



# A Task-Based Design Guide for Command and Control

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# HSI Requirements

**DoDD 5000.01**  
**May 12, 2003**

E1.1.29. Total Systems Approach. ...The PM shall apply human systems integration **to optimize total system performance (hardware, software, and human)**, operational effectiveness, and suitability, survivability, safety, and affordability. ...

**DoDI 5000.02**  
**December 2, 2008**

This Instruction **applies to:**

... b. **All** defense technology **projects** and acquisition **programs**, including acquisitions of services. ...

## ENCLOSURE 8 HUMAN SYSTEMS INTEGRATION (HSI)

...The PM shall have a plan for HSI in place early in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure that the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the system.

... HSI planning shall be summarized in the Acquisition Strategy and SEP and shall address the following: ...Human Factors Engineering,...Personnel,... Manpower, ... Training, ... Safety, and Occupational Health...

# HSI Requirements

**SECNAVINST 5000.2D**  
**October 16, 2008**



**OPNAVINST 5310.23**  
**November 10, 2009**

The **provisions of this instruction apply to all** DON organizations, to all Acquisition Category (ACAT) **acquisition programs, ...nonacquisition programs, and Rapid Deployment Capability programs.** ...CNO (N12) serves as Human Systems Integration (HSI)...advocate, and is the Navy HSI requirements authority. ...CNO (N12) serves as the single governance authority for HSI policy, requirements and resources... Chapter 7 Systems Engineering and Human Systems Integration ...The Program Manager (PM) ... shall **employ systems engineering** as a mechanism to achieve the program objectives of optimal **total system performance** ( hardware, software, **human**, firmware, ... **Systems engineering ... includes** the hardware, software and **human operators, maintainers, support personnel, and the operating environment.** ... PMs shall use a **systems engineering process** to translate operational requirements/capability needs into a system solution that **includes ...Human Systems Integration (HSI)**... The **PM shall apply HSI as part of a systems engineering approach.** ... **PMs** and sponsors **shall address HSI throughout all phases of the acquisition process** to optimize total system performance, minimize total ownership costs, and ensure that the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the system. ...When modifying a system (e.g., modernization or block upgrade), HSI issues and domains must be considered to ensure that configuration changes do not create new or unforeseen HSI issues.

...Responsibilities...Deputy CNO (Information Dominance) (CNO (N2/N6) ), ... shall:... **Ensure HSI requirements are adequately resourced....**

SYSCOMs will: ...Support PMs and CNO (N1) in the documentation of HSI technical requirements to ensure adequate resource sponsorship and technical authority assessment.

**So how do we get there and optimize total system performance?**

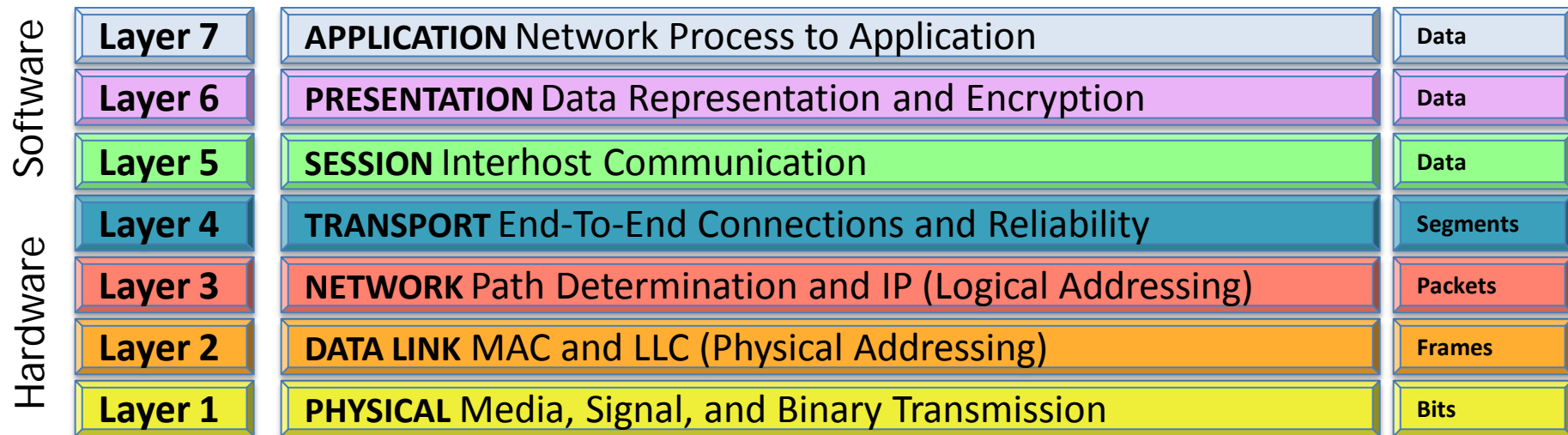
# Our Broad HSI Knowledge

Seven Pillars of Human Systems Integration +						
Human Factors Engineering	Manpower	Personnel	Training	Habitability	Survivability	Environment, Safety and Occupational Health
Human Performance	Workload	Personnel Classification	<del>KSA</del> <b>KIASAM</b>	Quality of Life	Anti-Fratricide Identification / Confirmation	Accident Avoidance
Cognitive, Physical, Sensory Abilities	Wartime Requirements (Quality/Quantity)	Recruiting	Initial Skill Skill Progression <b>Apprentice-Master</b>	Quality of Work	Personnel Protection	Safety Hazard Avoidance
Human Interfaces	Officer, Enlisted and Civilian	Retention	Functional Individual and Team	Environmental Limits and Controls	Damage Control	Health Hazard Avoidance
HCI GUI	Force Structure	Career Progression	Training Concepts	Personnel Services	Performance Effects of Ensembles	Risk Mitigation
Human Error Avoidance	Operating Strength	Skill Mix	Initial & Follow-on <b>Sustainment</b>		<b>Hardware/Software Configuration</b>	Medical
Top Down Analysis	<b>PBD</b>	Special Skills	Delivery Systems Realism/ Applicability		<b>Battlespace Omniscience</b>	
Design for Usability/ <b>Utility</b>		Occupational Standards	Organic Training Distance Learning <b>CBT ICW</b>			
Design for Maintainability		Distribution	Virtual Environment Intelligent Tutoring			
<b>Team Dynamics HSD</b>		Manning Concepts <b>Personality Classification &amp; Management, Personnel Management</b>	Knowledge (formal cognitive), <b>Intelligence (informal cognitive)</b> , Abilities (informal psychomotor), Skills (formal psychomotor), <b>Attitudes (formal affective), and Motivation (informal affective)</b>			

**Our Expertise**

# What is the Open Systems Interconnection (OSI) Model?

These OSI layers comprise the Software and Hardware configurations



Adapted from: Berkley (2003) SSC-Pacific. Human Systems Integration in Support of the Open Systems Interconnection (OSI) Reference 7-Layer Model. Bauer & Patrick (2004). A Human Factors Extension to the Seven-Layer OSI Reference Model. Retrieved 11/1/10 from <http://www.andrewpatrick.ca/OSI/10layer.html>.

# How does HFE relate to the OSI Model?

User	Layer 10	<b>NEEDS</b> Optimized Solutions for Technical Capability	<b>BooYah!</b>
	Layer 9	<b>HUMAN PERFORMANCE</b> Optimized Solutions for Technical Capability	<b>High Pk</b>
	Layer 8	<b>DESIGN</b> Human-Machine Interface (HMI) Through I/O Devices	<b>Ao</b>
Software	Layer 7	<b>APPLICATION</b> Network Process to Application	Data
	Layer 6	<b>PRESENTATION</b> Data Representation and Encryption	Data
	Layer 5	<b>SESSION</b> Interhost Communication	Data
Hardware	Layer 4	<b>TRANSPORT</b> End-To-End Connections and Reliability	Segments
	Layer 3	<b>NETWORK</b> Path Determination and IP (Logical Addressing)	Packets
	Layer 2	<b>DATA LINK</b> MAC and LLC (Physical Addressing)	Frames
	Layer 1	<b>PHYSICAL</b> Media, Signal, and Binary Transmission	Bits

Adapted from: Berkley (2003) SSC-Pacific. Human Systems Integration in Support of the Open Systems Interconnection (OSI) Reference 7-Layer Model. Bauer & Patrick (2004). A Human Factors Extension to the Seven-Layer OSI Reference Model. Retrieved 11/1/10 from <http://www.andrewpatrick.ca/OSI/10layer.html>.

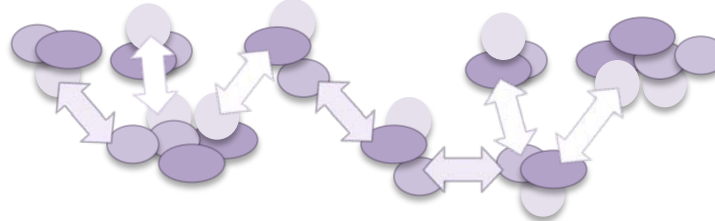
# Function-Based Knowledge Funnel

Disparate data sources, computational resources, and products into and out of the AOR

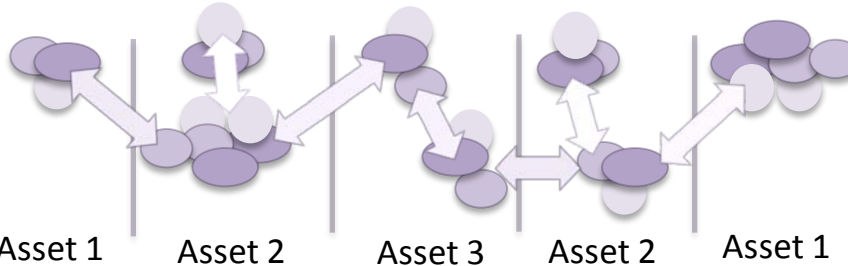


## Models & Heuristics;

Watchteam perceptions, inputs, taskings, ideas, concepts, and tacit knowledge



## Systems & Procedures



Data Centered Model  
drives the workflow  
and forces Users to  
make sense of the  
information and  
process to action.

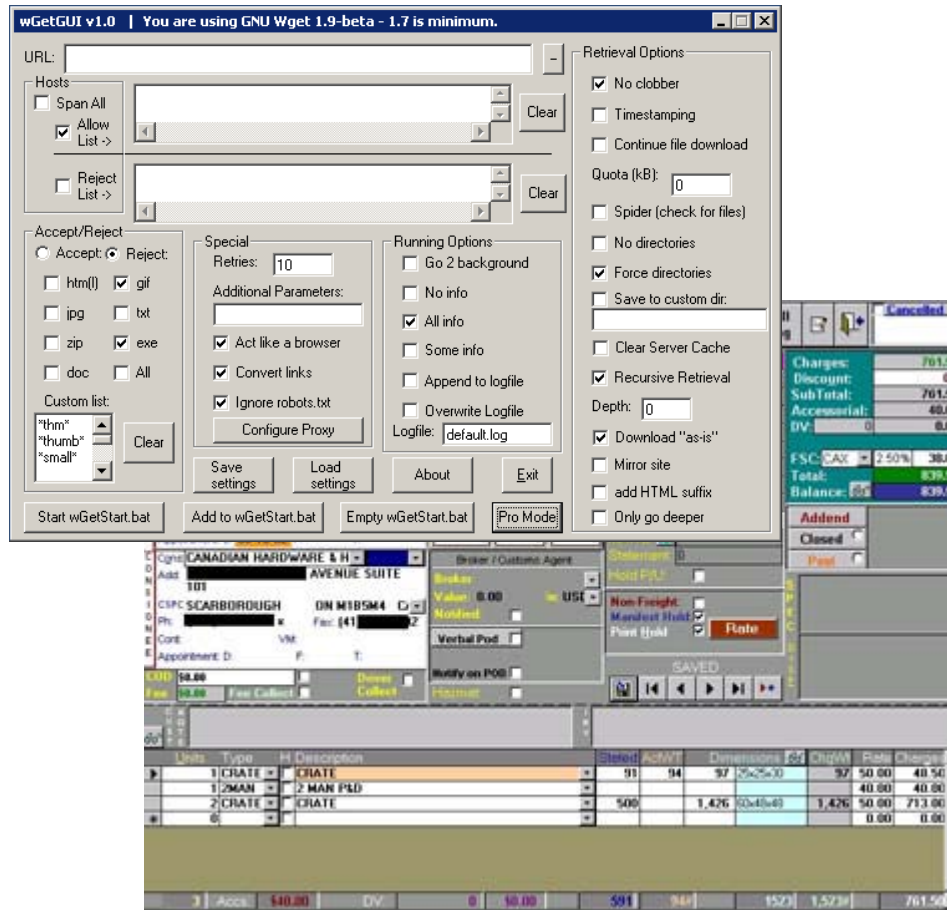


Strategic

Operational

Tactical

# Bad Design



Rejected.  
Not Compliant  
with MIL-STD  
1472F, DoD  
HCI Style  
Guide Vol 8.  
Contractor  
ignored  
repeated USG  
requests for  
oversight and  
inclusion in  
development  
effort.

Icon	Meaning
	Status – Available Health - Operational
	Status – Unavailable Health - Operational
	Status – In Use Health - Operational
	Status – Unknown Health - Operational
	Status – Available Health - Degraded
	Status – Unavailable Health - Degraded
	Status – In Use Health - Degraded
	Status – Unknown Health - Degraded
	Status – Available Health - Overheated
	Status – Unavailable Health - Overheated
	Status – In Use Health - Overheated
	Status – Unknown Health - Overheated
	Status – Available Health - Failed
	Status – Unavailable Health - Failed
	Status – In Use Health - Failed
	Status – Unknown Health - Failed
	Status – Available Health - Unknown
	Status – Unavailable Health - Unknown
	Status – In Use Health - Unknown
	Status – Unknown Health - Unknown



System Circuit Status Logs SS/SP View

Standard Conventions? SS/SP? Legacy carry over from old system?

Lat Long Act Time

000000:00 Z 000 0000

CRS: SPD: DPTH: MAX

**CIRCUITS**

ID	Name
MF/HF_JTR	
MF/HF_JTR_VOICE	
UHF_JTR	
UHF_JTR_VOICE	
VHF_JTR	
VHF_JTR_VOICE	
VLF/SLVR	
VLF/SLVR_AUDIO	

Display

Exit

**Define Label**

SYSTEM CONFIGURATION

Log/Alert Admin Alert Volume Common Logs Common Notes

System Data ECS Display SS/SP

Enter minimum time in minutes after current time a circuit remains on the schedule: 60 min

Enter number of hours prior to activation a circuit can be set to AutoActivate: 5 hrs.

Text Size

What is hidden beyond the scroll bar?

Not Compliant with MIL-STD 1472F. Contrast for visual acuity. What about deuteranopia and other forms of color blindness? 1 in 12 men are affected, women less so (ergo, user populace).

Accept Cancel

Standard Conventions?

Does not follow standard format

**TEMPLATES**

Name
MF/HF_JTR
MF/HF_JTR_VOICE
UHF_JTR
UHF_JTR_VOICE
VHF_JTR
VHF_JTR_VOICE
VLF/SLVR
VLF/SLVR_AUDIO

Exit

**ALERTS**

Filter Sort Volume

PRINTER Status: Degraded	0012
PRINTER Status: Faulted	0012
JTR Status: Unknown	
JTR Status: Faulted	0002
Printer terminate Requested	0001
JTR #1 Status: Faulted	
JTR Status: Degraded	
JTR #2 Status: Degraded	
JTR #2 Status: Faulted	
JTR #1 Status: Degraded	

Color continuity; Green "N" for degraded condition?

Differentiation required for failure!

Coincident coloring. Color coding redundant to label or shape

ACK DEL MIN A 00 ! 00 N 10

**ACCESS CONTROL LIST**

Function	Access Level
ACCESS CONTROL	Administrator
ACKNOWLEDGE ALERT	Operator
ACTIVATE CIRCUIT	Operator
ADJUST CIRCUIT	Operator
BACKUP	Administrator
CHANGE PASSWORD	Operator
CIRCUIT EDITOR	Operator
COLDSTART	Operator
COPY COMM PLAN	Operator
DB IMPORT	Installer
DB EXPORT	Installer
DELETE ALERT	Operator
DELETE CIRCUIT	Operator

Accept Cancel

Color continuity; green "N" for degraded condition?

Does not follow standard time format. Conversion or labeling required by User.

Poor use of space

Audibles Status: ENABLED 08:51:34

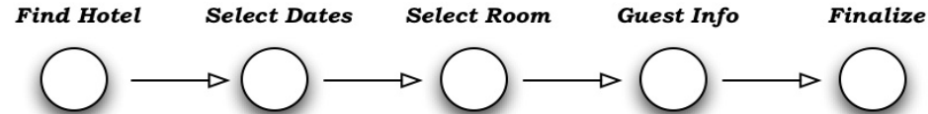
# Task-Based Versus Function-Based Design

## Worse than Bad Design

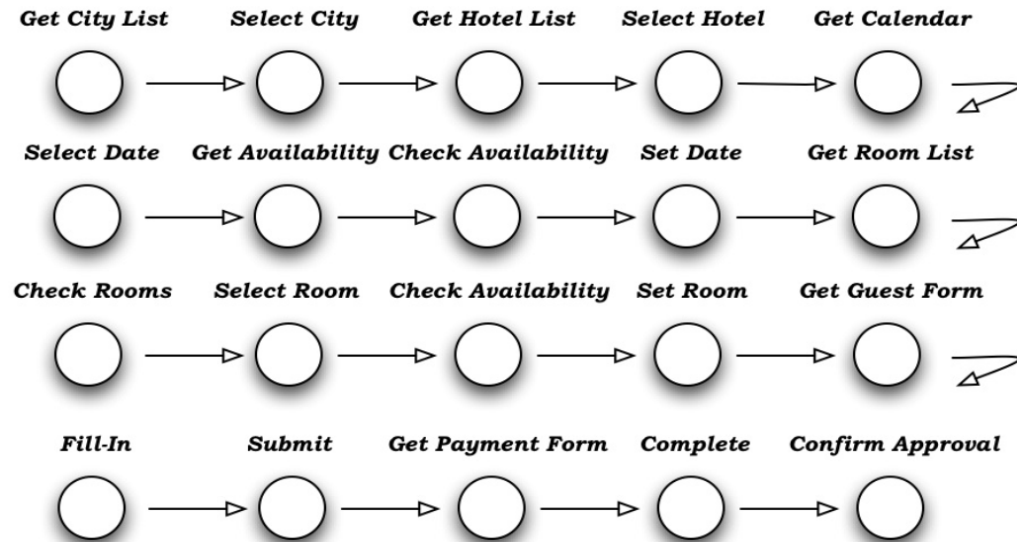
Trade-offs exist between  
Function-based and Task-  
based design.

Task-based design will be less  
effective for complex tasks that  
are poorly defined or too  
general.

Book a Hotel Room Task - Task-Based UI



Book a Hotel Room Task - Function-Based UI



# Function-Based Design

**BEFORE:** Multiple windows with data not integrated or organized by user tasks.

The screenshot displays a complex, multi-windowed software interface from a previous era of military planning systems. The main window features a 'Job Bar' at the top with 'Window' and 'Help' menus. Below this is a status bar showing 'UNCLASSIFIED' and an 'Enable UNCLASS' button. A series of task-based buttons (Parameters, 5 Tasking, 6 Planning, Launch, Preselection, Post-Launch, PML Mgt, Prompts) are arranged horizontally. To the right, a 'Filters' section includes checkboxes for 'Prompt', 'Tasking', 'Launch', 'Planning', and 'Post-Launch'. A 'Prompts' window is open, showing a list of prompts with columns for 'Prompt' and 'Time Remaining'. One prompt is visible: 'Tasking: Exception report ready for SP: 001000001'. Below the prompts list are 'Acknowledge' and 'Close' buttons. Another window, 'Prospective Plans', displays a table of mission data. At the bottom, a 'Select...' button is visible, along with a row of action buttons: 'Mark Plan UnSupportable', 'Send Exception/Acknowledge Message(s)...', 'Show Allowable Launch Areas', 'Create Mission/ Engagement', 'Call For Fire ...', and 'Close'.

**Job Bar**  
Window Help

UNCLASSIFIED Enable UNCLASS

Parameters 5 Tasking 6 Planning Launch Preselection Post-Launch PML Mgt Prompts

Prompt ☒ Tasking ☒ Launch  
Filters: ☒ Planning ☒ Post-Launch

**Prompts**

Action Prompts Notification Prompts

Prompt	Time Remaining
Tasking: Exception report ready for SP: 001000001	

Acknowledge Close

Strike Preview... Edit Strike Package... Create Strike Package... Print Report Delete Strike Package

**Prospective Plans**

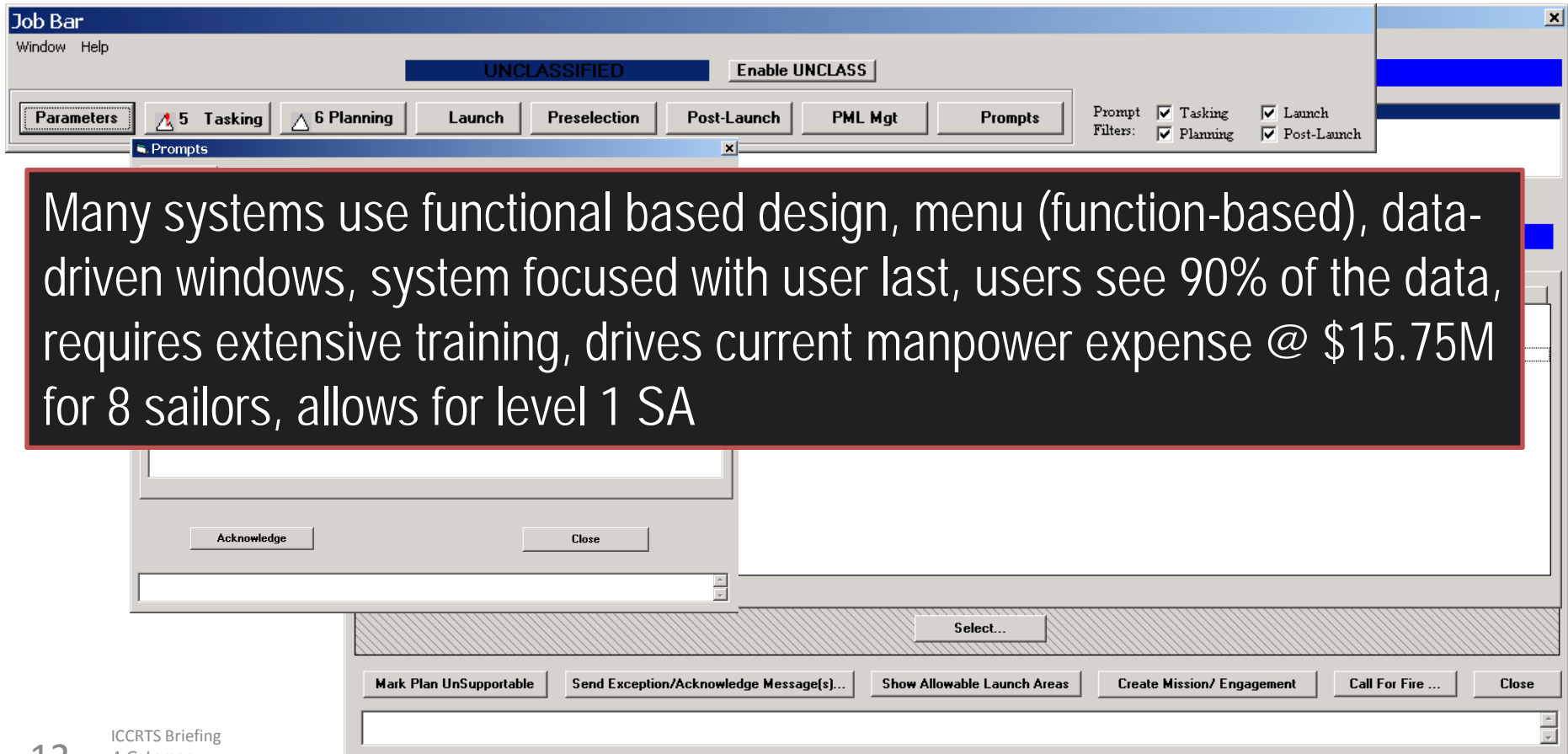
Type	Mission ID	BrID	Time /Type	RS Delta...	Missile T...	Cell/Tube
planned	048-001-01000		121240:00Z TGT		LAC-C	
planned	048-011-01000		121240:00Z TGT		LAC-C	
planned	048-021-01001		121241:00Z TGT		LAC-C	
planned	048-031-01001		121241:00Z TGT		LAC-E	
planned	048-041-01002		121242:00Z TGT		LAC-E	
planned	048-051-01002		121242:00Z TGT		LAC-E	
			121255:00Z TGT		LAC-E	
			121256:00Z TGT		LAC-E	

Select...

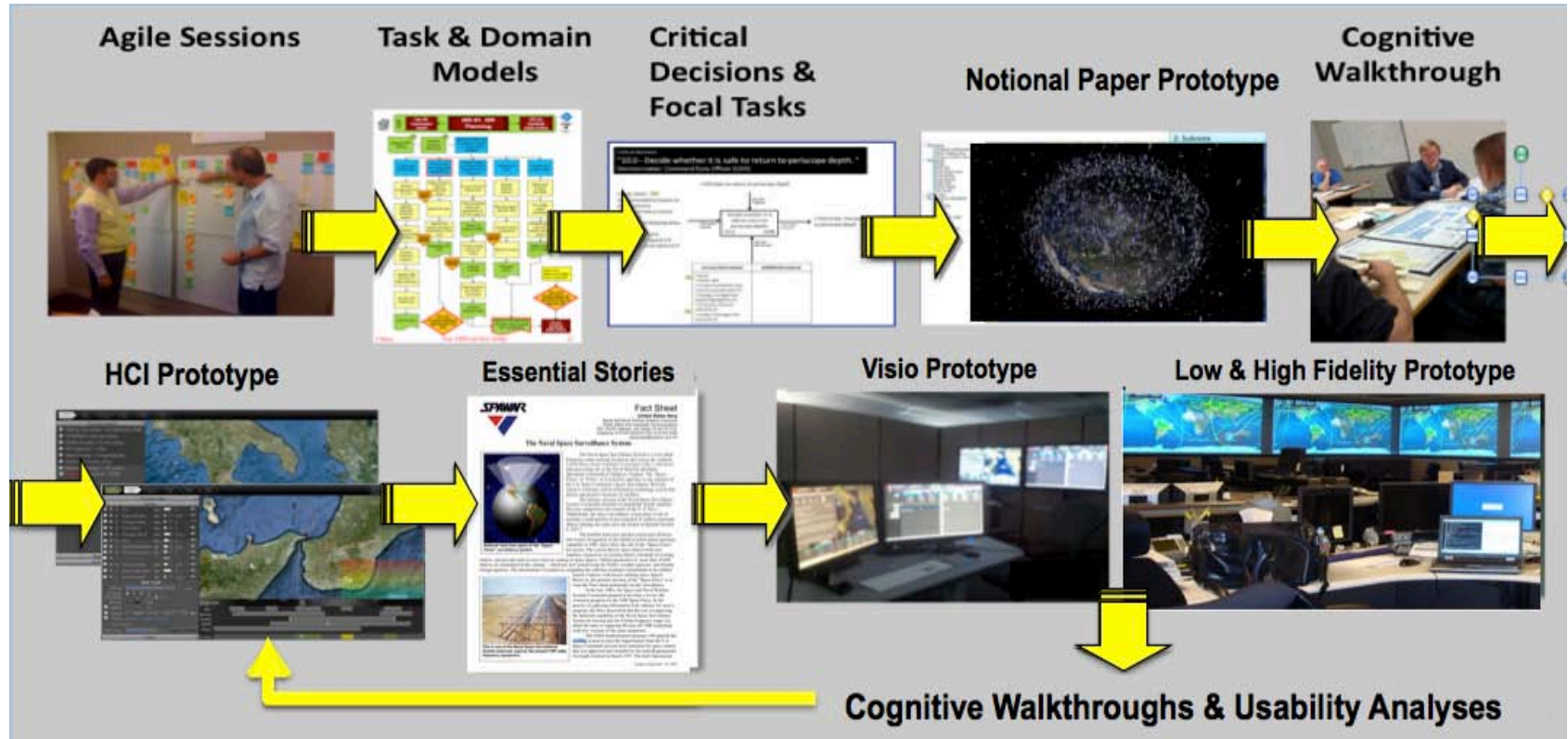
Mark Plan UnSupportable Send Exception/Acknowledge Message(s)... Show Allowable Launch Areas Create Mission/ Engagement Call For Fire ... Close

# Function-Based Design

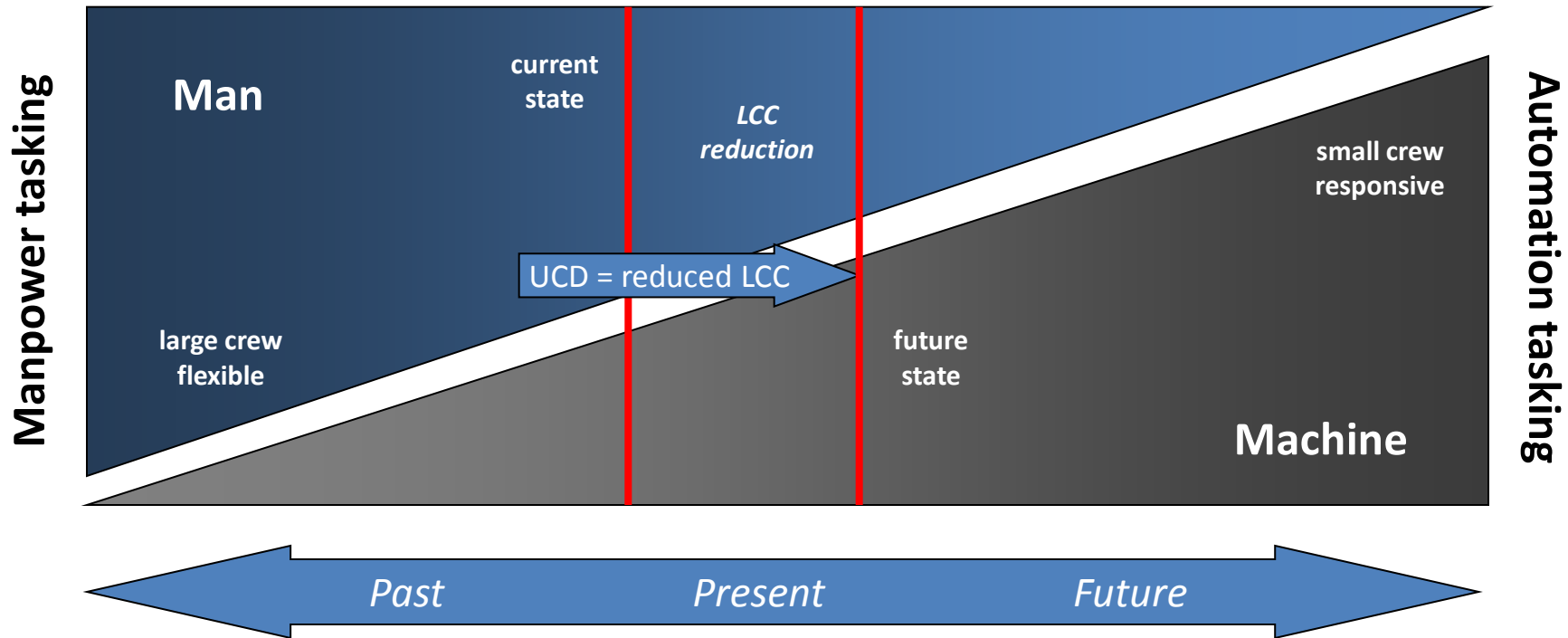
**BEFORE:** Multiple windows with data not integrated or organized by user tasks.



# UCD Agile Design Process



# Results of UCD Agile Design Process



**UCD is an HFE best practice focused on obtaining knowledge from the users to increase efficiency, performance, and improve long-term cost savings.**

Caution: Not all automation decreases workload. Potential to increase workload and error, decrease situational awareness.

# Why HFE provides best ROI

*Better funding of Human Factors Engineering can reduce costs over the lifecycle*

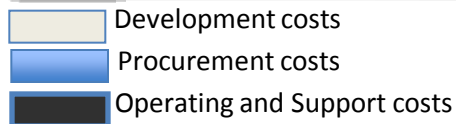
Comparison between air defense today (Aegis) requiring 8 watch standers and that of an air defense optimized crew of 4

\*Does not include additional ILS & ILE savings

\$15.75M

\$7.87M

\* \$1750K/billet/ship  
(over 35-year ship life)



*Providing warfighters greater situational awareness and tactical capability & Combatant Commanders more capability at less cost*

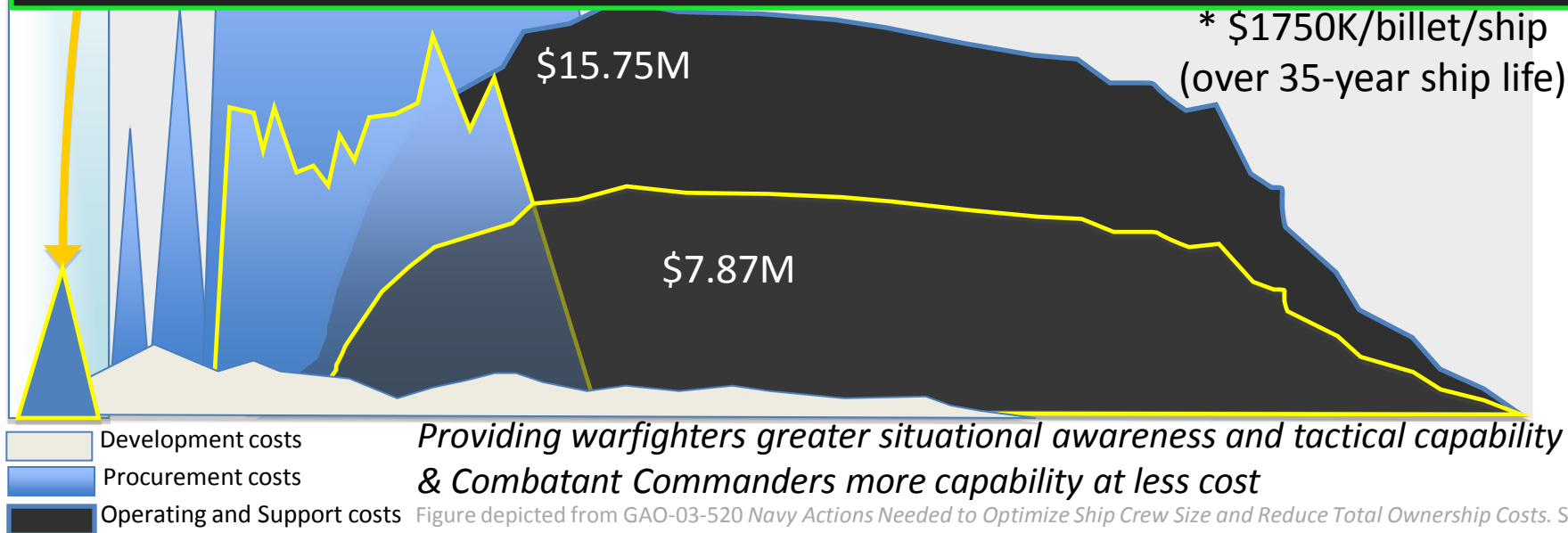
Figure depicted from GAO-03-520 Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs. Source of data: U.S. Navy affordability values from MMWS crew optimization thrust conducted for ONR 34



# Why HFE provides best ROI

*Better funding of Human Factors Engineering can reduce costs over the lifecycle*

Implementing Human Factors Engineering early in the design process optimizes the system design for the most expensive portion of a system...the Human. *Soldiers, Sailors, Marines & Airmen cost \$!*



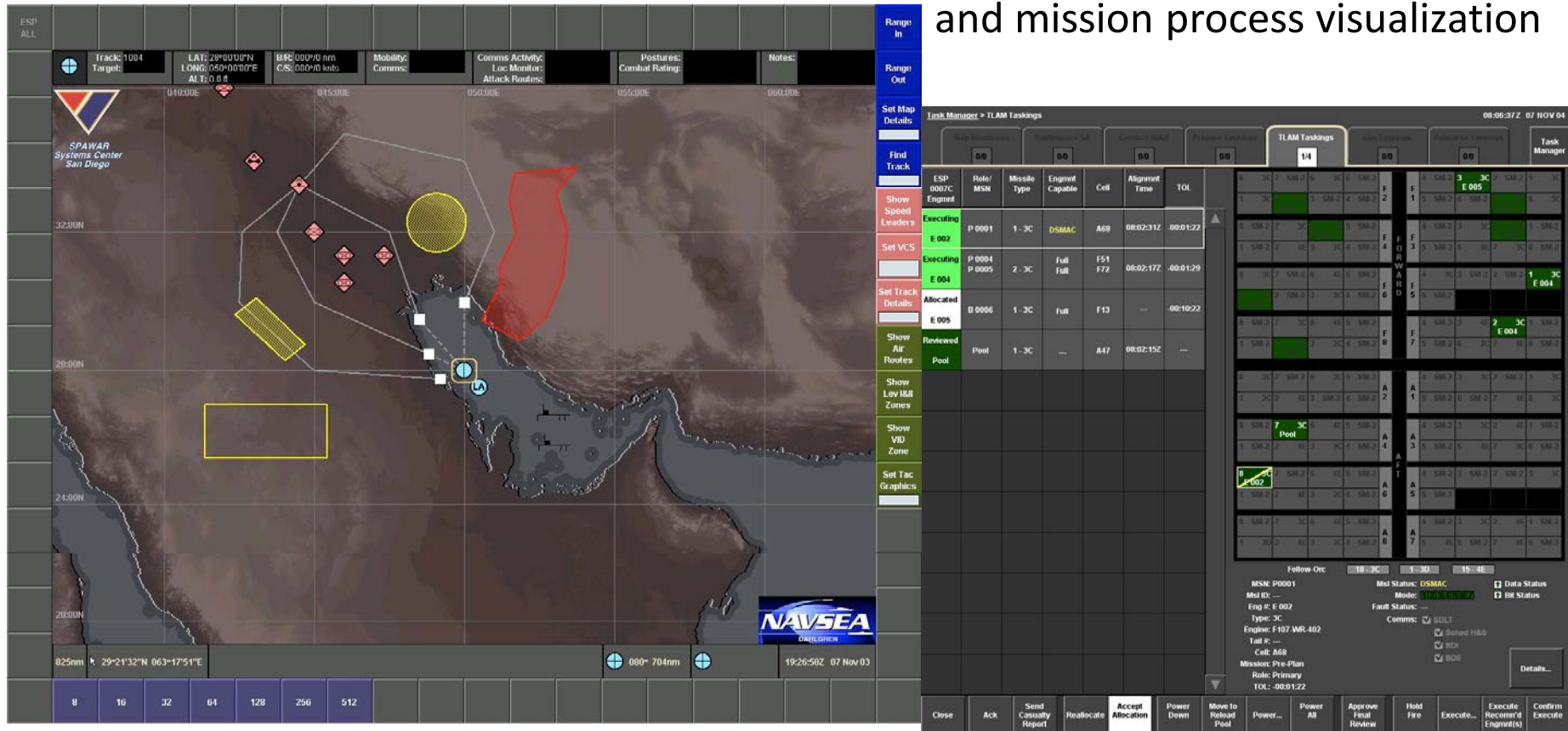
*Providing warfighters greater situational awareness and tactical capability & Combatant Commanders more capability at less cost*

Figure depicted from GAO-03-520 Navy Actions Needed to Optimize Ship Crew Size and Reduce Total Ownership Costs. Source of data: U.S. Navy affordability values from MMWS crew optimization thrust conducted for ONR 34



# Task-Based Design

**AFTER: Improved** user navigation through tasks and attention management and mission process visualization



# Task-Based Design

**AFTER: Improved** user navigation through tasks and attention management and mission process visualization

The screenshot displays the SPAWAR Task-Based Design interface. At the top, there's a header with 'Range In' and 'Range Out' buttons. Below this is a 'Task Manager' section with tabs for 'Task Manager', 'Task Manager', 'Task Manager', 'Task Manager', and 'Task Manager'. The main area features a map of the Pacific Ocean with a red triangle indicating a target location. To the right of the map is a 'Task Manager' panel with a table of tasks. The table has columns for 'Task ID', 'Task Name', 'Task Status', and 'Task Details'. The first row shows 'Task ID: 1001', 'Task Name: 1001', 'Task Status: 1001', and 'Task Details: 1001'. Below the map is a 'NAVSEA' logo and a 'PAUL GREEN' name. At the bottom, there's a 'Task Manager' panel with a table of tasks. The table has columns for 'Task ID', 'Task Name', 'Task Status', and 'Task Details'. The first row shows 'Task ID: 1001', 'Task Name: 1001', 'Task Status: 1001', and 'Task Details: 1001'. The interface also includes a 'Range In' and 'Range Out' button, a 'Set Map Details' button, and a 'Task Manager' button.

The Delta with a UCD approach: "User-Centered Design" is task-based providing decision-support, design with "Voice of Customer," user focused to optimize human performance, provides 10% of data as required, requires only familiarization, proven 50% manpower reduction; reduced to 4 sailors @ \$7.87M, while achieving level 2 SA or better

# Task-Based Knowledge Funnel

Users don't have to think. All of the information needed for the task at hand is there when needed.

Disparate data sources, computational resources, and products into and out of AOR

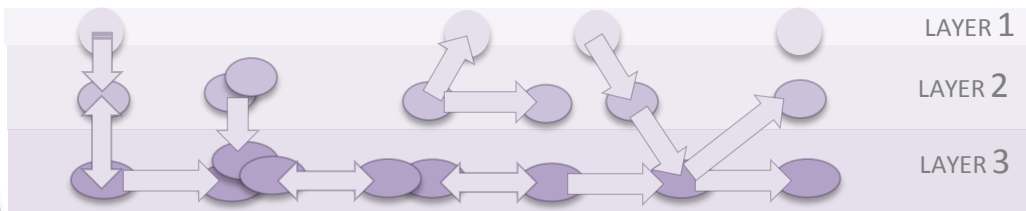
Proposed  
UCD support  
to provide  
Users leveled  
and layered  
information  
designed from  
tasking

Strategic

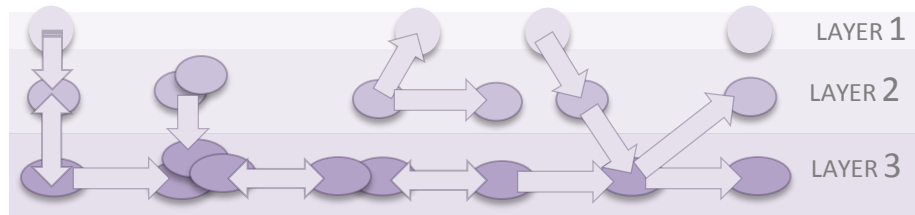
Operational

Tactical

Models & Heuristics based on levels and layers required by watch team



Systems & Procedures captured in the user Interface



Asset 1

Asset 2

Asset 3

Asset 2

Asset 1

User Centered Model  
drives the workflow to  
support the users at the  
appropriate level of  
action.



LAYER 1. Quick-Look always available or one-key popup. *Team and individual.*

LAYER 2. Information summaries and assessments. *User configurable, team and individual.*

LAYER 3. Detailed toolsets and analysis work domains. *User selectable, individual.*

# Task-Based Design

## Multi-Modal Watch Station (MMWS) Five Operator Pod



Multiple windows reduced to four (Task > Function)

Increases SA, design ensures Tactical Primacy

Significant ILS reduction for manned systems

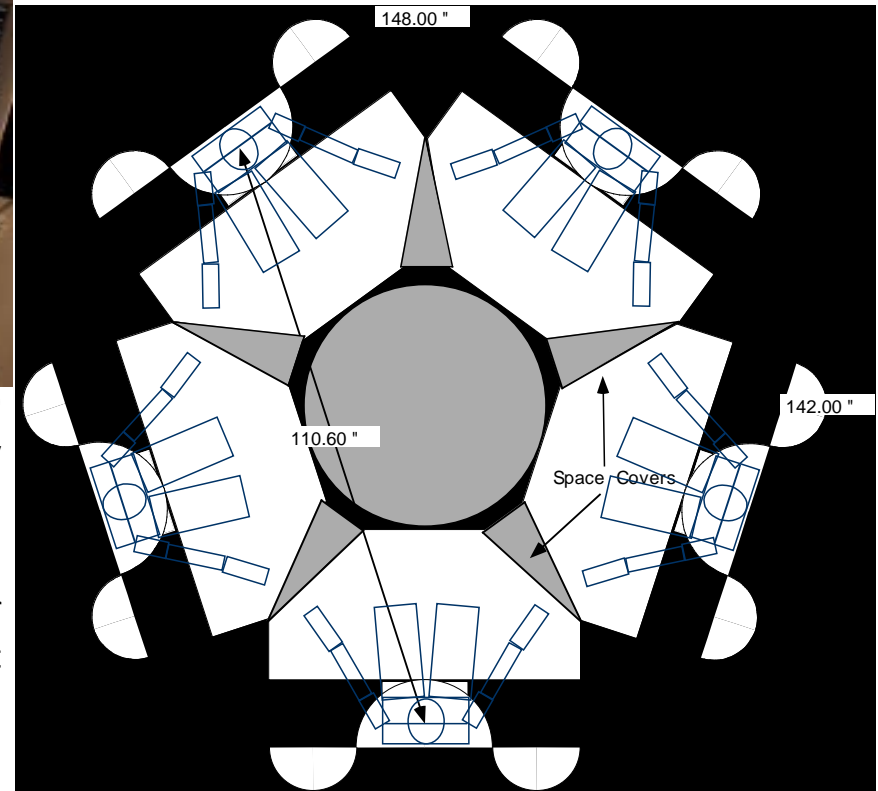
Manning reduced 8 Sailors 4 Civilians

Training reduced 2 weeks to 1 hour

Significant reduction in LCC

Repeatable proven results

Expert displays



# Task-Based Design

*User 2: “it’s because of the flow...everything, it flows...it’s got a real nice progression of flow through the whole thing...”*



*“... You took a 2 week Wallops Island course and put it into 30 minutes! ...and it probably in fact, sitting at the console, it could’ve been 15 minutes.”*



# HSI = HFE = UCD = Task-Based Design

Paired with *Lean Six Sigma* in a product development environment User-Centered Design (UCD) actualizes the full six sigma, *Power of performance* becomes attainable.

User-Centered Design = Human Factors Engineering which optimizes manpower and achieves more capability at less cost to accomplish the “correct” watch floor structure and workload balance.

Significant reduction in initial and sustainment training.

Significant ILS reduction for manned systems.

Design ensures tactical primacy.

Significant reduction in LCC.

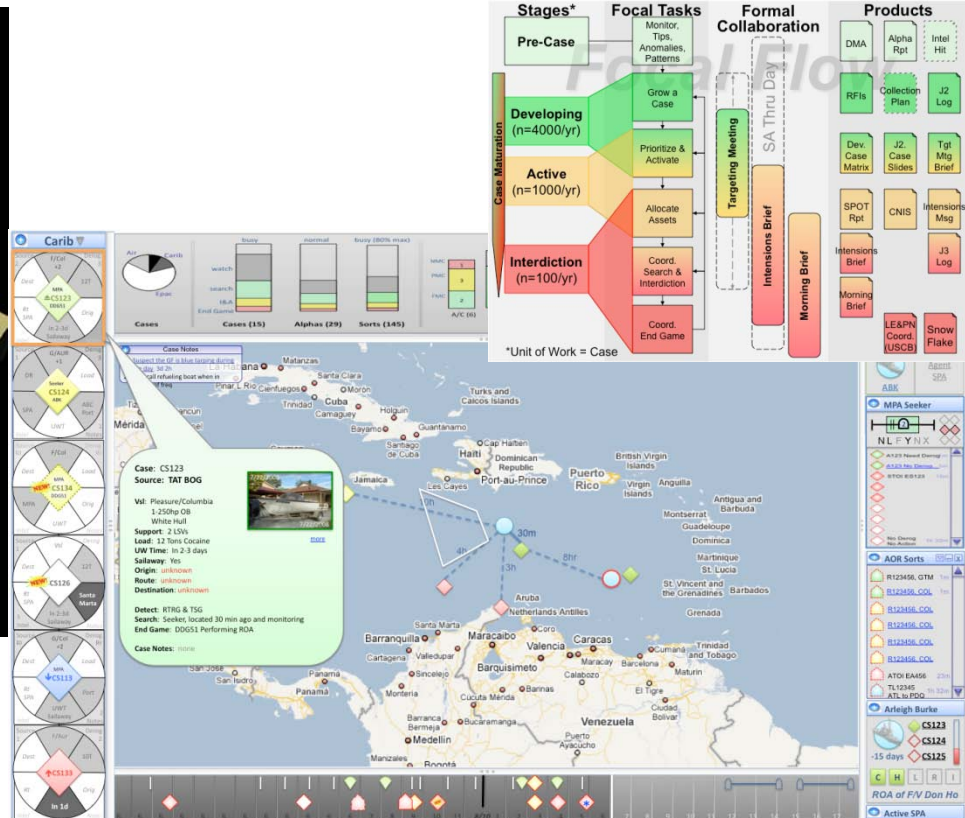
Repeatable proven results.

Increased SA.

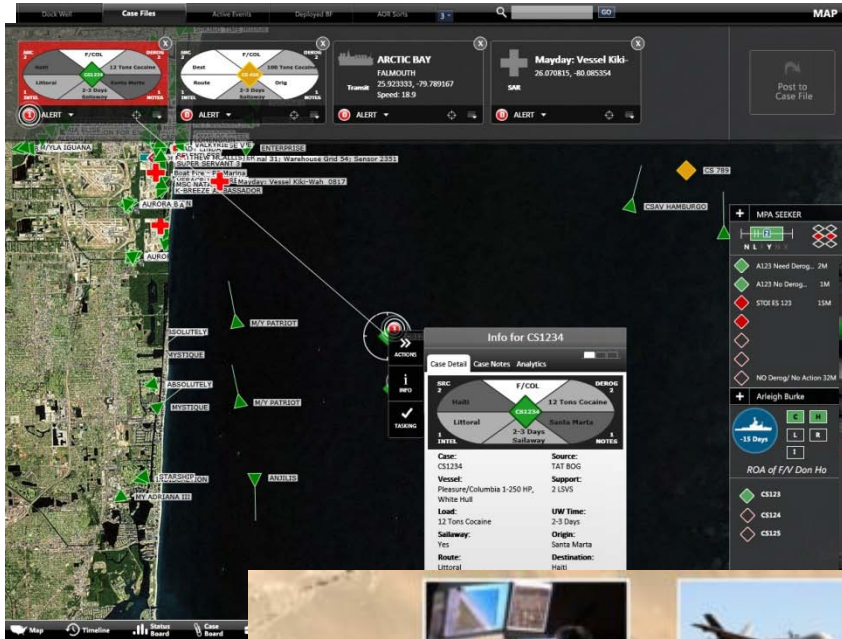
Expert displays.

# Task-Based Design

## Joint Interagency Task Force-South (JIATF-S)



redesigned space      increased SA  
repeatable, proven results      expert displays





# Way Ahead

How do we implement a task-based design approach within DoD?

Implement a task-based design approach within DoD?

Create a task-based design guide within DoD?

Create a separate CDRL DID?

ISO 9241-210, *Ergonomics of Human-System Interaction- Part 210: Human-centred design for interactive systems*, 2010