HCI Design Patterns for C2

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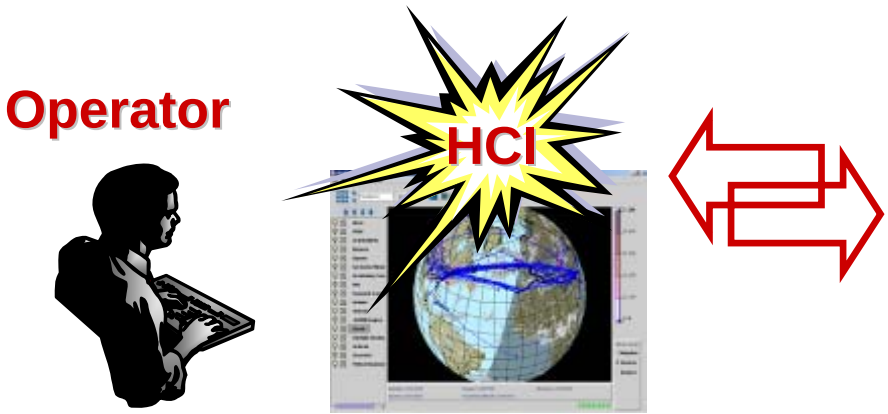
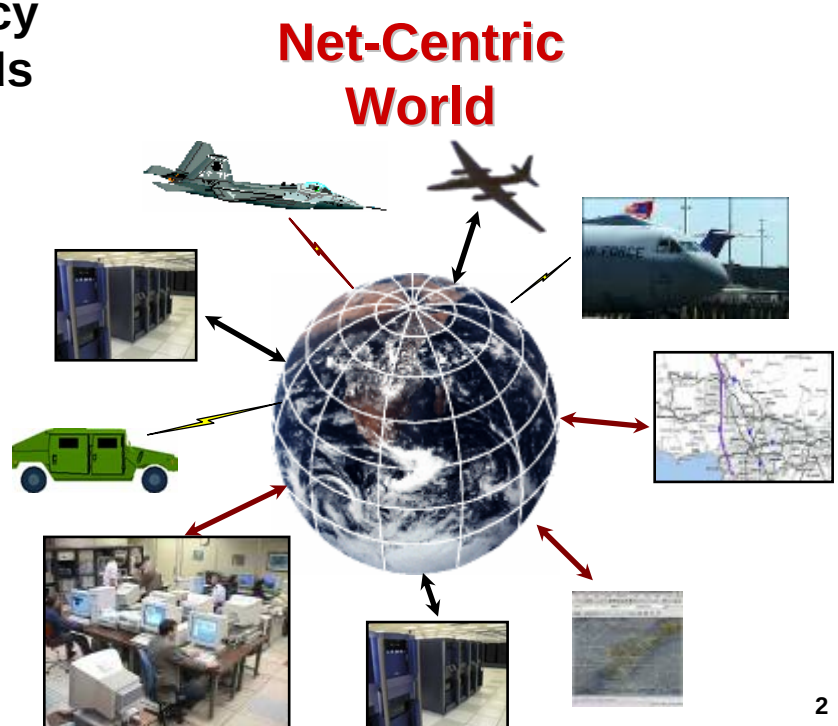
DoD Requirement

- **Command & Control (C2)**
  - Planning, coordinating, executing, monitoring, replanning
- **Network-Centric Operations**
  - Increased information access for C2
  - Can increase effectiveness & efficiency But introduces new cognitive demands
  - Human Computer Interface (HCI) critical element of system





Two Interaction Domains in HCI Design

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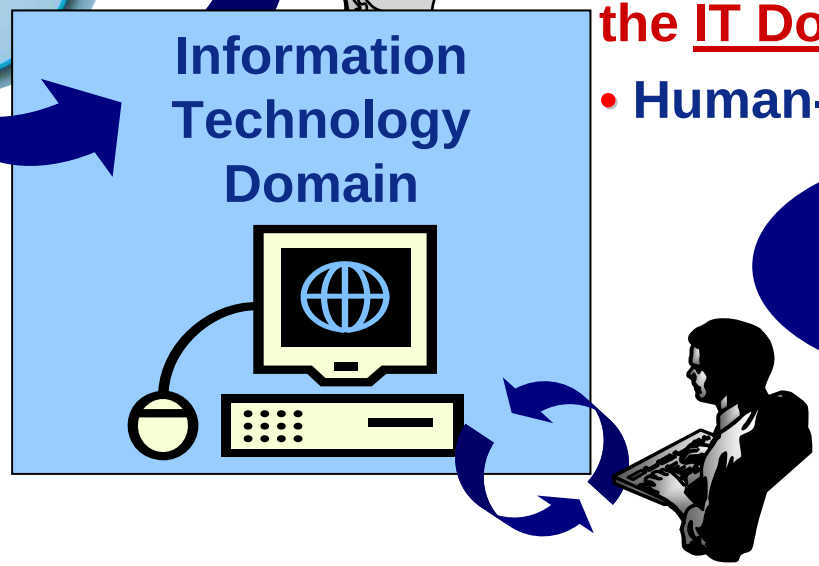
Work / Mission Domain

The Operator Accomplishes Mission-Relevant Goals within the Work Domain

- Human-Work Interoperability

Work-Centered HCI Guidelines



The Operator Acts within the IT Domain

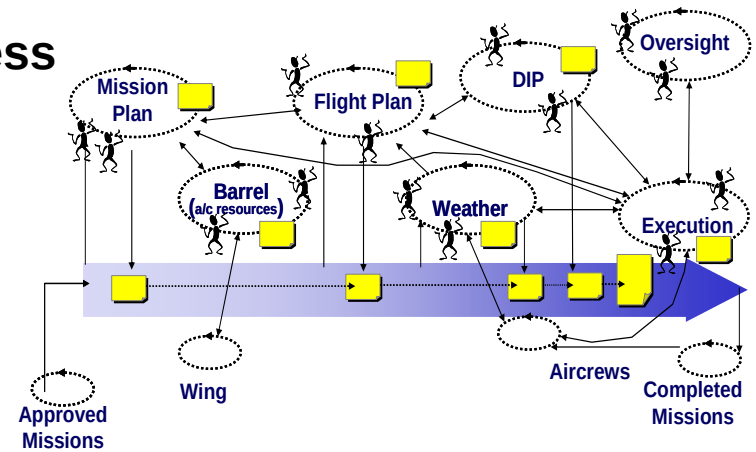
- Human-IT Interoperability

Existing HCI Guidelines

MIL-STD-1472E
MIL-STD-1801
ISO 9241

What Do We Mean by Work and Work-Centered?

- *Purposeful activity performed in a context*
- Activity performed by organic (human) and inorganic (technology) entities to achieve organizational objectives
- Individuals, groups, organization
- Human work benefiting by Information Technology (IT)
  - Building & Maintaining Situation Awareness
  - Team Coordination & Collaboration
  - Decision Making
  - Problem Identification & Resolving
  - Work (Load) Management
  - Product Development



- Effective IT mechanisms for aiding human work
  - Visualizations reflecting operator's mental models of own work
  - Automated data retrieval, fusion, and alerting

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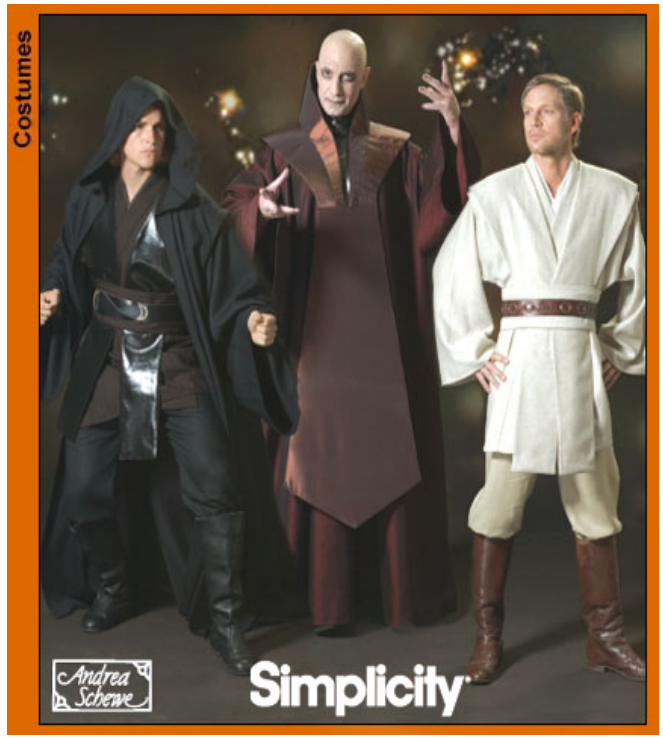
Halloween Costume Solutions

Off-the-Shelf

Custom Design

Design Pattern



Three Paths to Work-Centered HCI

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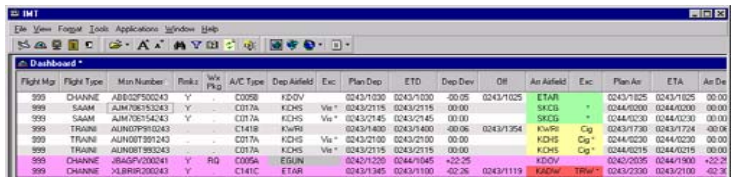
Off-The-Shelf

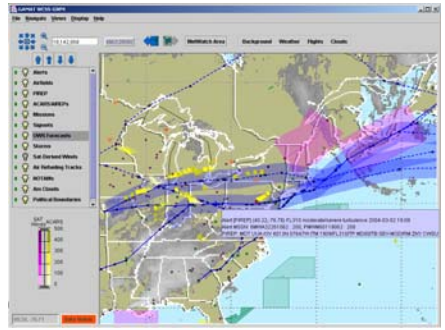
- Modern approach
- Low-Cost
- Low Risk (short term)
- Clumsy Fit to Work

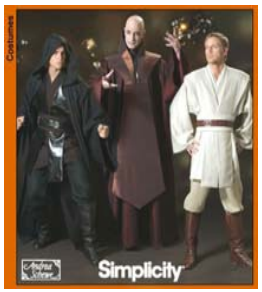
Augmented MS Excel

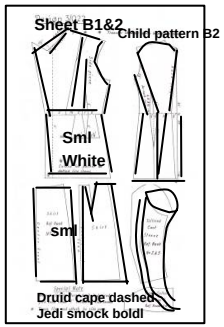


Custom Design

- Reflects Cognitive Systems Engineering
- Very Expensive
- Higher-Risk
- "Perfect Fit" to Work



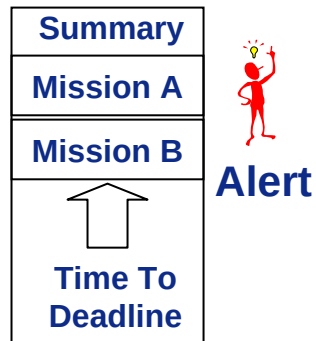


Design Pattern

- Practical HCI design
- Lower Expense than Custom
- Lower Risk than Custom
- *Tailored* Fit to Work

Original HCI

Design Pattern



Alert

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Case Study: HCI Design Pattern Return On Investment

Robert Dick & Alan Spiker, Anacapa Sciences Inc. (2006)

- ASW Human-Computer Interface developed using cognitive systems engineering methodology
- HCI Solution is “patternized” and reapplied in EW domain

	ASW “Original HCI”	EW HCI Reapplied
• Time to design:	72 month	6 months
• E6-E9 SMEs involved	44	1
• Payroll costs to Navy	75 man-days	0 man-days
• HCI man-years	11.0	0.5
• Cost to Program Office	>$2,000K	$70K

HCI Design Patterns

Addressing Human - IT Interoperability

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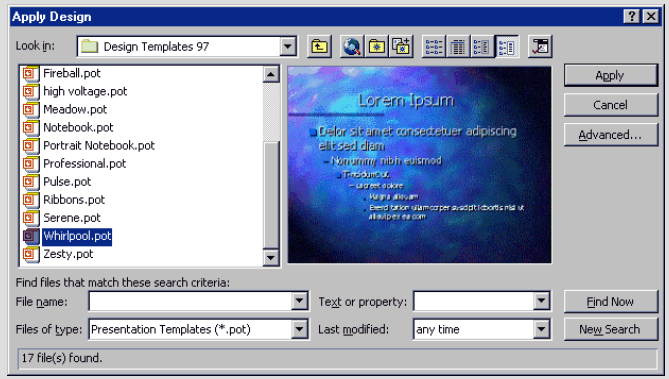
- **Design Patterns**
  - Physical architecture (Alexander, 1977)
  - Software coding (“Gang of Four”, 1994)
- **HCI Design Patterns**
  - “…a structured textual or graphical description of a proven solution to a recurring design problem” (Borchers, 2001)
  - Several online pattern libraries www.welie.com
  - New book! Tidwell, J. (2006). Designing Interfaces
  - Framed around common interactions with a ***general class of IT***
  - Applicable work domains are infinite

Website / Navigation: “Double-Tab”

Desktop App / File Selection: “Preview”



Mobile Phone: “Selection”

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Two Varieties of HCI Design Patterns

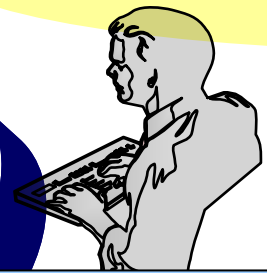
Work / Mission Domain

The Operator Accomplishes Mission-Relevant Goals within the Work Domain

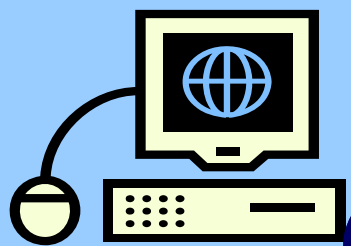
- Human-Work Interoperability

"Work-Centered Design Patterns"

Need Set for C2



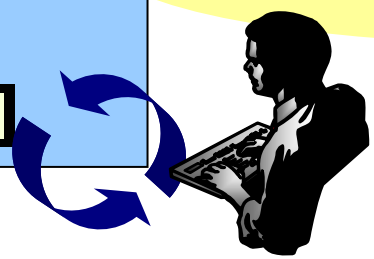
Information Technology Domain



The Operator Acts within the IT Domain

- Human-IT Interoperability

"IT-Centered Design Patterns"



Existing HCI DP

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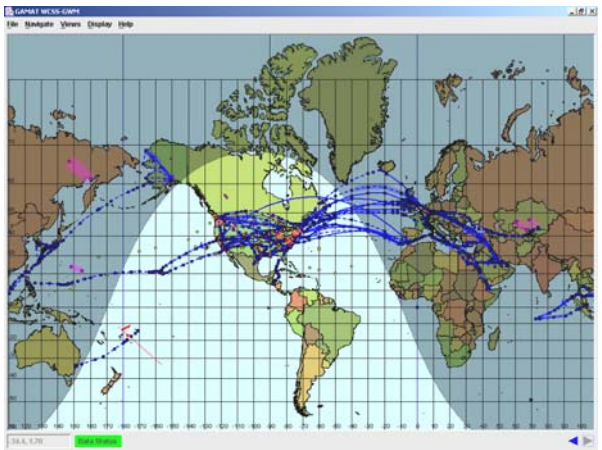
Scientific Objective
Identify HCI Design Patterns for C2

Hypothesis: Similar environments benefit from similar HCIs

Similar

≈

Work



Tailored

HCI

Reuse

Question: Where do we get the HCI design patterns to reuse?

Scientific Objective
Identify HCI Design Patterns for C2

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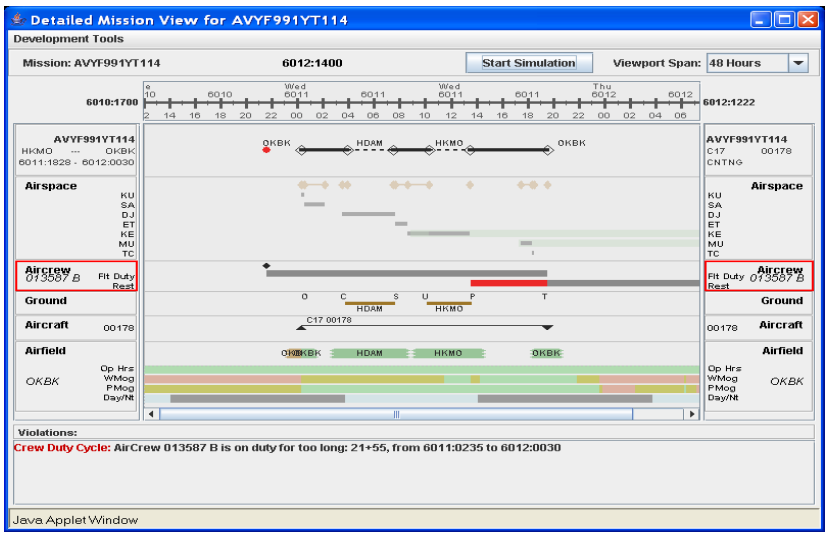
Hypothesis: Existing "Work-Centered" HCI can be reverse-engineered to uncover HCI Design Patterns



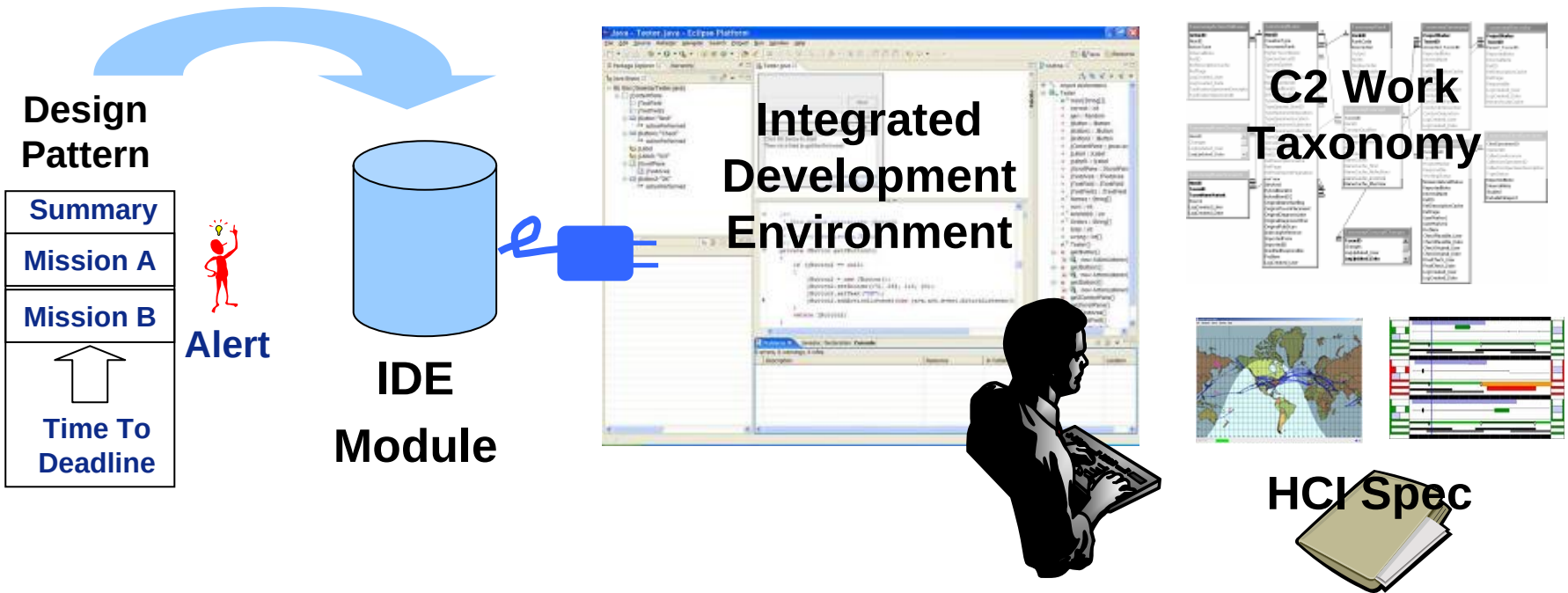
Functional HCI Design

1. ***HCI Design Pattern Hierarchies***
   a. Work-Centered DP
      a. Work-Centered DP
      b. IT-Centered DP
2. ***HCI Design Pattern Applications***
   a. Work Field Representation DP
   b. Automation DP
   c. Interaction DP

Question: What will we do with the HCI design patterns?

Vision: Tools for Software Developers

- **HCI Builder within an Integrated Development Environment**
  - HCI Design Patterns embedded in software modules for IDE
  - Software developer navigates C2 work function taxonomy
  - Reviews potential, relevant HCI Design Patterns per work functions
  - Selects, assembles, & populate HCI DP for specific project
  - Output: Notional HCI Design, Skeletal HCI Specification



Vision: Design Reference Library to Improve Joint Operations & Training

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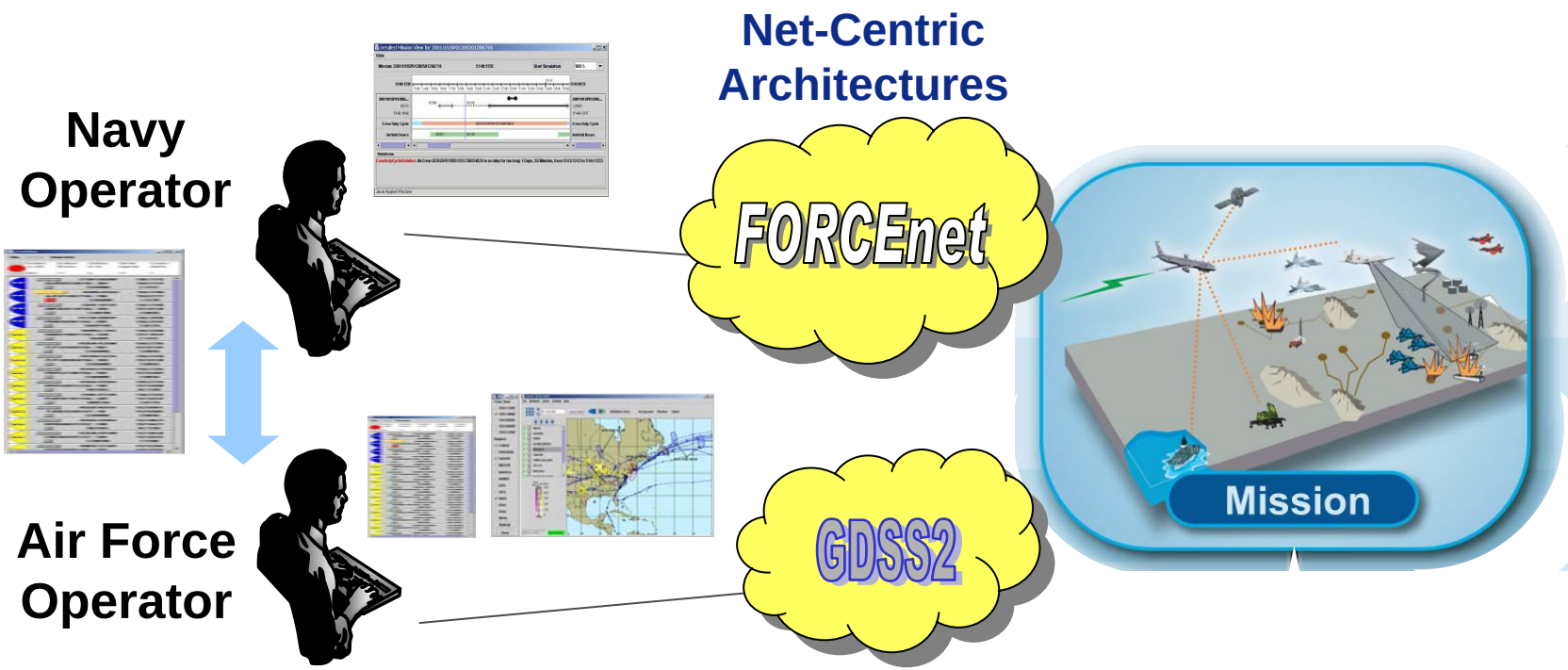
- **DOD Design Reference Library based on HCI Design Patterns**
  - **"Flexible standardization" of HCI in C2 across armed services**
  - **"Human-Human Interoperability" across armed services**
  - **Facilitates C2 operator training**

One Example: Joint AF-Navy Strike Operation



HCI Design Patterns for C2
Recap & Examples

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When Designers are faced with new problems…

Patterns fill a significant gap in the design process…

HCI Guidelines =
too generic…
only GUI look & feel

Completed HCI =
too complex,
difficult to abstract back into new task domains…

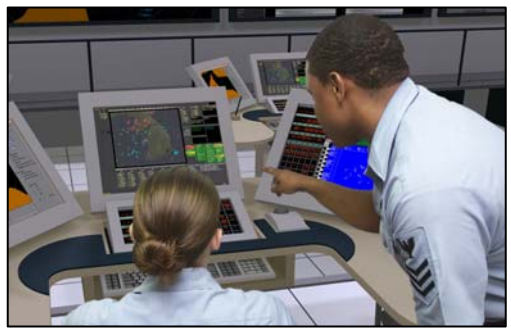
HCI Pattern =
Usable for multiple task and mission domains


XYZ Program

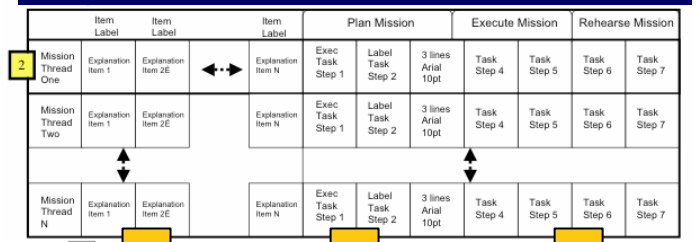
PHASE III PROGRAM

Task-oriented HCI Design Engineering Guidelines (TOHDEG)

PART I
(Draft Version 3.6)

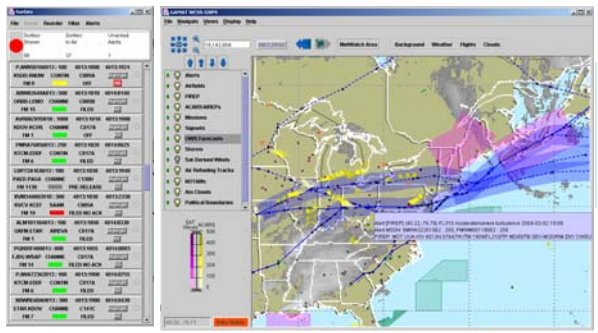


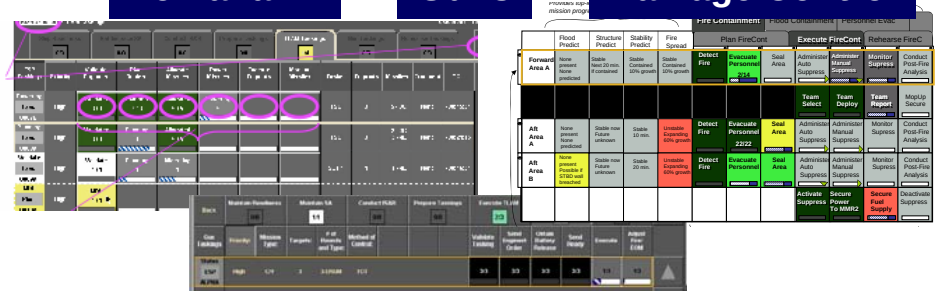
Step-based Task Navigation Pattern



Mission context application

Tomahawk | **Guns** | **Damage Control**





HCI Design Patterns for C2
Recap & Examples

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Patterns fill a significant gap in the design process…

HCI Pattern = Usable for multiple task and mission domains

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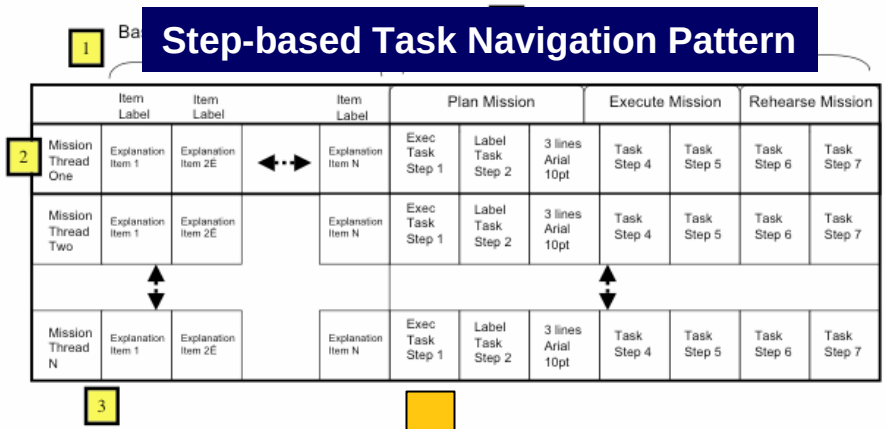

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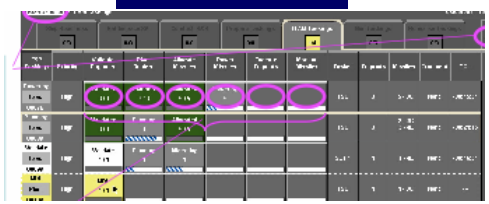
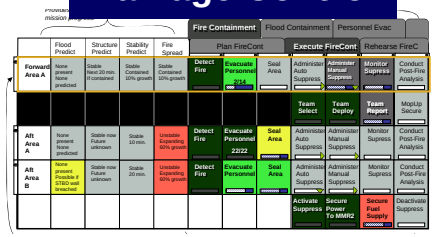


Guns

Damage Control



HCI Design Patterns for C2
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The Operator Accomplishes Mission-Relevant Goals within the Work Domain

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"Work-Centered Design Patterns"

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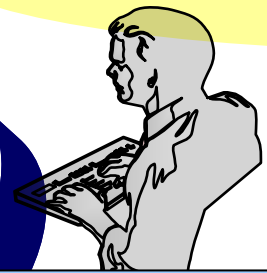

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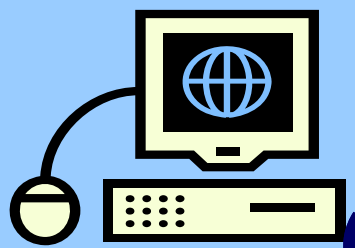

The Operator Acts within the IT Domain

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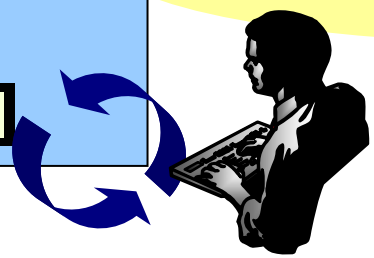

Existing HCI DP

HCI Design Patterns for C2
Recap & Examples

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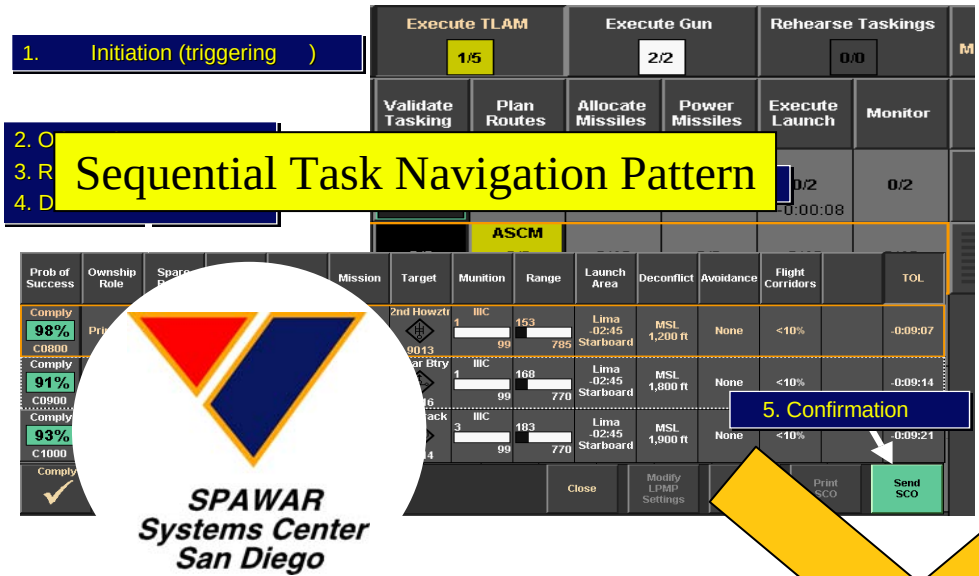
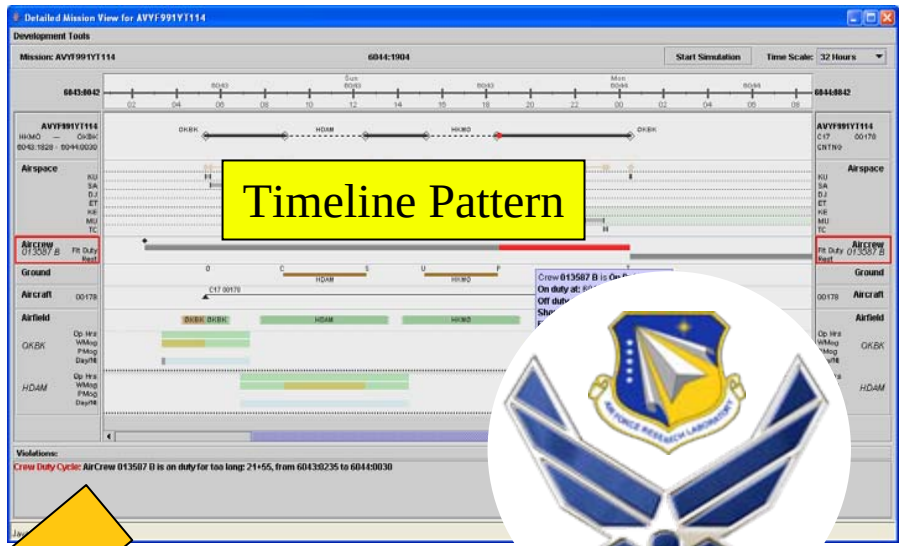
Tomahawk Launch Sequence Task Navigator



AF Mission Monitoring Tool



Time-Line Display for In-flight Missile Management

Sequence Display for Aircraft Maintenance Check

HCI Design Patterns for C2
Recap & Examples

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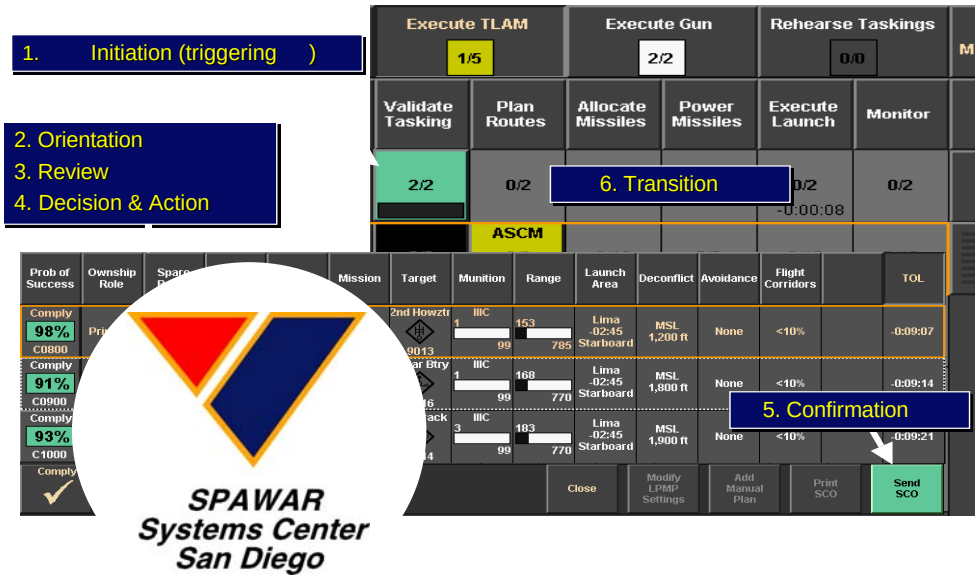

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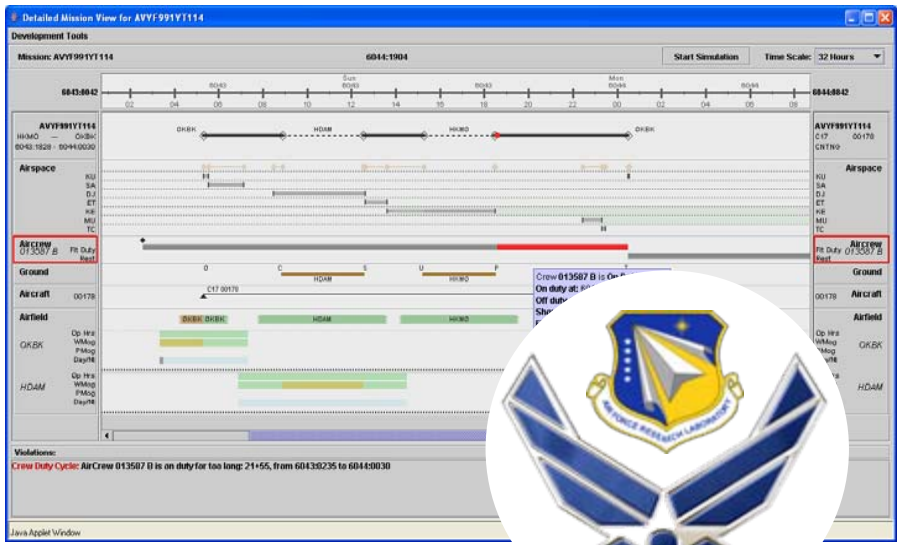

Detailed Examples in Conference Paper

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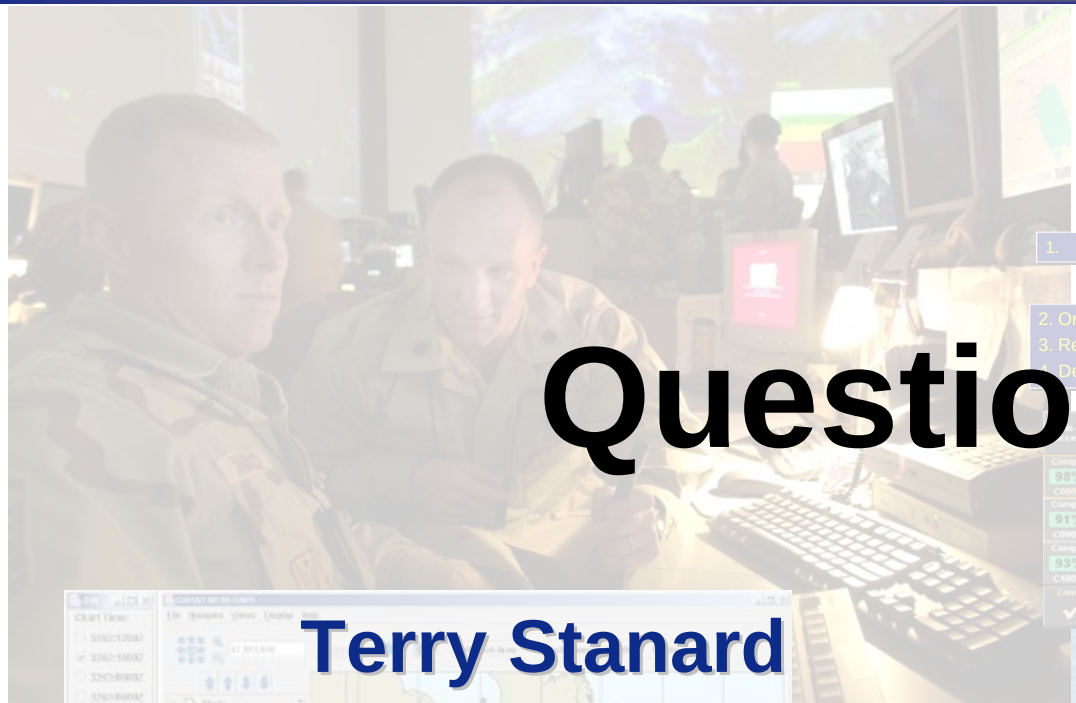
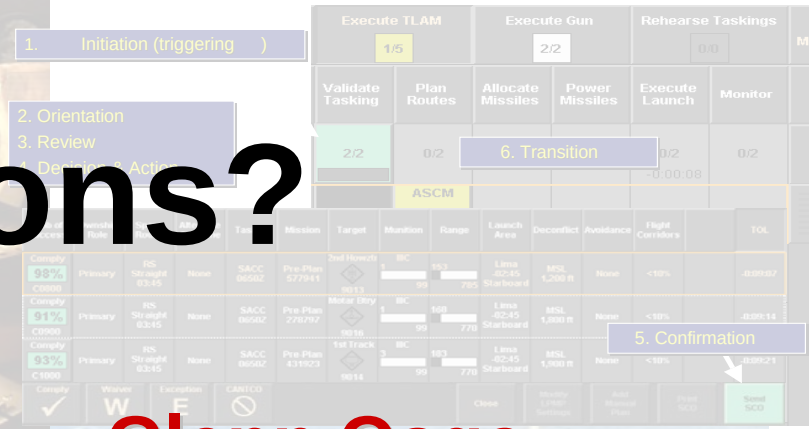
HCI Design Patterns for C2





Questions?

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