
# Human Systems Community of Interest

## Personalized Assessment, Education, and Training

**Dr. Elizabeth Uhl**

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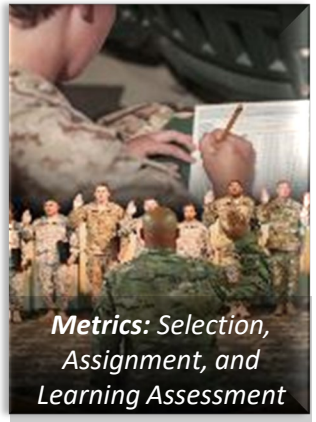
# 1.0

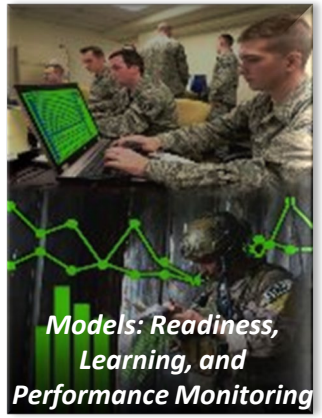
# Personalized Assessment, Education, and Training

*Right Person with the Right Training in the Right Job on the Right Team at the Right Time*

## VISION

**A readiness ecosystem to identify and develop knowledge, skills, competencies, and experiences to be mission ready for the 21st century operating environment**






## OPERATIONAL OPPORTUNITIES:

- Synthetic operational training and test infrastructure capability that enables us to Train-as-we-fight with advanced warfighting capabilities and complex joint-all-domain environments
- Individualized proficiency-based learning environments, technologies, and training paradigms for mission ready multi-capable warfighters
- Personalized assessments and data-driven analytics of training, education, readiness, and mission effectiveness for career-long talent management, individual learning, and organizational learning
- Environments enabling sophisticated autonomous systems and human operators to train as teams in operationally relevant contexts

## ENDURING CHALLENGES (OPERATIONAL CONSTRAINTS):

- Inadequate ranges and training infrastructure for advanced weapon system capabilities
- Live training potentially exposes capabilities and tactics
- Dynamic, evolving operational environments and adversaries
- Limited resources for manpower, training, and education
- Increased technological parity with adversaries

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# 1.0 PAE&T Taxonomy

**1.1 Personnel Selection and Assignment**

1.1.1: Individualized Measures of Aptitude and Competencies *

1.1.2: Career-Long Outcome Measures *

1.1.3: Predictive Models of Performance, Learning, Counterproductive Behaviors, and Retention

**1.2 Instruction/Training Design, Assessment, and Readiness Monitoring**

1.2.1: Data, Advanced Analytics, and Learning Sciences

1.2.2: Cognitive and Performance Modeling

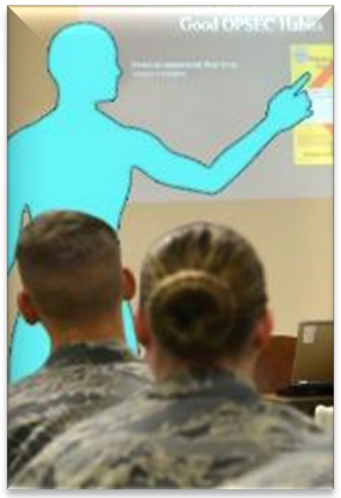
1.2.3: Innovative Instructional Design and Methodologies

**1.3 Advanced Learning Technologies**

1.3.1: VR/AR/MR and Integrated Simulation Systems

1.3.2: Intelligent Tutoring and Assessment Systems

1.3.3: Training for Human-Machine Teams *



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# 1.1 Personnel Selection and Assignment

**PAET**

*Ensure Department of Defense has fighting force required to defend the United States*

AF | Army | Navy

| | *Near* (2024-2028) | *Mid* (2028-2038) | *Far* (2038+) |
|---|---|---|---|
| Warfighting Capability | • Personalized assessments to improve assignment, force development, and readiness. | • Holistic, integrated understanding of service member capabilities supporting job performance and individual readiness | • Data-driven talent management of individual careers and team/unit personnel readiness |
| Technology Product | • Intelligent Assessment Systems | • Metrics for assessing human resiliency<br>• Systems to unobtrusively measure personnel completing skills to assess performance and inform skill training | • On-going and longitudinal assessment of performance to track job performance and training accomplishments through a career-long framework |

| S&T Efforts | Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|---|
| | • TAPAS | • Holistic Personnel Assessment<br>• Technology-Savvy Soldiers<br>• Team Assignment & Performance | • Developing a leadership competency model for all TYCOMS for use in Sailor assessment, selection, development<br>• The Assessment, Prediction, and Prevention of Destructive Employee Behaviors<br>• Targeted Talent Management Modernization (T2M2)<br>• Establishing a new Robotics and Autonomous Warfare enlisted rating |

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# 1.2 Instruction/Training Design, Assessment, and Readiness Monitoring

**PAET**

*Ensure Department of Defense has fighting force required to defend the United States*

AF | Army | Navy

| | Near (2024-2028) | Mid (2028-2038) | Far (2038+) |
|---|---|---|---|
| Warfighting Capability | • Improved targeting of training to individual needs to meet production demands, and increase learning gains. | •Ability to quickly and accurately identify and develop warfighter cognitive strengths<br>•Personalize training<br>•Quantitative Readiness assessment and management | •Ability to quickly and effectively generate joint and coalition training exercises<br>•Integrated team of teams training and assessment |
| Technology Product | • Use training technologies to develop adaptive curricula and content, via micro- and macro-adaption methods, that are based on the science of learning to rapidly develop expertise<br>• Increased training realism in wargaming exercises based on human factors modeling. | •Real-time assessment of complex cognitive task performance compared to expert model to drive critical task intelligent tutors<br>•Systems to unobtrusively measure personnel completing skills to assess performance and inform skill training | • Software & hardware to LVC-TE that simplify simulation development processes, enhance training utility by capturing performance data, and support integrated after action review for training units. |

| S&T Efforts | Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|---|
| | • Holistic Models for Decision-Making<br>• Information Mastery for Cognitive Warfare | • Leader Competencies for Complexity & Uncertainty<br>• Team Assignment & Performance<br>• Experience Design Tool<br>• Competency Based Experiential Learning<br>• Simulating and Assessing stress response in immersive training<br>• AI Research Center for Excellence in Education [Joint] | • Streamlined Marine After-Action Review Tool – Visualization (SMART-Viz)<br>• Fleet Adaptive Multilevel Measurement for Operations and Unit Systems (FAM2OUS)<br>• Distributed Open Ocean Mission Rehearsal<br>• MyNavy Foresight: developing a manpower planning/prediction tool |

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# 1.3 Advanced Learning Technologies

**PAET**

*Ensure Department of Defense has fighting force required to defend the United States*

AF | Army | Navy

## Warfighting Capability

### *Near* (2024-2028)

- Improved learner experience
- Increased efficiency in training investments

### *Mid* (2028-2038)

- Enhanced training fidelity
- Reduced manpower costs for instructors and white force support in training
- Improved training efficiency and effectiveness

### *Far* (2038+)

- Routine access to large force exercises representative of current and future threat environments
- Increased acquisition speed and agility for developing and transitioning new technology
- "Train as we Fight" capability for joint all-domain operations

## Technology Product

- Learning environments tailored to training objectives and outcomes
- Intelligent tutoring systems for initial skills training
- Proliferation of augmented & virtual reality training scenarios & capabilities
- AI-enabled AARs for training settings that will inform curriculum adjustments
- Integrated AR/VR training and job aiding
- Domain-specific LVC training
- Integrated training and test environments and infrastructure for specific domains
- Automated scenario authoring and performance assessment

## S&T Efforts

### Air Force Efforts

- Co-Learning for Adaptive Human and Machine Teams
- Just In Time Multi Mission Airmen/Warfighters
- Warfighter Learning Technology
- S-ODC: Synthetic Operational Training and Test Infrastructure for Distributed Command, Control, and Communications for Battle Management

### Army Efforts

- CompGen: Automated Scenario Generation
- Multi-modal Automated Performance Assessment across LVC
- Team Dimension training in VR
- Generalized Intelligent Framework for Tutoring w/ AAR
- Team-Adaptive Coaching for Training AI Competencies Using Reinforcement Learning (TACTAIC-RL)

### Navy Efforts

- Next Generation Infantry Battalion Training
- Simulation Enhancement and Modernization Suite.
- Live, Virtual, and Constructive Cyber Battle Damage Assessment for Training
- Investigating Locomotion Interfaces in VR to Train Spatial Knowledge
- A Novel Approach for Optimizing Training System & Synthetic Environment Algorithms

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# PAE&T Success Stories

## Occupational Aptitude Battery

### Challenge

- Officers lack exposure to and information about functional career paths that may be a good fit for their talents, and functional areas have limited validated talent data to support officer recruitment and selection.

### Impact

- The Occupational Aptitude Battery (OAB) provides innovative Talent Management methods to optimize officer career pathing by increasing officer exposure to functional area career opportunities, supporting functional area recruitment efforts, providing validated measures of officer talents for the Voluntary Transfer Incentive Program (VTIP), and enhancing the match between officer talents and career paths.

U.S. Army Photo (2017). https://flic.kr/p/XJBDbc

### Accomplishments and Transitions

- Developed the OAB, a holistic personnel assessment measuring critical knowledge, skills, and abilities (KSAs) for functional area careers.
- Initiated validations of the assessment with functional area incumbents and officers attending the Captains Career Courses.
- Actively engaged with TRADOC to prepare for an operational pilot in Q1FY24 and the transition of the assessment in Q2FY24, at which point it will be administered as a mandatory assessment to officers in the Captains Career Courses.

POC: Dr. Elizabeth Uhl. Elizabeth.R.Uhl.civ@army.mil

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# PAE&T Success Stories

## Army Talent Attribute Framework

### Challenge

- The Army lacked an integrated attribute framework for describing all jobs in the Army using a unified and comprehensive language. The lack of a standardized framework prevented the development of data-centric talent management systems, as envisioned in the Army People Strategy.

### Impact

- The Army Talent Attribute Framework (ATAF) creates a unifying lexicon of attributes enabling the Army to develop Human Capital policies, programs, and processes to support an integrated and efficient talent management system. Facilitates standardized, data-driven decision-making. Allows understanding and documentation of attribute requirements for current and future force, supporting modernization of talent management.

### Accomplishments and Transitions

- Published the ATAF, an ASA(M&RA)-approved, enterprise-wide lexicon for describing Soldier job requirements with support from ATMTF, OEMA, TRADOC G-3/5/7, and CAC.
- Incorporated into IPPS-A marketplace as common lexicon for identifying position KSB requirements and Soldier talent requirements to facilitate matching.
- Linked to TRADOC's Athena system of assessments.


Army Talent Attribute Framework

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# PAE&T Success Stories

## Joint Terminal Attack Controller (JTAC) Virtual Trainer (JVT)

**JVT is a mobile and deployable virtual reality trainer system for close air support and other fires training that J6 accredited in October 2022.**

### Accomplishments and Transitions

- Used for the first time to certify an entire small unit by 1st ANGELICO in pre-deployment certification exercise.
- The system was showcased to Fort Sill staff members to discuss potential integration into the PoI in support of the Scout-Observer, Joint Fires Officer, Fire Support Chief, and the Marine Artillery Officer Basic courses.
- Demonstrated to the Air Warfare Development Center (NAWDC) Joint Terminal Attack Controller Qualification Course – plans to provide system to the schoolhouse.
- Software and hardware updates were provided to Expeditionary Warfare Training Group, Atlantic (EWTGLANT) for continued development feedback.

POC: Dr. Peter Squire, Office of Naval Research


# Human Systems Community of Interest

## Systems Interfaces and Cognitive Processes

**Dr. Mark Draper**

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# 2.0 Systems Interfaces & Cognitive Processes

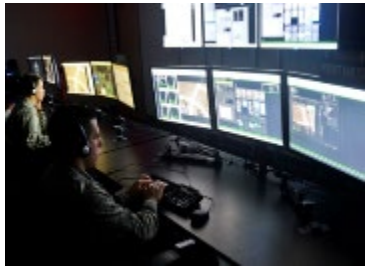
*Effective, Natural Human-Machine Teaming*

## VISION

***Supporting Warfighter teams with agents and machines through intuitive, individualized, and adaptive interactions.***

*Joint-All-Domain Operations*

*Team Performance Assessment*



*Human-Machine Teaming*


*Quantified Warrior*


*Special Project: OHIO*

| OPERATIONAL CAPABILITY OPPORTUNITIES: | ENDURING CHALLENGES/NEEDS: |
|---|---|
| • Maximize performance by coupling humans & intelligent machines | • *Metrics & baselining, joint cognitive systems* |
| | • *Robust, reliable natural language interfaces* |
| • Continually optimized warfighter performance | • *Real-time assessment & prediction of warfighter performance & functional state* |
| • Intuitive & contextually aware decision aiding & courses of action | • *Robust cognitive models & architectures for autonomous agents* |
| | • *Dynamic calibration of system transparency* |
| • Agile response to unexpected events | • *Intelligent task/attention management aids and processes* |
| • Manage perceptual abilities to exploit information throughput | • *Multisensory adaptive interfaces that enhance, not interfere* |
| • Interfaces that adapt to individual differences | • *Identification of reliable individual difference factors for design* |
| • Highly effective distributed Teams | • *Workflow models & tools to dynamically assess team performance* |
| | • *Team collaborative/communication tools & coordination methods* |

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# 2.0 SICP Taxonomy

## 2.1 Understanding Human/Cognitive Processing [WITHIN HUMAN]

2.1.1: Perception (Unitary and Multi-sensory) *

2.1.2: Dynamic Operator Functional State Assessment *

2.1.3: Cog Neuroscience/Performance Augmentation *

## 2.2 Human-Machine Interaction and Aiding [HUMAN-MACHINE]

2.2.1: Advanced Interface Methods (Adaptive, Multi-modal)

2.2.2: Intelligent Decision Aiding/Support

2.2.3: Dynamic/Adaptive Task Allocation and Authority Transfer (*)

2.2.4: Trust Calibration & Transparency

## 2.3 System Level Interfaces & Teaming [HUMAN-SYSTEM]

2.3.1: System Analyses and HSI (Organization) *

2.3.2: Teams: Processes, **Decision Aids**, Performance & Metrics (Shared SA;Cohesion) (*)

2.3.3: Data Analytics/ Socio-Cultural Analytics/ Exploitation Tools *

2.3.4: System Interface Design and Application

(*) Previous Gap

* Previous and Current Gap

* New Gap

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# 2.1 Understanding Human/Cognitive Processing [WITHIN HUMAN]

**SICP**
Optimizing Interfaces & Warfighter-Machine Teaming for Decision Superiority

| Warfighting Capability | *Near (2024-2028)* | *Mid (2028-2038)* | *Far (2038+)* |
|---|---|---|---|
| | **Improved warfighter battlefield SA** via synchronized, integrated multi-modal displays that maximize perceptual information throughput and minimize interference. | **Greater operational resilience** via bi-directional, contextually–tuned adaptations based on dynamic assessment of current operator state. | **Decision superiority**: Understanding, interactions, decisions and adaptations at speed of thought via brain-machine interface applications and fine-grained augmentation strategies. |
| Technology Product | *Multi-sensory perceptual models & interfaces*<br>*Impact of sensory / cognitive factors on perception & communication*<br>*Models for evaluation / validation of HMTs*<br>*HUD-enabled 360-degree dynamic battlefield awareness* | *AR/VR design guidelines to enhance perceptual performance beyond current limitations*<br>*Methods for bi-directional SA in HMT*<br>*Operationally validated guidelines for adjusting HMI/tasking based upon dynamic assessment of operator functional state.* | *Perceptual and cognitive requirements for optimized, situationally tuned HAT performance*<br>*Hybrid human-intelligent agent decision making across tactical and operational settings*<br>*Brain-machine interfaces for optimal speed of understanding and action.* |

| S&T Efforts | Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|---|
| | •Rapid Joint-Cognitive Awareness<br>•Holistic Models for Decision Making<br>•MOBIUS | • Technically Savvy Soldier (T-SAVVY):Testbed Development and TEV&V | •Investigating Unguided, Unstructured Exploration for Intellectual Readiness<br>•Investigating Cognitive Load and Decision Making with TEWA Decision Aids<br>•Investigating Warfighter Impacts & Needs for distributed, coordinated engagement systems<br>•Impacts of Navy culture on AI and engagement coordination acceptance and adoption** |

AF | Army | Navy



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# 2.2 Human-Machine Interaction and Aiding [HUMAN-MACHINE]

**SICP**
Optimizing Interfaces & Warfighter-Machine Teaming for Decision Superiority

AF | Army | Navy

## Warfighting Capability

| *Near (2024-2028)* | *Mid (2028-2038)* | *Far (2038+)* |
|---|---|---|
| **Enhanced awareness, trust, and control of complex, intelligent automation** with novel observability and directability tools, along with HMI for opportunistic sensing of the battlefield. | **Superior warfighter sense-making and decision-making of complex environments** via AI-enabled decision aiding agents, responsive to mission context and currently achievable courses of action. | **Highly functional, agile human-AI teams:** Warfighters augmented and synchronized with several skilled AI-teammates via natural, multi-modal interactions, shared bi-directional SA, and advanced anticipatory/predictive tools. |

## Technology Product

| | | |
|---|---|---|
| *HMI tools supporting tactical C2 of highly automated systems* | *Decision aids for understanding, planning, mission execution with AI* | *Cognitively, socially and culturally compatible AI-driven systems* |
| *Trust & transparency guidelines for AI/automation* | *Mission-tailored, customized AR/VR interfaces* | *Goal, intent & effects-based interactions/HMI* |
| *Adaptive Aided Target Recognition pipeline* | *Explainable AI methods & guidelines for appropriate reliance* | *Predictive algorithms for multi-domain battlefield technology integration* |
| | *Comms management, naturalistic voice control and AI-Assistant functionality* | |

## S&T Efforts

| Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|
| •HMI-enabled Decision Superiority<br>•Rapid Joint-Cognitive Awareness<br>•Legion<br>•MOBIUS<br>•JADPACT | •Scalable Cross-Echelon C2<br>•Enabling Soldier-AI Tech Adaptation<br>•Distributed Intelligence Enabling Soldier Lethality<br>•Crew Capability Enhancement<br>•Novel Forms of Joint Human-Intelligent Agent Decision Making | •Augmented Bridge Training<br>•Trust in Decision Aids and Scalable Autonomy<br>•AEGIS Doctrine Visualization Tool (ADVT)<br>•Augmented Planning Environment for Battlespace Awareness (APE)<br>•Performance in Noise (PiN)<br>•Comparison of touch screen operation with other input devices for cybersecurity and operator performance |

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# 2.3 System Level Interfaces & Teaming [HUMAN-SYSTEM]

**SICP**
Optimizing Interfaces & Warfighter-Machine Teaming for Decision Superiority

AF | Army | Navy

## Warfighting Capability

| *Near (2024-2028)* | *Mid (2028-2038)* | *Far (2038+)* |
|---|---|---|
| **Mission-effective force multiplication in complex operations**: C2 interfaces and HMI tools for adaptively managing multiple unmanned systems by a single operator. | **Enhanced distributed team performance** through flexible collaborative tools, cognitively compatible AI-teammates, and ad hoc team formation and optimization in response to mission changes. | **Resilient, robust JADC2 decision superiority** via real-time AI-monitoring & prediction of hybrid distributed team performance, selective application of BMI, and tactical repair strategies to recover from operational degradations. |

## Technology Product

| | | |
|---|---|---|
| *Shared HMI for enhanced team collaboration* | *Distributed Team assessment metrics (H-H-A) including networked communication analyses* | *AI-enabled dynamic teaming manager for optimized distributed team performance* |
| *Intelligent Task Manager* | *Guidelines for cognitively compatible AI as skilled teammates* | *Operationally valid BMI applications* |
| *Crewed/uncrewed tactical HMI* | *Team SA & decision aids for collab JADC2 with limited/variable communication environments* | *Optimized ideation within human-intelligent systems* |
| *Workflow tools for rapid ISR planning* | | |
| *Commander's Interface for rapid team reconfiguration* | | |

## S&T Efforts

| Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|
| •Dynamic Team Performance Assessment<br>•Team Optimization & Recovery<br>•HMI-enabled Decision Superiority<br>•MOBIUS<br>•LEGION<br>•JADPACT | •Scalable Cross-Echelon C2<br>•Enabling Soldier-AI Technology Adaptation<br>•Strengthening Teamwork for Robust Operations with Novel Groups<br>•Crew Capability Enhancement<br>•Hybrid Human Technology Intelligence | •MBSC for Human-Systems Integration<br>•AVO Interfaces<br>•HEADS-Holochip<br>•Investigating impact of fatigue on human performance<br>•Mixed reality for individual and team training |

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2.0

# SICP Success Stories

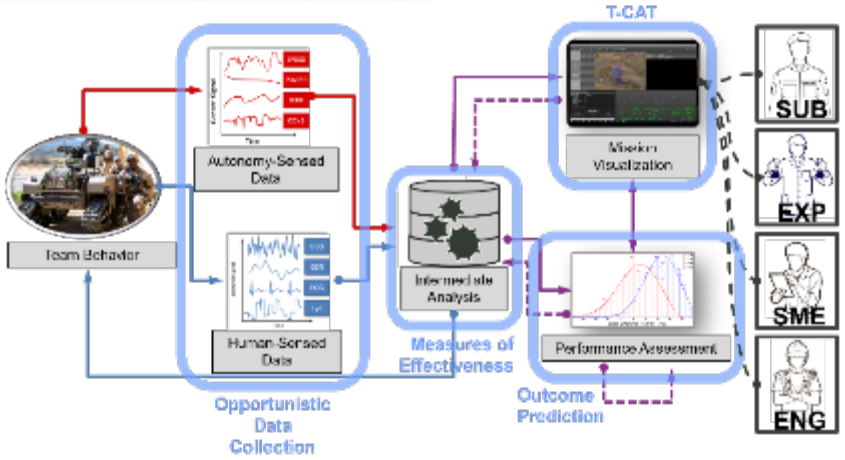
## *Toolkit for Continuous Assessment of Teams (T-CAT)*

### Challenge

Current approaches to assessing combat formations cannot support the continuous assessment of human-autonomy teams in complex, naturalistic (e.g., training) environments.

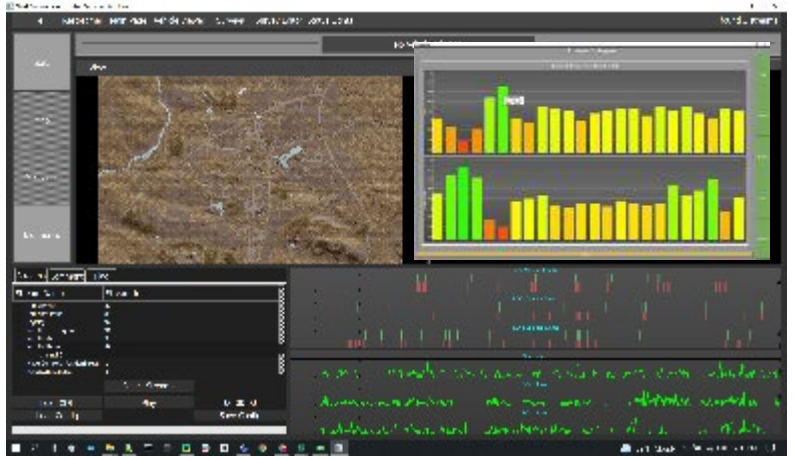
### Solution

**T-CAT enables multiple evaluators to time-synchronize, visualize, re-stream, and analyze NGCV Warfighter Machine Interface data alongside operational and physiological data, to help evaluators conduct assessment of human-autonomy teams in realistic, complex settings**.




### Approach

- **Individual and Team State Estimation:** Develop novel, integrative (physiology / behavior / coordination) algorithms, techniques, and technologies for processing human- and autonomy-sensed data, as well as military / scientific / engineering SME observations to infer team state and assess the quality of interactions **between humans and autonomy at multiple scales/echelons.**
- **Assessment Technologies: Develop Dashboard software technology that will enable collaborative assessment of human-autonomy teams by a diverse group of expert stakeholders.**



### Results

- **Developed Software Concept at TRL3 to support experimentation during FY21 and FY22 Information for Mixed Squads (INFORMS) Soldier Touch Point experiments.**
- **Delivered Initial Software Toolkit at TRL4 to, initial software toolkit employed during T3 (PM Main Battle Tank System) experiment.**
- **Transitioned T-CAT version 1.0 capability to DEVCOM Ground Vehicle System Center, including dynamical systems analysis modules for near real-time team effectiveness estimation.**

**POC: Andrea Krausman**

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# SICP Success Stories

## Enhanced IMPACT for Force Protection C2 – Medusa Counter Small UAS

**Challenge:** Mitigate small UAS threats on AF bases and optimize operator decision making via enhanced C2 for counter-sUAS

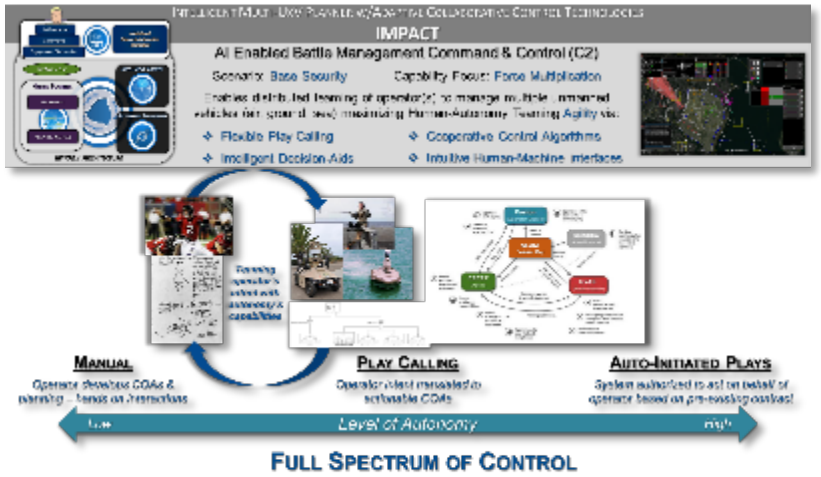
**Solution:**

– **AI Enabled C-sUAS Battle Management Capability**
  – IMPACT inspired suite of human machine interfaces that supports play calling/AI COA generation capability
  – New thin client architecture in place of existing Medusa C2 Android Based system
  – Joint tasking amongst IMPACT operators and security forces via ATAK plug-in development

**Approach:**

– Series of CTAs with current Medusa operators aided in information requirements generation
– Rapidly analyze, demo, evaluate & iterate on system design

***FEB '24: Demonstrated / Tested new Cloud-Based Thin-Client HMI and Software Architecture @ Medusa Test Range with Live Assets***




*"Human effectiveness research in cognitive science, data presentation, and human-machine interfaces is vital to optimize human-machine teaming performance."*

- *Maturing Technology into Air Force Systems*
- *Responding to Urgent Needs*

***Strategic Capabilities driving future Air Force technological advantage***

- *Global Persistent Awareness*
- *Resilient Information Sharing*
- ***Rapid Effective Decision-Making***
- *Complexity, Unpredictability, & Mass*
- *Speed & Reach of Disruption & Lethality*

***C-sUAS Urgent Needs (JEON ST-0008, JUON EC-0009, JUON CC-0558, 7AF UON)***
***Rapid Fielding Requirements Document (RFRD); Joint CUAS Capability Office (JCO)***
***OSD Guidance***

- *Modular Open-Systems Architecture*
- *Gov't Owns the Technical Baseline, Integrator*
- *COTS / GOTS S/W & H/W*

BDOC


Security Forces

Developing Capability → Air Force Needs → Product Concepts

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# SICP Success Stories

## *Effective Aided Target Recognition That Preserves Soldiers' Situational Awareness*

POC: Chloe Callahan-Flintoft

### Challenge

Aided Target Recognition (AiTR) systems have the potential to drastically improve Soldier lethality by directing Soldier attention to threats in the environment. However, failure to properly integrate these augmented displays with a Soldier's natural visual processing can have life threatening effects, such as monopolizing attentional resources and diminishing situational awareness.

### Solution

Use a computational neural model to generate and test hypotheses of AiTR implementation that leverage human cognitive mechanisms to optimize benefits of AiTR while mitigating potential losses.

### Approach

**The model predicts that delaying the onset of the AiTR highlights briefly (250 ms) would allow for a more even distribution of attentional resources and lessen the "tunnel vision" effects of highly salient AiTR highlights. To test this, Soldiers from Joint Base San Antonio took part in an experiment where they searched scenes for people with weapons. Participants either viewed the scenes alone, with AiTR highlights, or with AiTR highlights delayed in onset by 250 ms. Participants were then given a memory test on the background items of the scenes as a metric for situational awareness.**

### Results

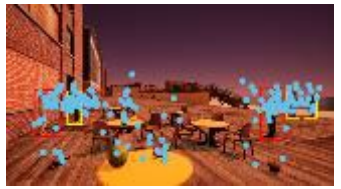
Results indicated that participants made fewer eye fixations (a metric of attention) on background items when AiTR highlights were present and, consequently had poorer situational awareness. However, these effects were mitigated when highlight onset was delayed. These results were transitioned to C5ISR researchers and a delay-condition has been incorporated in the ATLAS data collection.

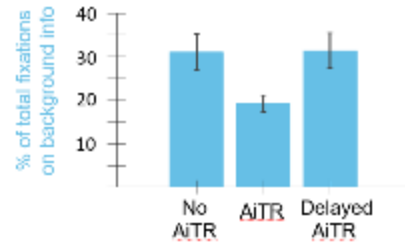
**Attentional allocation**

Fixation pattern w/o AiTR

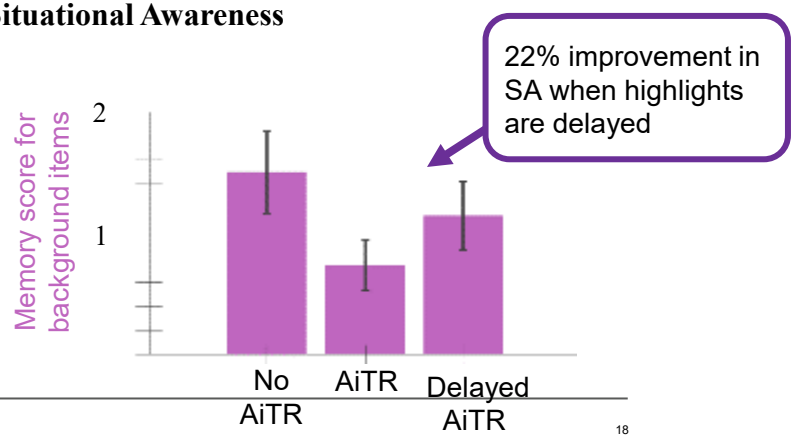
Fixation pattern w/ AiTR

Fixaition pattern w/ delayed AiTR






**Situational Awareness**



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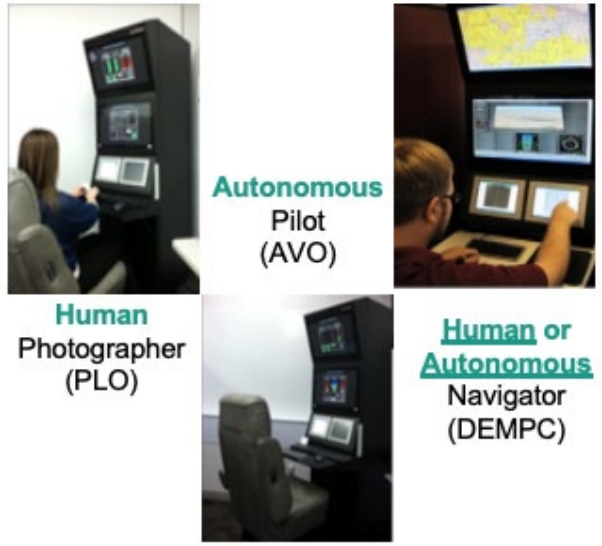
# 2.0 SICP Success Stories

## *Trust Contagion within and across Human-AI Teams and Team Constellations*

- **Goal:**
  - **Understanding and exploring the spread of trust and distrust within and across Human-AI Teams**
- **Approach:**
  - Mixed between- and within-subject experiment manipulating verbal and behavioral trust and trustworthiness of AI teammate
- **Results**
  - Successfully spread trust and distrust within a HAT through behavioral and communication spreading
    - Numerous significant findings using conventional measures (Performance, Process, Subjective Trust)
    - The novel dynamic trust spread measure indicates that trust/distrust spread through influence, which is linked to performance
    - Trust dynamics also depend on whether behavioral and communication spreading match (i.e., both spreading trust) or mismatch
  - Theoretical and methodological advances in understanding of how behavioral and verbal trust spread within a human-autonomy team through influence
    - Development of a novel dynamic trust spread metric that can be implemented in HATs to measure the spread of trust or distrust in real-time

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# 2.0 SICP Success Stories

## JADPACT: Joint All Domain Planner with Adaptive Collaborative/Control Technologies

### Challenge

The DoD's CJADC2 concept envisions leveraging AI, ML and autonomy to enable the speed, scale, and resilience necessary to win near peer fights. Battle Management is not currently well integrated across the DoD services or allies, which reduces effectiveness of battlespace effects. Developing integrated human and AI/ML/autonomy enabled distributed teams is needed to achieve decision superiority.


### Solution

Develop & validate concepts for a Joint All Domain Battle Manager Workstation (JADBMW) cognitive work aids, tightly coupling humans and machines to support rapid and adaptive execution of tasks to meet Commander's Intent using Cognitive Systems Engineering methods.

### Results

- Initial KA with air, space, and cyber SMEs completed and report delivered
- Envisioned work support process developed and informally validated by operators
- High level work aiding concepts developed and validated by operators
- Preliminary accompanying ops scenario developed and validated by operators
- Preliminary AI integration / HMT aiding opportunities identified

**Tri-Service JADO - focused Human Factors TIM:**
*30-31 Jan 2024 - WPAFB*


# Human Systems Community of Interest

## Protection, Sustainment & Warfighter Performance

**Dr. Logan Williams**

**Air Force Research Lab**

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# 3.0

# Protection, Sustainment, and Warfighter Performance

## *Ensuring Warfighter Safety and Survivability*

## VISION

**Enable superiority of Warfighters by understanding and overcoming key operational degradation stressors and providing protection from environmental threats.**

*Nutrition and Sustainment*

*Physical &Cognitive Augmentation*

*Wearable sensor technology*

*Protection and performance optimization*

### OPERATIONAL CAPABILITY GOALS & OPPORTUNITIES:

- Ubiquitous, unobtrusive real-world, real-time performance assessment will maintain peak warfighter readiness.
- Leveraging individual differences maximizes warfighter performance and protection.
- Enhanced technologies to optimize physical & cognitive performance, recovery, and reduce operational stressors produce a more ready/lethal force.
- Optimized nutrition to modulate and enhance health and performance sustains performance and readiness; 6.1 and 6.2 from BioTech feeds this area

### ENDURING CHALLENGES:

- Lack of tri-service data repository, data standards, and authority to operate commercial wearable sensors prevents the collection of large-scale data and analysis
- Accounting for human variability to optimize mission performance by understanding how individual differences impact mission performance and warfighter readiness.
- Difficulties fully “stress-testing” performance interventions in simulated environments that don’t replicate “fog of war”
- Transitioning from correlative biological measures to causative performance outcomes though robust testing & analysis.

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# 3.0 PSWP Taxonomy

**3.1 Sensing, Monitoring, and Assessment**

3.1.1: Sensing and Monitoring (Incl. Wearables)

3.1.2: Assessment

**3.2 Sustainment and Enhancement Technologies and Techniques**

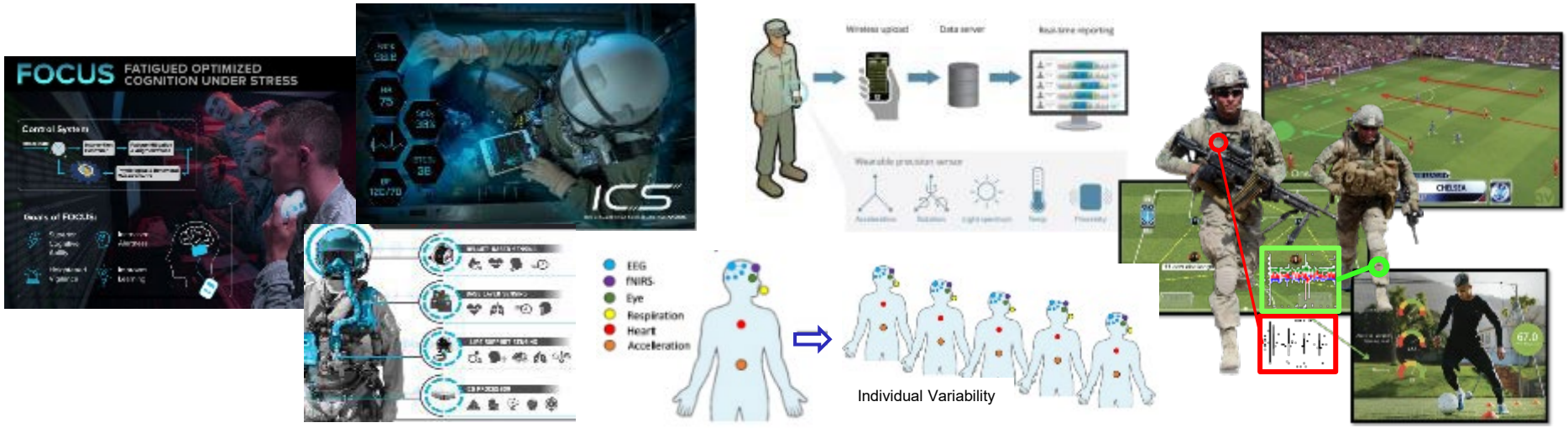
3.2.1: Training Enhancements

3.2.2: Physical & Cognitive Augmentation

3.2.3: Nutraceutical Interventions & Treatments

**TECH/CAPABILITY GAPS:**

- (3.1.1) Ubiquitous sensor technology and data collection/analysis infrastructure will provide real-time real-world performance data, to inform, predict, and optimize unit readiness (physical & psychological)
- (3.1.2) Advanced algorithms that account for the influence of human variability allow system optimization for human interactions, including human-machine teaming with semi-autonomous assets
- (3.2.1/3.2.2) Understanding the who, what, when, and how allows targeted development of materiel/non-material sustainment and enhancement interventions which maximize protection and performance (e.g. neurostimulation, nutrition, fatigue management, training, etc.)
- (3.2.3) Understanding how the gut responds to military stressors & nutrient intake may lead to meaningful interventions which optimize warfighter performance



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# 3.1 Sensing, Monitoring, and Assessment

## PSWP

**Peak Warfighter Performance & Readiness**


AF | Army | Navy

### Warfighting Capability

| *Near (2024-2028)* | *Mid (2028-2038)* | *Far (2038+)* |
|---|---|---|
| Improved readiness within confines of existing policy and infrastructure and through the ability to sense, understand, and portray human performance and wellness data (e.g. sleep/fatigue management, stress monitoring, injury reduction) in an ecologically valid way. | Physiologically informed mission-specific predictive models and real-time interventions (e.g. GLOC detection, Hypoxia detection) which preserve warfighter capacity and readiness with individual specificity. | Real time assessment of warfighter readiness and effectiveness during operations; at individual and unit level – real time decision support based on warfighter status and environmental conditions for all warfighters. |

### Technology Product

| | | |
|---|---|---|
| Rapidly implemented algorithms and wearables to assess operator state, self report monitoring, and fitness data. Non-invasive interventions and initial stages of an HP integrated ecosystem for lifecycle management (e.g. OHWS, FOCUS). Robust data sets to drive policy change as needed. | Context or environment-specific monitoring technologies and predictive algorithms (e.g. integrated cockpit sensing, MASTR-E) for high-impact warfighter demographics or mission sets. Non-invasive, targeted interventions (e.g. microbiome) and total exposure tracking. HP integrated ecosystem for complete lifecycle management. | Ubiquitous and unobtrusive monitoring technologies for warfighter and environment. Robust, distributed sensor networks (including wearables) with integrated data feeds and predictive algorithms. Long term exposure tracking for enduring readiness.<br>***Services Collaborate with Wearable Tech*** |

### S&T Efforts

| Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|
| • Holistic Health Assessment<br>• Integrated Cockpit Sensing<br>• Fatigue Optimized Cognition Under Stress (FOCUS)<br>• Operational Based Vision Assessment<br>• **Optimizing Human as a Weapon System (OHWS - Air)** | • **Measuring & Mastering Soldier Tactical Readiness & Effectiveness (MASTR-E)**<br>• Soldier & Squad Lethality<br>• HP Analytics for Decision Dominance<br>• **Optimizing Human as a Weapon System (OHWS - Land)** | • **Physiological Monitoring Tools, Tech & Analytics (PMT2A)**<br>• Streamlined Marine After-Action Review Tool – Visualization (SMART-Viz)<br>• **Command Readiness, Endurance and Watchstanding (CREW) / Optimizing the Human as a Weapon System (OHWS Sea)** |

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# 3.2 Sustainment and Enhancement Technologies and Techniques


| | *Near (2024-2028)* | *Mid (2028-2038)* | *Far (2038+)* |
|---|---|---|---|
| Warfighting Capability | Improved performance across physical/cognitive/sensory domains via targeted interventions for specific career fields. Increased peer support networks to increase psychological readiness and reduce attrition. Overall increase in readiness to deploy. | Enable peak performance in specific domains of need, based upon individually optimized performance. Shifting the mean performance upwards for all warfighters (e.g. improved marksmanship). | Ubiquitous Human Machine Teaming to enhance operator effectiveness and decision superiority. |
| Technology Product | Broadly optimized nutrition, physical training, and team cohesion interventions. Technologies which facilitate peer support. Knowledge products connecting performance metrics to operational outcomes and mission success. Optimization of physical/cognitive/sensory performance standards. | Individually targeted nutritional, physical, and cognitive interventions tailored to the individual, such as nutritional supplements, circadian rhythm alignment, pharmacological dosing, physical training, and moral resolve, or technological interventions. | Fully integrated data collection and algorithm employment to optimize mission performance with teamed assets. Use of AI predictive algorithms and semi-autonomous assets to optimize human workloads, asset management, and inter-service coordination. |

| S&T Efforts | Air Force Efforts | Army Efforts | Navy Efforts |
|---|---|---|---|
| | • Performance Readiness Optimization (PRO)<br>• Human Representation in Digital Engineering (HRDE)<br>• Psychological & Behavioral Readiness Toolsets | • Enhancements for Soldier and Squad Overmatch<br>• Performance Probiotics for Warfighter Fatigue Mitigation<br>• Intestinal Health | • Incapacitation Prediction for Readiness in Expeditionary Domains: Integrated Tool (I-PREDICT)<br>• Warrior Resilience<br>• SMART Helmet |

AF | Army | Navy

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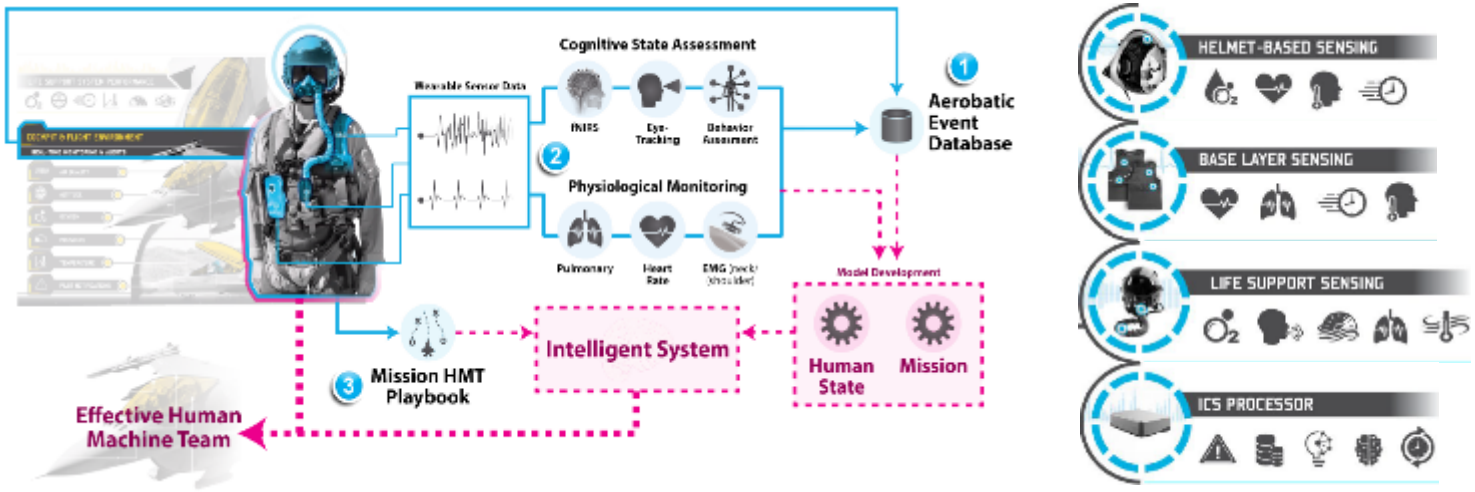
# 3.0 PSWP Success Stories

## USAF Flight Test of Integrated Cockpit Sensing




**Description:** Initiated flight testing of Integrated Cockpit Sensing system – an entirely pilot-worn physiological and environmental sensor system which provides real-time measurements of pilot vital signs, respiratory function, air quality, and cockpit environment.

**S&T Accomplishments:** AFRL, 711 Human Performance Wing developed a unique enabling technology uniquely positioned to create rich data sets of pilot performance utilizing a completely sensor-, platform-, and domain- agnostic solution. The ICS system is entirely pilot-worn (i.e. does not utilize aircraft power) to enable rapid integration with any airborne platform using an open-architecture, sensor-agnostic data integration system. Data available to DoD labs, industry partners, and academia via Cloud One IL5 & IL6 repositories (ATO: 59/422 TES).

**Impact:** Provides both real-time alerts & post flight analysis to aid in root-cause investigation of pilot physiological episodes, enables early problem detection, provides training and performance feedback, and resolves human-machine interface concerns. The ICS system will help explain & prevent previously unexplainable physiological episodes which, from 2013-2020 resulted in 224 lives lost, 186 aircraft mishaps, $11.6 billion in damages, and widespread pilot performance impacts, aircraft grounding, and reduced unit combat readiness.

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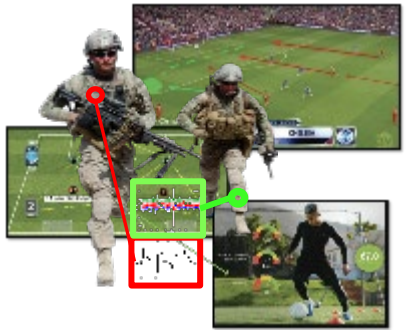
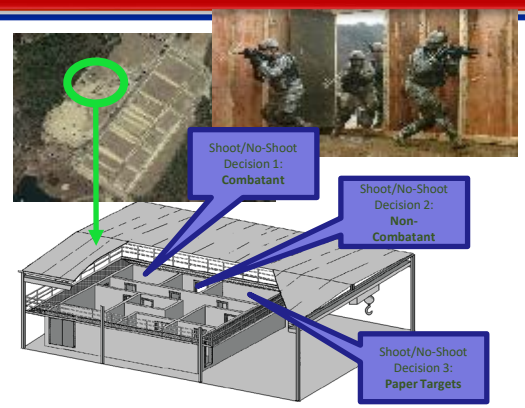
# PSWP Success Stories



## Small Unit Performance Analytics (SUPRA)

MASTR-E
MEASURING AND ADVANCING SOLDIER TACTICAL READINESS AND EFFECTIVENESS




**Description:** SUPRA is a DEVCOM Soldier Center S&T effort under the MASTR-E Program. The objective of SUPRA is to develop quantitative metrics of Small Unit performance during the execution of Battle Drill 2a and 6. At its core, SUPRA is building a catalog of "Game Tape" of Infantry Squads executing consistent Battle Drills. As "Game Tape" is generated, advanced analytics can be utilized to improve different aspects of team/collective performance.

**S&T Accomplishments:**

- Within the last month, SUPRA completed its final data collection for the MASTR-E program. This collection included squads from the 4th Infantry Division and 75th Ranger Regiment, bringing the total number of squads tested to 36 and total Soldiers to over 300.
- Transitioned data visualizations and squad metrics to ONR via the SmartViz program
- 9 abstracts and 1 thematic session submitted leveraging SUPRA data and results. All were accepted: 6 at ICSPP, 1 MORS, 1 I/ITSEC, and 1 MHSRS.

**Impact:**

- This effort advanced the ability to quantify Small Unit performance during the execution of two critical Battle Drills and provides quantitative data to support leadership's subjective assessment of effectiveness
- The SUPRA capability has high potential to impact training and acquisition:
    - Will be utilized as part of Maneuver Battle Lab Infantry Squad Study
    - Will be utilized as part of DEVCOM SC Trade Space S&T effort to quantify equipment effects on unit performance
    - Will be utilized as part of DEVCOM SC CASTLE S&T effort to link objective, live data to the Synthetic Training Environment
    - Will pursue joint TMI proposal with PEO STRI for the development of an automated After-Action Review (AAR) capabililty for Home Station Training

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# 3.0 PSWP Success Stories

## *Improved Force Readiness of the USMC through Physiological Monitoring Tools, Technologies, and Analytics (PMT2A)*


**Description:** Developed and delivered dashboards and interfaces that are being adopted by the Services and SOCOM to support greater understanding of physical human performance, which has directly impacted Marine Corps School of Infantry-East's (SOI-E) ability to reduce injury-related attritions from >1% to 0.7%- a manpower cost savings of ~$4M.

Also provided interfaces and a digital processing pipeline for SOI-E Athletics Trainers (ATs), which saves 15-17 min / per evaluation translating to 414 man-hours saved annually. The time savings resulted in an additional 24 in-field evaluations that allows ATs to be more proactive and will help drive down injuries and increase course completion.