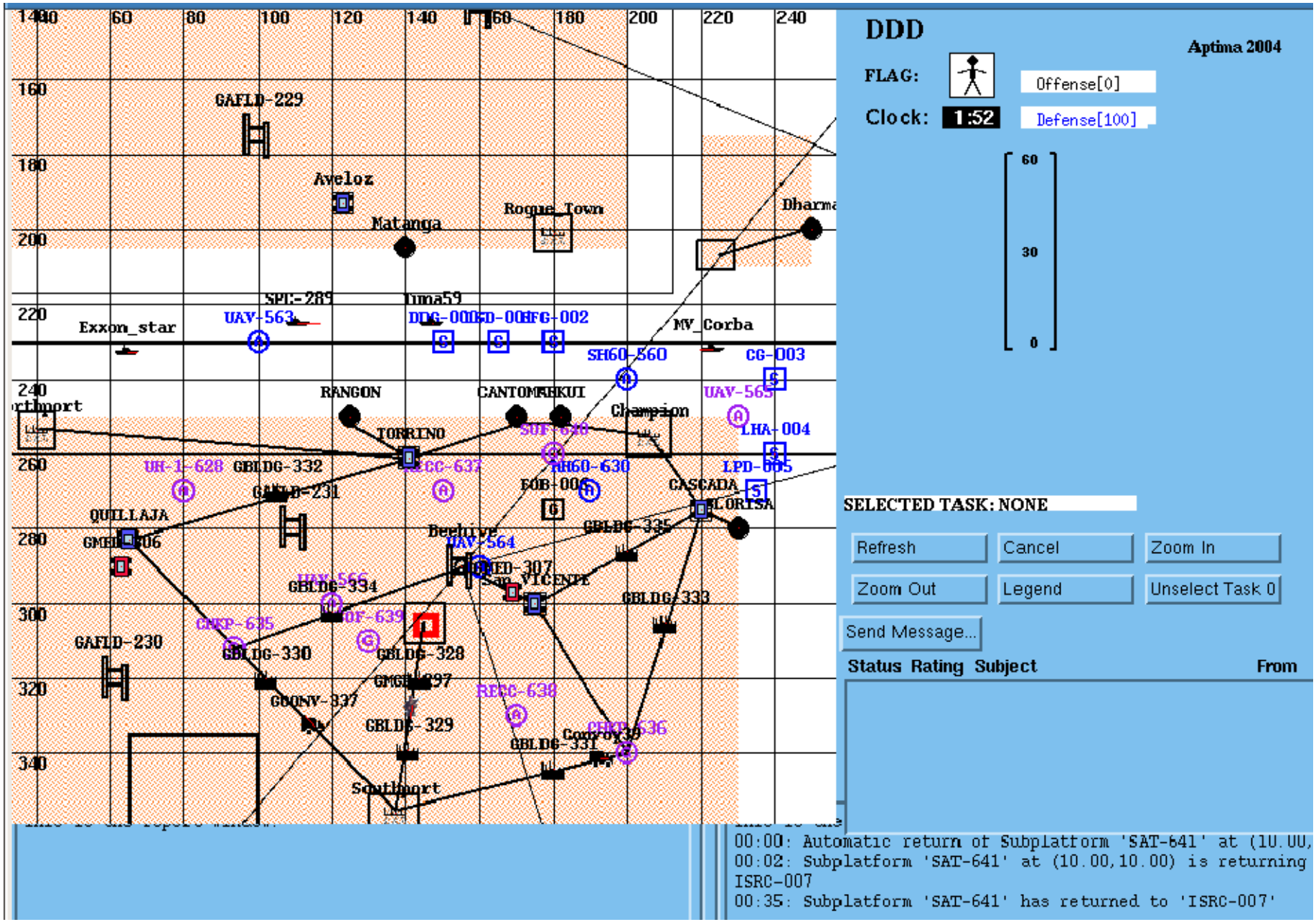
- ISR complexity that must be managed
  - **interdependent information flows (sea-ground, ground-sea)**
  - **intel, info request from future plans, …**
  - **one asset cannot measure all attributes of a task**
  - **assets are "owned" by different DMs**

# ASSET CAPABILITIES FOR MEASURING TASK ATTRIBUTES

| | Fishing Village | | | Refg Camp | | Med Facility | | Bldg | | Truck Convoy | | GP | Fishing Boat | | Oil Tkr | Merchant Vessel | | PB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Refugees | Weapons | Crowd | Weapons | Crowd | Temperament | Med Capability | Temperament | Activity | Cargo | Country | Country | Temperament | Cargo | Status | Cargo | Status | Country |
| UAV | P | P | | P | | | | | P | | P | | | P | | P | | P |
| MSPF | | | | | | | | | | | | | P | P | s | P | P | s |
| RECC | P | | P | | P | P | | P | s | P | s | P | | | | | | |
| SOF | P | | P | | P | P | | P | s | P | s | P | | | | | | |
| UH-1 | s | s | | s | | | s | | s | | s | s | s | | s | | s | s |
| AV8B | | | | | | | | | | | | | | | | | | |
| AH-1 | | | | | | | | | | | | | | | | | | |
| HH60 | s | s | | s | | s | P | s | s | | s | s | s | | s | | s | s |
| SH60 | s | s | | s | | | | | s | | s | s | P | | P | | P | P |
| RHIB | | | | | | | | | | | | | s | s | s | s | s | s |
| Ships | | | | | | | | | | | | | s | | s | | s | s |

- **P** denotes primary capability, **s** denotes secondary capability
- UAVs, helos (SH60, HH60, UH-1), and (AV8B, AH-1) are the primary <u>detection</u> assets

# DISTRIBUTED-DYNAMIC DECISIONMAKING (DDD) IMPLEMENTATION



# Dynamic Information Web Space

Fishing Boat | Titus

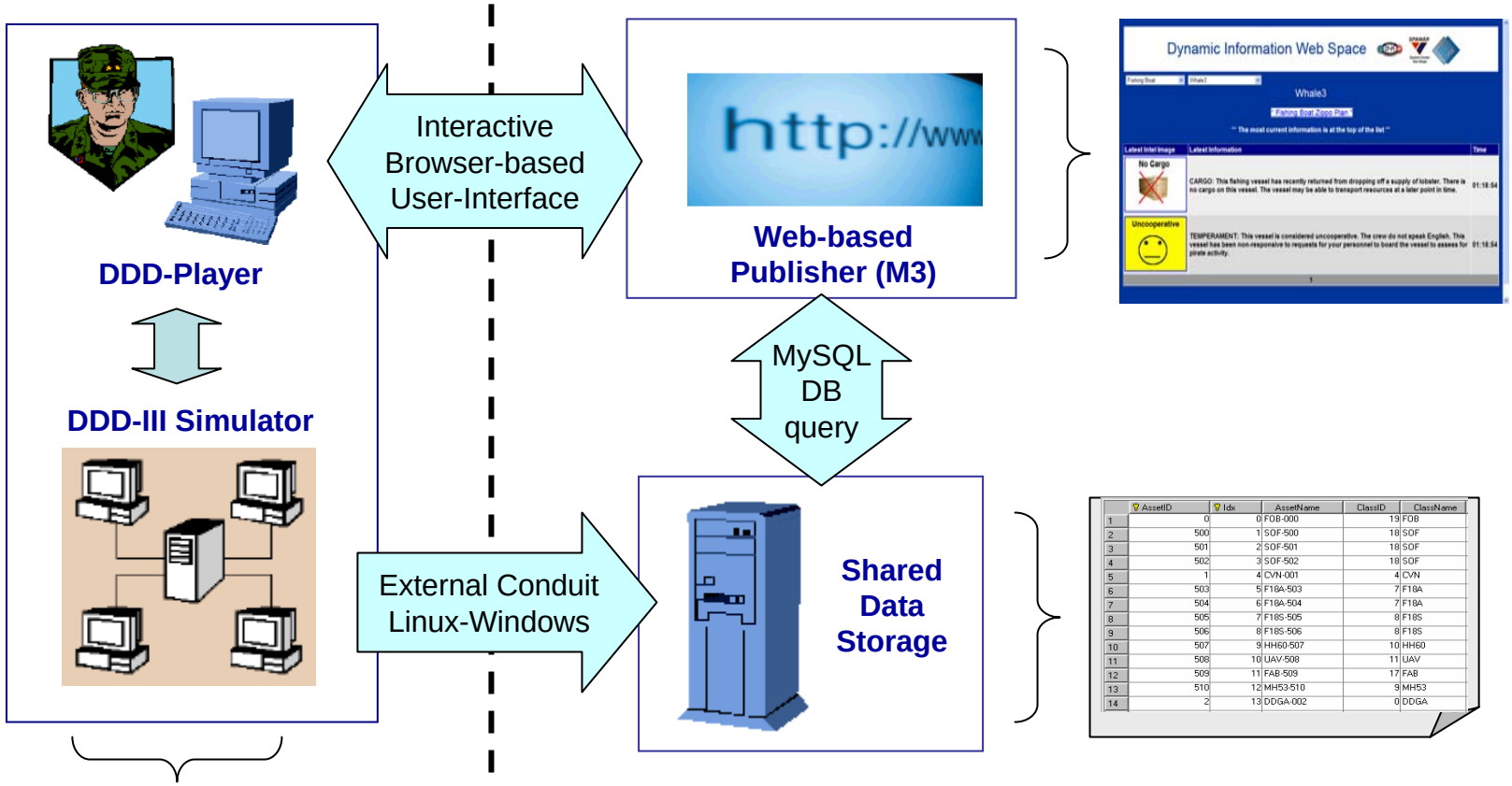
## Titus

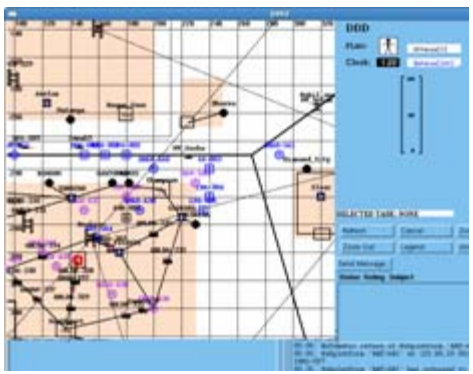
* Fishing Boat Zippo Plan *

** The most current information is at the top of the list **

| Latest Intel Image | Latest Information | Time |
|---|---|---|
| No Cargo | CARGO: This fishing vessel has recently returned from dropping off a supply of lobster. There is no cargo on this vessel. The vessel may be able to transport resources at a later point in time. | 01:30:01 |
| Friend | TEMPERAMENT: This vessel is considered friendly. It is moving at a slow pace and appears to be replenishing its fishing supply to aid the food supply for a nearby refugee camp. | 01:30:01 |
| Weapons | CARGO: This vessel is carrying weapons. Be aware that if appropriate action is not taken following Zippo and ROE, these weapons may end up in the hands of terrorists or insurgents in fishing villages. | 01:10:57 |
| Uncooperative | TEMPERAMENT: This vessel is considered uncooperative. The crew do not speak English. This vessel has been non-responsive to requests for your personnel to board the vessel to assess for pirate activity. | 01:10:57 |

# THE DDD-M3 TOOL DYNAMIC WEB INTERFACE



- The external conduit extracts static and dynamic information on **measured** task attributes from the DDD and stores it in a shared MySQL data base
- All measured attributes are time-stamped

# ELEMENTS OF THE PLANNING/EVACUATION MISSION

## ❑ Phase 1: Selecting the best site

- **Which village provides the most suitable site, considering the fact that many refugees may be injured and require medical assistance?**
  - **What factors contributed to that decision?**
- **Which other villages might also be considered if the first site does not provide sufficient capacity?**
- **Which villages did you rule out as evacuation sites?**
  - **What factors contributed to that decision?**
- ***What information was missing or not available* to you that you needed/would have liked to help you develop your plan?**
- **How confident are you in your recommendation of the most suitable site?**

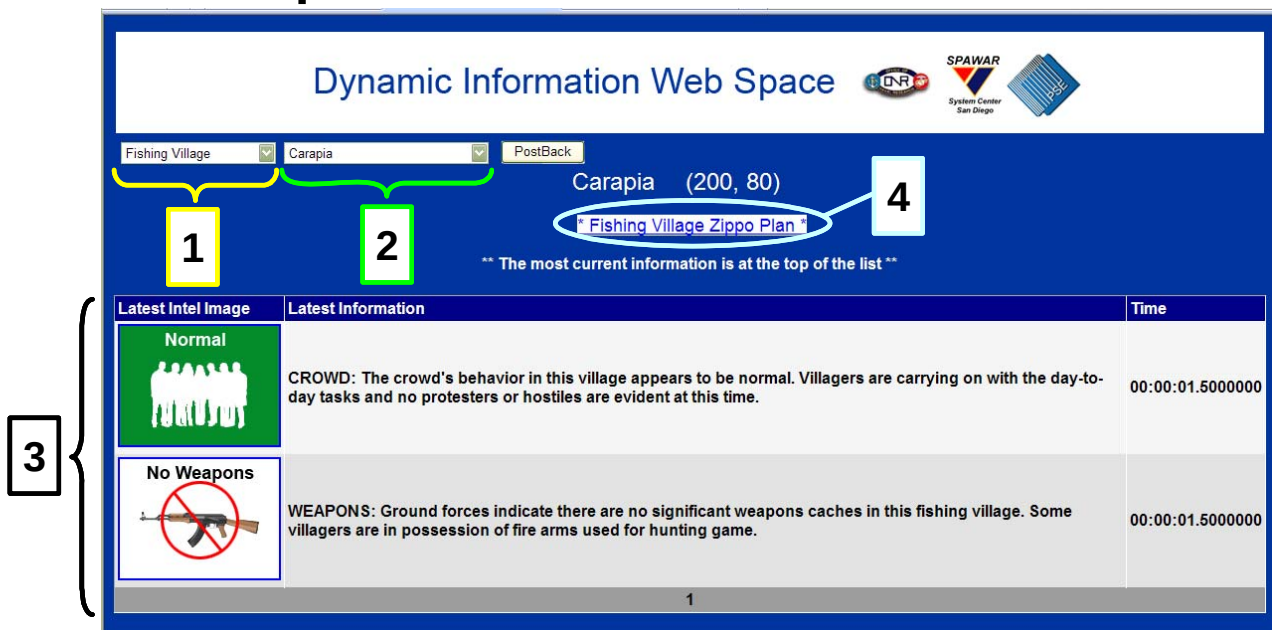
## ❑ Phase 2: Securing and moving refugees

- **What new information has been provided that is related to the situation and might affect the evacuation plan?**
- **What issues/problems do you foresee in evacuating the refugees?**
- **What resources are required to evacuate the refugees?**
- **What tasks do you recommend be conducted prior to evacuation that relate to:**
  - **Securing the evacuation site**
  - **Supplying the evacuation site**
  - **Securing the evacuation route**
- ***What information was missing or not available* to you that you needed/would have liked to help you make your decision?**
- **How confident are you in your recommendations?**

# Interface between DDD and Web

**Link provided from BRM System or Information Space Folder**

1. **Dropdown menu of classes of assets (e.g., Fishing Village)**
2. **Dropdown menu of specific member of that class (e.g., Carapia).**
3. **Selecting specific class member → its ISR information.**
   - **Image depicting current status/attributes**
   - **Latest information**
   - **Time stamp. *The most current information is at the top of the list*.**
4. **Link to ZIPPO plan for that class of assets**



# THE M3 TOOL – EXAMPLE of PAGES USED BY PLANNERS

1

Multi-Mission Manager (M3)
SCC Page

Last Updated: 1/17/2007 9:10:42 AM

By: --Name-

HistTimeline | SCC Tasks | Guidelines | SCC ROEs | Maps | Codes

3

2

-Overall-

-EvacPla-

-AT/FP-

## Cantilles Intel Log

**COUNTRY: Cantilles**

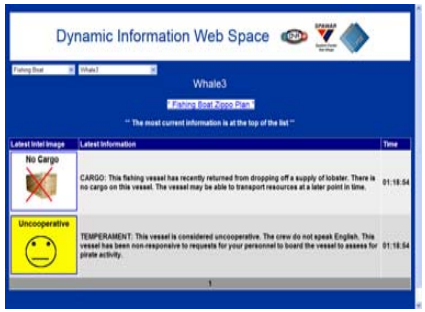
**RISK LEVEL: MODERATE / HIGH**

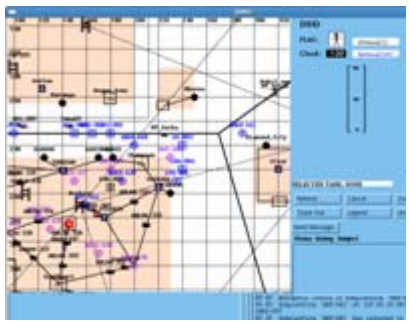
| RECENT INCIDENTS | | Detail |
|---|---|---|
| **Date** | | |
| 23March07 | **US Marines attacked at temporary refugee camp** | US Marines on the outskirts of eastern Diamond Island were fired upon by suspected BAM rebel group. The Marines, who were guarding the perimeter of a temporary refugee camp, were forced to return fire. |
| 22March07 | **Bartolan patrol craft attacked** | Bartolan military patrol craft attacked with small fire and RPG; suspected insurgents from Asiland. |
| 20March07 | **Militants plan attack on Shallotsville** | Intelligence sources in northern Zuma suggest that BAM is planning a large-scale attack on Shallotsville. The Bartolan capitol has been temporarily moved to Champion. |
| 19March07 | **ESG-1 => JTF-1 Operation Ensuring Hope** | ESG-1 join forces with JTF-1 for operation ENSURING HOPE for Humanitarian Assistance & Disaster Relief and Support & Stability Operations to include Non-Combatant Evacuation, Support to Counterinsurgency, Maritime Security and continue GWOT. |
| 16March07 | **Emergency supplies arrive** | Red Cross and CARE air drop initial supply of emergency equipment to temporary shelter on Bartola. |
| 13March07 | **Temporary camps set up** | Temporary shelters set up on Bartola and Cathal. Plans under way to establish evacuation of displaced refugees and rescue of refugees that have taken to higher ground. |
| 08March07 | **Asiland suffers major damage from tsunami** | Tsunami, due to earthquake off the western coast of the Marianas Islands, hits Deepwater Straits region affecting primarily Asiland and severly damaging Asiland's major port. |

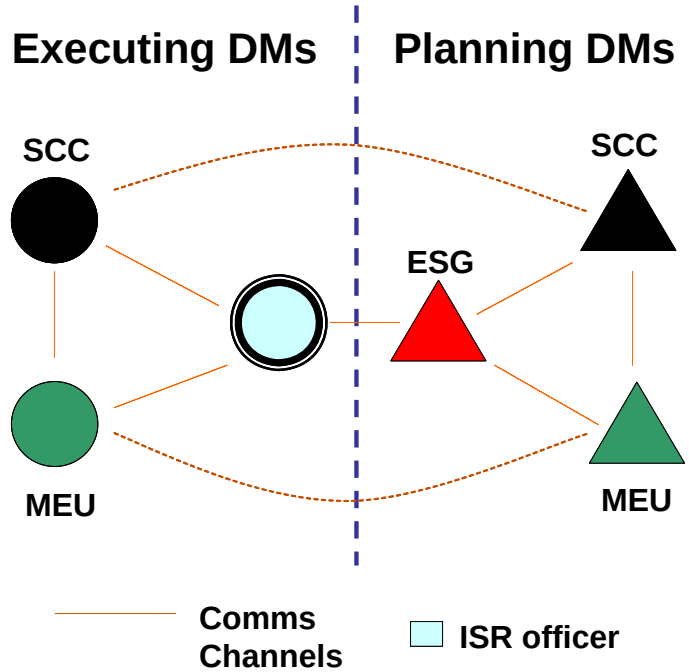
# LEVELS OF ISR COVERAGE INDEPENDENT VARIABLE

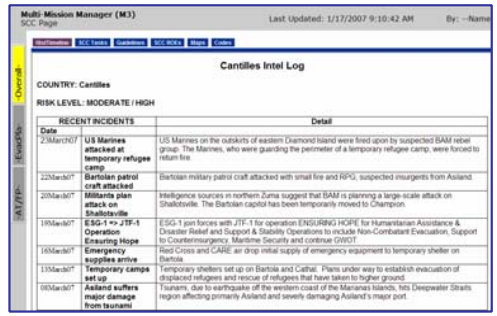
- **A2C2 Primary Purpose**
  - **Explore how ESGs with alternative structures and processes relating to an ISR officer affects performance and information flow in an information rich planning & execution environment**
  - **Three levels of ISR:**
    - **No ISR Officer (self-synchronized)**
    - **ISR Coordinator**
    - **ISR Commander ("owns" UAVs)**
    - **No ISR Officer, ISR Coordinator, ISR CDR**
    - **Motivated by ESG C2 alternatives**
- **Command 21 Primary Purpose**
  - **Determine how different information presentation strategies – inspired by NCW concepts – facilitate performance in both planning and execution**
- **Shared Purpose**
  - **Investigate the interaction of ISR Officer responsibilities with information presentation/structure**

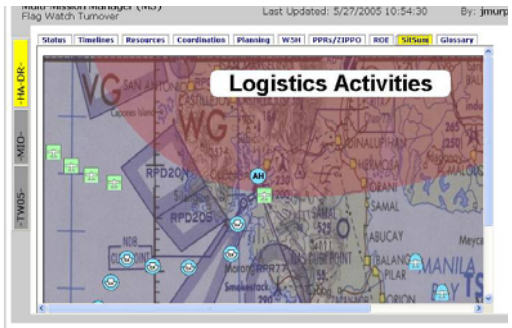
# SCHEMATIC OF MAJOR SUBORDINATE COMMANDS FOR EXECUTION AND PLANNING DECISIONMAKERS

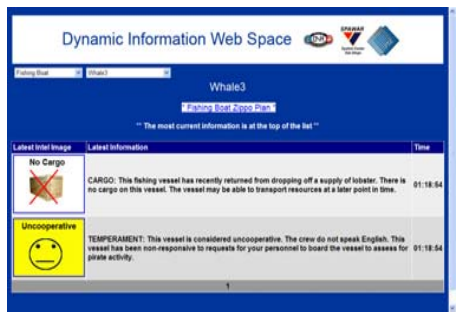


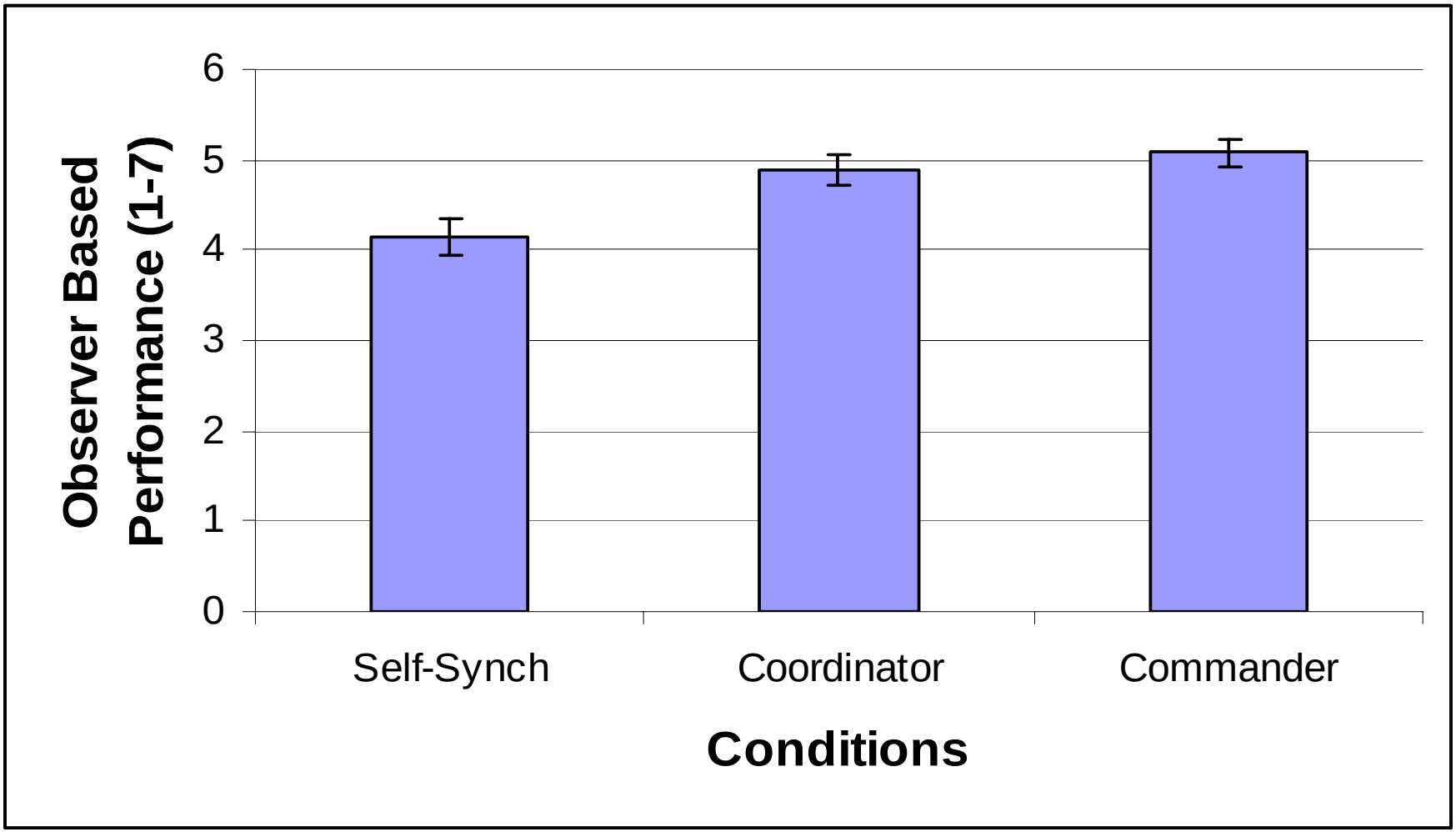


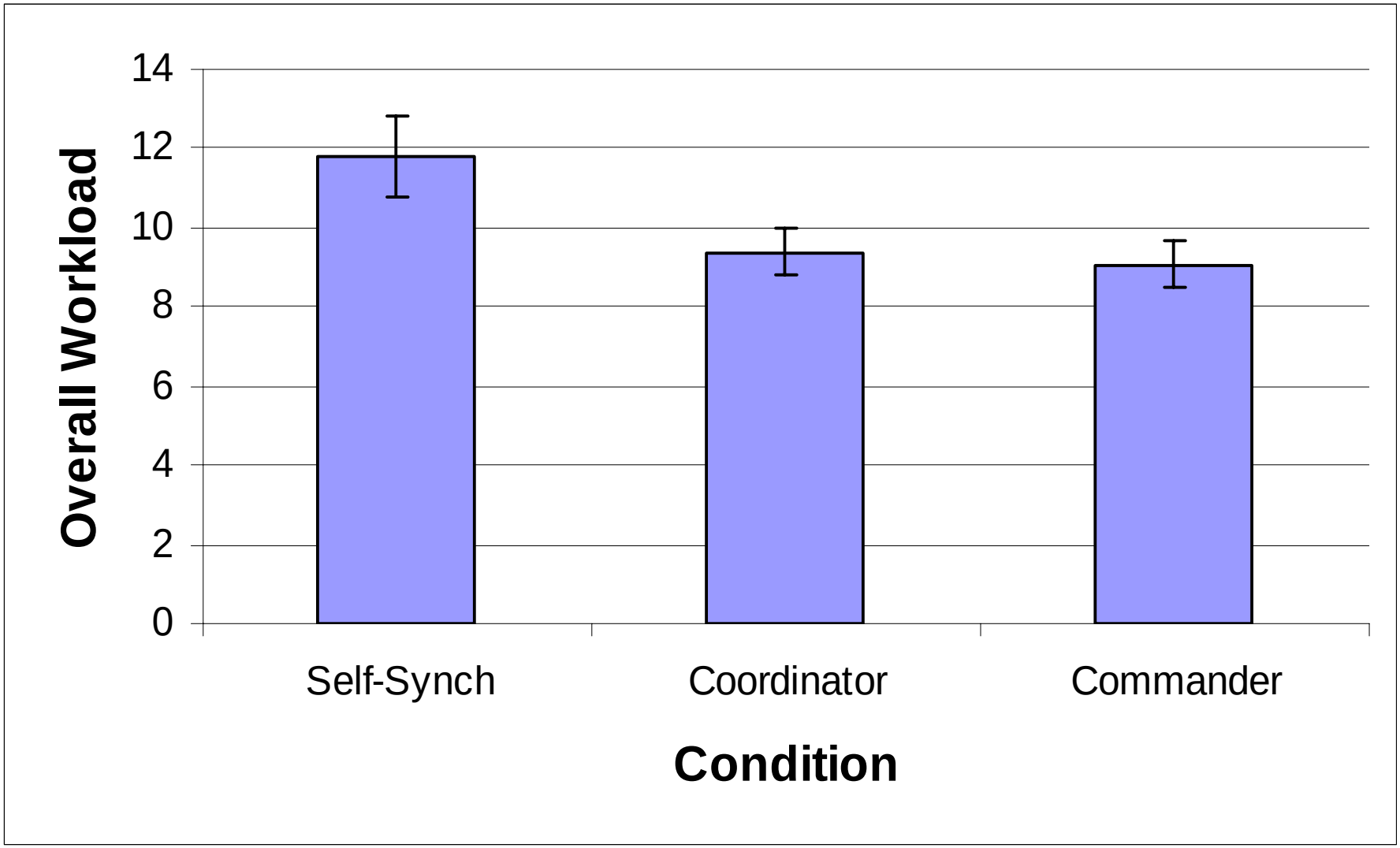



# OVERALL MEAN PERFORMANCE FOR THE THREE EXPERIMENTAL CONDITIONS



# OVERALL WORKLOAD FOR THE THREE EXPERIMENTAL CONDITIONS



# EMPIRICAL FINDINGS: Con't
# COMMUNICATIONS BY CATEGORY

**Figure 4. Mean Number of Information Requests by Experimental Condition.**

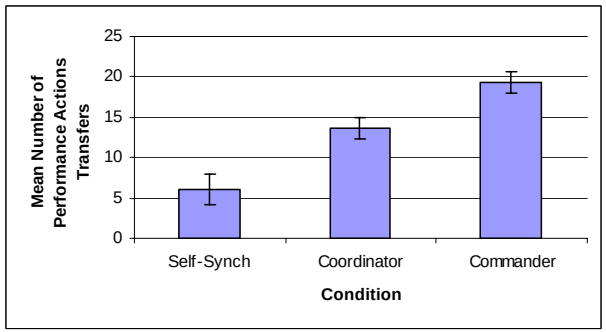



**Figure 5. Mean Number of Information Transfers by Experimental Condition.**

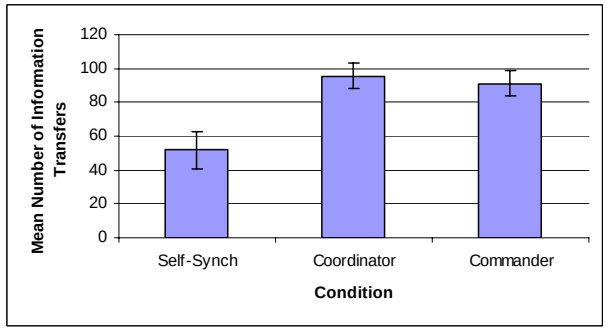
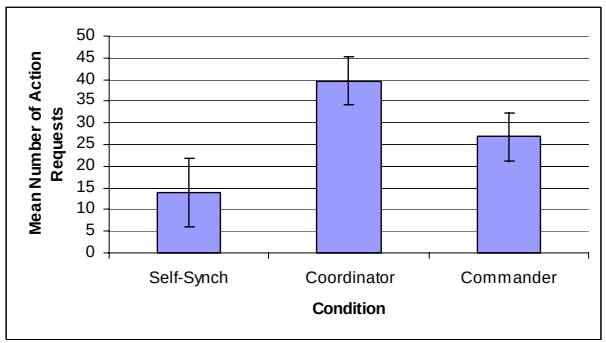



**Figure 6. Mean Number of Action Requests by Experimental Condition.**



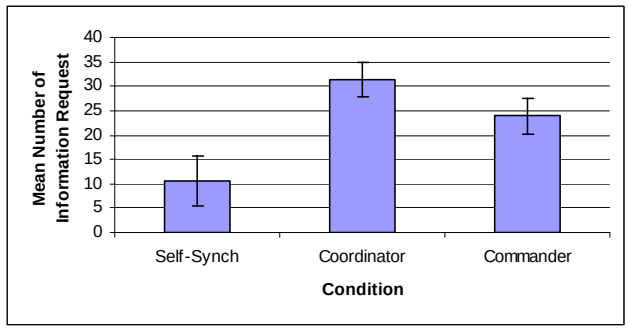


**Figure 7. Mean Number of Action Transfers by Experimental Condition.**