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NetCentric Warfare and HSI Issues: Littoral Combat Ship

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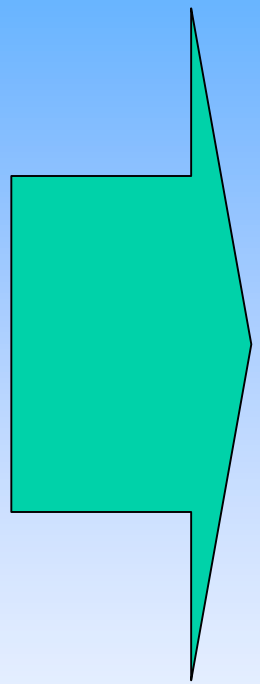
The Adversary

Old Paradigm

- Identifiable
- State Oriented
- Predictable
- Easy to find



New Paradigm

- Amorphous, cellular
- Transnational, global
- Fanatical
- Hard to Find

Identification, tracking, and targeting through NetCentric Warfare are keys to success

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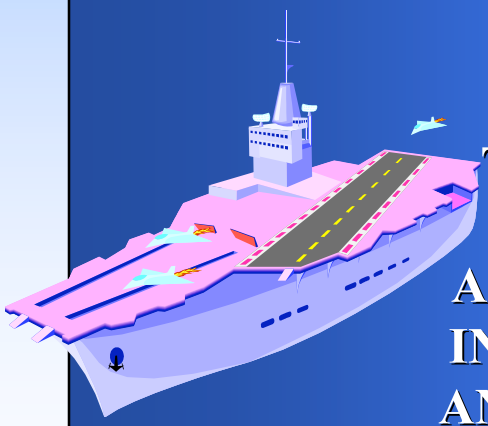
OBJECTIVE: FUSION OF TECHNICAL INFORMATION, SENSOR DATA AND NON-TECHNICAL INTELLIGENCE SUPPORT TO ACHIEVE NETCENTRIC WARFARE SUPERIORITY

SENSOR AND INTEL DATA



IDENTIFY KEY METHODS OF TRANSFORMING INTELLIGENCE AND SENSOR DATA INTO KNOWLEDGE AND BATTLESPACE AWARENESS

HUMAN FACTORS

Leadership Decision-Making

IDENTIFY KEY VULNERABILITIES OF DECISION MAKING PROCESSES

SUPPORT TO THE WARFIGHTER

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"Sensor-To-Shooter" Network

- Requirements for the network
  - command, control, communications, computing, and intelligence,
  - ***a suite of knowledge management tools that transform data into information, as well as collaborate up, down, and across their chain of command***
  - wireless technologies with bandwidth at sea

Littoral Combat Ship is a platform of such tools

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LCS Integration and HSI

- Integration Issues
  - Contractor Sea Frames and Government Mission Package Design
  - Timing Sea Frame Ahead of Mission Systems
  - Missions: MCW, SUW, ASUW
  - Legacy Systems
  - New and TBD designs

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LCS Training and Manning

- Training Architecture
  - Integration with computing environment
- Manning
  - 75 man
  - At sea initials estimates exceed
  - TDFA, TDTA
    - KSA Assessment
    - Offload to Shore
    - Automation
  - Reduce air detachment

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LCS Automation and Workspace

- Automation
  - TDRA, TDFA,TDTA
  - Can't presume decreased workload
  - Situation awareness
  - Vigilance- performance degradation during emergency
- Habitability and Workspace Design
  - Motion
    - Task completion
    - Sea sickness/ injury
  - Exposure
  - Anthropometry
    - Reach
    - Range of motion
    - Equipment, uniforms (wet suits, dry suits, life jackets)

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LCS Displays and Controls

- Displays
  - Undersea/Surface and Airborne Systems Situational Awareness
  - Visual angles, glare and lighting
  - NVGs
- Controls
  - Reach
  - Operation with gloves
  - Proximity to displays
  - Standard operation

Increased RISK to Successful HSI Design

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Risk Mitigation

- Processes
  - TDRA, TDFA, TDTA
  - Communication, Cooordination and Standardization between Sea Frame, Air and Mission Packages
  - Man-in-the-loop Testing
  - Usability Testing
- Metrics (realistic environments)
  - Task accuracy – over time and in sea states
  - Workload
  - Dynamic Data Acquisition (accelerometers)
  - Video tied to data
  - Physical, Cognitive and Vestibular Performance Batteries

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Summary

- HSI Challenges are Varied and Extensive
- Processes
- Metrics (realistic environments)
- Apply Findings
- Result is Designs that Optimize Human Performance

BACK-UP SLIDES

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Dynamics Data Acquisition System

Recent Test Example

Friday 6 February
- Significant wave height of about 3 ft
- Training mission in the vicinity of 1-SD buoy
- Test team used iteration to shake down hardware installation

Saturday 7 February
- Significant wave height of 5.2 ft per wave buoy
- Following training mission, Detachment moved to vicinity of SC Basin Wave Buoy and conducted Heading Test
- OIC and others reported aggressive wave conditions (6 ft) and that their maximum safe velocity was 20-25 kt

Sunday 8 February
- Significant wave height of 5.9 ft per wave buoy
- Following training mission, Detachment moved into vicinity of SC Basin Wave Buoy and conducted Heading Test
- OIC and others reported conditions less than those of previous night (3-5 ft) and were able to operate at higher speeds

NSW RIB Efforts

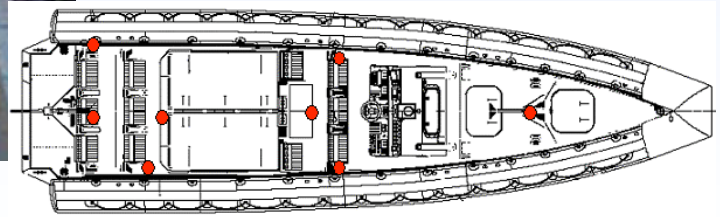
Instrumentation

Location on RIB	# DDLs	#, Type, & Location of Accelerometers
Forward machine gun mount	one DDL	two 3-dof accelerometers (one on upper plate & one on deck on aft tripod leg)
Forward Row within Forward Crew Area	one DDL	two 3-dof accelerometers (one on deck to starboard and one on deck to port)
Second Row within Forward Crew Area	one DDL	one 6-dof accelerometer and angular rate sensor set on deck, at craft centerline, beneath communication box
Forward Row within Aft Crew Area	two DDLs	two 3-dof accelerometers (one on deck at centerline & one set to starboard)
		two 3-dof accelerometers (one on deck at centerline and one set to port)

Accelerometers

Personal DDLs

Cameras



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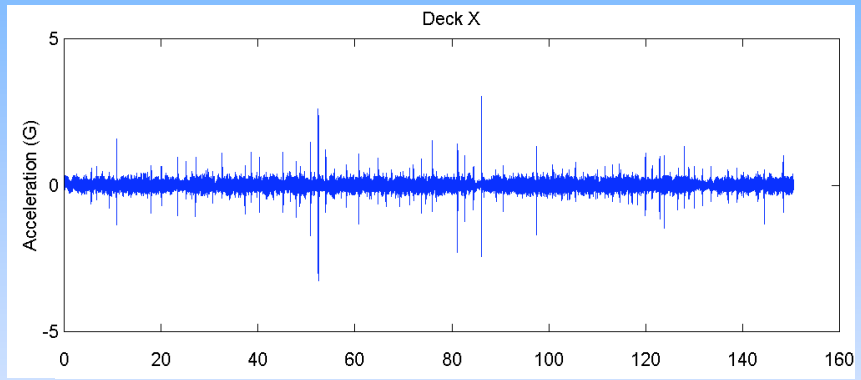
Dynamics Data Acquisition System

Resulting Data

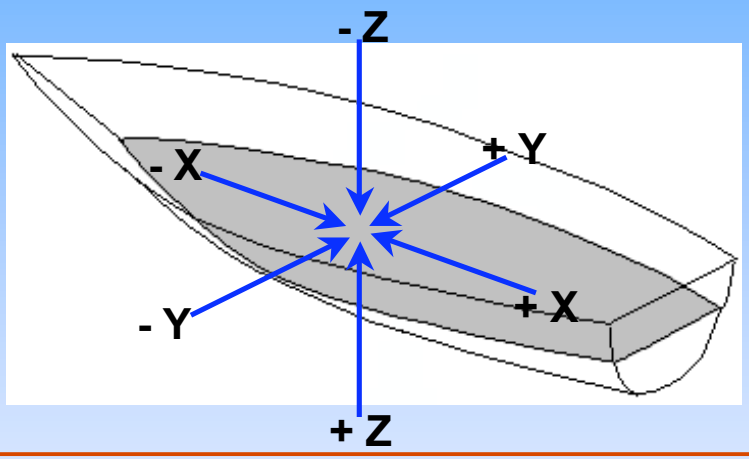
Dynamics Data Acquisition System

Resulting Data

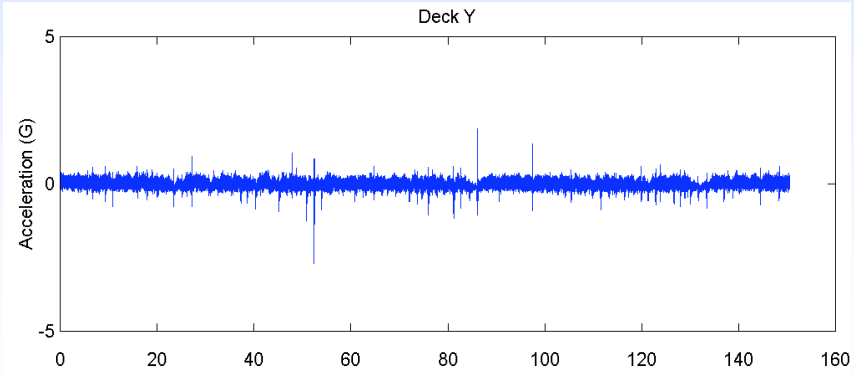
Deck X



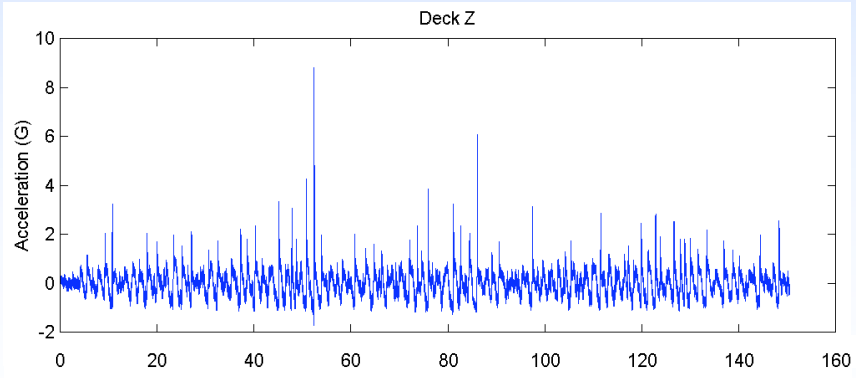
Direction of Force



Deck Y



Deck Z



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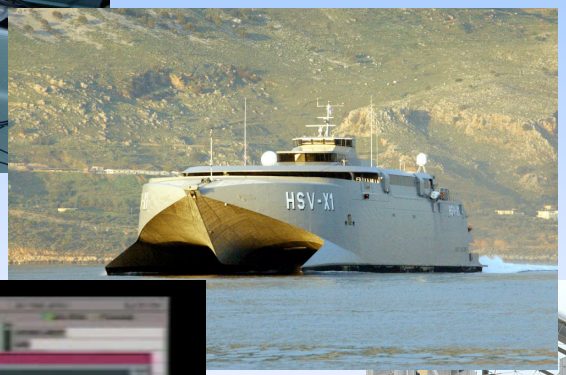
Other Available Instrumentation

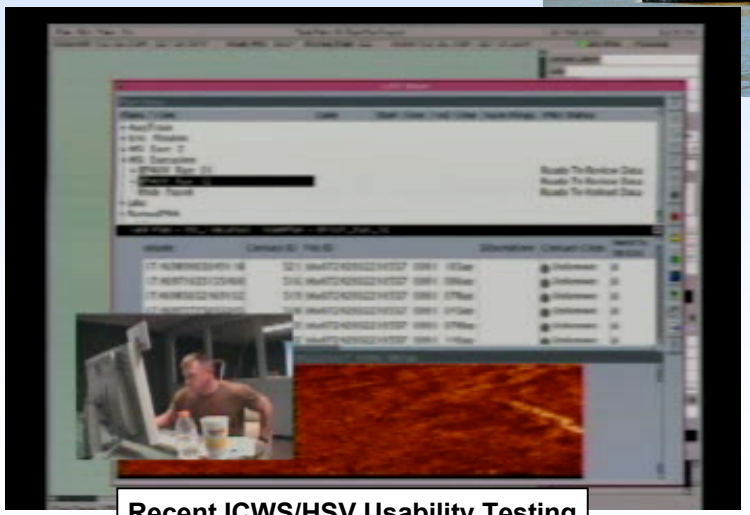
Portable Usability Lab

Portable Lab Control Station

- **Scan-Converter** - captures and records tested Graphical User Interfaces (GUI)
- **Video Mixer and Recorder** - to selectively record video and GUI inputs in picture-in-picture (PIP) format



- **Video Cameras** - remotely operated pan, tilt, and zoom



Recent ICWS/HSV Usability Testing

Setup for LCAC Maintenance Demo

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SOF Performance Assessment Battery

PAB Overview

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The SOF PAB was initiated and funded by SOCOM's Surgeon General. It consists of both physical and cognitive tests designed to quantify sailor performance and thus operational capability, troop readiness, etc.

Physical Testing: The physical battery consists of five tests, each requiring participants to operate particular pieces of physical assessment equipment. Participants are briefed on how to use the equipment and asked to use each a number of times (3 to 5 repetitions for most) to establish baseline values.

Cognitive Testing: During training, each participant performs the cognitive portion of the PAB for a maximum of nine sessions (approximately three sessions, each approximately 30 minutes long, per day). The cognitive testing requires the participant to sit in front of a computer, observe visual stimuli, and respond appropriately by pressing one of several keys on the keyboard.

Vestibular Testing: For the MKV SOC PAB scheduled for 5APR04, NEDU and the HSI&E Team are adding Vestibular tests to characterize operational impact to operators' sense of balance.

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SOF Performance Assessment Battery

Physical Battery

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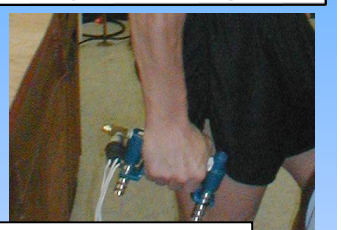
1. **Manual Dexterity:** Participants are asked to disassemble and reassemble a weapon (Model 747 carbine, 5.56 mm). This disassembly and reassembly is performed twice in succession and timed. Appropriate familiarity with the weapon is established before the task is performed for a recorded time.

2. **Maximal Handgrip Strength and Endurance:** Participants perform three maximal voluntary contractions (MVC) with their dominant hands and the average of these three values is recorded. A value equal to 50% of the average MVC is calculated and displayed on the computer. As a measure of endurance, participants then maintain a force equal to 50 ± 5% of the average MVC for as long as possible. They also perform the same maneuver with their non-dominant hands. The average MVC, duration, and integral (force x time) is recorded on a laptop computer.

3. **Step Test:** While wearing a 20-kg weight vest, participants mount and dismount a set of steps as many times as possible in 60 seconds. Safety spotters flank participants during all tests. The steps are of the Harvard Step Test form: two steps, each ten inches in height, for a total of twenty inches vertical rise. A computer records the number of cycles.

4. **Pull-Ups:** Using a portable pull-up apparatus and flanked by safety spotters during this test, participants perform as many pull-ups as possible. Safety spotters flank the participants during all tests. A computer records the number of pull-ups.

5. **Shooting Skills:** Specially modified weapons (Model 747 carbine, 5.56 mm) are used to assess the ability of participants to quickly acquire and hit a series of randomly appearing targets. Weapons operate pneumatically (with no ammunition). A laptop computer remotely connected to the weapon records scoring.



Handgrip Strength & Endurance Test

Step Test

Shooting Skills Test

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SOF PAB

Cognitive Battery of Tests

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1. **Matching to Sample:** This test measures short-term spatial memory and pattern recognition.

2. **Complex Reaction Time:** This test is designed to evaluate the subject's reaction time when confronted with multiple choices.

3. **Visual Vigilance:** This task assesses sustained visual attention and choice reaction time by testing a participant's ability to continue making decisions and rapid responses to visual signals over a prolonged time.

4. **Serial Addition-Subtraction:** This test is designed to measure a participant's ability to perform simple mathematical calculations.

5. **Logical Reasoning:** This task is designed to measure a participant's general reasoning ability.

6. **Repeated Acquisition:** This task is designed to measure a participant's ability to learn, decode, and acquire a new key press sequence during each session.

All Cognitive Tests Administered by Laptop

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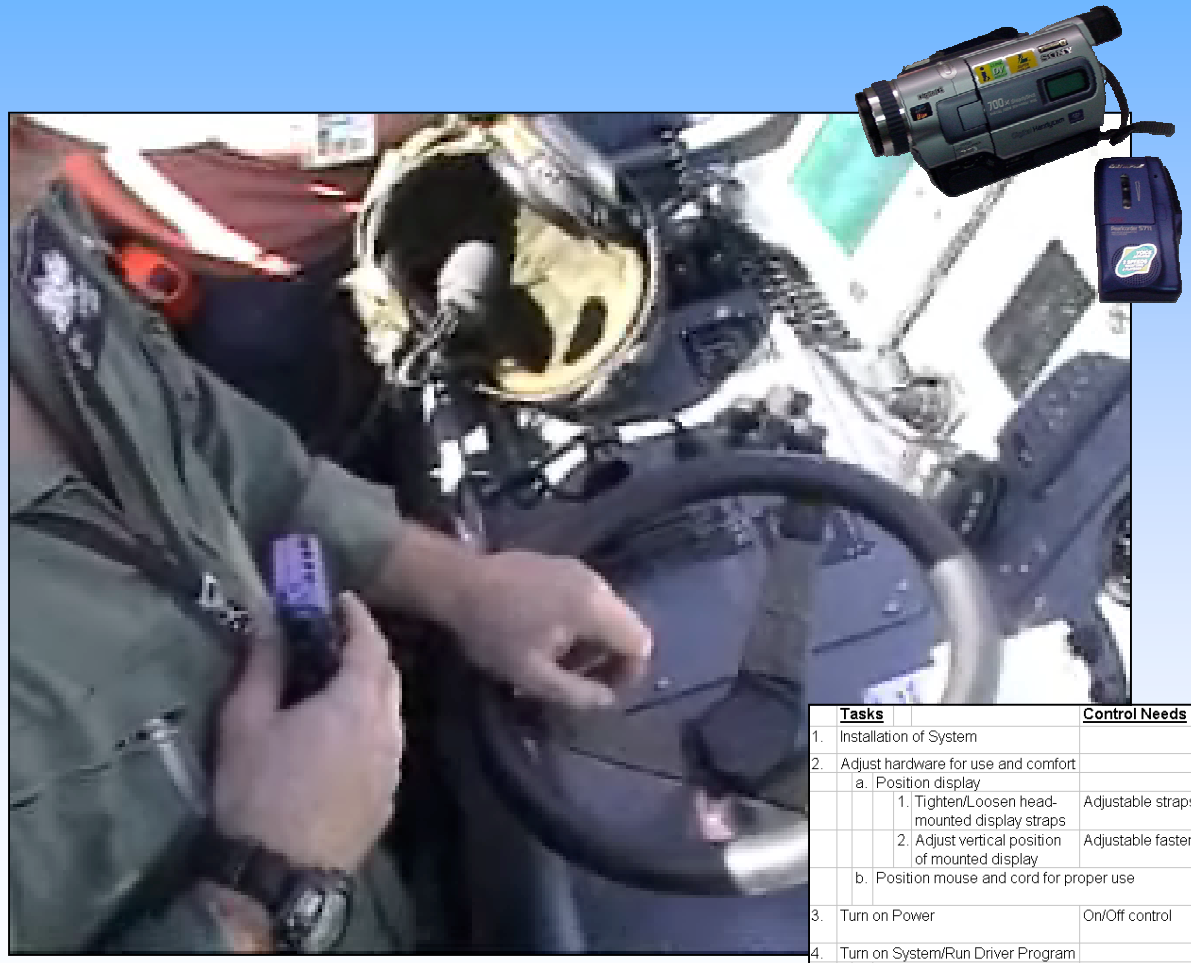
NSW RIB Efforts

Task Analysis



	Tasks	Control Needs	Display Needs
1.	Installation of System		
2.	Adjust hardware for use and comfort		
	a. Position display		
	1. Tighten/Loosen head-mounted display straps	Adjustable straps	
	2. Adjust vertical position of mounted display	Adjustable fastener	
	b. Position mouse and cord for proper use		
3.	Turn on Power	On/Off control	Confirmation of power "On"
4.	Turn on System/Run Driver Program		
	a. Turn on system	On/Off	Indication that computer/display/ controls are on,

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