Achieving a Fieldable, Acquisition Process for Human-Centered DoD Systems
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Wileman, Susan (10 Nov 2005). Personal Conversation between PI and representative of Navy Cost Analysis Division.
<table>
<thead>
<tr>
<th>Name</th>
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<tr>
<td>Ann (“Amy”) Bisantz</td>
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Capabilities-Based Acquisition

Win the War

RESULTS…not PLATFORMS

Destroy the Will of the Enemy
  - Exploit Info Ops
  - Engage Targets with Survivable Weapon Systems

Quickly Neutralize Key High Value Targets
  - Assess Effects of Attacks in Near Real Time

Destroy the Bridges
  - Destroy the Will of the Enemy
  - Deter Enemy Advancement

Destroy Fuel Reserves
  - Win the War

EBO Terms (Effects-Based Operations)

- Objective
- Effect Desired
- Capability
Guidebook Acquisition Process in Phases

**JCIDS (or Department process)** – Capability needs identified. Concept defined. Non-materiel and materiel-upgrade solutions preferred over new acquisition.

**Concept Refinement** – Refine the initial concept. Conduct Analysis of Alternatives. Define Technology Development Strategy (TDS).

**Technology Development** – Reduce technology risk. Determine product’s technology set.

**System Integration** – Integrate subsystems. Complete design. Reduce risk.

**System Demonstration** – Demonstrate useful system operation consistent with Key Performance Parameters.

**Production & Deployment** – Achieve operational capability that satisfies mission needs.

**Operations & Support** – Execute cost-effective operational support program.
Capabilities Expressed in Joint Task List(s)

- OP 3.2.4 Suppress Enemy Air Defenses
  To coordinate, integrate, and synchronize attacks that neutralize, destroy, or temporarily degrade surface-based enemy air defenses by destructive and/or disruptive means. (JP 2-01.1, 3-01.4, 3-03, 3-09, 3-09.3, 3-50.21, 3-60, 4-01.1) (JP 1, 3-05.3, 3-15, 3-17, 4-01.1, CJCSM 3500.05)

- Measures
  M1 Percent Of enemy air defenses destroyed.
  M2 Percent Of friendly air losses to enemy air defenses.
  M3 Percent Of friendly air sorties attacked by enemy air defense.
  M4 Percent Of air operations (strike packages) adequately supported by SEAD assets.
  M5 Percent Of attacks assessed to have greater collateral damage/effects than planned/expected.
Type in “Frustration”
20 of the 56 MS Word standard clip art graphics depict people with electronics. None of these appear when you type in “computer.”
“Until we are able to shape corporate life around human values, the context for work won’t bring out the best in human behavior, nor will it produce the kind of creativity that corporations recognize they need in order to innovate and grow.”

Kathleen Gumbleton, Founder & CEO
E-Strategic Research, Inc.
Fast Company Magazine, September 2005
“Human systems integration shall be used to optimize total system performance (hardware, software, and human), operational effectiveness, and suitability, survivability, safety, and affordability.” – DoDD 5000.1

“A comprehensive plan for HSI shall be in place early in the acquisition process.” – DODI 5000.2
What Does DoD Include in HSI?

Human Systems Integration (HSI)

- Focusing attention on the human part of the system
- Manpower
- Personnel
- Training
- Human Factors
- Safety
- Occupational Health
- Habitability
- Personnel Survivability

Cognitive
Physical
Sensory
Team Dynamics
Cognitive Portion of Tasks Not Addressed

- **OP 3.2.4 Suppress Enemy Air Defenses**
  
  To **coordinate, integrate, and synchronize** attacks that neutralize, destroy, or temporarily degrade surface-based enemy air defenses by destructive and/or disruptive means. (JP 2-01.1, 3-01.4, 3-03, 3-09, 3-09.3, 3-50.21, 3-60, 4-01.1) (JP 1, 3-05.3, 3-15, 3-17, 4-01.1, CJCSM 3500.05)

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Initiatives

- Navy’s Human Centered Design Environment (HCDE)
- National Research Council
  - Army and Air Force
- Air Force Research Laboratory SBIRs
  - Sponsor of the work we’re doing

Commercial, too
- Microsoft, Lexis Nexis, National Cash Register, etc.
  - Microsoft hiring anthropologists
Cognitive Engineering in the Navy

- Human Centered Design Environment for Complex Systems
  - An integrated engineering environment wherein capabilities are provided for addressing the role of human operators and decision makers in complex systems.
  - Circa 1998 effort

- Folded into Navy’s Integrated Design Environment
  - People who worked to research and develop HCDE thought it had died.
  - Used by one of the DDX contractors.
  - Hard to get a handle on how its being used and results achieved.
NRC Committee Goals (Pew)

- Provide a comprehensive review of issues involved in design throughout the system life cycle that need to be addressed by a consideration of human cognitive and physical performance characteristics.

- Evaluate the state of the art in Human-Systems Integration and product development processes, design methodologies, and design tools.

- Develop a vision for an integrated, interdisciplinary, and generalizable human-system design support methodology and tool set.

- Recommend a research plan on how to achieve this vision.
Embedding Cognitive Systems into Systems Engineering Practice.

Develop a **process and toolset**

to embed the application of the emerging practices and technologies of cognitive systems into the traditional practice of systems engineering.
SBIR AF 05-071 Participants – 5 Answers

- Aptima
- Charles River Analytics
- CHI Systems
- Deal Corp
- Florida Institute for Human & Machine Cognition
- Klein Associates
- MIT
- Ohio State
- Roth Cognitive Engineering
Who’s Answer is Right?

- Three Services
  - One integrated tool already exists
- Five Answers from AFRL SBIR

- Ken Boff says there is growing agreement across services on HIS at a high level.
- Glen Discussions: Community of practitioners does not present a united front.

- How do you make the answer responsive to change (short cycle and long cycle)?
Success Means Culture Change

- Contracts Require a Deliverable
- Culture Change Requires Buy-In

In 1997, Czaja wrote, “One problem faced by human factors engineers in system design is convincing project managers, engineers, and designers of the value of incorporating human factors knowledge and expertise into the system design process.”

Talking about knowledge-based systems in 1989, Diaper writes, “Managers have the formal power in the team, but if they are ignorant of the Naturalist Knowledge Engineering (NKE) process, may not use that power to the best advantage of the project. The NKE should ensure that everyone involved understands the process; educating the managers may need more diplomacy than is needed when educating the other team members.”
Need to Include Stakeholders in Change

- System boundaries
  - Technical Practice Alone Does not Define System
  - “Above my pay grade…”

- Example: Program Managers as Advocates
  - Need to work toward performance metrics
    - How do you measurably tie human performance to operational performance?
    - Susan Wileman of Navy Cost Analysis Division
      - Adding another engineering discipline will add costs to front-end of program.
      - Program managers will be the ones on the line justifying the additional costs.
        - Can use qualitative arguments, but must be compelling.
Include All Stakeholders in Change

- Program Managers
  - Cognitive Engineers must participate in technical management tasks.
    - PMs need to answer the cost, schedule, risk questions
      - Perception that cognitive engineering is too expensive
      - “Too little, too late” allocated to human performance
    - 225 human factors/cognitive engineering methods tabulated
      - Only four address technical management.

- Need to know how to use Human Factors & Cognitive Engineers
  - Terminology not fixed – confusing
    - What is a CSE? A CE? What should their range of influence be?
  - What value do they bring? Where do I need them? How many of them do I need?
Planning Tool – Transport System

**JCIDS**

- User needs have not been explicitly captured
- Potential consequences of error
- Solution is revolutionary (versus evolutionary)
- Human participation is being augmented with automation and semi-automated systems
- Solution has explicit human-performance goals

**Concept Refinement**

- User needs have not been explicitly captured
- Solution provides situation awareness
- Solution supports multiple missions
- Solution will be used in coalition or multi-national deployments
- Solution interoperates with other solutions
- Physical processes are difficult to characterize or unstable
- Status of the environment is difficult to known or is unstable
- Humans are involved in solution operation
- Human participation is being traded
- Cognitive performance enhancement is explicitly desired

**Technology Development**

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- Human participation is being traded
- Cognitive performance enhancement is explicitly desired

**System Development and Demonstration**

- Intensive training program must be developed prior to fielding
- Solution requires logistics support
- Solution requires maintenance
- Solution interoperates with other solutions
- New technology must be tested with human subjects
- Performance of expert users has not been explicitly characterized
- Reaction times are short
- Physical processes are difficult to characterize or unstable
- Status of the environment is difficult to known or is unstable
- Humans need to make decisions or solve problems
- Solution provides situation awareness
- Successful information transmission is critical
- Human memory use is required for expert performance
- A high degree of human attention is required

**Production and Deployment**

- User interface requires rework or modification
- Initial deployment field surveys are required
- User interface must be tested
- Solution must be tested with human subjects

**Operations and Support**

- Changes to Doctrine, Organization, Training, Manpower, Leadership, Personnel, or Facilities are indicated
- Manpower reduction is desired to decrease ownership costs
- Repeated failures are due to operator error
- User field surveys are required
Planning Tool – Process & Control Aid

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Potential consequences of error
Solution is revolutionary (versus evolutionary)
Human participation is being augmented with automation and semi-automated systems
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## Planning Tool Inputs for SD&D

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Stakeholder Outreach – a Program

Each Ring a Separate Project.
Process of Processes

JCIDS: Capability Need Identification and Concept Generation

Doctrine, Operations, Training, Manpower, Leadership & Education, Personnel, Facilities: DoD Component Enterprise Infrastructure

Planning, Programming, Budgeting, & Execution: Government Budgeting

Contractor Acquisition: Technology Development, System Definition, Design, Manufacture, Test, V&V

Science and Technology: Technology Development

Operation, Sustainment and Training: DoD Component Usage
Make Change Available and Attractive

- No outsiders.
  - Process and product must be inclusive.
  - Short-term cooperation & collaboration enables long-term competition.

- Easy access when budget is limited.
  - Open source environment with guides.
  - Government: Combatant commanders, sponsors, JCIDS participants.
  - Universities: Support research and capstone design projects.
No Outsiders: Three Approaches to SoS – Jack Ring

HCDE
NRC goal?

Interconnection
Fission
Fusion

Z(S1) Z(S5) Z(S2)
Z(S3) Z(S6) Z(S4)
Z(S7.1) Z(S7.2)
Change Must Be Understandable

- Human Systems Need to be Addressed in An Integrated Fashion
  - PM: “How do you divide HSI boundaries?”
    - Manpower
    - Personnel
    - Training
    - Human Factors
    - Safety
    - Occupational Health
    - Habitability
    - Personnel Survivability
  - How do you communicate areas of responsibility to program planners?
    - I don’t do safety or occupational health?
Is The Whole Individual Being Addressed?

Cognition  Affect

Conation
Air Operations Center

What happens when you put 160 colonels inside one acre?
Presentation’s End

- Not showing the solution.
- Examining how to create an environment in which the solution can be organically grown.
  - How you get to “best of breed” perhaps.
- Engaging the community.
Discussion
Ideas, Suggestions, Solutions, Updates

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