

Decision-Centered Command and Control:

*Designing Large Scale Decision Support Environments to
Enable Effective Team Decision Making*

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Traditional Approaches for Decision Support Environment Construction

- Collect N+1 individual workstations – maximization of the space
- Arrange rooms by org. divisions, technology systems, process flow
- Add personnel until the work of the domain can be accomplished



- Project any individual display onto a wall

Problems Created by Traditional Approaches

- Weak support for coordination and collaboration
 - Network based Voice + Chat briefings (ClicktoMeet) to keep everyone on the same page
- Poor observability of the current state of the operations
 - “Human Attention Director” position created
- Poor mechanisms for the redirection of agents and assets based on the changes in the world
 - Who is working what threats? Who can I re-task for this emerging threat?
- Lack of shared team awareness of the state of the world

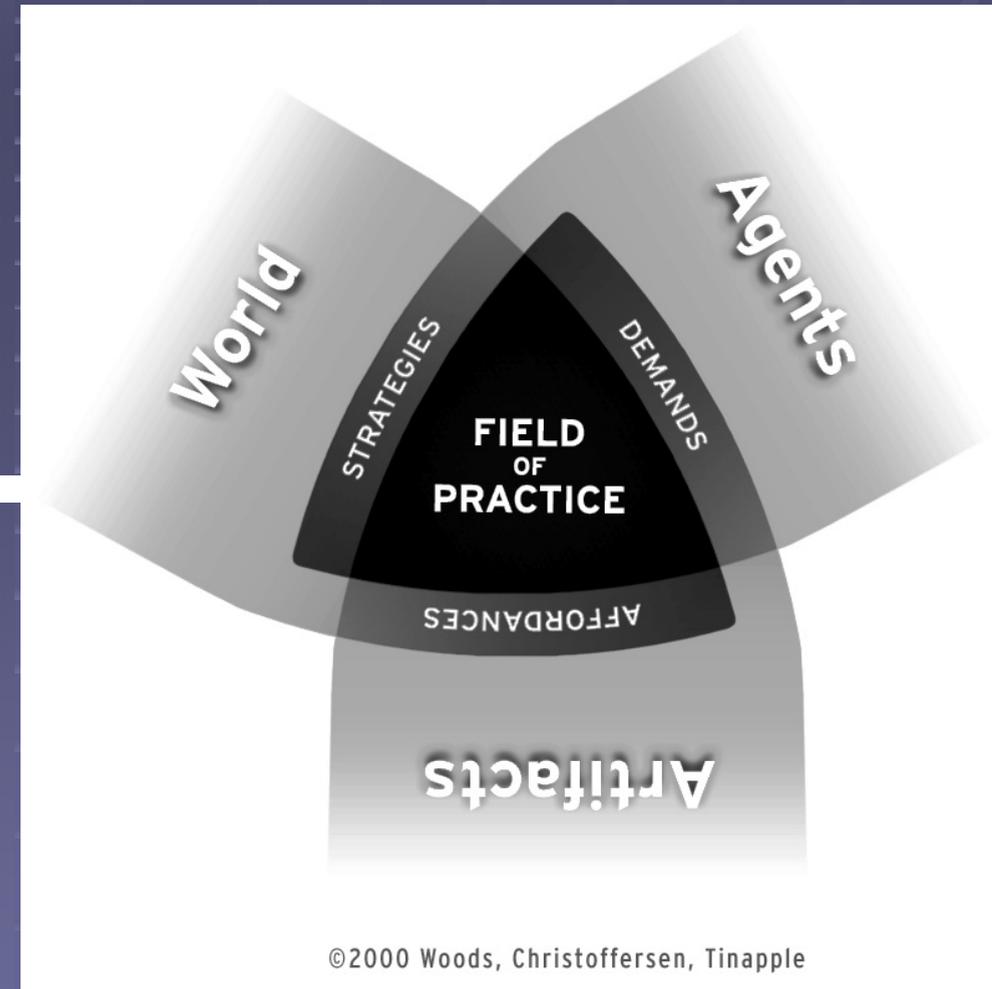
What is needed when designing a Decision Support Environment

- Design the entire space as a whole
 - Not just the scaling up of individual workstations
- Design explicit, complementary components for a team of warfighters
 - Multiple decision-makers – each a component of another decision-makers' environment
 - Asynchronous processes
- Design a decision-centered context
- Utilize technology when it supports the decision making needs

A Decision Support Environment must be treated as an entire Joint Cognitive System to effectively support multi-agent decision making teams

Joint Cognitive System (JCS)

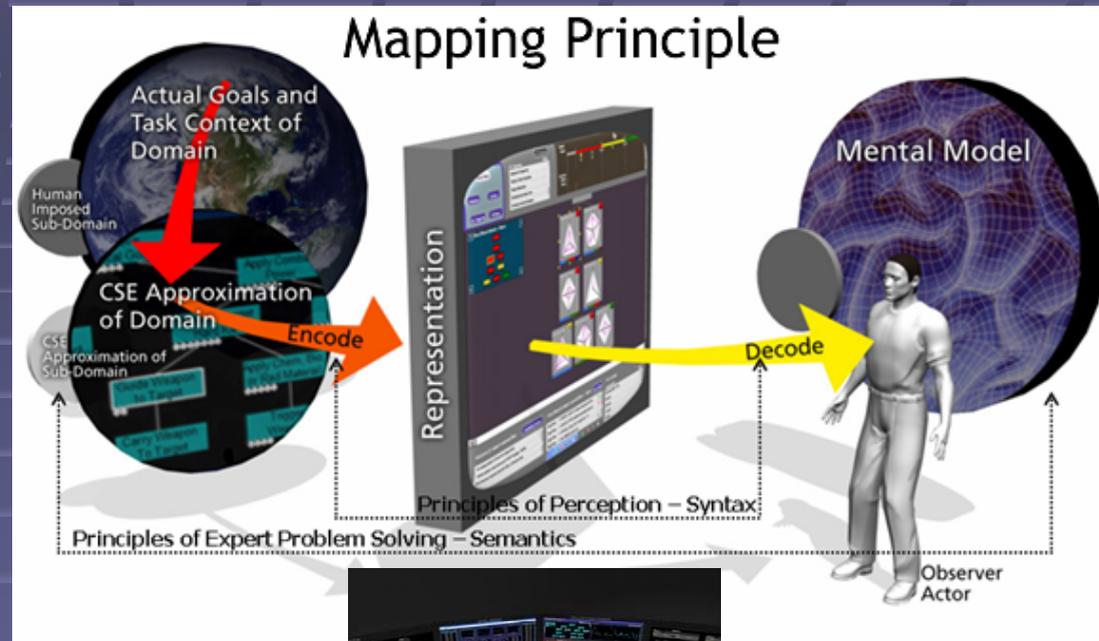
- The combination of human problem solver and automation/technologies which must act as co-agents to achieve goals and objectives in a complex work domain (Hollnagel & Woods, 2005)



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The Mapping Principle

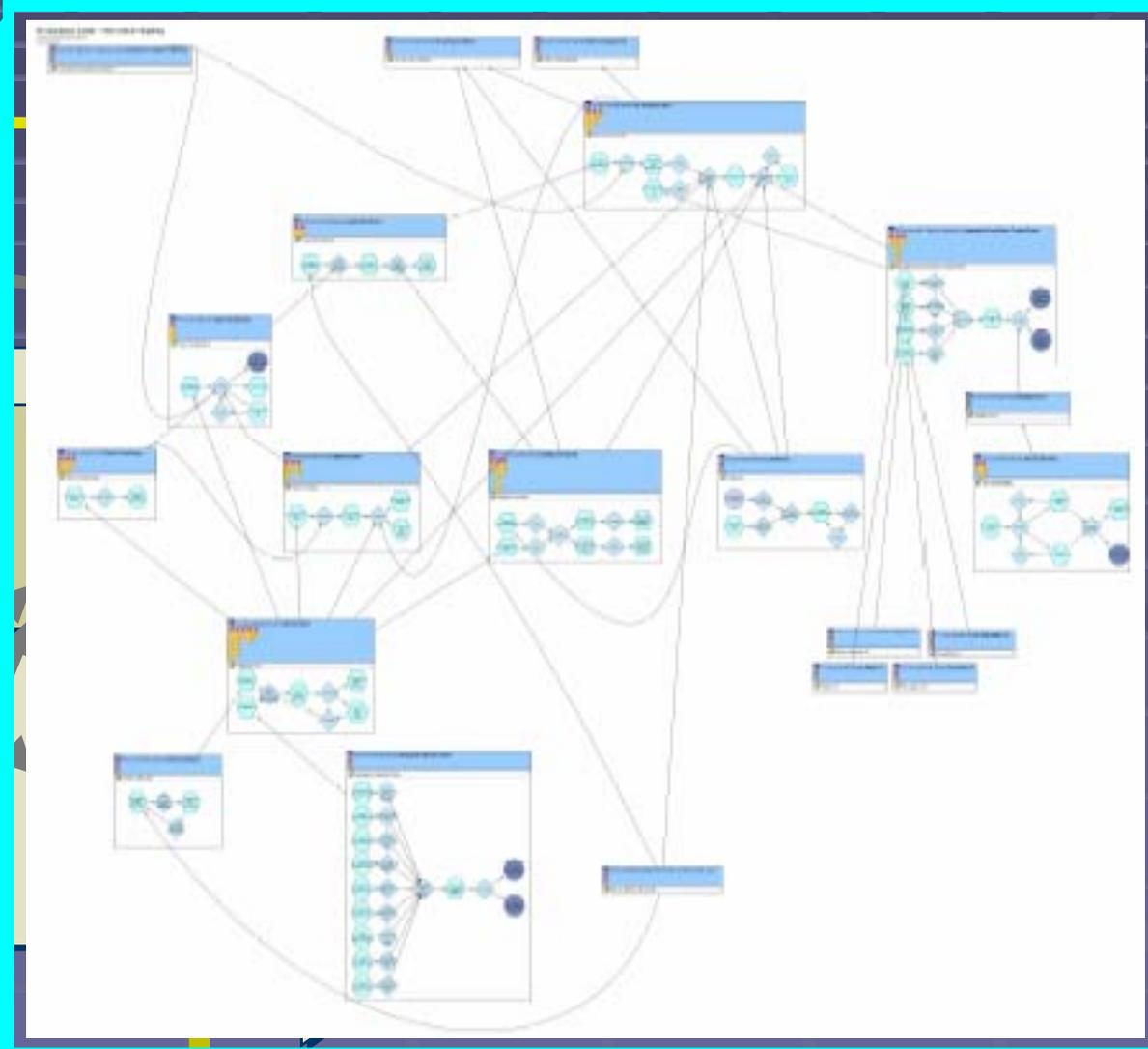
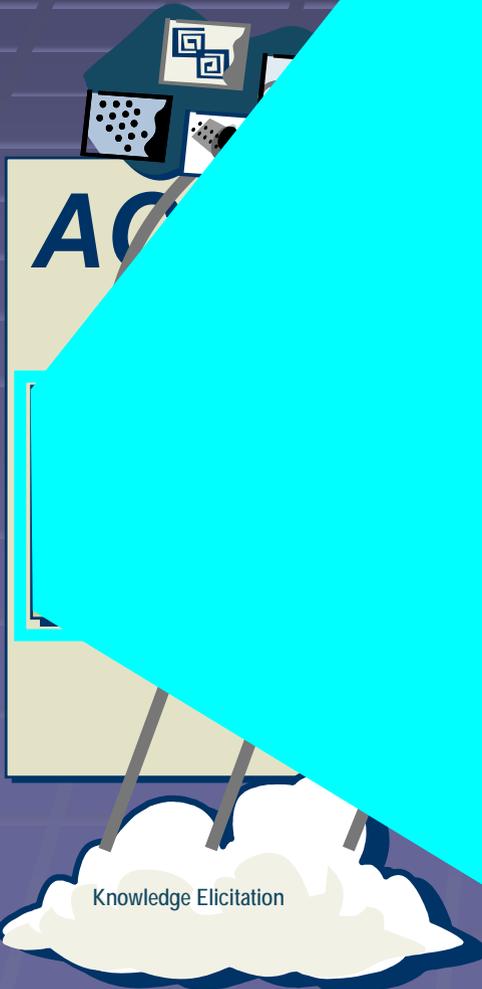
- Accurate Representation Design requires:
 - The actual goals and cognitive demands of a domain,
 - Principles of how humans problem solve and build mental models,
 - Principles of perception used to encode the CSE approximation of the domain



- For a DSE the key is to develop a mapping between information on the state of the domain to multiple presentation technologies
 - Assign functional roles to be supported by each display devices;
 - Using all displays in a complementary manner; and
 - Design additional mechanisms utilizing multiple display for team coordination and directing attention

The ACWA Methodology... A Proven Systems Engineering Approach for Decision Support Environments

Analysis



CSE Support Requirements for Achieving Highly Effective Joint Cognitive Teams

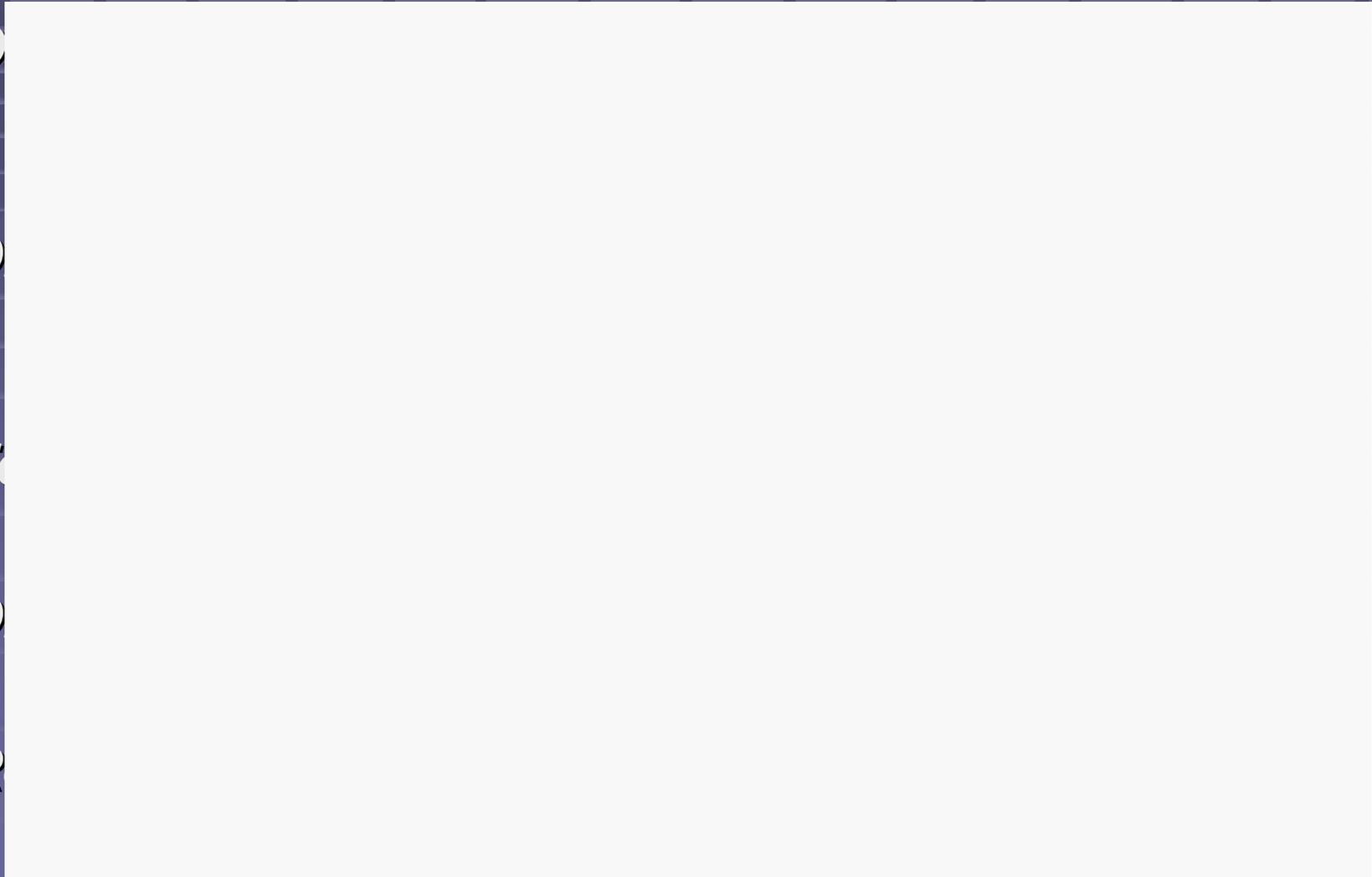
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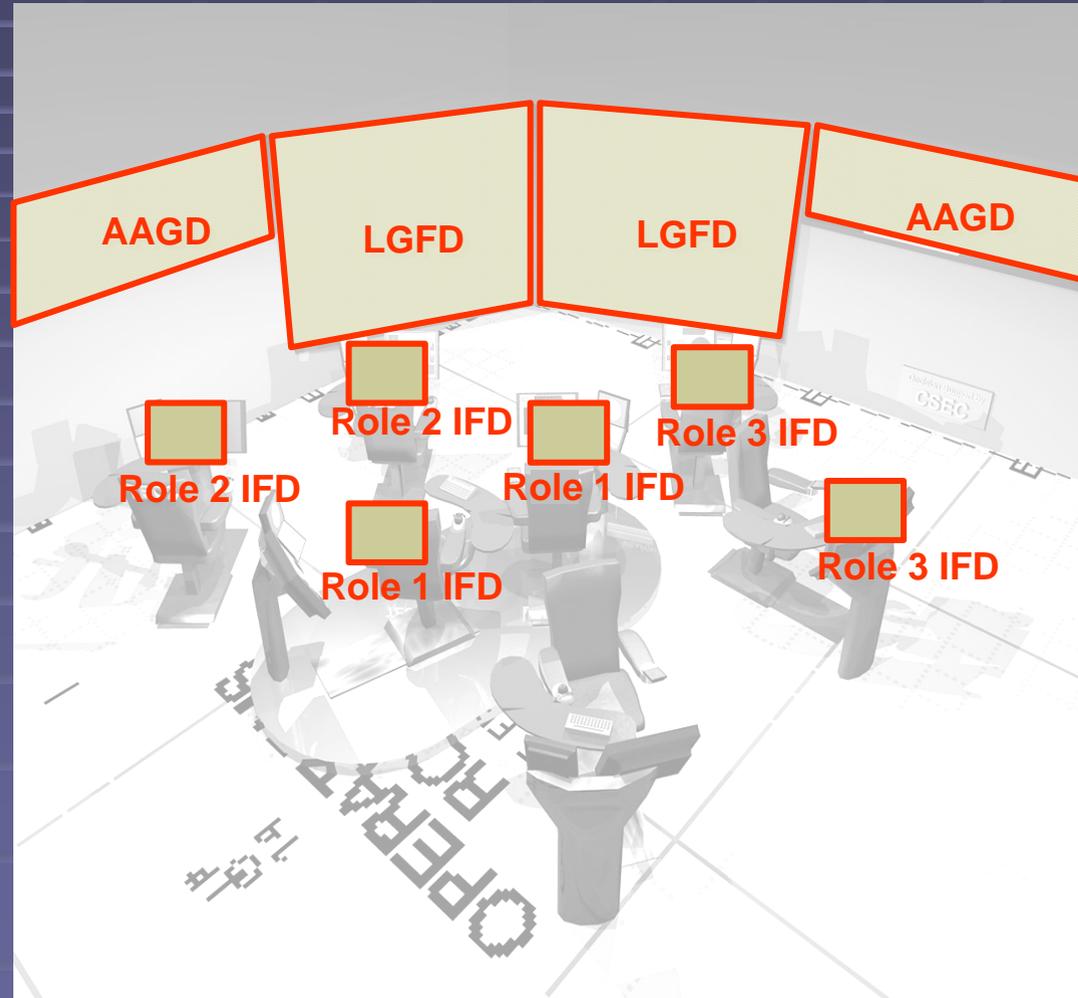


Case Study: Large Scale Decision Support Environment for Naval C2 Center

An application of Macro-CSE

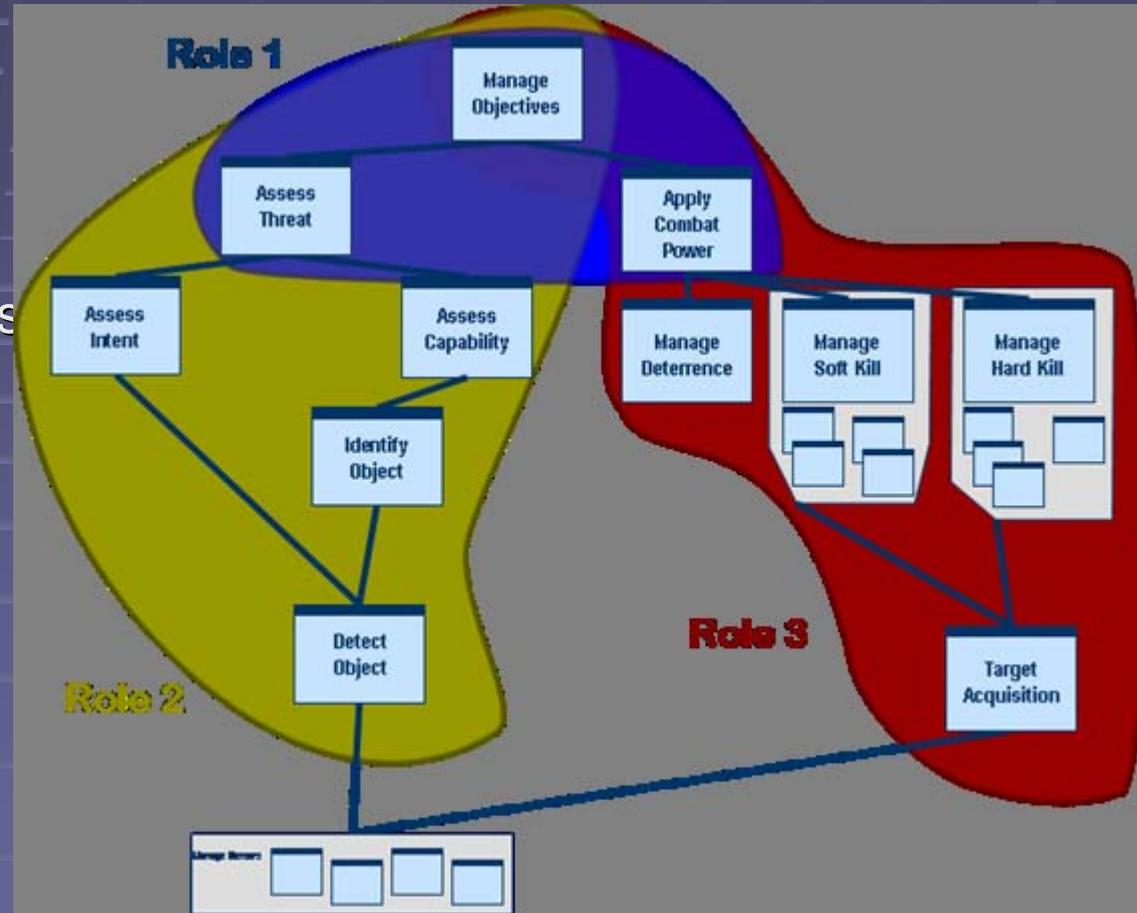
Large Scale Decision-Centered Environment

- Cognitive analysis artifacts can establish criteria for:
 - Functional role allocation
 - Physical arrangement of workstations
 - Explicit collaboration and coordination design needs
 - Contextual content of shared group, alarm and individual displays
- This LSDCE is comprised of:
 - Large Group Functional Displays (LGFD),
 - Alarm / Alert Group Displays (AAGD), and
 - Individual Functional Displays (IFD) on the individual workstations



Functional Role Allocation

- Roles centered around goals within a functional representation of the domain
- Dividing the goals and decisions of the domain based on their natural functional breaks
- New type of supervisory role – not just “overseeing”
- Collaboration across roles/teams explicit within FAN



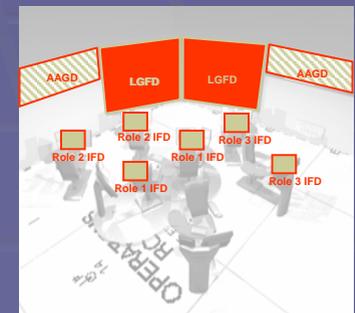
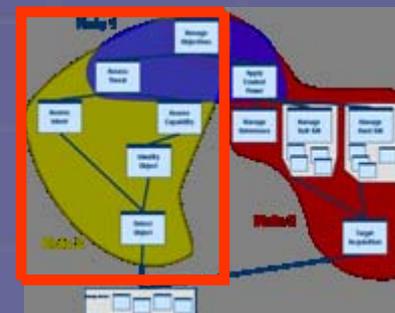
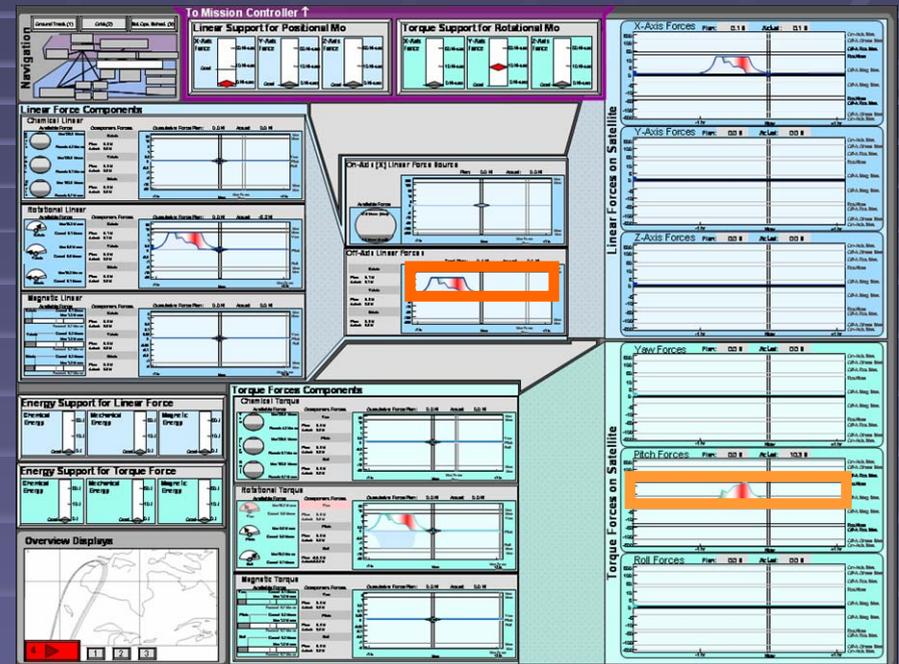
Physical Arrangement of the Room

- Based on the functional roles from the FAN – left side of the room: threat assessment, right side: weapons assignment
- Supervisory position has the raised “over the shoulder” view
- Arranged for effective interpersonal communication between role/team members
- “Heartbeat of activity” evident within C2 Center



Large Group Functional Displays (LGFD)

- Increase Observability by providing common ground
- Provide shared frame of reference, making agents' intent and activities observable to all C2 role/team members
- “WFO Glow” – to direct the attention of warfighters to emerging events
- The “what” is being worked, “why” it is being worked and what needs to be worked is evident from this functional perspective

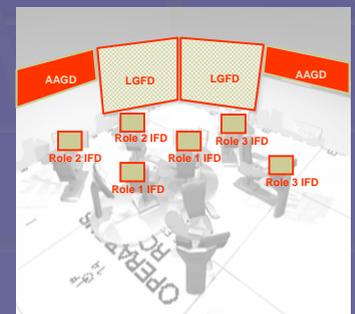


Alarm / Alert Group Displays (AAGD)

- Supports the users re-directing their own attention as anomalous events occur
- Support coordination between team members by making activity ownership observable
- Support understanding of anomaly propagation (and alternative root causes) via functional organization

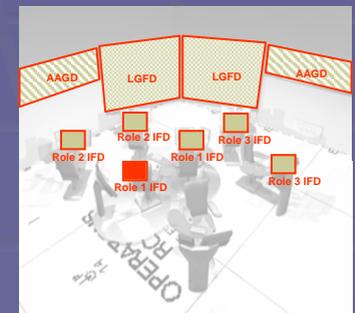
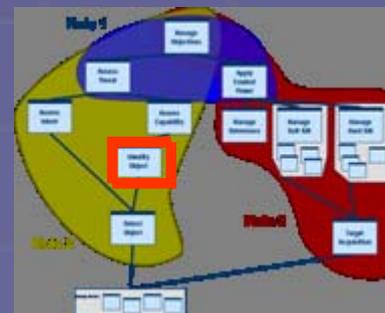


Alarm Panel used in Nuclear Reactor Control Room



Individual Functional Displays (IFD)

- Supports detailed cognitive work related to a specific functional area (role)
- The collection of IFDs portrays an entire information space
- Supports warfighter control actions within their functional role by presenting information at the appropriate level of abstraction
- Designed to support visual momentum between IFD and LGFD
- Situated to provide adequate viewing of the LGFDs and AAGDs



A Decision Center, not just a room

- The scaling up of personnel and technologies does not adequately support the cognitive demands placed on Command Team as a whole
- Treating a C2 Center as a Decision Support Environment will improve the resilience and agility of the Command Team
 - Individual Decision Making
 - Command Group Decision Making

ACWA is the only proven CSE method for C2 Center design in the fight today

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Questions?

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