Use of Mockups to aid design of the USCG SENTINEL Class patrol boat

Assistant Commandant for Human Resources

Office of Human Systems Integration for Acquisitions (CG-1B3)

Agenda

1. Introduction
2. Methodology
3. Results
4. Recommendations
5. Conclusions

1. Introduction

USCGC Fast Response Cutter (FRC) SENTINEL Class Patrol Boat

- Characteristics
  - Number Planned: Up to 58
  - Length: 154ft.
  - Beam: 25ft.
  - Max Sustained Speed: >28kts.
  - Endurance: >5 days
  - Stern Launch: One cutter boat
  - Crew: 3 officers, 20 crew

- Features
  - Enhanced Coast Guard response time with a minimum top speed of 28 knots
  - Conduct all missions through Sea State 4 at speeds up to transit speed for 8 hours on all headings
  - Survive through Sea State 6 at speeds up to loiter speed for 8 hours on all headings
  - Armed with a stabilized 25mm machine gun mount and 4 non-stabilized, crew-served .50 caliber machine guns
  - Fully interoperable C4ISR system with Coast Guard's existing and future assets, and the DoD

1. Introduction

USCGC Fast Response Cutter (FRC) SENTINEL Class Patrol Boat

- Replace the aging 110’ ISLAND Class Patrol Boats
- Help to meet the service’s need for additional patrol boats
- Increased capability in interoperability
- Acquisition began in 2007
- Lead cutter scheduled for delivery spring of 2011
- 8 cutters currently on contract (of the 58 planned)
- Mock-ups of the pilothouse, galley and mess deck were required in the acquisition documentation
- Validate operational suitability and assess how well HFE has been addressed in the design

1. Introduction

Scope of the HFE technical assessment:

- Ensure that the SENTINEL's pilothouse, galley, and mess deck mock-ups meet the requirements set forth by the Circular Of Requirements (COR):
  - *The FRC-B design shall provide operational and maintenance workplaces, equipment, controls, and displays in accordance with ASTM F1166, the ABS Guide for Crew Habitability on Ships, and OPNAVINST 9640.1A (Contract HSCG23-08-C-2FR125, Section 088-1.2).*
- This requirement was assessed in terms of the following:
  - General Design (088-1)
  - Communications (088-2)
  - Accessibility (088-3)
  - Maintainability (088-4)
  - Controls, Displays, and Alarms (088-5)
  - Error-Tolerant Design (088-6)
  - Workstation Design (088-7)
  - Labeling (088-8)

1. Introduction

Objectives of the HFE technical assessment:

- Identify accomplishments
- Identify opportunities for improvement

Goal of the HFE technical assessment:

- Obtain the data necessary to determine whether the proposed design provides the users with the tools and capabilities required to safely and efficiently conduct their tasks, and meet mission requirements.

Agenda

1. Introduction
2. **Methodology**
3. Results
4. Recommendations
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2. Methodology

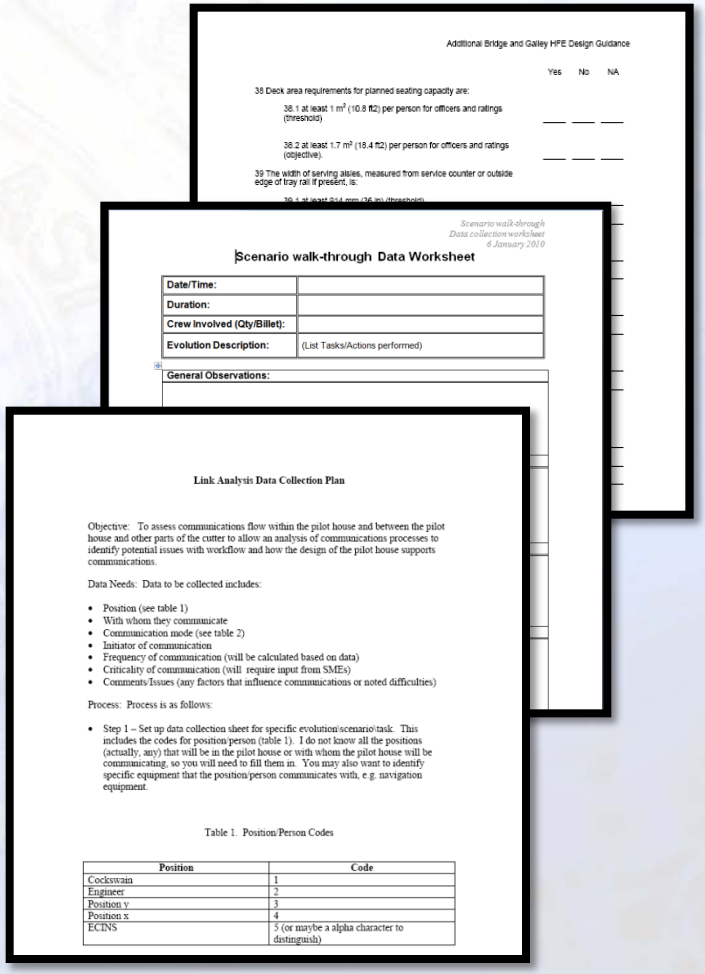
3 Phase Approach:

- Phase 1: Planning
  - Review all FRC acquisition documentation, particularly those with HFE implications
  - Legacy familiarization on 87’ Coastal Patrol Boat (CPB)
  - Scenario development for use by the SMEs during mockup evaluations
  - Develop data collection tools
- Phase 2: Data Collection
  - Heuristic
  - Scenario based
- Phase 3: Analysis
  - Heuristic assessment
  - Usability assessment
  - Link analysis

2. Methodology

Data collection tools

- Heuristic assessment checklist
  - ASTM F1166 (2007),
  - Applicable sections of the ABS Habitability Guidance Notes
  - IACS Recommendation for Application of SOLAS Regulation V/15 (2007), Bridge Design, Equipment Arrangement, and Procedures
- Usability assessment checklist
  - Task descriptions and human performance-related characteristics and parameters to be observed
- Link analysis tool
  - Aspects of the tasks conducted that focus on the types, strengths and other characteristics of relationships between people or people and equipment could be collected



Additional Bridge and Galley HFE Design Guidance

Yes No NA

38 Deck area requirements for planned seating capacity are:

38.1 at least 1 m^2 (10.8 ft^2) per person for officers and ratings (threshold)

38.2 at least 1.7 m^2 (18.4 ft^2) per person for officers and ratings (objective).

39 The width of serving aisles, measured from service counter or outside edge of tray rail if present, is:

Scenario walk-through Data collection worksheet 6 January 2010

Scenario walk-through Data Worksheet

Date/Time:	
Duration:	
Crew Involved (Qty/Billet):	
Evolution Description:	(List Tasks/Actions performed)

General Observations:

Link Analysis Data Collection Plan

Objective: To assess communications flow within the pilot house and between the pilot house and other parts of the cutter to allow an analysis of communications processes to identify potential issues with workflow and how the design of the pilot house supports communications.

Data Needs: Data to be collected includes:

- Position (see table 1)
- With whom they communicate
- Communication mode (see table 2)
- Initiator of communication
- Frequency of communication (will be calculated based on data)
- Criticality of communication (will require input from SMEs)
- Comments/Issues (any factors that influence communications or noted difficulties)

Process: Process is as follows:

- Step 1 – Set up data collection sheet for specific evolution/scenario/task. This includes the codes for position/person (table 1). I do not know all the positions (actually, any) that will be in the pilot house or with whom the pilot house will be communicating, so you will need to fill them in. You may also want to identify specific equipment that the position/person communicates with, e.g. navigation equipment.

Table 1. Position/Person Codes

Position	Code
Cockswain	1
Engineer	2
Position y	3
Position x	4
ECINS	5 (or maybe a alpha character to distinguish)

2. Methodology

Mockup evaluation scenarios

- Pilothouse
  - Search and Rescue (SAR)
  - Counter Narcotics / Go-Fast
  - Alien Migrant Interdiction Operations (AMIO)
  - Living Marine Resources
  - Maritime Domain Awareness
  - General Defense Operations
  - Damage Control for Main Space Fire
- Galley and Mess Deck
  - Loading Stores
  - Preparing Meal for Crew
  - Serving Meal to Crew
  - Clean-up After Meal
  - Training on Mess Deck
  - Crew Injuries Medical Procedures

2. Methodology

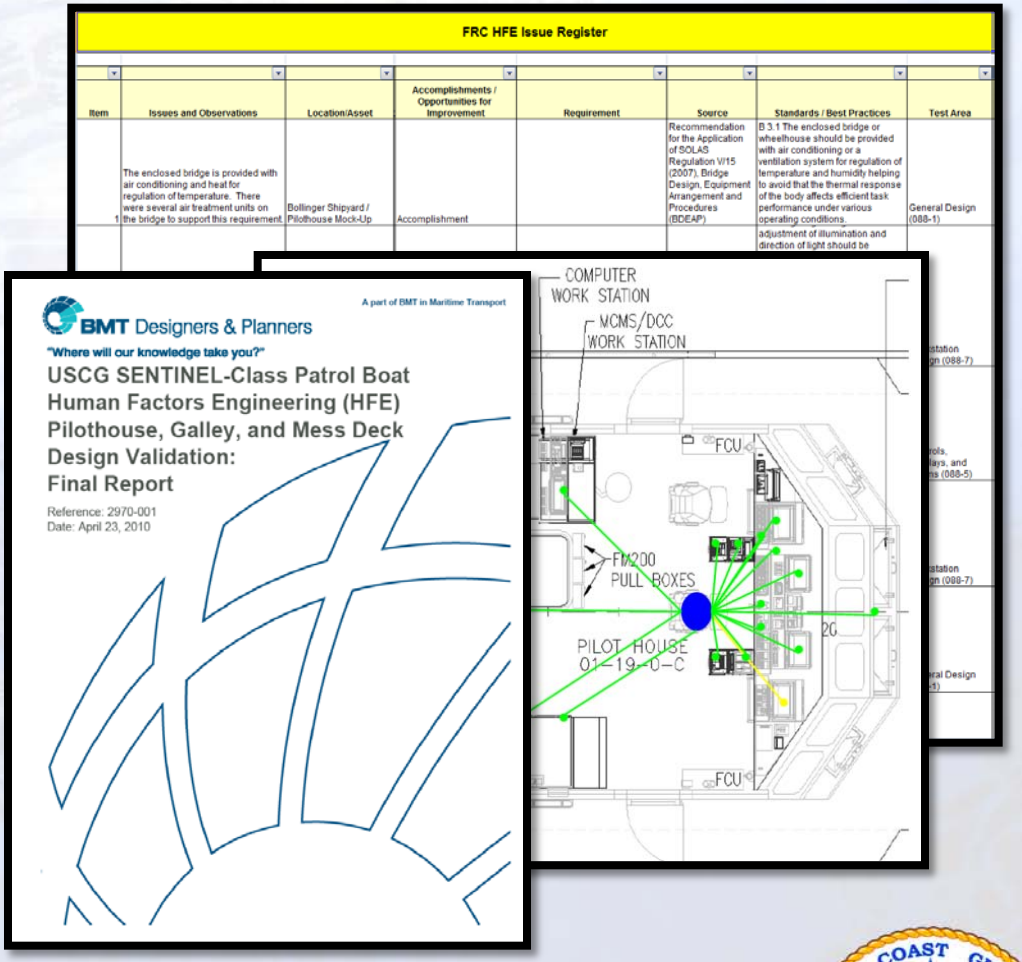
Data Collection

- Pilothouse mockup
  - Crew from 87’ CPB
- Galley and mess deck mockup
  - Experienced Food Service (FS) SMEs

2. Methodology

Analysis and Reporting

- Compile accomplishments as well as opportunities for improvement into a matrix
- Include observations, trace to requirements, standards, test area
- Analyze link analysis data



Agenda

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3. Results

Opportunities for Improvement by COR HFE Section

COR HFE Section Number	COR HFE Section Name	Items Noted in Pilothouse	Items Noted in Galley / Mess	Total Items Noted
088-1	General Design	3	17	20
088-2	Communications	4	0	4
088-3	Accessibility	10	10	20
088-4	Maintainability	1	4	5
088-5	Controls, Displays, and Alarms	2	0	2
088-6	Error-Tolerant Design	1	1	2
088-7	Workstation Design	21	15	36
088-8	Labeling	2	0	2
Total Items Noted By Location		**44**	**47**	**91**

Agenda

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3. Results
4. **Recommendations**
5. Conclusions

4. Recommendations

Example pilothouse recommendations

Issue	Recommendation
There are not adequate hand grabs at the bridge forward console.	Install additional overhead hand grab rail at the forward main console, just aft of the console, and forward of the chairs.
The only SIPERnet Chat ability available on the bridge is at the CO console. Chat option is needed at Chart Table (or another secondary location) for the Navigator/QMOW	Provide SIPERnet Chat capability at the chart table or another secondary location for the NAV or QMOW to utilize. This is significantly improve information flow and operational tempo in emergency conditions and critical evolutions.

4. Recommendations

Example galley and mess deck recommendation

Issue	Recommendation
Currently the only means for filling mop buckets to clean the galley and mess spaces is down the stairs on the lower level.	Install faucet in cleaning locker that is mounted at 24” from the deck for ease of filling cleaning buckets and increased safety.
There currently is no means for allowing access to the galley during off hours and maintaining security of the dry stores.	If dry stores are required to be secured, install accordion style door aft of the freezer to the port bulkhead that secures on the starboard bulkhead.

Agenda

1. Introduction
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5. Conclusions

- Many recommendations already implemented
- Working with Sponsor and Program to implement more
- Mockup assessments featured in Acquisition Directorate publication
- “The mock-up review identified some necessary changes that were incorporated into the bridge design.”

Delivering the Goods
News from the U.S. Coast Guard Acquisition Directorate
July 2010

U.S. Coast Guard Embraces Human Factors Engineering

By Linda M. Johnson

WASHINGTON – The U.S. Coast Guard recognizes the importance of human factors engineering when it comes to designing, building and acquiring new assets and systems.

"The Coast Guard is a very technologically focused organization for an obvious reason—we rely on things that float and go to sea," said Christian Kijora, human factors engineering team lead in the Coast Guard's Human Systems Integration for Acquisitions Division. "But it's the people who get the job done. We ensure that the technology we provide to our people does the best job for them so they can do the best overall job for the citizens of the United States."

Human factors engineering is the discipline of applying what is known about human capabilities and limitations to the design of products, systems and work environments. Its goal is to improve system performance, reliability and ease of use while reducing ownership costs, training requirements, operational errors and user fatigue.

"Human factors is a branch of engineering psychology that deals with human performance and systems," Kijora explained. "It's about making use of the technical elements of human performance when you design, build or acquire a system. The reason why we do that is because human performance is the most limiting factor in systems integration today."

The process involves creating a design based on people's capabilities. "Our mantra is to design the system for the user, not try to design the user for the system," he said. "It's a lot easier and cheaper, and it helps keep the program on track as far as cost, schedule and performance. On the other side of it, the users get a system that is designed for them so they get greater user satisfaction. It also improves retention and overall performance of the unit."

"What we do has a significant impact on the total ownership cost to the organization and operational capabilities," Kijora said. "We help balance and make those trade-off decisions with the program manager to make sure that person is buying the right thing to support program goals."

Human factors engineering is part of a larger effort known as human systems integration, which is a management and technical approach applied to seven distinct disciplines: manpower, personnel, training, human factors engineering, system safety, personnel survivability and habitability. Human factors engineering is particularly concerned with the last four disciplines.

continued on page 2

Dawn Gray with the Coast Guard's human factors engineering team reviews the bridge mock-up for the first Sentinel-class Fast Response Cutter. The mock-up review identified some necessary changes that were incorporated into the bridge design. *U.S. Coast Guard photo by Chris Kijora*

inside:

Mission execution begins *here*. www.uscg.mil/acquisition

Questions / Discussion

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