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A Task-Based Design Guide for Command and Control

Presented to: 2012 Command and Control Research and Technology Symposium
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Alan Lemon, Human Systems Integration
Michael Cowen, Research and Applied Sciences
Space and Naval Warfare Systems Center, Pacific
Command & Control Technology - Experimentation Division
User-Centered Design & Engineering Branch, Code 53621

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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…

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HSI Requirements

SECNAVINST 5000.2D
October 16, 2008

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.

OPNAVINST 5310.23
November 10, 2009

...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

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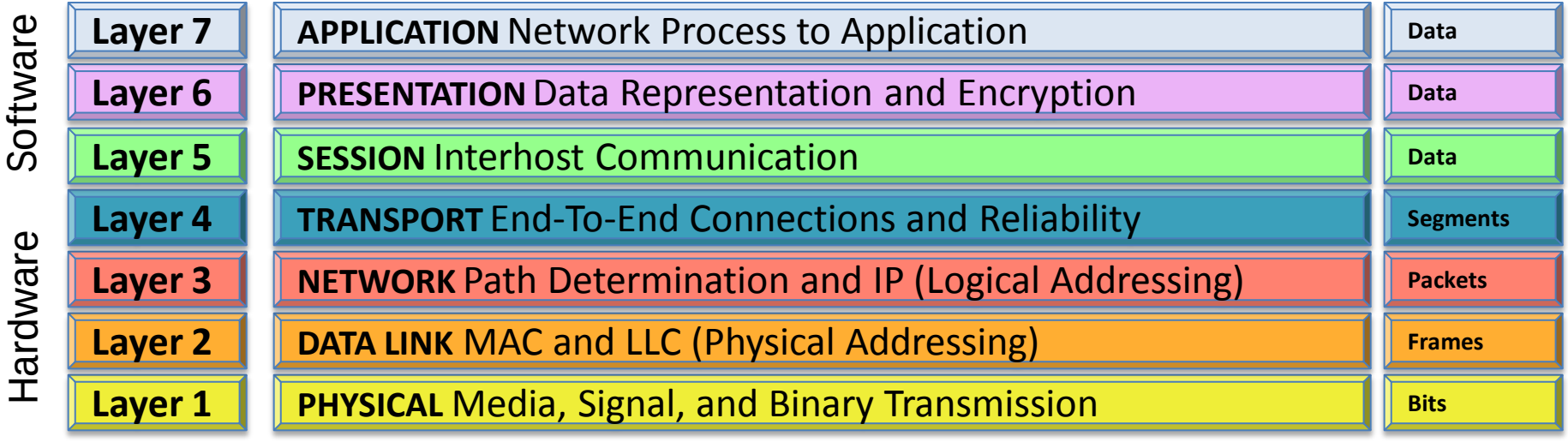
Our Expertise

Seven Pillars of Human Systems Integration +						
Human Factors Engineering	**Manpower**	**Personnel**	**Training**	**Habitability**	**Survivability**	**Environment, Safety and Occupational Health**
Human Performance	Workload	Personnel Classification	~~KSA~~ **KIASAM**	Quality of Life	Anti-Fratricide Identification / Confirmation	Accident Avoidance
Cognitive, Physical, Sensory Abilities	Wartime Requirements (Quality/ Quantity)	Recruiting	Initial Skill Skill Progression **Apprentice-Master**	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 **Sustainment**		**Hardware/ Software Configuration**	Medical
Top Down Analysis	**PBD**	Special Skills	Delivery Systems Realism/ Applicability		**Battlespace Omniscience**	
Design for Usability**/ Utility**		Occupational Standards	Organic Training Distance Learning **CBT ICW**			
Design for Maintainability		Distribution	Virtual Environment Intelligent Tutoring			
Team Dynamics HSD		Manning Concepts **Personality Classification & Management, Personnel Management**	Knowledge (formal cognitive), **Intelligence (informal cognitive)**, Abilities (informal psychomotor), Skills (formal psychomotor), **Attitudes (formal affective), and Motivation (informal affective)**			

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.

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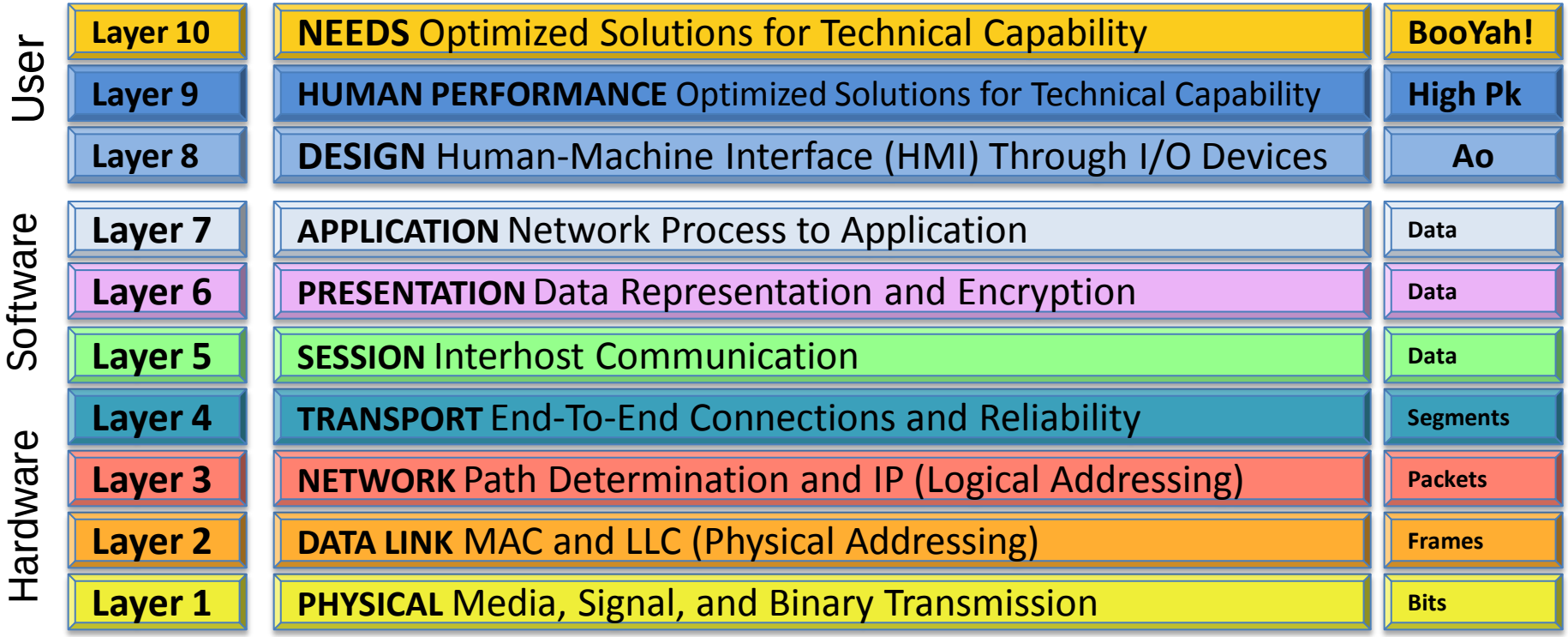
How does HFE relate to the OSI Model?



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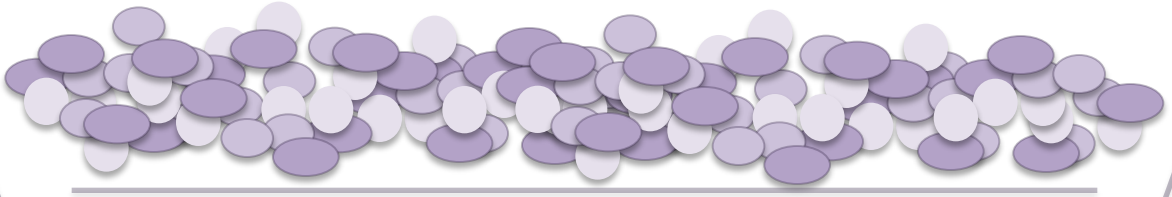
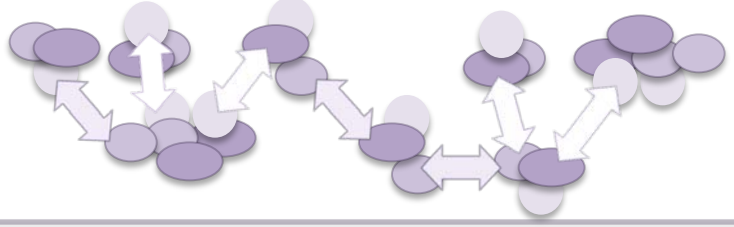
Function-Based Knowledge Funnel

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

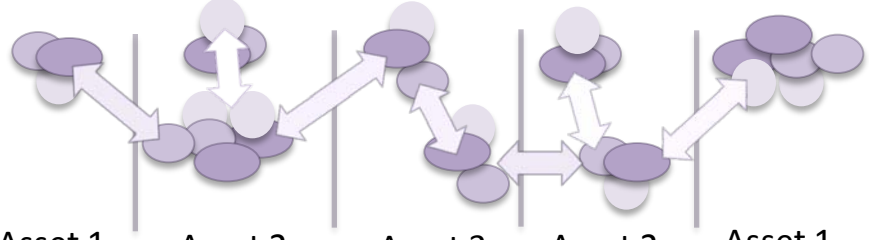


Models & Heuristics;

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



Systems & Procedures



Asset 1 Asset 2 Asset 3 Asset 2 Asset 1

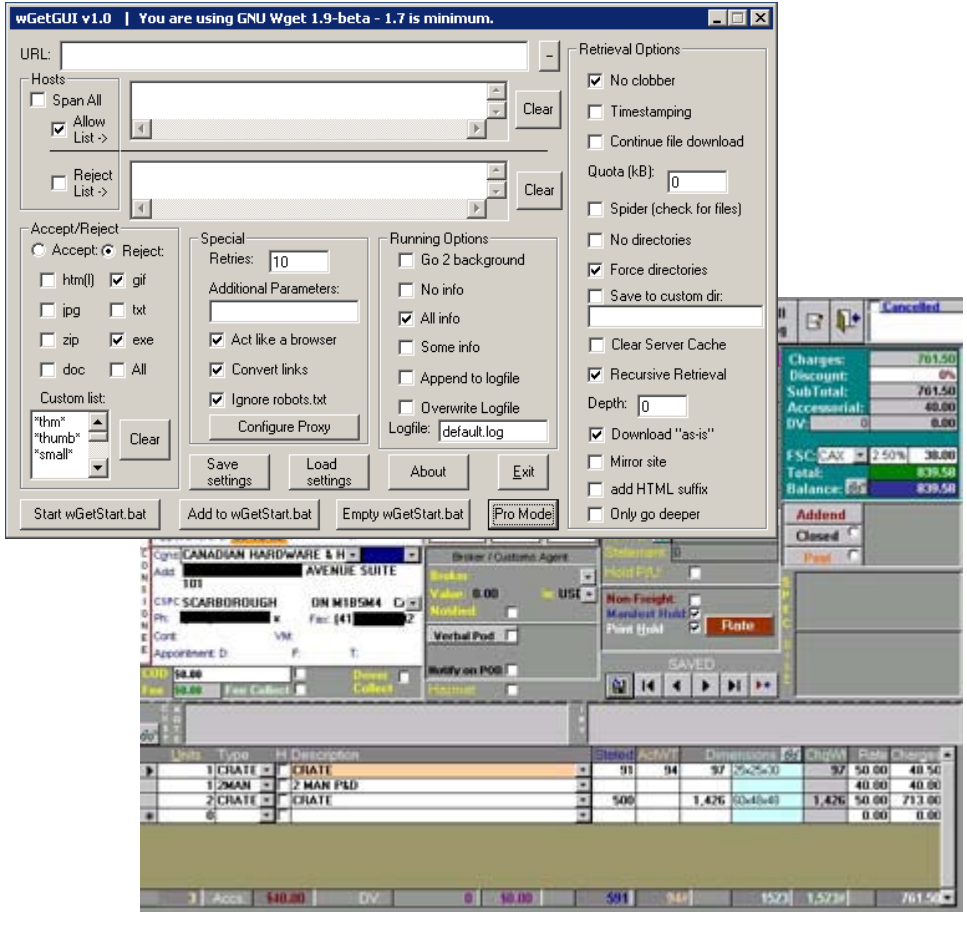
Strategic

Operational

Tactical

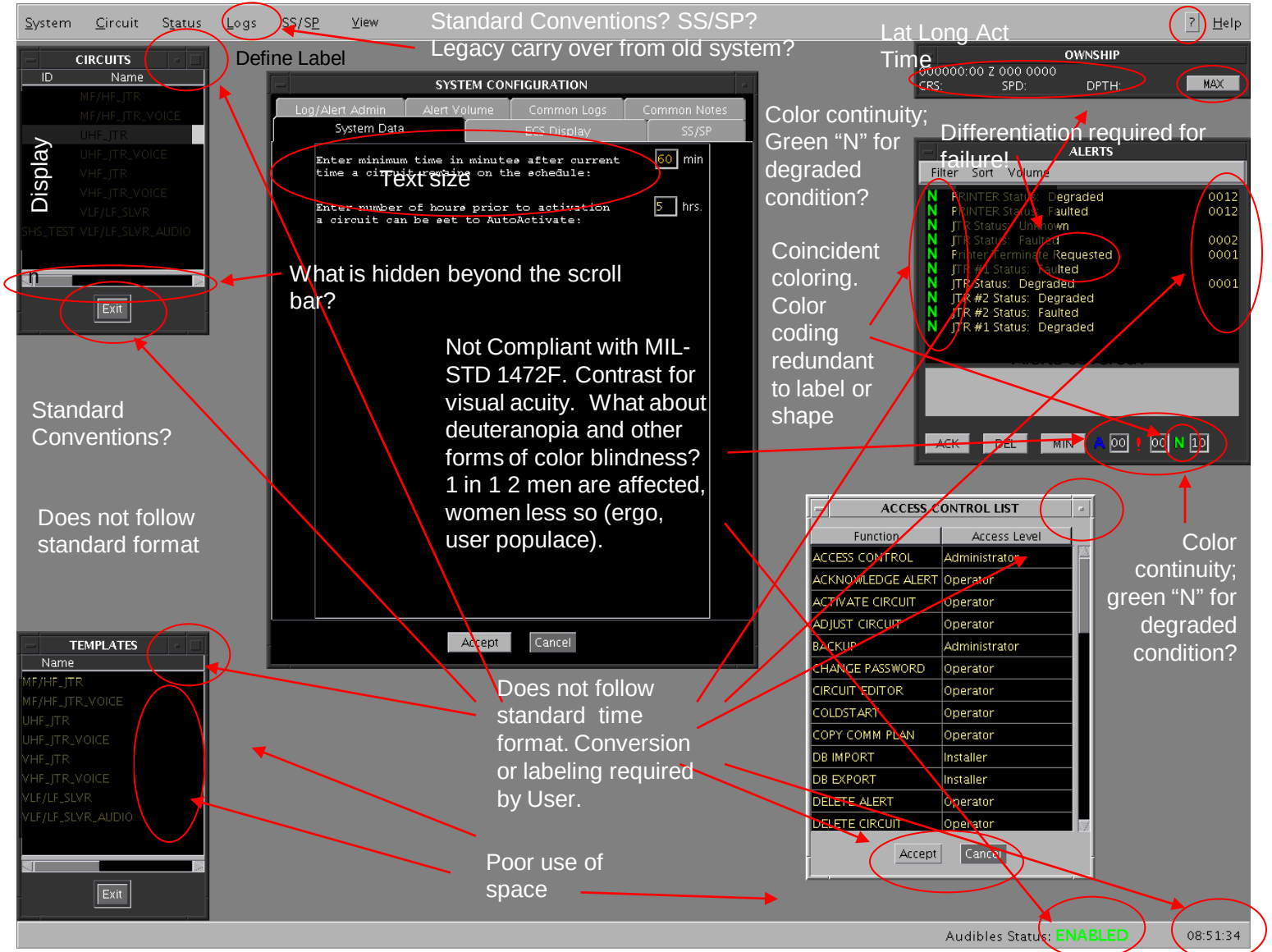
Data Centered Model drives the workflow and forces Users to make sense of the information and process to action.

Bad Design



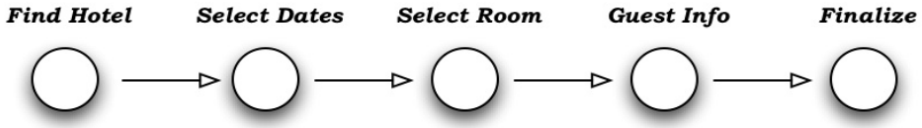
Rejected. Not Compliant with MIL-STD 1472F, DoD HCI Style Guide Vol 8. Contractor ignored repeated USG requests for oversight and inclusion in development effort.

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



Task-Based Versus Function-Based Design

Book a Hotel Room Task - Task-Based UI

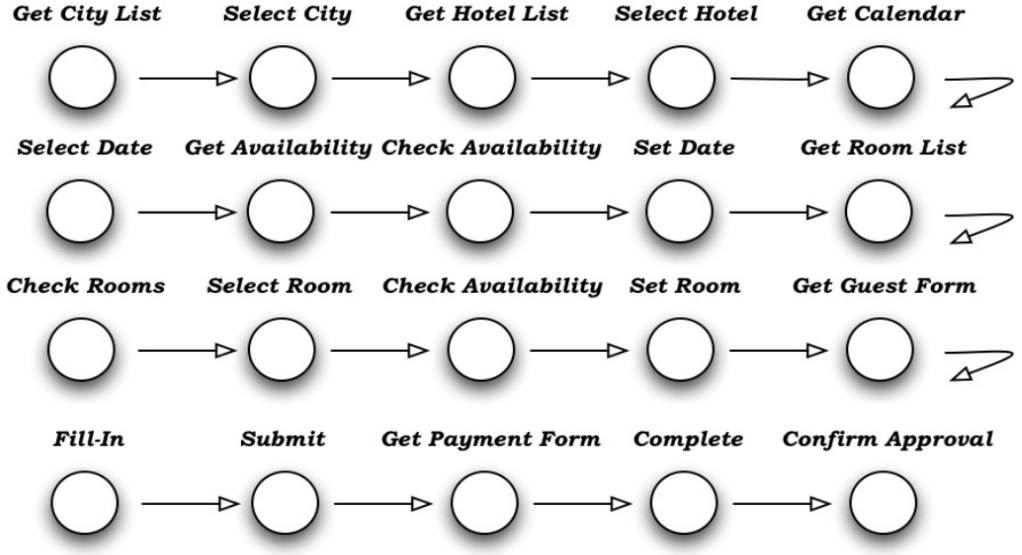


Worse than Bad Design

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 - Function-Based UI



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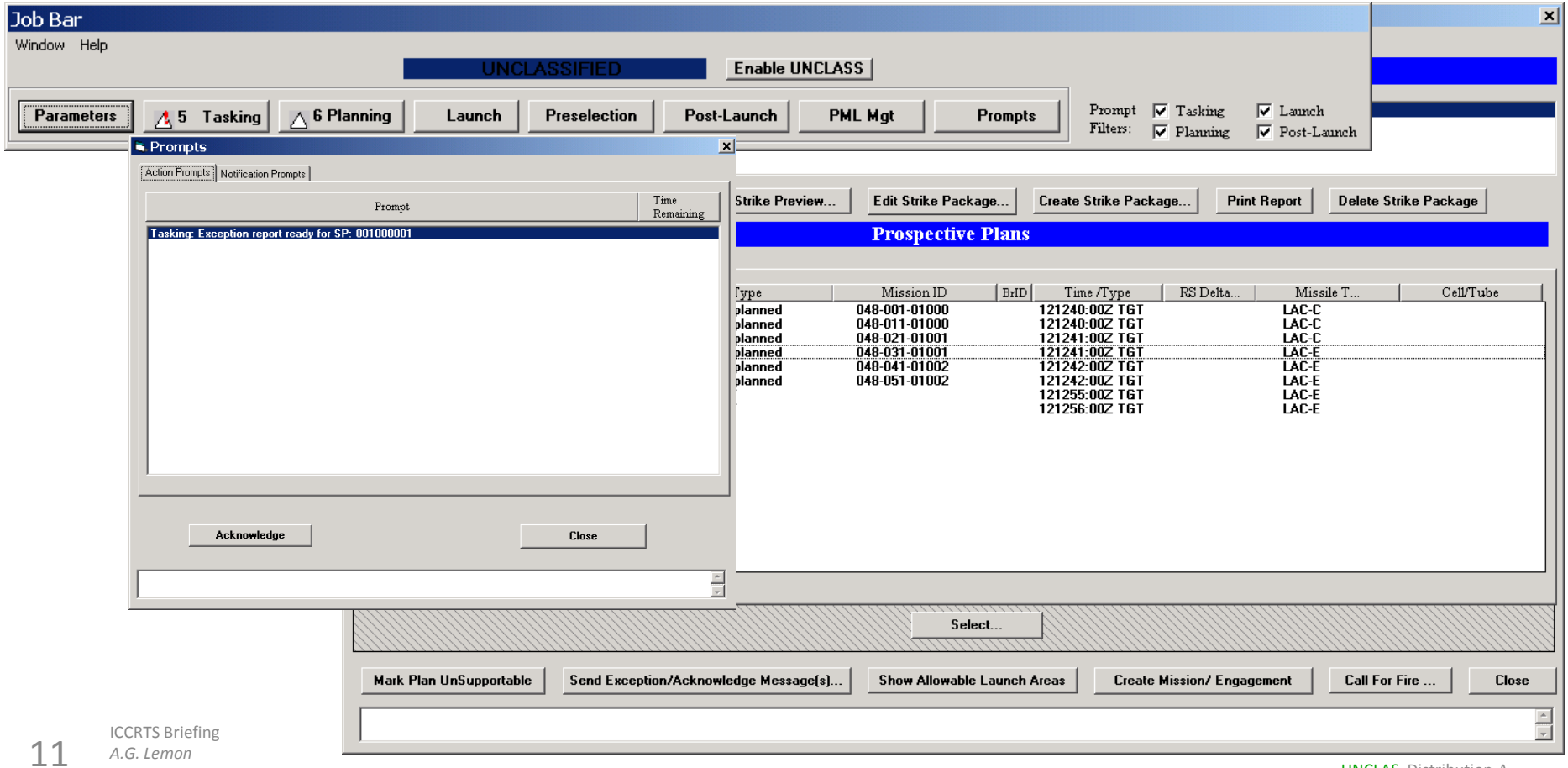
Function-Based Design

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



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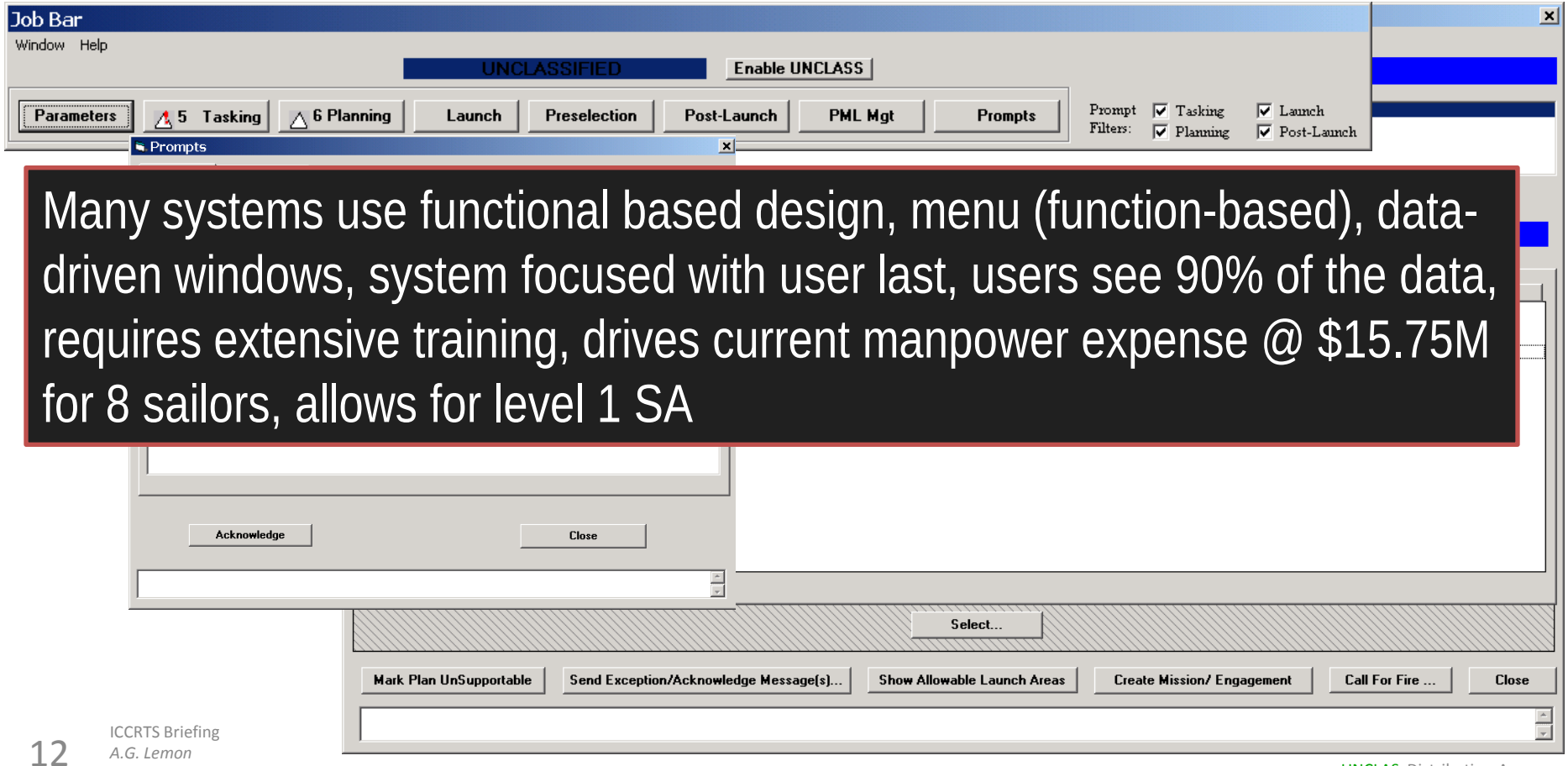

Many systems use functional based design, menu (function-based), data-driven windows, system focused with user last, users see 90% of the data, requires extensive training, drives current manpower expense @ $15.75M for 8 sailors, allows for level 1 SA

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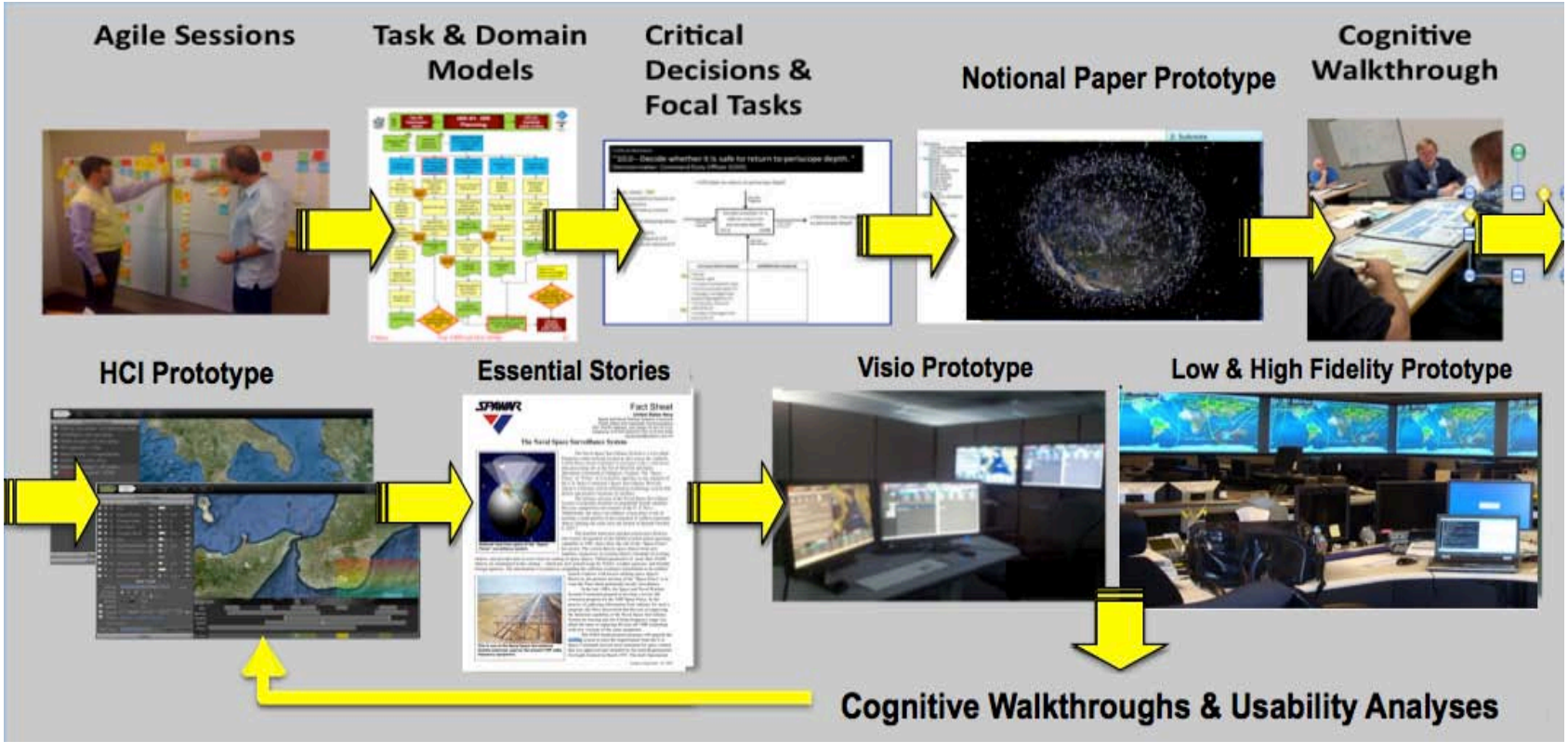
UCD Agile Design Process



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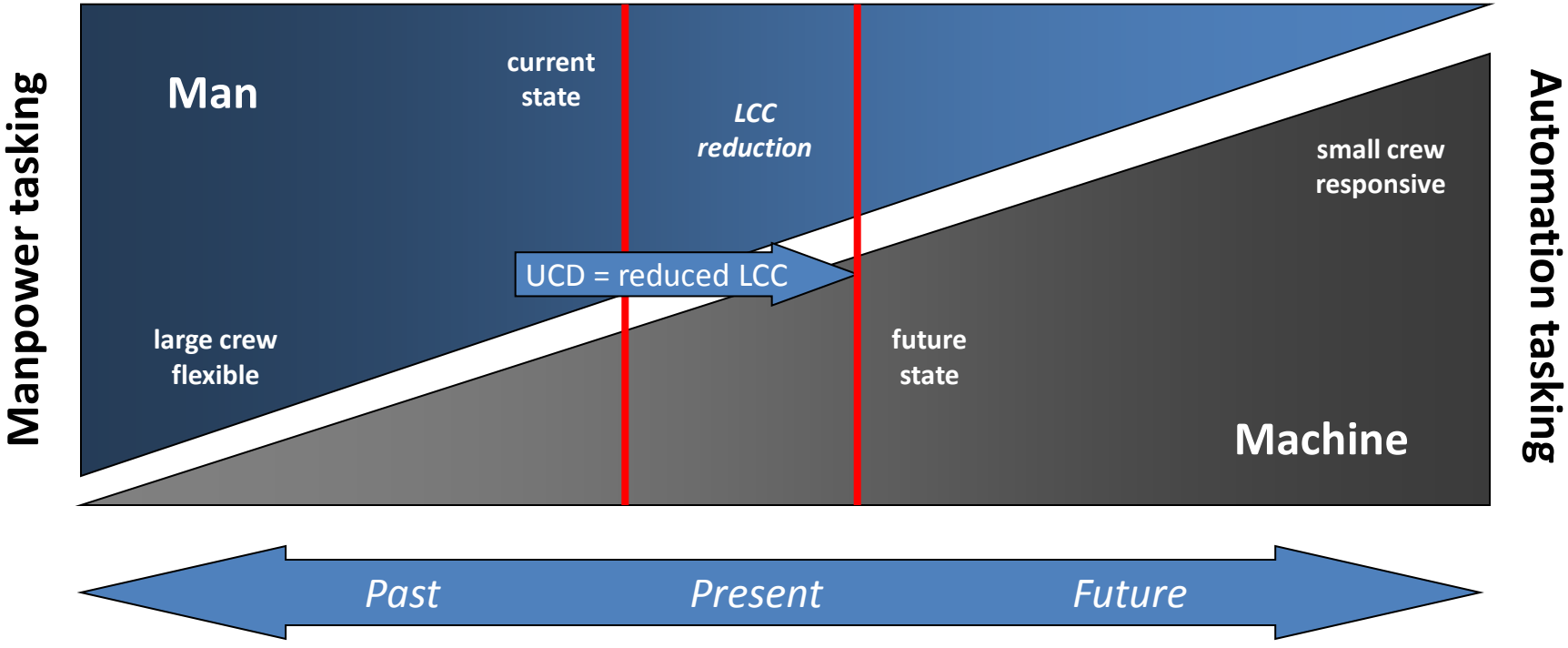
Results of UCD Agile Design Process



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.

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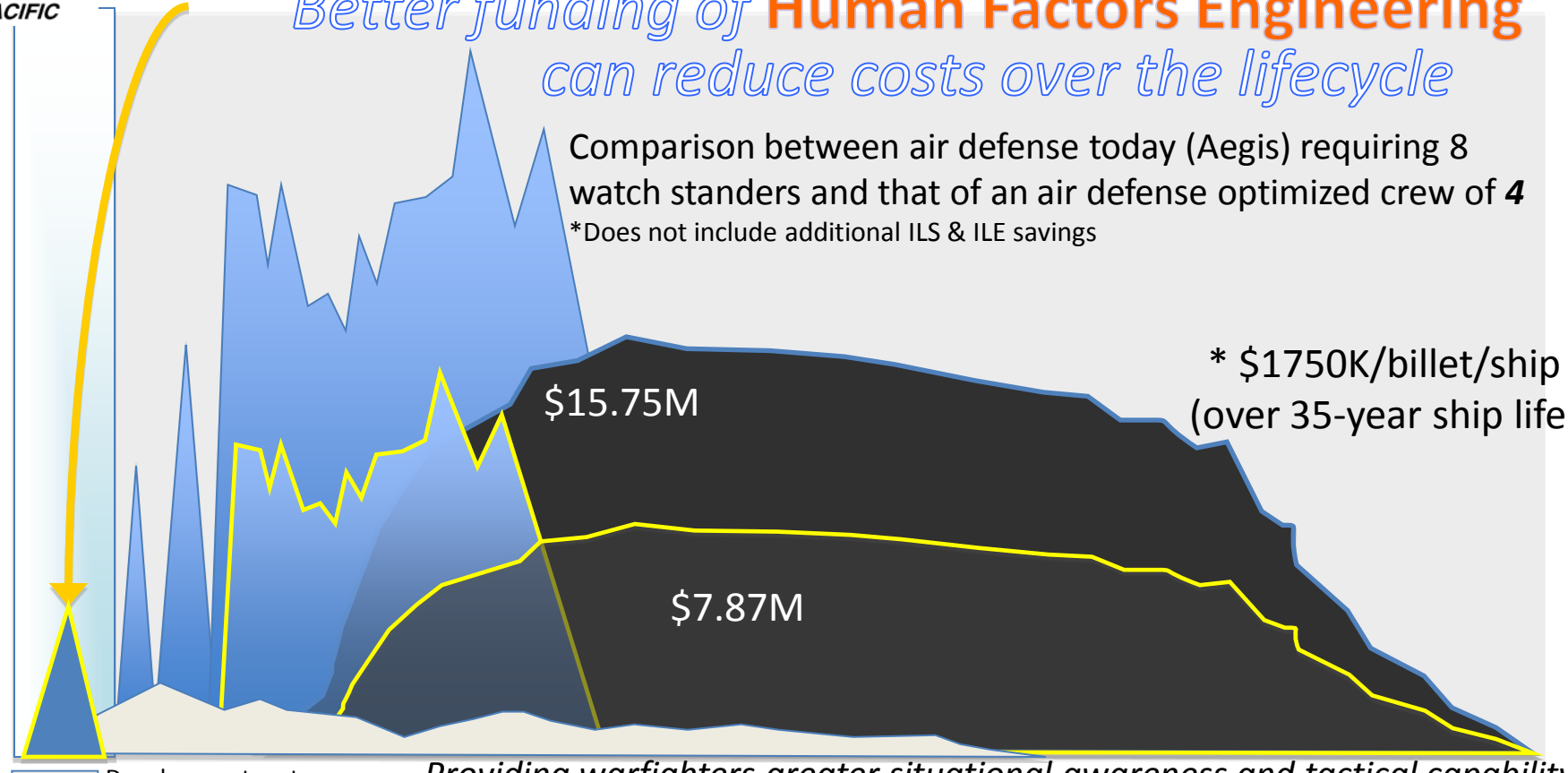
Why HFE provides best ROI

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



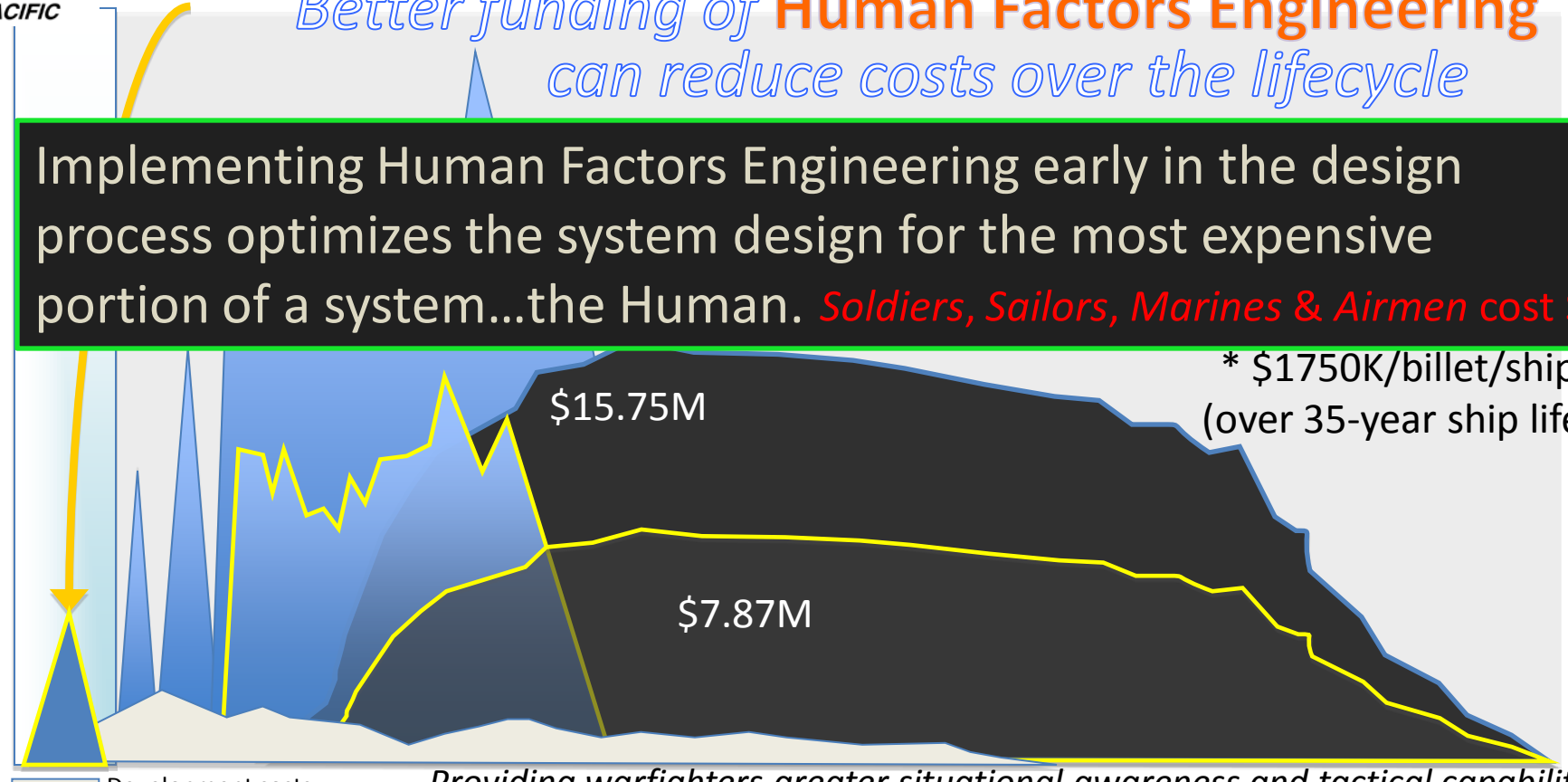
Providing warfighters greater situational awareness and tactical capability & Combatant Commanders more capability at less cost

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 $!



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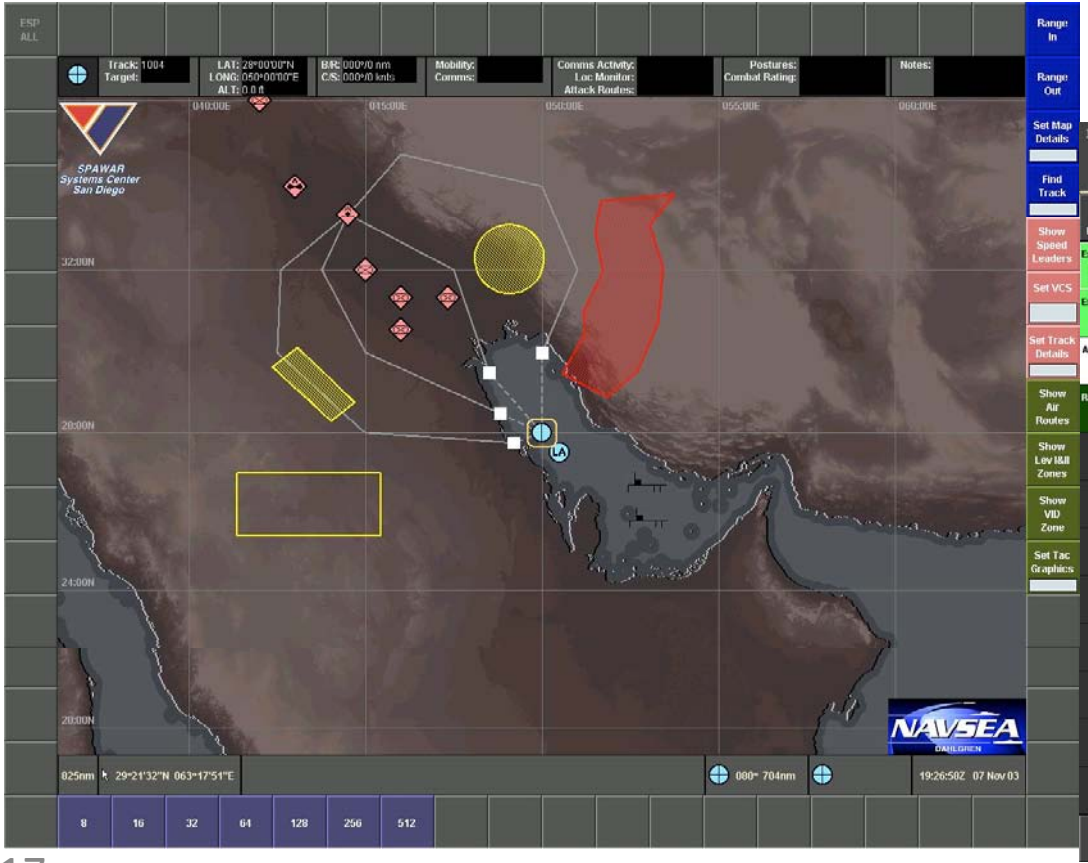
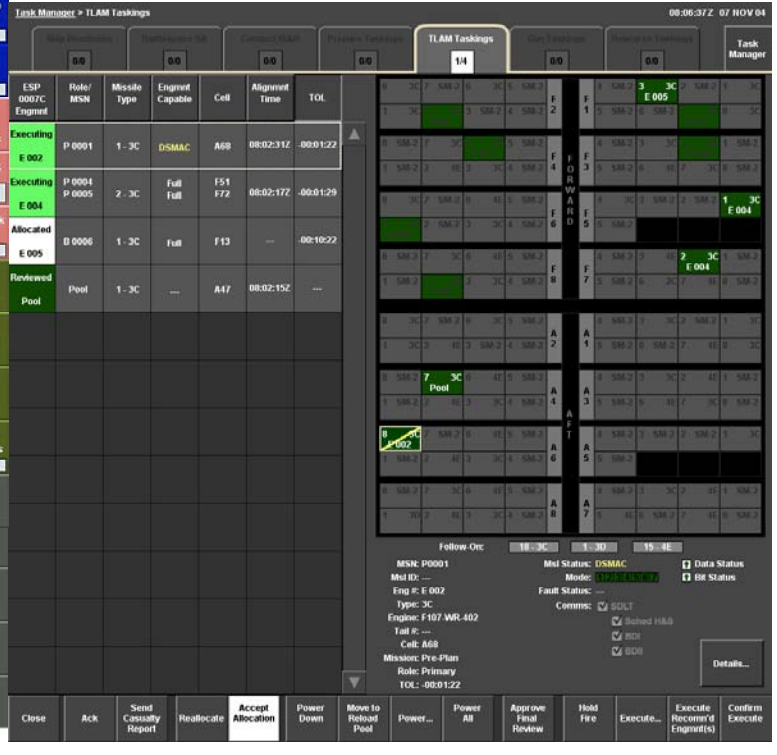
Task-Based Design

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





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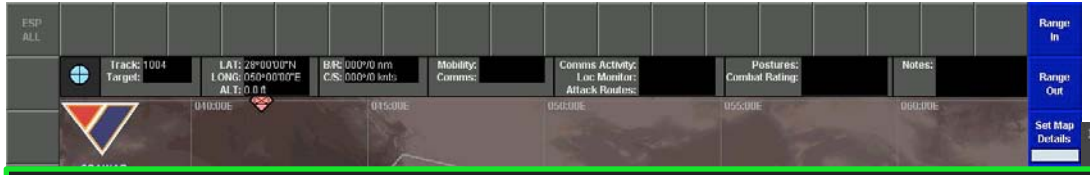
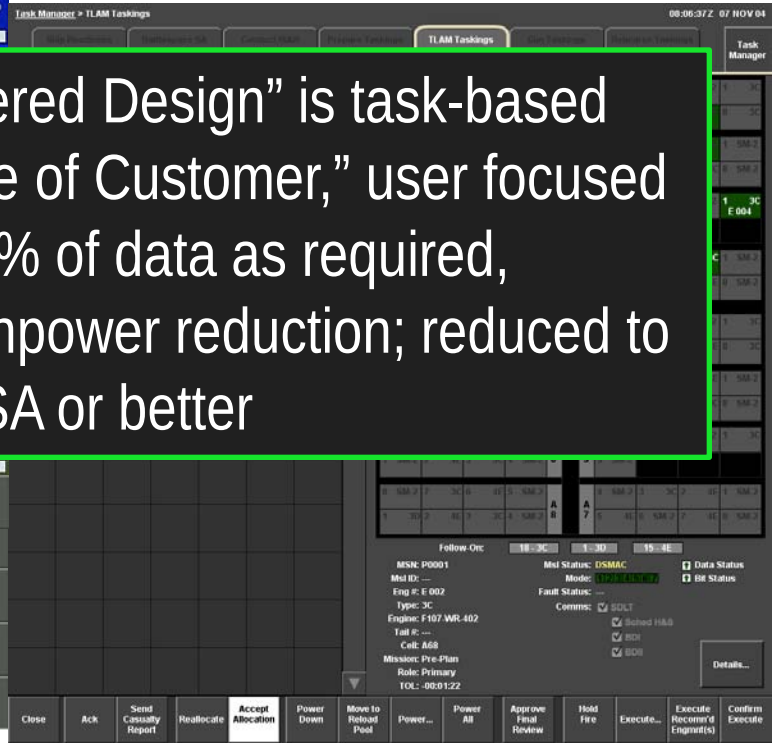
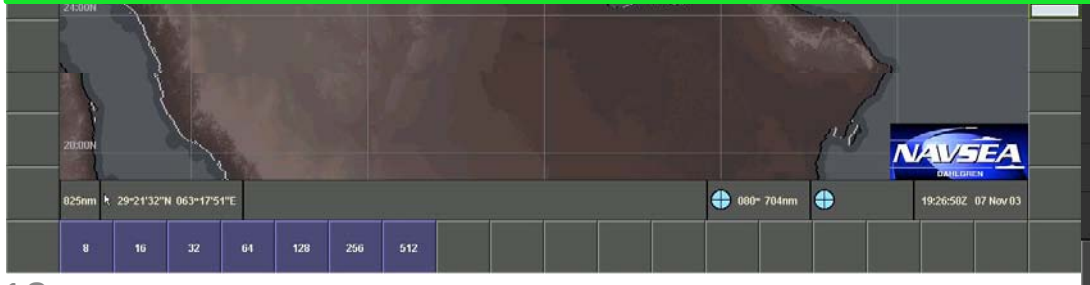




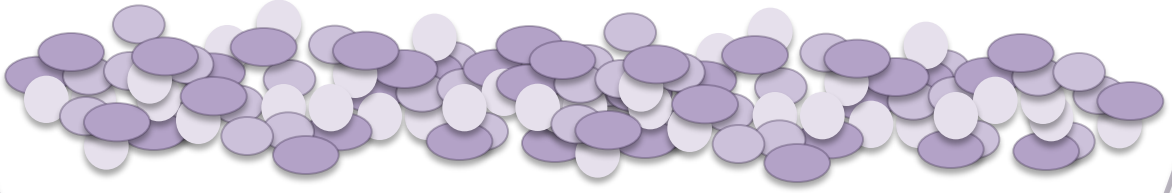
The Delta with a UCD approach: "User-Centered Design" is task-based providing decision-support, design with "Voice of Customer," user focused to optimize human performance, provides 10% of data as required, requires only familiarization, proven 50% manpower reduction; reduced to 4 sailors @ $7.87M, while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

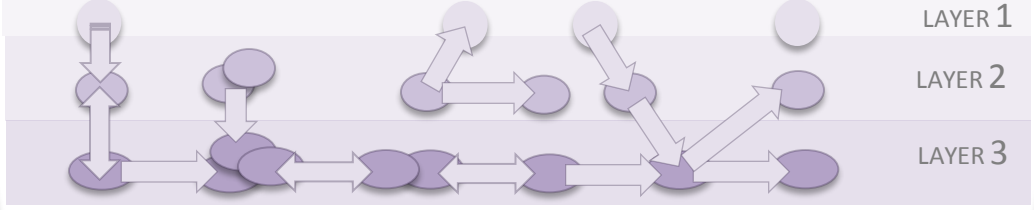
Disparate data sources, computational resources, and products into and out of AOR



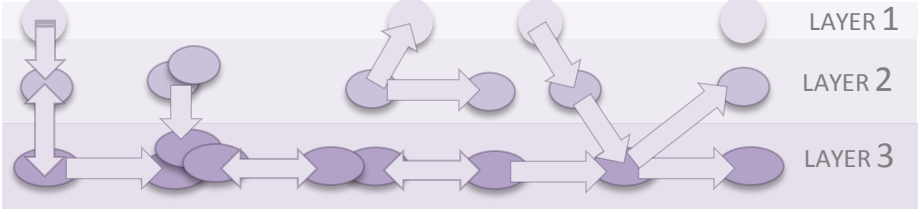
Proposed UCD support to provide Users leveled and layered information designed from tasking

- Strategic
- Operational
- Tactical

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



Systems & Procedures captured in the user Interface



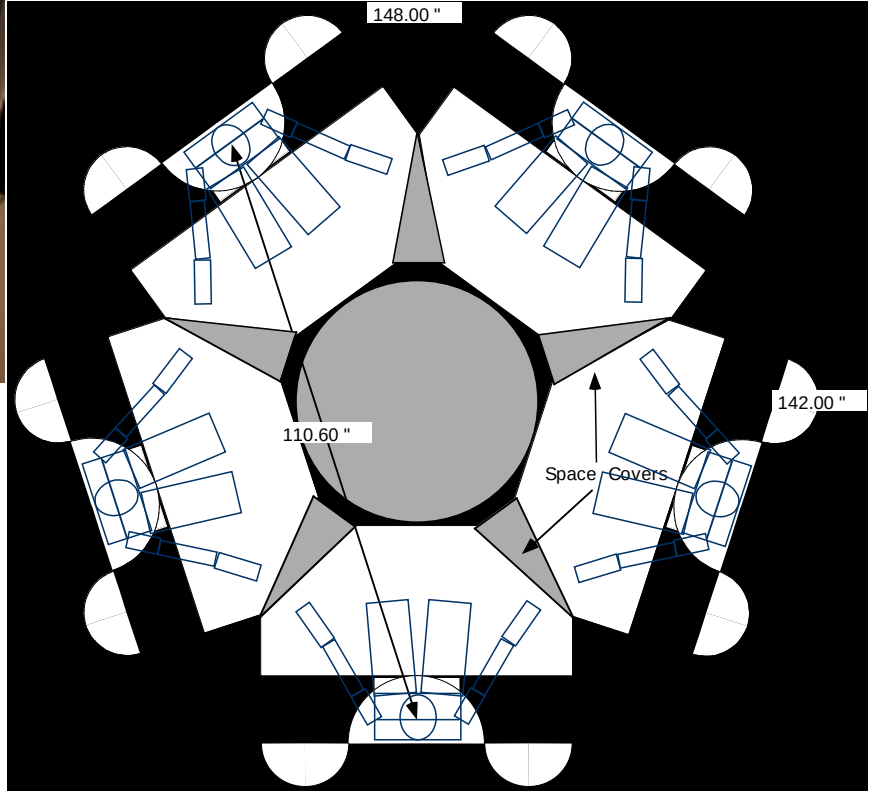
Asset 1 Asset 2 Asset 3 Asset 2 Asset 1

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

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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."

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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.

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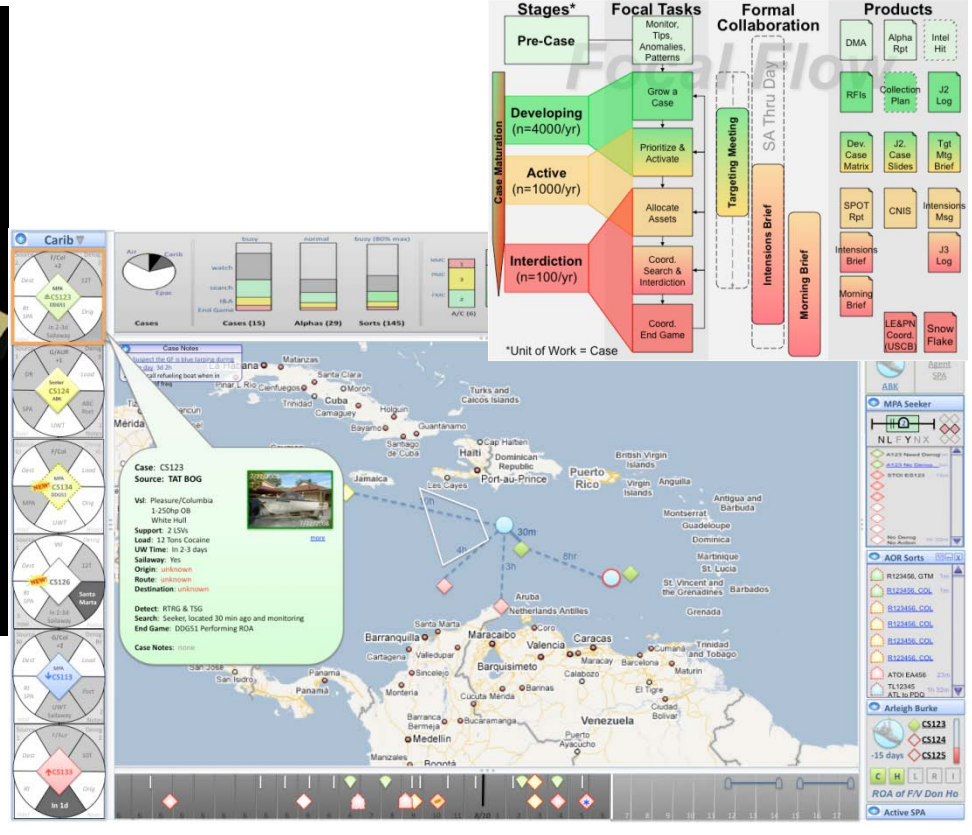
Task-Based Design

Joint Interagency Task Force-South (JIATF-S)



redesigned space increased SA

repeatable, proven results expert displays

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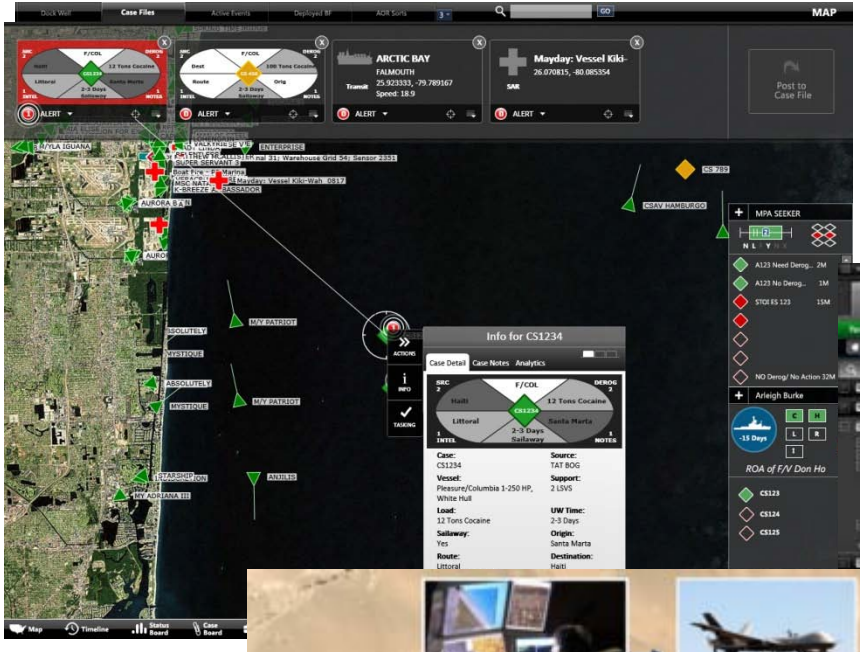

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Way Ahead

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