

Human Systems COI Taxonomy & Definitions

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Personalized Assessment, Education, & Training

Research and development in personnel assessment will produce integrated measures and adaptive testing for more precise assessment of individual potential, yielding improved personnel selection and assignment. While work in education and training will produce competency-based systems for full spectrum, rapidly updated, adaptive training that will accelerate learning. Together these capabilities will enhance warfighter readiness and retention while decreasing costs for skills acquisition and maintenance.

THRUST AREA 1: First Principles for Training Design

S&T Focus Areas on Roadmap:

- Automated Knowledge Elicitation / Engineering
- Mechanisms of Cognitive Processing
- Multi-Level Modeling for Readiness Management
- Cognitive Model and Scale Integration
- Integrated LVC Training and Assessment

Addressing These Technical Challenges:

- Develop ability to model individual expert behaviors
 - Need pedagogical models/knowledge elicitation for training development (e.g., intelligent tutoring systems (ITS))
 - Need to validate high resolution metrics to measure mission effectiveness at individual and unit level
 - Need computational models of human cognitive, psychomotor, and perceptual capabilities for current and future missions

Providing These Operational Opportunities:

- Technologies for large scale Live, Virtual and Constructive (LVC) training environments
- Better models enable building more realistic synthetic agents to play blue or red forces

THRUST AREA 2: Personnel Selection and Assignment

S&T Focus Areas on Roadmap:

- Predictors: Expand/refine non-cognitive measures (Tailored Adaptive Personality Assessment System)
- Outcomes: Expand/refine behavior & performance data
- Models: Expand/refine predictive analytic model for integrated cognitive + non-cognitive measures to predict attrition, performance, & behaviors

Addressing These Technical Challenges:

- Predictor measures: Existing measures lack individualized precision and are not integrated
- Outcome measures: Performance, behaviors difficult to measure/systematically obtain over a career
- Predictive models: Existing models are stove-piped and based on group probabilities

Providing These Operational Opportunities:

- Deliver life-long learning
- Continuous career field learning and management

Systems Interfaces & Cognitive Processes

Research and development in this area will produce human-technology interfaces that enhance warfighters' ability to focus on their primary mission. These cognitively engineered interfaces will be intuitive to use, will learn with experience, and support mixed-initiative communication.

THRUST AREA 1: Intelligent, Adaptive Aiding

S&T Focus Areas on Roadmap:

- Physiological, Behavioral, And Cognitive Sensing & Assessment
 - Socially-Guided Machine Learning
- Cognition, Performance and Individual Differences
 - Computational Models of Operators' Beliefs, Desires, Intentions and other Mental States
- Molecular Signatures
- Applied Neuroscience
 - Human-System Co-Adaptation
- Gesture/non-verbal interaction

Addressing These Technical Challenges:

- Immature intuitive, multisensory, adaptive interfaces
- Lack of robust and reliable natural language interfaces
- Absence of effective gesture control interfaces
- Fragile cognitive models and architectures for autonomous agents and synthetic teammates
- Insufficient degree of trust calibration and transparency of system autonomy
- Immature decision support tools

Providing These Operational Opportunities:

- Seamless human-machine interfaces to enable optimized weapon system and warfighter performance in all contested domains and mission environments:
 - Focus: Highly effective, agile human-machine teaming
 - Ensure safe and effective systems in uncertain and dynamic environments

THRUST AREA 2: Human-Machine Teaming

S&T Focus Areas on Roadmap:

- Human-Robot Interaction
- Cognitive Architectures and Integrated Intelligent Systems
 - Socio-Cognitive Architectures
- Mission-Specific Natural Language Dialogue
 - Unrestricted Natural Language Dialogue
- Gesture/non-verbal interaction
- Trust Calibration
- Multisensory Perception and Interfaces

- Fusion Exploitation Tool Suite
- Interfaces to C2 Information Systems
 - Distributed Intelligent Interfaces for Human-Centric Info Systems
- Mission Planning and Scheduling Tools

Addressing These Technical Challenges:

- Immature tools for individual and team functional state assessment
- Fragile cognitive models
- Operationalize minimally invasive sensor suites
- To Identify the appropriate biomarkers for determining operator performance
- Absence of effective gesture/non-verbal interfaces

Providing These Operational Opportunities:

- Seamless human-machine interfaces to enable optimized weapon system and warfighter performance in all contested domains and mission environments:
 - Focus: Create actively coordinated teams of multiple machines
 - Ensure safe and effective systems in uncertain and dynamic environments

Protection, Sustainment & Warfighter Performance

Research and development in this area will produce better understanding of the critical environmental stressors and the human factors yielding individual performance differences in operational environments in order to mitigate their effects. This includes designing systems that support and exploit individual differences, and developing operationally relevant metrics to monitor and assess performance.

THRUST AREA 1: Understanding and Quantifying the Effects of Critical Stressors

S&T Focus Areas on Roadmap:

- Physical Performance and Individual Differences
- Real-Time Data Analysis and Performance Prediction
- Warfighter Assessment in All Environments

Addressing These Technical Challenges:

- Sensors needed that are non-invasive, don't influence performance, and provide meaningful data
- The underlying mechanisms by which specific stressors influence performance are poorly understood
- The influence of human variability on the effects of stress on warfighter performance is poorly understood. Some people perform better with stress, others perform worse
- High fidelity models that predict performance and injury are lacking

Providing These Operational Opportunities:

- Real-time monitoring of Warfighter performance
- Understanding the underlying mechanisms through which performance is influenced

THRUST AREA 2: Critical Stressor Mitigation Strategies

S&T Focus Areas on Roadmap:

- Development of Physical Augmentation Devices
- Modeling Effects of Mitigation Strategies

- Reducing Effects of High G Environments
- Reducing Physical Load

Addressing These Technical Challenges:

- Tools to model effects of augmentation on physical performance and injury potential are still in development
- Route planning tools require high fidelity models of human physiological response to critical stressors
- Individual variability influences the extent to which physical augmentation can mitigate physical loads

Providing These Operational Opportunities:

- Model individual responses to critical stressors to enable leveraging of individual variability to improve Warfighter performance

Human Aspects of Operations in Military Environments

Research and development in this area will yield capabilities that exploit knowledge of combatant and non-combatant beliefs, attitudes, and norms that motivate threat behaviors. These capabilities will improve sociocultural situation awareness, enable more accurate forecasts of human behavior, and consequently yield more robust courses of action.

THRUST AREA: Exploiting Social Data, Dominating Human Terrain, Effective Engagement

S&T Focus Areas on Roadmap:

- Media Predictive Analytics
- Augmented reality Tactical Displays and Novel Sensors
- Full Spectrum Social Media Exploitation for I/W, Information Operations, and Strategic Communication
- Foreign Language Translation and Narrative Analysis for Text, Video and Audio
- Military Relevant Transdisciplinary Research on New Threat Actors, Crisis Response, And Human Security Needs in Cyber and Real-World Contexts

Addressing These Technical Challenges:

- Lack advanced modeling and complex algorithms to process new social data streams for actionable information in real-time
- Poorly understand new social dynamics including cyber-social behavior, global reach and new social innovations
- Few well developed counter-measures, TTPs and resources to guide military engagement in the human domain to impact rapidly changing crises
- Goals to drive military capabilities are reliant upon programs that are *not* fully funded and *not* structurally aligned/accountable to long-term military objectives

Providing These Operational Opportunities:

- Predictive, autonomous analytics to forecast and mitigate human threats and events
- Provide real-time situational awareness (SA)
 - Engage and defeat new adversaries and tactics
 - Anticipate human crises & mission problems