The Human in Defense Systems

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Outline

• Challenges and Opportunities
• Human-Centric Acquisition
• Connections Between the ASD(R&E) Communities of Interest
• Guiding Vision: Man-Machine Interfaces
• Developing a Systems Engineering “Language”
Challenges and Opportunities
Challenges and Opportunities

• Challenges:
  – Reducing the cost of defense systems throughout their life cycle
  – Research in human systems does not always transition into Programs of Record (PoR)

• Opportunities:
  – Human systems research significantly impacts the DOTMLPF spectrum
Challenges and Opportunities

• The DoD and Industry are working together to:
  – Eliminate bad human-systems integration
  – Develop tactics, techniques, and procedures to optimize human performance
Challenges and Opportunities

• Request Industry to further participate by:
  – Mirroring the DoD placement of the human at the center of the Acquisition Process
  – Encouraging human systems researchers to think of the Programs of Record as their “customer”
Human-Centric Acquisition
DoD S&T Focus Has Traditionally Been System Centered

**Enablers/Commons**
- Space Programs (PNT, Comms, ISR)
- Cyber
- EW/EMS
- C2
- Undersea Offensive

**Focused on big acquisition systems**
- Air Force
- Navy
- Marine Corps
- Army

Distribution Statement A: Approved for public release; distribution is unlimited.
A car is not this....
…it is this!

Mostly materiel with human interface
Soldier system is not this...
Mostly human with materiel interface
Human-Centered Acquisition

- The human is the starting point for system design
- Expands upon the capabilities of the Warfighter
Interactions with the Requirements writers within the Joint Staff and Components will bring human systems considerations into the planning cycle.
Connections Between the ASD(R&E) Communities of Interest
Interactions with Human Systems Col

Existing Interactions

- Electronic Warfare/ Electronic Protection
- Biomedical
- Weapons Technologies
- Sensors and Processing
- Ground and Sea Platforms
- Cyber Security
- Autonomy
- Materials and Manufacturing
- Advanced Electronics
- Counter IED
- Energy and Power
- C4I
- Air Platforms
- Counter WMD
- Engineered Resilient Systems

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Joint Human Systems IR&D
Technical Interchange June 2013

Contact: Jaymie Durnan, Jaymie.a.durnan.ctr@mail.mil

Online Virtual Interchange

HS COI Selection

Evaluation Criteria

- Link to technology gap
- Tech insertion opportunity
- Risk level
- Meets requirement?
- Innovation

Submissions Evaluated by CoI Subarea Leads, Service Reps and SMEs

Results

19 companies selected to brief 43 projects

DefenseInnovationMarketplace.mil

Nov 12  Mar 13  May 13  24-28 Jun 13  Dec 13
Joint Human Systems IR&D
Technical Interchange June 2013

• All 19 companies provided follow-on opportunities
  – Meetings, site visits, data exchanges
  – Key organizations at OSD and Services are engaged
  – Working CRADAs, MOAs, and research proposals

• Industry feedback
  – “Marketplace very helpful to get the “Big Picture” of the Human Systems CoI”
  – “Tri-Service approach very effective and efficient”
  – “Senior level insight helped provide context to Fedbizopps data”
  – “Left the Technical Interchange knowing someone in DoD was interested in their projects”

• DoD Next Steps
  – Track actions and status outcomes of projects
  – Committed to using process
Changing the Emphasis of DoD Data Analytics

- Interacting with data analytics researchers to focus part of their research on decision making
- DoD is hosting a Technical Interchange Workshop to better understand how decision scientists, computer scientists, and visual display experts need to interact to optimize decision support tools
- Systems Integration Laboratories (SILs) will be used to evaluate the effectiveness of data analytics toolsets in human decision-making scenarios

Contact: Bindu Nair, bindu.r.nair.civ@mail.mil
Vision for Decision Support

Data Repository

Leads to:
- Change of doctrine
- Individual training

Outcomes captured for meta data analysis

Individual makes a decision which leads to action

Understand individual decision making

Provide appropriate data to assist decision process

Change of doctrine

Individual training

Outcomes captured for meta data analysis

Individual makes a decision which leads to action

Vision for Decision Support

Change of doctrine

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Guiding Vision: Man-Machine Interfaces
Guiding Vision: Natural Human-Technology Interactions

These soldiers will move through this building...without speaking a word

Need to replicate this for human–technology interactions

More interactive and faster responding “hybrid human-machine teams”
Converge Multiple Domains: Natural Human-Technology Interactions

**Computational Modeling**
Simulate human information processing

**HUMAN**

**MACHINE**

**Knowledge Systems**
Store/search for information

**Neuroscience**
Brain’s operating principles

**Evolutionary Biology / Social Psychology**
Cognitive and Behavioral operating principles

**Context Inference**
Reason about a situation

**Computer Vision**
Lays groundwork for reasoning about a situation

Contact: CDR Joseph Cohn, joseph.v.cohn.mil@mail.mil
Developing a Systems Engineering “Language”
Set-based design:

- A design method that requires a shift in how one thinks about and manages design
- Allows more of the design effort to proceed concurrently and defers detailed specifications until tradeoffs are more fully understood

Contact: Sue Butler, Natick Soldier RDEC, susan.j.butler8.civ@mail.mil
**Platform Soldier and Small Unit Air Ground**

Chassis/Frame

**Dynamic, Flexible, Variable** (biological/physiological/psychological/sociological based)

**Rigid, Static** (laws of physics based, very small platform)

**Rigid, Static** (laws of physics based)

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**Systems Engineering Approach**

**Air**

- Avionics
- Engines, motors
- Cameras, lens, imaging, sights
- Computers, sensors, levers
- JP-8, batteries, etc
- Comms devices, systems and network connectivity
- Diagnostics & Maintenance

**Ground**

- Vehicle Electronics
- Engines, motors
- Cameras, lens, imaging, sights
- Computers, sensors, levers
- JP-8, batteries, etc
- Comms devices, systems and network connectivity
- Diagnostics & Maintenance

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**Subsystems** (few examples only)

- **Electronics**
  - "Humionics" – brain, contextual processing
- **Propulsion**
  - Muscles & willpower
- **Optics**
  - Eyes & Vision
- **Controls**
  - Brain & cognitive processing
- **Fuel / Power**
  - Food & water
- **Communications & Networks**
  - Verbal & non-verbal language, social networks, culture
- **System Health**
  - Fitness & wellness

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**Soldier/Small Unit: The Army's ONLY weapons system platform not aligned to an integrated architecture**

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**Applying MilStd.881 Construct**
Platform Soldier and Small Unit Air Ground

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Subsystems (few examples only)

Electronics

“Humionics” – brain, contextual processing

Worn & borne electronics

Avionics

Vehicle Electronics

Engines, motors

Cameras, lens, imaging, sights

Computers, sensors, levers

Batteries, fuel cells, generators, etc

Comms devices, ad hoc mobile network

Diagnostics & Maintenance

Propulsion

Muscles & willpower

Engines, motors

Engines, motors

Engines, motors

Optics

Eyes & Vision

Cameras, lens, imaging, sights

Computers, sensors, levers

Computers, sensors, levers

Controls

Brain & cognitive processing

Computers, sensors, levers

Computers, sensors, levers

Fuel / Power

Brain, muscle & willpower

Batteries, fuel cells, generators, etc

JP-8, batteries, etc

JP-8, batteries, etc

Communications & Networks

Verbal & non-verbal language, social networks, culture belongingness / unit cohesion

Comms devices, ad hoc mobile network

Comms devices, systems and network connectivity

Comms devices, systems and network connectivity

System Health

Diagnostics, prognostics, treatment, fitness & wellness

Diagnostics & Maintenance

Diagnostics & Maintenance

Diagnostics & Maintenance

Combining socio-technical system technical system

Applying MilStd.881 Construct

System Engineering the Army’s “Soldier System”

Soldier and Small Unit: The Army's ONLY weapons system platform not aligned to an integrated architecture
**Soldier and Small Unit Systems Illustration of the Challenge**

*(in comparison to other Weapons Platforms)*

### Systems Engineering Approach

Applying MilStd.881 Construct

### Platform

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- **Controls**
  - Brain & cognitive processing Willpower
  - Computers, sensors, levers

- **Fuel / Power**
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  - Brain, muscle & willpower
  - Batteries, fuel cells, generators, etc

- **Communications & Networks**
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- **System Health**
  - Diagnostics, prognostics, treatment, fitness & wellness
  - Diagnostics & Maintenance

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**Soldier/Small Unit: The Army’s ONLY biologically-based weapons system platform**
Summary

• Human systems research provides opportunities to bend the cost curve of DoD acquisition
• DoD is emphasizing the connection between the human and the technology
• DoD is sponsoring several workshops to build upon the “Guiding Visions”